Top Management Team attributes and the probability of firm default

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A thesis submitted in partial fulfilment of the requirements of Sheffield Hallam University for the degree of

Doctor of Philosophy

July 2019

I would like to dedicate this thesis to my late father, Haroon Bhaiyat and mother, Fatima Bhaiyat. They have always given me unconditional love, encouragement and support.

I would also like to dedicate this thesis to my beloved wife, Sara Bhaiyat and my son, Haroon Bhaiyat. Without Sara's love, patience, sacrifice and trust throughout this process, this thesis would not have been possible, and without Haroon's inspiration to remind me of what is truly important I would have found it so much harder to carry on.

And finally, I would also like to dedicate this thesis to my brother, sister, father in law, mother in law and my entire family. I thank all my family, Faisal, Sofia, Farhana, Rashid, Aalia, Sana, Farhan, Mohammad, Yakoob and Salma for their wonderful contribution and encouragement.

Thanks to all my friends and colleagues who gave me their unwavering support and encouragement …

Declaration

I hereby declare that except where specific reference is made to the work of others, the contents of this thesis are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other university. The findings of this research have been presented via one conference paper and two emerging papers. This dissertation is my own work and contains nothing which is the outcome of work done in collaboration with others, except as specified in the text and Acknowledgements. This thesis contains fewer than 80,000 words not including appendices, bibliography, footnotes, tables and equations.

The researcher undertook research ethics, research design and execution, philosophy of business research, survey methods 1 and 2 training at Sheffield Hallam University. The researcher also attended training provided by Dr Chris Stide at the University of Sheffield on Multilevel modelling and Structural Equation Modelling using Mplus. For the purposes of this thesis, the researcher self-taught SPSS, Bloomberg Certification, R-programming and Latex.

Firoz Haroon Bhaiyat

July 2019

Acknowledgements

Firstly, I would like to express my sincere gratitude to my director of studies Dr Malihe Shahidan for her continuous support of my PhD study, for her patience and motivation. Her guidance helped during this research and writing this thesis. I have truly enjoyed having her as my director of studies and mentor for my PhD.

I would also like to thank my Supervision team: Prof. Nigel Garrow and Dr Dora Chan for their insightful comments and encouragement. Their comments and immense knowledge provided me with guidance and direction to view my research from different perspectives.

My deepest appreciation also goes to Dr John Fry for his insightful comments with the statistical analysis and R coding. His expert opinion with quantitative methods has helped me develop as a researcher and allowed me to reflect a new set of skills in this research.

I would also like to thank all my friends and colleagues from room 7217, the Finance, Accounting and Business Systems department and the Sheffield Business School for their continuous support and encouragement throughout this research journey. I would like to specifically thank the staff from room 7217 who have provided me with a forum for intellectual discussion, questioned my perspectives and provided me with differing perspectives.

Finally, I would like to thank all participants and attendees to the BAM Corporate Governance SIG in 2016 and 2018 for their valuable feedback, comments and support. Their specific comments have helped develop this research by providing additional perspectives on the work undertaken.

Abstract

This PhD research investigates the effects of the key top management team (TMT) attributes on the probability of a firm's default. Specifically, the study pursues motivation, loyalty and effectiveness as the key characteristics to analyse. Synthesising the Behavioural theory of the firm, Upper Echelons theory, Resource Based View, Agency theory and Seasons of tenure alongside other key TMT theories this research develops a theoretical model. The literature on TMT and financial distress has focused mostly on the role of the CEO or different definitions of the TMT, however, the role of the CFO is very rarely studied. This research argues that the role of the CFO is extremely important when a firm faces financial difficulties and is key to the definition of TMT that influence the financing decisions of the firm. In addition, this research uses both accounting based measures and market based measures for predicting the likelihood of default while a majority of the literature in this field has used either accounting based measures or market based measures. This research uses multilevel modelling on a hierarchical dataset to address some of the limitations of previous research by modelling for the variability of regression intercepts and slopes and addressing the violation of the independence assumption. Using a sample of UK listed companies, on the FTSE 100 index for the period 2013 to 2016, this research uses OLS regression, Polynomial regression, Random Intercept model and Random Intercept and Random slope models as robustness checks to test the theoretical model developed. The study concludes that there is a relationship between key TMT attributes and the likelihood of default. The effect of the attributes varies for the short-term, long-term and accounting measures of the probability of firm financial distress. The study provides models that will be key to future governance ensuring a financially healthier corporate environment.

List of Abbreviations

AIC	Akaike information criterion
AIM	Alternative Investment Market
ANOVA	Analysis of Variance
BAM	British Academy of Management
BB	Bloomberg
BBC	British Broadcasting Corporation
BIC	Bayesian informaiton criterion
CBI	Central dei Bilanci
CDS	Credit Default Swaps
CEO	Chief Executive Officer
CFO	Chief Finance Officer
COO	Chief Operating Officer
CSR	Corporate Social Responsibility
CVA	Creditor Voluntary Arrangement
DRSK	Default Risk Bloomberg Function
EDF	Expected Default Frequency
EM	Emerging Market
EU	European Union
FT	Financial Times
FTSE	Financial Times Stock Exchange
GICS	Global Industry Classification Standard
GM	General Manager
GMM	Generalised Method of Moments
HR	Human Resource
ICC	Intracalss Correlation
IPO	Initial Public Offering
ISC	Institutional Shareholders Committee
IT	Information Technology

KMV	Kealhofer Merton Vasicek model
LLP	Limited Liability Partnership
LME	Linear Mixed Effects
LOGIT	Logistic Regression
LogLik	Log-likelihood
LSE	London Stock Exchange
M&A	Merger and Acquisition
MANOVA	Multivariate Analysis of Variance
MBA	Masters of Business Administration
ML	Multilevel model
NN	Neural Network
NPI	Narcissistic Personality Inventory
OFT	Office for Fair Trading
OLS	Ordinary Least Square regression
OPEB	other employment benefits
OTC	Over the counter
PLC	Public limited company
PPI	Payment protection insurnace
PR	Public Relations
R&D	Research and Development
RBV	Resource Based View
RIM	Random Intercept Model
RISM	Random Intercept and Slope Model
ROA	Return on Asset
ROE	Return on Equity
ROI	Return on Investment
RPA	Recursive Participating Analysis
S&P	Standard and Poor's
SIC	Standard Industrial Classification

SIG	Specian Interest Group
SOX	Sarbanes Oxley
SPSS	Statistical analysis program in social sciences
TMT	Top Management Team
UK	United Kingdom
US/USA	United States of America
VAT	Value added tax
VRIN	Valuable, Rare, Inimitable and Non-substituable
WSJ	Wallstreet Journal

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Chapter 1

Introduction

1.1 Background

The beginning of (quarter 1) 2018 saw the number of company insolvencies in England and Wales at the highest level in the first quarter of a year since 2014 (McDaid, 2018). Between January and March 2018, there were 4,462 company insolvencies as opposed to 3,964 during the same period in 2017. Fig. 1.1 shows the number of company insolvencies in England and Wales since 1985 and highlights the two main recessions faced by the UK economy. It shows that immediately after the two previous recessions the number of corporate insolvencies peaked.

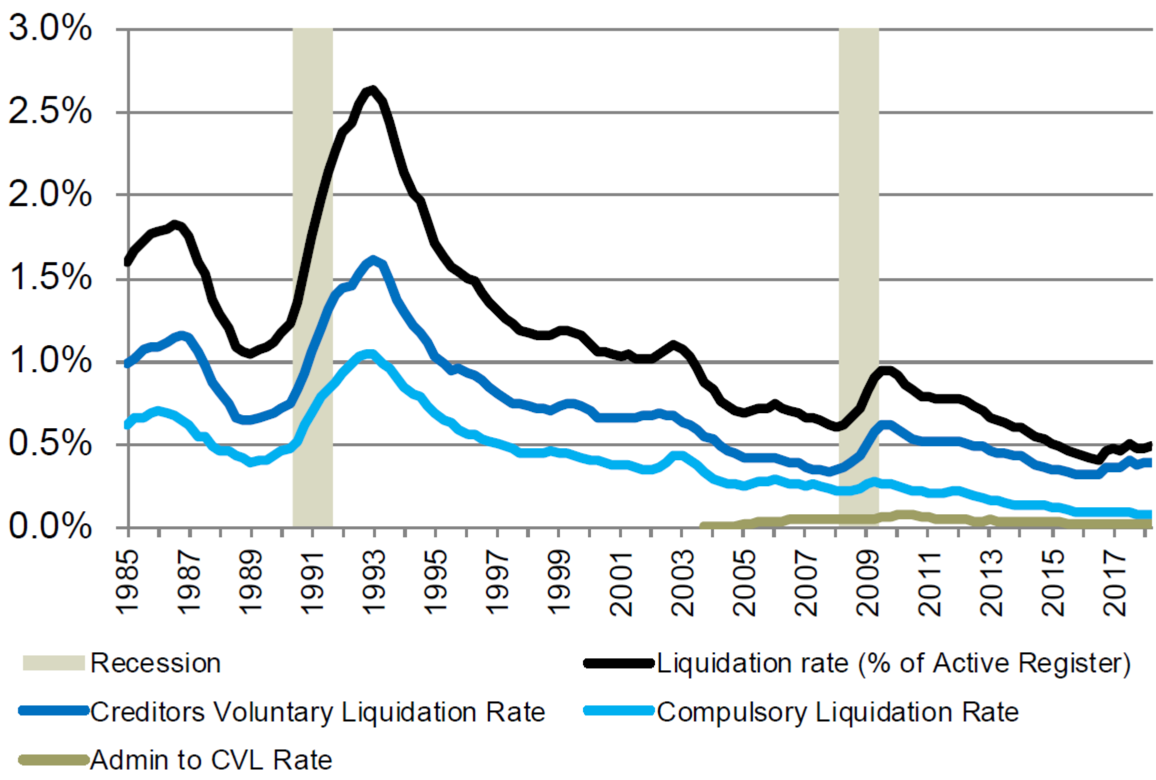

Fig. 1.1 Company Liquidation rate in England and Wales (Source: McDaid, 2018)

The global financial crisis (2007/2008) proved to be a difficult trigger point for many companies and eventually played a big role in the collapse of many. The landscape of the UK high-street retailers has been continuously changing with each year providing a further challenge to these companies. The years that followed, the financial crisis has seen big retail brands, such as Woolworths, Comet, JJB and Phones4U, file for administration (Ruddick, 2015). The British Retail Consortium also warned that closures of retail outlets, 2 out of 3 town shops, further caused a loss of 800,000 jobs (Tugby, 2015). In a study undertaken, by Riley et al. (2014), to assess the impact of the global financial crisis on the supply side of the UK economy, found that bank lending to businesses had declined.

However, they did not find much evidence to support that the banking sector impairment and the lack of reallocation of resources to businesses had been the key factor in holding back productivity growth. This could lead to the argument that the companies that kept afloat compared to the companies that failed, within this difficult environment, was as a result of strong management skills and management decisions relating to various aspects of the business before and during the crisis.

A company going through insolvency or nearing default has far-reaching effects beyond the company itself. It has an effect on the workforce, customers, the economy, the taxpayers etc. There have been countless examples where corporate failure has led to the taxpayer paying redundancy costs for the failing business. One such example was the insolvency of Comet, which left taxpayers with a £49.4m bill (Neville, 2012). Recently the discount chain Poundworld announced the closure of nearly 100 stores putting over 1,500 jobs at risk as part of an insolvency procedure (Cahill, 2018). TPG Capital (owners of Prezzo restaurants) went through a similar procedure of closing nearly a third of their stores losing around 500 jobs. The impact of corporate insolvency was further noted in one of UK's biggest collapse in a decade, Carillion a FTSE 350 construction business. The collapse of this construction business led to over 2,300 job losses, it had a knock-on effect on the entire sector and caused financial difficulty for firms within its supply chain (Thompson, 2018).

The case of Carillion is especially interesting as currently, the government is investigating the behaviour of its directors and the corporate culture that existed within the business. The directors of the firm were accused of driving the company off a cliff and making a relentless dash for cash by taking low-margin contracts, which did not make money (Thomas, 2018).

Trends in corporate failure show that firms that fail to perform are usually followed by Top Management Team (TMT) turnover and it is seen that firms performing above expectation usually reward their TMT. Firms in financial distress usually did not prepare for management succession (Dua and Singh, 2010). In addition, the most significant causes of financial distress identified by Memba and Job (2013) can be attributed to the TMT of a firm. They also found that the most likely impact of financial distress was the TMT turnover or replacement. This shows that responsibility of firm performance is given to the TMT of the firm and therefore supporting a hypothesis that there are key management attributes that have a significant relationship with the performance of a firm.

There has been considerable academic and professional debate in the recent years around the role of the TMT and their relationship with the performance of a firm. There is evidence to show that there was considerable improvement in the performance of a firm once incumbent management was replaced (Denis and Denis, 1995; Huson et al., 2004). High levels of management turnover have also been associated with fraud (Sun and Zhang, 2006) and default or bankruptcy (Gilson, 1989, 1990; Ofek, 1993). There have been various studies investigating different management attributes and their relationship with the performance of a firm. However, only a few studies have focussed on the relationship between the TMT and the probability of firm default. A majority of the focus within the TMT has been on the CEO and Chairman with only a few studies focusing on the role of the CFO.

The primary financial objective of a public listed company is the maximisation of Shareholder wealth (Watson and Head, 2013). When a company becomes insolvent the shareholders have everything to lose and nothing to win and maybe the culture of maximisation of shareholder wealth in return has led to the management of companies not being keen to accept insolvency. It was noted in a study by Franks and Sussman (2000a, 2000b), that bankruptcy is considered as an option of last resort by management. Therefore posing the question, when should a company's primary objective change from 'maximisation of shareholder wealth' to 'maximisation of creditor wealth'? This conflict has given rise to what Harner and Griffin (2013) call the 'Ostrich Syndrome'. They noted that management of troubled companies often bury their heads in sands until it is too late to remedy. But is this syndrome a result of the management trying all possible options to work towards its primary goal of shareholder wealth maximisation? This could also possibly be a conflict between the agency theory and the stakeholder theory i.e. when should the managers work towards the interest of the shareholders and when should they shift their focus to another stakeholder's interest.

This study develops a theoretical model emerging from key management theories: Resource Based View, Resource Dependence Theory, Knowledge Based View, Entrenchment Theory, Agency Theory, Stakeholder Theory, Stewardship Theory, Transaction cost theory, Political theory, Upper Echelon Theory, Seasons of Tenure, Ostrich Syndrome, Animal Spirits, Hubris and Narcissism. These theories have been selected through the literature review undertaken in order to provide a model of the TMT of the firm.

This research aims at exploring the relationship between key TMT attributes and the probability of default of a firm. A significant relationship and theoretical model will help understand specific reasons attributable to management for the failure of an organisation. In addition, it will provide specific reasoning to ensure that firms are able to work towards reducing their probability of default by addressing the key attributes.

1.2 Recent UK Corporate Insolvency cases

Ralph (2018) reported that a string of bankruptcies in the UK was driving up costs of credit insurance. The Association of British Insurers identified that over £340bn of UK trade was covered by trade credit policies. In the article, it was further highlighted that the collapse of Carillion, Toys R Us, HMV, Game and Woolworths had led to large losses across the trade credit insurance industry.

Below are a few recent cases of corporate insolvency that highlight a range of causes but most importantly the effect of administration on the employees of the company in the UK. These are summarised in Table 1.1 where some key points are listed that were discussed in the media.

- Conviviality (Rovnick, 2018) - The previously AIM-listed owner of Bargain Booze, employing approximately 2500 employees, filed for administration in March 2018. Just prior to the administration, the company had provided two profit warnings, declared that they found a forgotten tax bill and failed to raise additional funding from shareholders. The CEO, who was previously decorated for the above-market growth, resigned just prior to the administration announcement. The FT article further highlights, the reservations of investors that stemmed from the lack of confidence in the management team and specifically the chairman. Conviviality forecasted a profit of around £50m and days later made the administration announcement.

- Countrywide (BBC, 2018) - Countrywide Farmers PLC, employing approximately 700 people, filed for administration in March 2018. The company had been looking at restructuring options for a 12-month period and successfully sold its LPG business. The company had identified a purchaser for its retail business, however, this was referred to phase 2 by the Competition and Markets Authority. The sale could not be completed due to the referral and given the company had an ongoing trading difficulty and cash flow pressure the only option left was to file for administration. This has led to a number of staff redundancies as the company had to make cost savings. The Chief Executive of the firm quit in January 2018 (Rovnick, 2018) following a profit warning that caused a sharp decline in its shares.

- Maplin (Wood, 2018) - Maplin, a UK electronics retailer employing approximately 2300 employees, filed for administration in March 2018. The company was owned by private equity investors and had been looking for a buyer for 12 months. The company felt a financial squeeze after the credit insurance on the suppliers was removed. The company made 63 people redundant with significant effects to its headquarters in London and Rotherham.

- Toys R Us (Ralph, 2018) - Toys R Us UK, a giant toys retailer, collapsed in February 2018 which led to the closure of all its stores and approximately 2000 employees made redundant. The collapse caused a shortfall of approximately £1.1 billion which included £23.7 million owed to suppliers, approximately £22.1 million of unpaid VAT, £8.4 million in redundancy payments, £80 million of pension scheme deficit and £2.5 million in gift cards. Similar to Maplin, the loss of credit insurance was a factor in the failure of Toys R us as the company failed to find a buyer.

- Carillion (Davies, 2018) - Carillion, a FTSE 350 construction business employing approximately 19,500 employees, collapsed in January 2018. The company relied on large contracts with very low margins and when the contracts underperformed the company felt a financial squeeze. It was unable to raise further funds and had to enter liquidation rather than file for administration. This was due to the lack of cash to continue trading in administration and the funding for the public services contracts funded by the government could only be received by an official receiver which was only possible in a liquidation. Recklessness, Hubris and Greed among directors were noted in reports compiled by two select committees. The big-four accounting firms were also blamed in this report as they enjoyed a parasitical relationship with their clients. The committee specifically identified and criticised the Chief Financial Officer (CFO), Chief Executive Officer (CEO) and the Chairman and recommended that they are banned from holding future directorships.

- Palmer and Harvey (Vandevelde, 2017) - Palmer and Harvey PLC, a food wholesaler employing approximately 3400 employees, entered administration in November 2017. A combination of cash squeeze and the Booker-Tesco merger meant that P&H was struggling and this eventually led to a loss of 2,500 jobs.

- HMV (Robinson, 2013), an entertainment retailer employing 4,500 employees, filed for administration in January 2013 which led to the closure of more than 100 stores and a loss of more than 1,400 jobs. Banks and suppliers refused to provide additional funding which led to a cash squeeze and the company eventually collapsing. Hilco UK purchased the £176m debt of HMV for around £40m from Lloyds and RBS in order to take control of the retailer and eventually to become the new owner.

- Jessops (BBC, 2013), a high street camera retailer employing over 2,000 staff, filed for administration in January 2013. The company struggled to meet its profit targets and due to substantial cash outflows relating to rent, they got into a financial squeeze leading to the firm filing for administration.

- Comet (BBC, 2012a), an electrical retailer employing over 6,500 employees, filed for administration in November 2012 due to stiff competition. The company had been struggling for some time and was sold for £2 to OpCapita a year before its collapse.

- Clinton Cards (Felsted and Thompson, 2012), a greeting cards retailer employing over 8,000 staff, filed for administration in May 2012 as a result of high levels of debt and high rents from its large store portfolio. This resulted in 3,000 job losses and a closure of 350 stores.

- Game (BBC, 2012b), a video game retail company employing over 8,000 employees, filed for administration in March 2012 which led to an immediate closure of 277 stores and redundancy of 2,104 employees. The company suffered from high fixed costs relating to rents and ambitious international expansions which led to a cash squeeze.

- Zavvi (BBC, 2008b), a music, games and DVD chain employing over 3,400 staff filed for administration in December 2008. It was hit by the default of Woolworths (its main supplier) which led to the firm struggling to source stock through new arrangements adding to the working capital pressure.

- Woolworths (BBC, 2008a), a store chain and supplier (entertainment UK) employing over 30,000 staff through 815 stores filed for administration in November 2008. The company struggled with mounting amounts of debt and a liquidity squeeze brought on by the lack of trade credit insurers prepared to insure Woolworths.

Table 1.1 Recent cases of UK Corporate Insolvency (Source: Author's own collection adapted from various news sources listed above)

Company	**Key points relating to Insolvency**
Conviviality	Profit warning; Discovered forgotten tax bill; failed to raise emergency funds; CEO stepped down shortly before administration
Countrywide	CMA referred takeover of retail arm; which meant business could not be sold
Maplin	Failure to find new buyer
Toys R us	Failure to find new buyer
Carillion	Recklessness, hubris and greed among directors; Blamed big-four accounting firms; Criticised specifically CFO, CEO and Chairman
Palmer and Harvey	Failed to sell business; impact of Booker and P&H takeover;
HMV	Failed online technology; bank debt; too many stores and expensive leases
Jessops	CEO joined just before collapse; too many stores and expensive leases
Comet	Decline in additional income; Outstanding debt to parent company
Clintons	Biggest supplier forced company into administration
Game	Suppliers stopped doing business; high fixed costs; ambitious international expansion
Zavvi	Demise of woolworths
Woolworths	£385m debt; high rents

1.3 Scope

The research focuses on the probability of default measured, as a measure of firm performance, by the Bloomberg 1-year, Bloomberg 5-year and Altman Z-score probability of firm default for UK public listed companies. The Bloomberg default probability is developed using the Merton (1974) model and is a market based measure of default prediction and the Altman (1968) Z-score is an accounting based measure of default prediction. The TMT from the perspective of this research is the CEO, Chairman and CFO. The Executives of the firm from the perspective of this research are the CEO and the CFO. The key TMT attributes the research focuses on are Motivation, Loyalty and Effectiveness. Motivation is broken down into short-term motivation, measured by average Salary paid to the executives and Long-term Motivation, measured by average Bonus paid to the executives. Loyalty is measured by the average tenure of the TMT. Effectiveness is broken down into effectiveness at board level, measured by the number of directors on the board, and effectiveness at the firm level, measured by the average number of employees.

1.4 Rationale

A majority of previous literature in the context of the TMT and firm performance focussed on different measures of profitability. There has been little research undertaken on the effect of TMT on the probability of firm default. The research has focussed on the US (Schultz et al., 2017) or East Asian (Ting, 2011) markets and research in this field from the context of the UK listed companies is almost non-existent. In addition, the TMT has been previously defined mostly only as CEO and Chairman or the entire board of directors. The focus of this research is on the CEO, Chairman and CFO as the TMT. The CFO would play a key role in corporate finance strategies and decisions, which would have a direct impact on the probability of a firm default.

There is a lack of an existing theoretical model addressing the relationship between TMT attributes and the likelihood of default for UK listed companies. This research will provide a theoretical model developed from previous theories to explain the relationship of key TMT attributes and the probability of default. A majority of the research studying the relationship between different TMT attributes and the likelihood of firm default uses a single measure i.e. either accounting or market based measures for the likelihood of firm default. This research develops empirical models using both accounting and market based measures of probability of firm default which allows a much better understanding of the relationship.

A large amount of research within the TMT and the probability of firm default has used regular regression for time series or cross-sectional data. This research uses multilevel modelling on a hierarchical dataset which allows the research to address some of the flaws of the earlier models when the independence assumption of linear regression is broken. It would be of importance to regulators and academics to compare the theoretical and empirical model with key current corporate governance initiatives. It would also be useful to shareholders and the management to consider how this theoretical model may be applied in practice and would it generate results as predicted by the model. The principal argument behind the existence of this relationship is that the increase in default probability increases the TMT turnover. This would lead to the argument that there must be distinct attributes that distinguish the TMT of a firm with a high default probability and a firm with a low default probability within the same industry.

1.5 Aim

The overall aim of the research is to explore the relationship between the TMT attributes and the probability of firm default.

1.6 Objectives

The key objectives of the research are:

1. To critically review and synthesise the literature on key TMT theories.

   This objective aims at establishing the scope of the TMT and reviewing the literature on key theories to understand the different attributes of the TMT.

2. To critically review and synthesise the literature on the TMT and firm performance.

   This objective undertakes a critical review of the recent academic literature on the relationship between various attributes of the TMT and various measures of firm performance. It helps in clearly identifying the research gap the thesis addresses and the relevance of the research to key stakeholders.

3. To critically review and synthesises literature: establishing the scope, conceptualising and classifying the determinants of the probability of firm default.

   This objective provides a framework of definitions within which the focus on the probability of default operates. It primarily aims at reviewing academic literature on the key determinants and key measures of the probability of firm default. To critically review and synthesise literature comparing and contrasting accounting based probability of default vs market based probability of default.

4. To develop a Theoretical model to test the relationship between TMT and the probability of firm default.

   This objective provides a theoretical model developed from the critical review of literature that explains the relationship between the TMT and the probability of firm default. The theoretical model then provides the research with key hypothesises that allow for it to be tested within the context of UK public listed companies.

5. To empirically test the theoretical framework model using the UK FTSE 100 listed companies.

6. To identify future corporate governance recommendations for listed companies facing financial distress. And, to provide recommendations based on the analysis of the key findings.

   Finally, this objective aims at bringing the above objectives together in order to provide some key recommendations of relevance to key stakeholders to the research.

1.7 Research Questions

- Is there a relationship between key TMT attributes and the likelihood of firm financial distress?
  - Is there a relationship between executive motivation and the likelihood of firm financial distress?
  - Is there a relationship between TMT loyalty and the likelihood of firm financial distress?
  - Is there a relationship between TMT effectiveness and the likelihood of firm financial distress?

1.8 Hypotheses

This research identifies key hypotheses to test through the review of theoretical and empirical literature. The hypotheses tested are as follows:

Hypothesis 1a *There is no relationship between executive short-term motivation and the likelihood of firm financial distress*

Hypothesis 1b *There is a negative relationship between executive long-term motivation and the likelihood of firm financial distress*

Hypothesis 2 *There is a negative relationship between TMT loyalty and the likelihood of firm financial distress*

Hypothesis 3a *There is no relationship between TMT board level effectiveness and the likelihood of firm financial distress*

Hypothesis 3b *There is a positive relationship between TMT firm level effectiveness and the likelihood of firm financial distress*

1.9 Contribution

There is lack of clarity on the relationship between key TMT attributes and the probability of firm default within the UK. There is considerable academic literature on the impact of the TMT on the profitability or performance of a firm and a majority of this research is within the US context. This research aims to contribute to existing literature by developing a theoretical model that explains the relationship of the TMT and their impact of the probability of firm default. The research further introduces a new key management role in the TMT definition i.e. the CFO that has previously not been studied within a similar context. The findings of this research answers some key questions and raises some further questions about the regulatory constraints on the TMT. The findings of the research will be of primary relevance to Investors (Shareholders and Debtholders), TMT of a firm, regulators and other researchers with an interest in the subject.

This research uses a multilevel modelling approach on a hierarchical dataset which helps overcome breaking the independence assumption of linear regression. The research uses multidisciplinary theories to develop a theoretical model on TMT and the likelihood of default. This model is then developed empirically using a dataset of UK listed companies. The empirical model is then tested on an out of sample case to test its reliability and validity. The model would help in future identification of strengths and weaknesses within a firms TMT and allow the firm to specify its key management attributes to the firms required level of the probability of firm default.

The findings contribute to the UK corporate governance code by undertaking a further scrutiny and providing a better understanding of the role of the CFO. In addition, the findings provide some further clarity on the debate around board size, salary and tenure as indicated by the corporate governance code and previous literature.

This research argues that the role of the CFO is extremely important when a firm faces financial difficulties and is key to the definition of TMT, which has rarely been addressed in the prior literature. In addition, this research uses both accounting based measures and market based measures for predicting the likelihood of default whereas a majority of the literature in this field has used either accounting based measures or market based measures. There is very little literature on the effect of TMT attributes on financial distress or the likelihood of financial distress for the UK, which is addressed by this research. The most important contribution is the contribution of the research to the UK corporate governance code to ensure a better understanding of the effect of the key management attributes and the role played by the CFO.

The model developed in this study allows stakeholders to identify the likelihood of default based on key management attributes earlier than that indicated by the accounting and market based measures and address any concerns earlier. This will also be key to future governance to ensure a financially healthier corporate environment, designing optimal executive contracts and remuneration, and timely response to signs of financial weakness.

1.10 Some Key terminology in the study

TMT: The TMT for the purpose of this study refers to the position of the CEO, the CFO and the Chairman. The research does refer to other studies and definitions used by researchers of the TMT and this will be clarified in those instances.

The probability of firm default: This is the likelihood that a firm will default on its debt and enter into a formal insolvency process. This term is interchangeably used with financial distress. A company gets into financial distress if it is unable to pay its debts as they fall due. Once a company is in financial distress, insolvency law starts casting its shadow. In the UK the insolvency law imposes collective governance mechanisms on the insolvent company and its creditors. The insolvency laws provide a range of choices between a liquidation procedure for an orderly winding up of the insolvent company's affair and a rescue or reorganisation procedure. (Armour et. al., 2008)

Executives: The executives for the purpose of this study refers to the position of the CEO and the CFO. The research does refer to other studies and definitions used by researchers of the executives and this will be clarified in those instances.

1.11 Structure

This thesis is structured as follows:

- Chapter 2 Theoretical Literature Review This chapter develops a theoretical model by undertaking a review of the literature on key TMTs. This chapter identifies the hypotheses to be tested and establishes the concepts in the research emerging from the theoretical model.
- Chapter 3 Empirical Literature Review This chapter undertakes a critical review of the literature on determinants of firm default and its relationship with corporate governance and the TMT. This chapter further explores prior literature within the context of the theoretical model developed in the previous chapter and critiques its findings within the context of this study.
- Chapter 4 Methodology This chapter identifies the measures used for each of the individual concepts identified in chapter 3 through a discussion of the various measures previously used in academic literature and in practice.
- Chapter 5 Presentation of results This chapter presents the results of the empirical models developed by introducing the theoretical model to a sample dataset.
- Chapter 6 Analysis and Discussion This chapter analyses the results of the models developed and discusses the key results within the broader context of existing prior literature. In addition, this chapter also presents an out of sample test of the empirical model on a recently failed listed company.
- Chapter 7 Conclusions and Recommendations This chapter summarises the key findings of the study, critiques some of the key limitations of this research, provides recommendations for further research and provides a thesis summary.
- Bibliography
- Appendices

Chapter 2

Theoretical Literature Review

2.1 Introduction

This chapter reviews key theories used in Top Management Team (TMT) research and critiques them using theories from other disciplines to develop a theoretical framework. This framework identifies three broad categories of TMT attributes namely: Motivation, Loyalty and Effectiveness. The sections that follow identify a key theory for each of these attributes and reviews other theories that further develop our understanding of the key theory and the TMT attributes. Finally, the theoretical framework underpinning this research is presented.

2.2 Theoretical Framework

The theoretical framework for this study is developed through the review of these key theories discussed above and how they are categorised within the different aspects of the behavioural theory of the firm. A diagrammatic representation of the theoretical framework is presented in Fig. 2.1. The behavioural theory of the firm is the key underpinning theory of this research. The four attributes within this theory are categorised into developing four broad attributes of the TMT. Hence, this research argues that firstly the TMT of a firm set the goals and make key strategic decisions to achieve these. Secondly, the TMT are leaders of a coalition of individuals within a group i.e. the organisation. Thirdly, the TMT are provided with compensation in excess of what would be deemed sufficient for the efficient running of the organisation. And finally, the TMT of a firm may undertake behaviour or actions that may be deemed as "good enough" as opposed to undertaking behaviour or actions to maximise the wealth of the shareholders or the returns to the organisation. These four arguments relate to the four attributes of the behavioural theory of the firm and are broadly categorised as TMT effectiveness at board level, TMT effectiveness at the firm level, TMT Motivation and TMT Loyalty.

The framework underpins further four key theories for each of the four attributes of the Behavioural theory of the firm. These are Resource Based View for Decision Making Process, Knowledge Based View for Coalition of groups, Agency Theory for Organisational Slack and Seasons of Tenure for Satisficing Behaviour. In addition to these four key theories, additional relevant theories are attached to help better understand each of the four attributes. These are the Stakeholder Theory for Decision Making Process, Social Identity Theory for Coalition of Groups, Entrenchment and Stewardship theory for Organisational Slack and Service Profit Chain and Upper Echelons Theory for Satisficing Behaviour.

Using the Resource Based view, the framework argues that the TMT is a VRIN resource within the organisation that make key decisions which give the organisation a sustained competitive advantage. The stakeholder is a further combination of the Resource Based view and the market based view which identifies key stakeholders to the firm beyond the shareholders and the TMT are one of these key stakeholders.

Using the Knowledge Based view, the framework argues that knowledge within the organisation gained by the individuals within the organisation is the most important resource available that allows a firm to gain a sustained competitive advantage. This within the context of the social identity theory further develops as individuals within a group take pride and self-esteem by their membership in the group and identifying differences from other groups.

Using the agency theory, the framework argues that due to the existence of the agency problem within organisations executives have to be compensated more than what would be considered an appropriate amount for the successful running of the firm. The excess amount that is paid is to ensure that the executive directors do pursue own objectives and goals but instead pursue the objectives and goals of the shareholders. This is further supported by the Entrenchment theory, which argues that executives will ensure that the firms or its resources are more valuable under their control, therefore, making them indispensable. However, the stewardship theory is an alternative to the agency theory as this argues that the executive directors are responsible stewards to the shareholders and do not need to receive excess compensation.

Finally, using the seasons of tenure the framework argues that the TMT of an organisation goes through different seasons the length of which would be different based on the individual, team and organisations. The strategy and action adopted by the TMT are influenced by the season they are currently in and as the tenure of the team increases the seasons could change. This importance of tenure within the theory is further highlighted by using the Service-Profit Chain as a theory which clearly links employee satisfaction within a firm to employee loyalty to the firm which is further linked to employee productivity for the firm. Finally, the Upper Echelons theory, the roots of which can be drawn back to the behavioural theory of the firm, further argues that TMT experiences and expertise influences their interpretation of situations and in turn affects their choices.

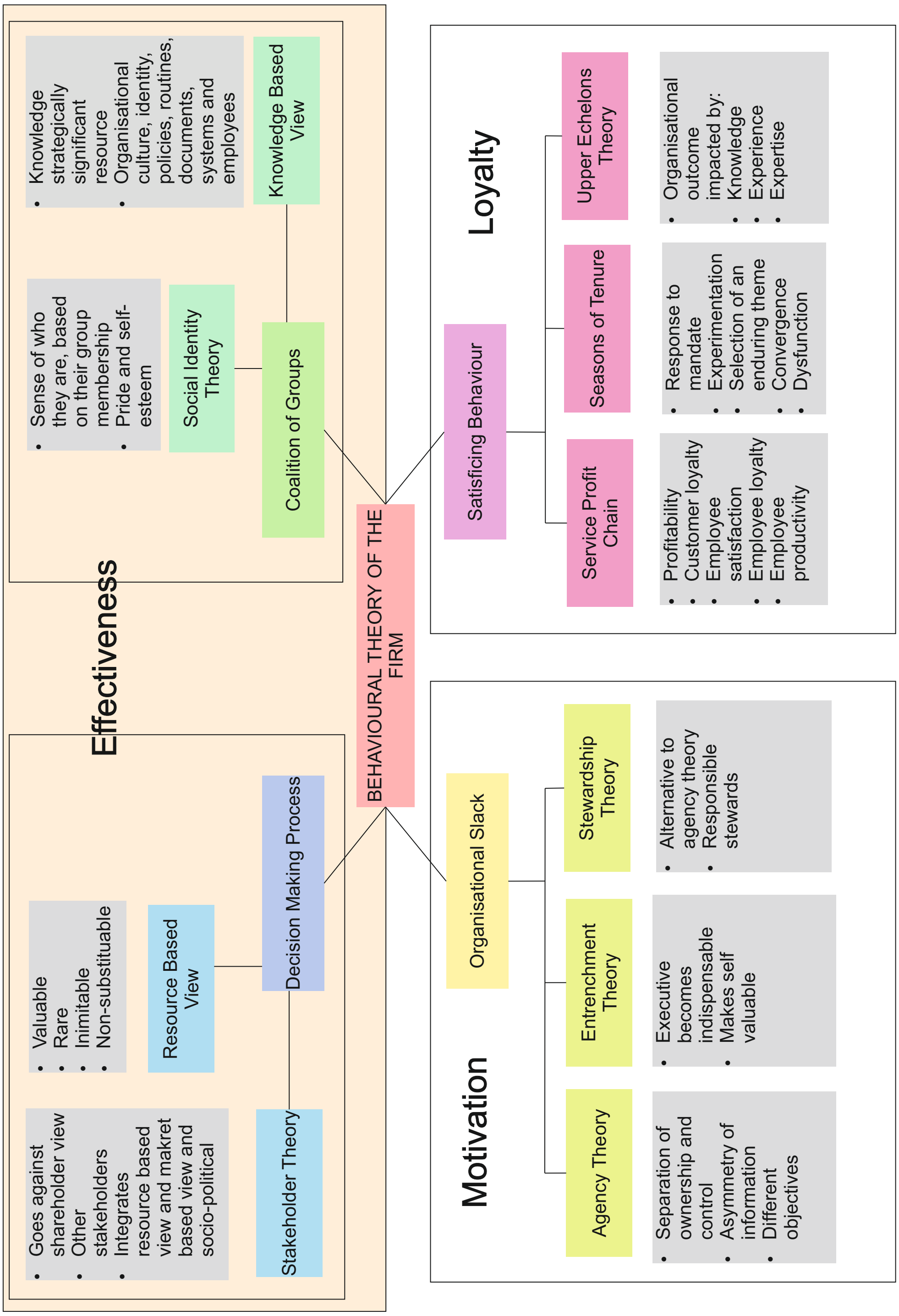

Fig. 2.1 The Theoretical Framework (Source: Author's own collection)

2.3 Behavioural theory of the firm

The behavioural theory of the firm (Cyert and March, 1963; March and Simon, 1958) emphasises the role of individuals within the economic theory of the firm. It acknowledges that organisational goals are often conflicting as they are defined at the individual level rather than at the organisational level. The theory further stresses the limitations of human rationality and stresses that individuals do not always strive to maximise their utility but attempt to attain realistic goals. The alternative solutions available to problems faced by the firm are limited to the definition of the problem and the individuals understanding of these definitions. This is how human limitations affect firm decision making and behaviour. Kaczmarek (2017) argued that there has been an increase in the utilisation of multiple and cross-disciplinary theories in corporate governance research, specially the behavioural theory of the firm which draws from both social psychology and sociological theories.

March and Simon (1958) state that the managers bring their own set of "given" skills or knowledge to a decision-making situation. This is further supported by Sutton (1987) who states that this decision-making is based on the managers "construed reality" rather than a "real" situation. A key distinction of the upper echelons theory is that the focus is solely on the TMT of the firm. A key criticism of the research developing on upper echelons theory was highlighted by Cannella and Holcomb (2005), i.e. as the upper echelons theory relates to the TMT, "team" being the focus, a majority of the research fails to focus on this element and only focusses on the individual perception element.

The behavioural theory of the firm (Cyert and March, 1963) suggests that managerial decisions are not always based on rational motives but are influenced by the natural limitations of managers as human beings. This is the root of the upper echelons perspective and in order to study the complex psychological dimensions of managers, one can use their demographic attributes as proxies (Hambrick and Mason, 1984).

Nielsen (2009) undertook a review of literature on TMT over a 22 year period and found that upper echelons theory was the most common theoretical perspective used, often combined with social psychological theories and in some cases, it was combined with strategy process or firm internationalisation. The research also found that only a few studies applied agency, entrepreneurship, change, signalling, firm growth, Resource Based view and social network theories. Nielsen (2009) found that in almost half the studies reviewed the dependent variables were organisational level outcomes (firm innovation, strategic reorientation, the degree of diversification and internationalisation, and organisational risk and crisis). In addition, it was found that performance was the most common outcome variable and that only 3 of the articles reviewed theoretically modelled and empirically tested upper echelons outcomes.

Pettigrew (1992, pg163) introduces the term 'managerial elites' to TMT and therefore includes those who occupy a formally defined position or those at strategic positions in the definition of TMT. Hambrick and Mason (1984, pg193) define TMT as the 'powerful actors in an organisation' and Finkelstein and Hambrick (1994, pg 8) define the TMT as the most influential executives at the head of an organisation the '…top three to ten'.

Origins of the Upper echelon and firm process Internationalisation perspectives can be traced back to the Behavioural Theory of the Firm. This theory highlights the relevance of the role played by individuals in the firm by introducing the social aspect to the economic theory of the firm and argues that organisational goals are defined at the individual level rather than at the firm level. The Behavioural Theory argues that management, as humans, do not have rational motives and maximising behaviour, instead they have bounded rationality (Simon, 1947) which influences their decision-making.

2.4 Theoretical perspective for Executive Motivation

This section reviews theories relating to TMT loyalty and its relationship to organisational outcomes. It commences with a discussion of the agency theory which is the key theory underpinning this attribute. This is then followed by a critique of the agency theory under the light of the entrenchment theory and stewardship theory.

2.4.1 Agency Theory

"If both parties to the relationship are utility maximisers there is good reason to believe that the agent will not always act in the best interest of the principal" (Jensen and Meckling, 1976)

Berle and Means (1932) in their book 'The Modern Corporation and Private Property' highlighted the issue around monitoring of executive autonomy with an increase in the wide dispersion of ownership. This idea was further developed by Jensen and Meckling (1976) into a very widely used theory today, namely 'agency theory'. The key argument behind this theory, as presented in Fig. 2.2, is that in modern day corporations the ownership and control of the organisation is widely separated i.e. the principal (owner) employs the agent (manager) to control or run the firm. The key assumption of the theory is that the agent is likely to be self-interested and opportunistic in his behaviour as opposed to having behaviour consistent with the interest of the principal.

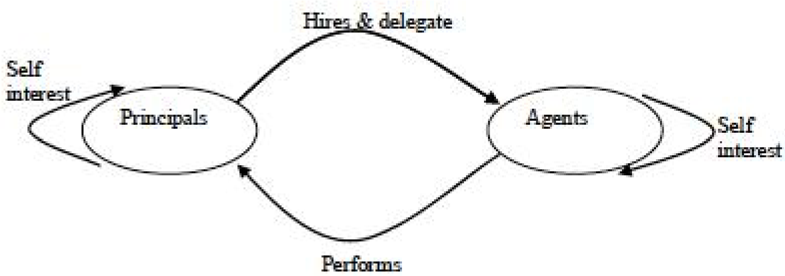

Fig. 2.2 The Agency model (Source: Abdullah and Valentine, 2009)

"How does it happen that millions of individuals are willing to turn over a significant fraction of their wealth to organisations run by managers who have so little interest in their welfare" (Jensen, 2001)

The agency theory research has developed as corporations develop to reflect and understand the true nature of the TMT. For example, Wiseman and Gomez-Mejia (1998) relax the theory's assumption that managers are purely economic agents, whilst Pepper and Gore (2015) emphasise on internal governance as a key assumption and reevaluate the predictions through the behavioural agency theory. Shi et al. (2017) emphasise on external governance mechanisms, such as external monitoring and control, to reevaluate the predictions of the agency theory and what this means for intrinsic motivation to behave ethically.

In order to ensure the agent behaves and controls the firm in the best interest of the principal, the principal needs to counter the problems. This action by the principal incurs costs, which are known as the 'agency cost'. Agency theorist base their research on this very basic assumption that all managers are self-interested opportunistic agents whose behaviour would only be aligned to that of the principal by countermeasures such as, incentives. There is little focus on the attitudes, conduct and relationships of board effectiveness (Roberts and Young, 2005).

The agency theory states that employees are self-interested, individualistic, bounded rationality and rewards and punishment are prominent in such firms (Jensen and Meckling, 1976). Zahra and Stanton (1988) argue against board composition and firm performance as they find no relationship in their study. However, the agency theory argues that due to the separation of ownership and control insider-dominated boards will aggravate the conflict of interest of manager and therefore outside directors help in policing and monitoring management behaviour.

Jensen and Meckling (1976), in their study, propose that good corporate governance structures should be able to mitigate the conflict between management and stakeholders and the conflict between shareholders and bondholders. The management that has superior information and control of the firm compared to the other stakeholders are able to transfer the firm's wealth to themselves. Similarly, shareholders that control a firm when its solvent are incentivised to transfer the firm's wealth from the bondholders to themselves. In addition, large shareholders influence the firm to create greater wealth for themselves at the expense of other minority shareholders and bondholders. However, Kaczmarek (2017) argued that there has been an over-reliance on agency theory as the main perspective for research within corporate governance which has led to a lack of realism of context and failing to unveil the board process and social context.

2.4.2 Entrenchment Theory

The Entrenchment theory as proposed by Shleifer and Vishny (1989) revolves around managers investing the firms' resources in assets that are more valuable under them than any other alternative management, even if this investment is not value maximising for shareholders. This allows them to then make themselves valuable to the firm and demand a higher compensation from shareholders to remain within the firm.

The entrenchment theory suggests that managers undertake decisions that increase their own value to shareholders (Shleifer and Vishny, 1988). Guest (2009) found that CEO compensation increased significantly in the year following the acquisition. Girma et al. (2006) found the firm performance had an insignificant impact on executive compensation but firm size has a positive effect. Similarly, Gregg et al. (1993), a UK study, found a weak correlation between firm performance and director remuneration however firm size was found to be an important determinant. Sun et al. (2016) find that managers with a high percentage of own firm shares are in a better position to protect their private interests from the risk of bankruptcy due to high leverage, therefore supporting the entrenchment hypothesis.

Shleifer and Vishny (1989) argue that managers face pressures, such as monitoring by the board (Fama and Jensen, 1983), managerial labour market (Fama, 1980), competition (Hart, 1984) and threat of takeover (Ruback and Jensen, 1983; Scharfstein, 1988), to act in the interest of shareholders. Managers counter these forces by entrenching themselves i.e. making themselves valuable to the shareholders and costly to replace allowing them to raise their wages in negotiations. Shleifer and Vishny (1989) further argue that a manager collecting rents will do what it takes to continue keeping the rent. Anderson et al. (2018), embed the entrenchment theory in the paper to argue that when ownership and control are separated, the firm performance is dependent on having the right management and incentivising them appropriately.

2.4.3 Stewardship Theory

The stewardship theory is based on assumptions that oppose those made by the agency theory. Critics of the agency theory see the assumptions relating to the self-interest and self-serving motives of the TMT as pessimistic and suggest the pro-organisational motives of the TMT supporting the stewardship theory. Stewardship theory states that the TMT aims and motives are not opposed to those of shareholders instead both aim to maximise the long-term stewardship of the firm and therefore all their aim and motives are well aligned. In addition, the stewardship theory argues in favour of combining the roles of the CEO and Chairman by highlighting the negative effects of separating the roles. The stewardship theory suggests that independent directors offer counselling and advice rather than monitor and control activities. This is further argued by Glinkowska and Kaczmarek (2015) that the key motivating factor, as per the stewardship theory, for managers is job satisfaction.

Davis et al. (1997) define stewardship theory as “a steward protects and maximises shareholders’ wealth through firm performance because by so doing, the steward’s utility functions are maximised”. Fig. 2.3 presents this relationship where the Shareholders empower and trust their stewards who are intrinsically and extrinsically motivated. These motivated stewards work towards protecting and maximising the wealth of their shareholders.

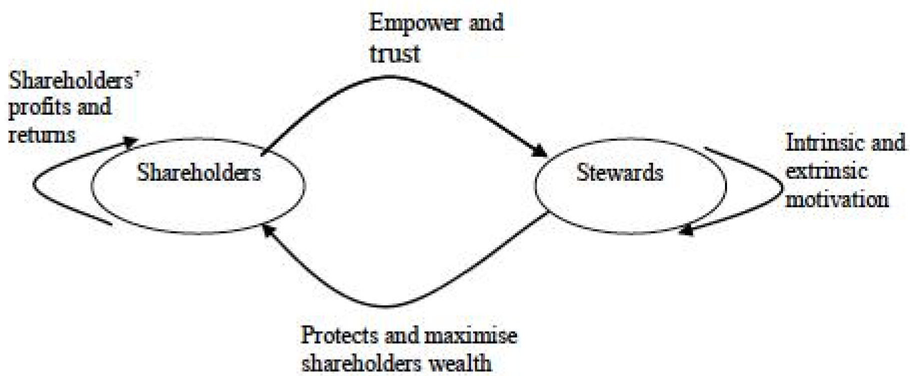

Fig. 2.3 The Stewardship model (Source: Abdullah and Valentine, 2009)

This theory argues against the agency theory as it does not emphasise on the perspective of individualism (Donaldson and Davis, 1991) instead that the TMT are stewards to shareholders and aim to maximise the wealth of shareholders by integrating their goals with those of the organisation. This theory further argues that the TMT will feel satisfied and motivated as the firms' success is attained. The agency theory treats the TMT as economic beings (Argyris, 1973), whereas the stewardship theory recognises the TMT autonomy built on trust (Donaldson and Davis, 1991). Daily et al (2003) argued that the TMT try to maximise firm performance and shareholder wealth as they wish to protect their own reputation (Shelifer and Vishny, 1997). This argument is supported by Fama (1980) who states that the TMT want to be good stewards as they manage their own careers as effective stewards. Abdullah and Valentine (2009), liken the stewardship theory to the working conditions in Japan where the employee takes ownership of their own job and works at it diligently. They further add that combining the role of the CEO and Chairman would reduce agency costs, as they would be better stewards safeguarding the interest of shareholders. This argument is supported by the findings of Donaldson and Davis (1991) as their evidence showed an increase in the ROE (return to shareholders) by combining the two roles.

Agency theory argues that the objectives of the principal (shareholder) and the agent (manager) are not aligned and mechanisms need to be in place to provide protection to shareholders (Eisenhardt, 1989). However, stewardship theory argues that the objectives of the managers as stewards of the shareholders are aligned (Donaldson and Davis, 1991). Roll (1986) argues that managers intend to be honourable stewards for the shareholders however hubris, which is overconfidence, leads to managers making incorrect decisions. Gregory (1997) argues that within the M&A context, hubris and behavioural theories of management are possible explanations for M&A outcomes. Stewardship Theory, unlike agency theory, supports the argument that CEO duality will facilitate superior firm performance (Dalton et al. 1998). The theory suggests that managers are highly motivated stewards of the shareholders and there is no misalignment of interest. This was evidenced by Donaldson and Davis (1991) where they examined 337 US firms (76% of which had CEO duality) and found dual structures to outperform independent chair structures.

2.4.4 Hypotheses linked to Executive motivation

Hypothesis 1a *There is no relationship between executive short-term motivation and the likelihood of firm financial distress*

Hypothesis 1b *There is a negative relationship between executive long-term motivation and the likelihood of firm financial distress*

2.5 Theoretical perspective for TMT Loyalty

This section reviews theories relating to TMT loyalty and its relationship to organisational outcomes. It commences with a discussion of the seasons of tenure which is the key theory underpinning this attribute. This is then followed by a critique of the upper echelons theory and the service profit chain.

2.5.1 Seasons of Tenure

Hambrick and Fukutomi (1991) proposed a lifecycle in the form of the seasons of CEO tenure. The different seasons give rise to different patterns of attention, behaviour and firm performance under the individual executive. The authors referred to a study undertaken by Eitzen and Yetman (1972), where they studied college basketball coaches and the relationship between the tenure of the coach and team performance. The findings suggested that the longer the coaching period the better the team performance however after an average period of 13 years the team performance steadily declined.

Hambrick and Fukutomi (1991) provide 5 stages of the CEO's tenure, from commencement to departure, in the seasons of tenure theory. They further argued that a CEO's peak performance will be in the 'Convergence' stage and during the 'Experimentation' stage, depending on earlier success, a CEO may undertake actions significantly different to the mandate they received on commencement.

Hoskisson et al. (2017) highlight that executive tenure is the most studied attribute of executives within risk-taking literature (Boeker 1997; Hambrick and Fukutomi, 1991; Hambrick et al. 1993; Miller 1991) i.e. long-tenure executives take fewer risks as they are reluctant to make changes with the exception where tenure increases innovation (Kimberley and Evanisko, 1981).

Hambrick and Fukutomi (1991) primarily focussed on the CEO but argue that the theory may be applied to other managerial positions in general. The key elements of this theory are that the CEO's paradigm is based on two elements i.e. the pre-existing knowledge that the manager brings and their toolkit. In addition, another key element of the theory is the conditions within the firm on the executive's entry. Hambrick and Fukutomi (1991) argue that the CEO's commitment to their paradigm, task knowledge, information diversity, task interest and power evolves over their tenure which gives distinction to the seasons proposed in the theory.

The five seasons proposed by the theory are Response to Mandate, Experimentation, Selection of an Enduring Theme, Convergence and Dysfunction.

Critical CEO Characteristics	1 Response to Mandate	2 Experimentation	3 Selection of an Enduring Theme	4 Convergence	5 Dysfunction
Commitment to a Paradigm	Moderately strong	Could be strong or weak	Moderately strong	Strong; increasing	Very strong
Task Knowledge	Low but rapidly increasing	Moderate; somewhat increasing	High; slightly increasing	High; slightly increasing	High; slightly increasing
Information Diversity	Many sources; unfiltered	Many sources but increasingly filtered	Fewer sources; moderately filtered	Few sources; highly filtered	Very few sources; highly filtered
Task Interest	High	High	Moderately high	Moderately high but diminishing	Moderately low and diminishing
Power	Low; increasing	Moderate; increasing	Moderate; increasing	Strong; increasing	Very strong; increasing

Fig. 2.4 The Five Seasons of CEO Tenure (Source: Hambrick and Fukutomi, 1991)

As portrayed in Fig. 2.4, the seasons would commence with responding to a mandate given by the board of directors or the predecessor, following which a season of experimentation may commence after gaining a strong political foothold. In the third stage, the executive reflects on the first two seasons and selects the themes that work best or most comfortable following which a period of actions is initiated to support and converge on the theme. Finally, the positive effects of the executives continuing tenure are outweighed by the negative effects. Hambrick and Fukutomi (1991) propose that CEOs whose tenure spans all five seasons will experience their peak performance at some intermediate point and performance very early and very late will be lower. A CEO's tenure that does not span all the five seasons may avoid a downturn or the curvilinear relationship to performance may not be seen. In addition, the authors propose that the longer the tenure the stronger the association between executive background attributes and attributes of the organisation (significance to upper echelons theory) and the greater the executive's discretion the greater the manifestation of the seasons.

2.5.2 Upper Echelons Theory

The Upper Echelons Theory (Hambrick and Mason, 1984) is a key strategy theory that links firm behaviour and performance with management attributes. The origins of which can be traced back to the behavioural theory of the firm (Cyert and March, 1963).

Hambrick and Mason (1984) and Hambrick (2007) argue that human limitations influence management perception, evaluation and decisions relating to problems and therefore influencing their choices and behaviour. These human limitations are accessing, processing and using information (Holmes et al. 2011). This shows how deeply rooted this theory is to the Behavioural Theory of the Firm. Sutton (1987) explains that management decisions are based on their perceptions of reality ("construed reality") rather than on the "real" situation as they apply their own value and cognitive base to a situation. This notion that managers bring their own values and the cognitive base was proposed by March and Simon (1958) which is the starting point of the Upper Echelons theory. This was further supported by Dutton et al. (1983) who suggested that managers "cognitive maps" help them view a situation acting as a lens, hence they "construct, rearrange, single out, and demolish many 'objective features of their surroundings" (Weick, 1979:164).

Hambrick and Mason (1984) explain the Upper Echelons theory through the perceptual model of strategic choice presented in Fig. 2.5. They argue that the manager's perception of the situation is influenced by their cognitive base and values. This results in a limited field of vision of the situation further resulting in selective perception and interpretation. Therefore, the strategic choice available to the manager is limited by their perception of the situation.

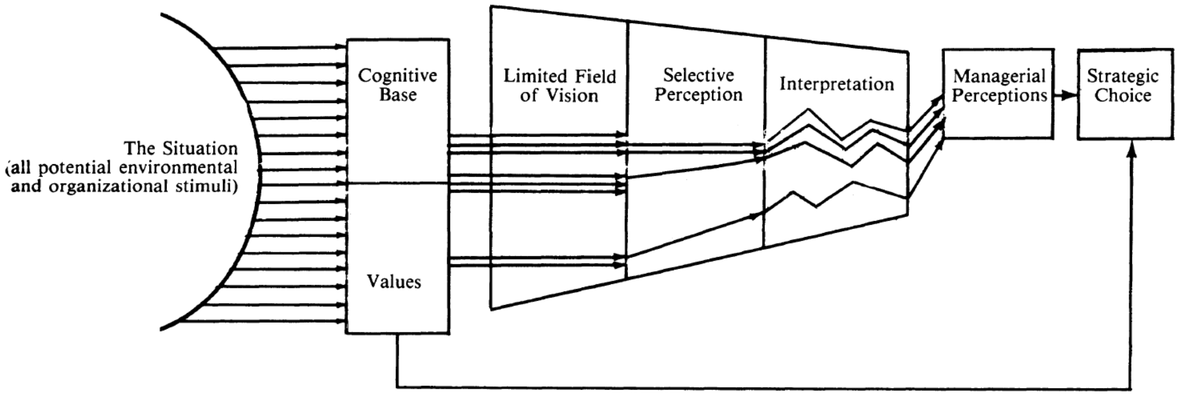

Fig. 2.5 Perceptual Model of Strategic Choice (Source: Hambrick and Mason, 1984)

The behavioural theory of the firm (Cyert and March, 1963) states that choices made by TMTs are not always following a rational motive but are increasingly influenced by limitations of the TMTs as human beings. This is the basis of the upper echelons theory. The strategic choices that TMTs make are influenced by their 'behavioural factors' which in turns impacts a firm's performance. Managers have a complex psychological dimension in their personalities as all humans and Hambrick and Mason (1984) and Hambrick (2007) suggest that demographic attributes can be used as measures for these. The organisational demography approach acknowledges the existence of intervening variables between demographic composition and organisational outcomes, however, it is not considered necessary to explore these, as they are mostly mental processes, which are difficult to assess and measure reliably (Pfeffer, 1983: 351). Hambrick and Mason (1984) combined the strategic choice and organisational demography perspective to develop the upper echelons theory.

Organisational demography is widely used in upper echelons research due to the difficulty accessing psychological dimensions and their actual behaviour (Daily et al., 2003; Hambrick and Mason, 1984; Pettigrew, 1992). Studies have focused on the relationship between demographics and organisational outcomes such as strategy and performance (Finkelstein et al., 1996; 2009) and dispersion of group over specified categories are preferred as a measure for demography than central tendencies, such as mean or median (Blau,1977; Pfeffer, 1983). Wang et al. (2016) argue that due to the nature of the variables used in prior upper echelons theory, research has provided mixed empirical findings.

Early empirical research has focused on TMT attributes heterogeneity (such as age, functional track, career experiences, education etc.) and firm's competitive behaviour (Hambrick et al., 1996), level of diversification (Michel and Hambrick, 1992), innovativeness (Bantel and Jackson, 1989), Corporate Strategic Change (Wiersema and Bantel, 1992) and performance (Michel and Hambrick, 1992; Murray, 1989; Norburn and Birley, 1988).

Hambrick and Mason (1984) argue a new emphasis for organisational research highlighting the dominant grouping of TMT of an organisation. They view the firm's outcomes as reflections of the value and cognitive base of its 'actors'. They further argue that the upper echelons theory would provide a greater probability to predict organisational outcomes, support selecting and developing upper echelons and help predict a competitor's moves and counter moves. Hall (1980) argued that large organisations run themselves and are flooded with events that drive their progress (Hannan and Freeman, 1977). Hambrick and Mason (1984) view organisational outcomes as reflections of the values and cognitive bases of powerful actors within the organisation. The upper Echelons Theory states that executive experiences, values and personalities affect their decisions (Hambrick, 2007).

Numerous studies have found support for the "upper echelons perspective" i.e. the relationship between executive attributes and complex business problems (Dearborn and Simon, 1958), organisational innovation (Hage and Dewar, 1973), structure (Miller and

Tolouse, 1986), strategy (Boeker, 1989), subsequent company growth (Eisenhardt and Schoonhoven, 1990) and effectiveness in implementing specific types of strategy (Gupta and Govindarajan, 1984).

2.5.3 Service Profit Chain

The Service Profit Chain is a theoretical concept about how service companies make money by linking employee, customer satisfaction and financial performance (Loveman, 1998). The theory argues that employee and customer loyalty are primary drivers of profitability rather than coming at the expense of profitability. It is further argued that this link is not exclusive to service companies but non-service companies as well. The service profit chain theory is a theory based on multiple disciplines with an application by many management teams. The theory, as portrayed in Fig. 2.6, argues that internal service quality has a link with employee satisfaction, which in turn has a link with employee loyalty. This equates to external service quality which has a link with customer satisfaction further linking with customer loyalty. All of which links together to influence, revenue, growth and profitability.

Fig. 2.6 The Service Profit Chain (Source: Loveman, 1998)

This theory can be traced back to the work of Reichheld and Sasser's (1990) work on customer satisfaction and loyalty. Reichheld (1996) argues against the conclusion that market share is the main factor impacting profit and instead argued that customer loyalty is the main factor impacting profitability. Reichheld and Sasser (1990) and Schlesinger and Heskett (1991) further argued on the linking between employee outcomes, customer outcomes and financial results.

Heskett et al. (1994) provide detail on the links in the service-profit chain by analysing cases of service organisations at each individual stage. They identify that at an automobile dealer's the sales loss was as much as $36,000 monthly as a result of replacing a sales representative with five to eight years of experience with someone with less than one year experience. This was also seen at a brokerage firm where the cumulative losses of replacing a broker were almost $2.5 million in commission as it usually took, a broker, 5 years to rebuild relationships. This led to Heskett et al. (1994) concluding that employee loyalty drives productivity.

Bowen and Schneider do agree that high-performing employees are more likely to lead to external service quality through a positive service experience. Thus employee satisfaction is associated with higher retention (Harrison et al., 2006). However, the Service Profit Chain has been criticised for placing emphasis on employee satisfaction (Bowen and Schneider, 2014) as employee satisfaction does not explain performance or customer experience. Kamakura et al. (2002) highlight the cost effects of this that would in turn reduce profitability and Homburg et al. (2009) argue that there is a limit to improving customer satisfaction. Hogreve et al. (2017) further indicate the need to integrate complementary pathways to the Service Profit Chain framework and challenge the implicit rationale that firms should always maximise employee satisfaction, external service quality to improve firm performance.

2.5.4 Hypothesis linked to TMT loyaly

Hypothesis 2 *There is a negative relationship between TMT loyalty and the likelihood of firm financial distress*

2.6 Theoretical perspective for TMT Effectiveness

This section reviews theories relating to TMT loyalty and its relationship to organisational outcomes. It commences with a discussion of the Resource Based View and Knowledge Based View which is the key theory underpinning this attribute. This is then followed by a critique of the stakeholder theory and social identity theory.

2.6.1 Resource Based View

The Resource Based View (RBV) of a firm is a theory that explains the competitive nature of firms. It revolves around the manner in which firms utilise the set of tangible and intangible resources at their disposal to produce goods/services to compete with each other. Barney (1991) proposed that in order for firm's resources to hold potential for a sustained competitive advantage they must have the following attributes: (a) valuable, (b) rare, (c) imperfectly imitable and (d) non-substitutable (VRIN). These resources need to be non-homogenous and not perfectly mobile. If all the firms within a sector have the same resource, then it is not possible for a firm to gain a sustained competitive advantage. Lieberman and Montgomery (1988), mention the benefit gained by the so-called 'first movers', i.e. a firm that makes the first move is able to gain a competitive advantage compared to firms with similar resources. However, for a firm to be a 'first mover' it should have prior knowledge and the opportunity to utilise the resources before other firms which in itself is a resource (Wernerfelt, 1984; Barney 1991). Alternatively, competing firms would seek to erode another firm superior resources and capabilities through poaching, imitation, replication or substitution (Sudarsanam, p63, 2012).

Fig. 2.7 presents the resources available to a firm under the RBV as defined by Sudarsanam (2012). Tangible assets consist of plant, equipment, land and natural resources, raw materials, semi-finished goods, waste products and by-products, and stock of finished foods (Penrose, 1959). Human Resources in a firm are unskilled and skilled labour, clerical, administrative, financial, legal, technical, and managerial staff (Penrose, 1959).

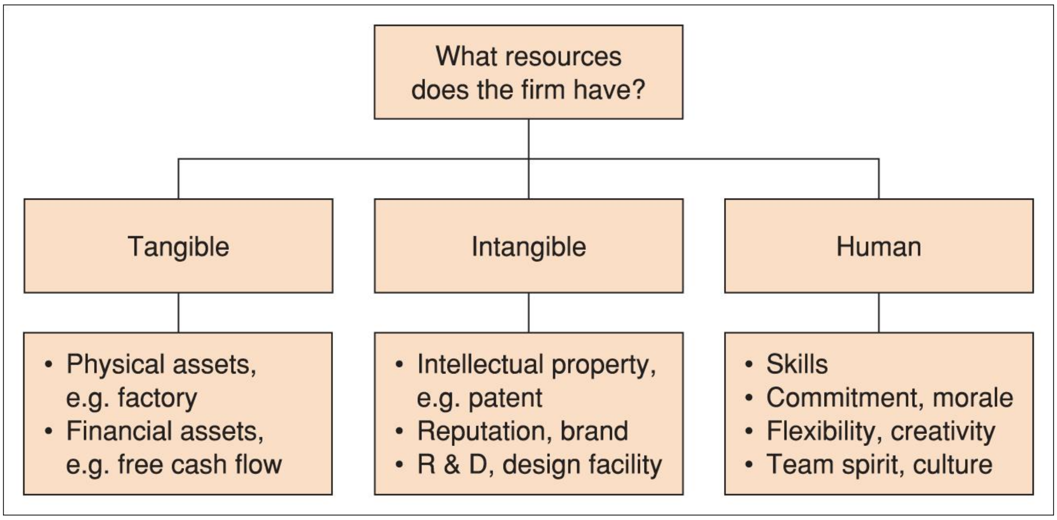

Fig. 2.7 Firm Resources (Source: Sudarsanam, 2012)

Sudarsanam (2012) further defines the organisational capabilities, presented in Fig. 2.8, available to a firm that allows it to gain a sustained competitive advantage.

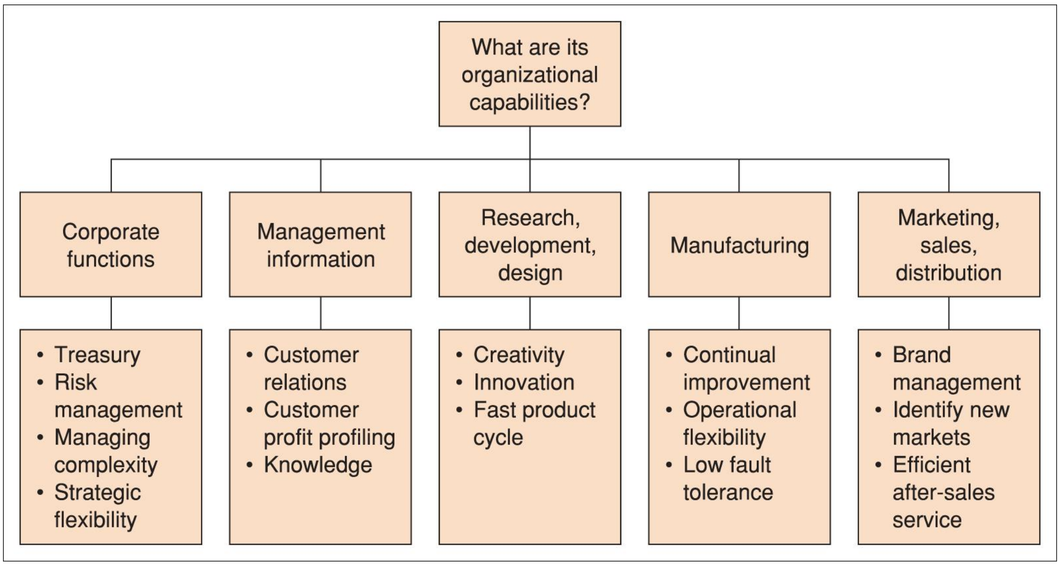

Fig. 2.8 Organisational Capabilities (Source: Sudarsanam, 2012)

Penrose (1959) states that for some purposes human resources can be treated as tangible assets, for example, some employees may be part of a substantial investment in the firm and it may suffer a capital loss if such employees leave. Barney (1991) classified the numerous resources into three categories as proposed by previous researchers: physical capital resources (Williamson, 1975), human capital resources (Becker, 1964) and organisational capital resources (Tomer, 1987). The focus here is on the human capital resources which he describes as the training, experience, judgement, intelligence, relationships and insight of individual managers and employees. Becker (1962) whilst focusing on on-the-job training, then further classified human capital into specific and general human capital. Teixeira (2014) in a review of Becker's work highlights that general human capital (training) increased the productivity of the employee in other firms and therefore the firm would pass this cost on to the employee. Whereas specific human capital (training)increased the productivity of the employee more for in the firm providing it and hence the firm would be willing to support this cost.

The TMT of a firm is one of the many resources that firms use to gain competitive advantage. Arguably, the TMT is the only resource to implement the most suitable combination of resources for a firm to gain a competitive advantage. As a human resource, the attributes of the TMT of a firm are likely going to be dissimilar to other firms making them a firm-specific, durable and scarce resource. The more a resource has these three attributes the more valuable it is to the firm (Amit and Schoemaker, 1993).

"... it is never resources themselves that are 'inputs' in the production process, but only the services that the resources can render. The services yielded by resources are a function of the way in which they are used - exactly the same resource when used for different purposes or in different ways and in combination with different types or amounts of other resources provides a different service or set of services." (Penrose, 1959:25)

This quote by Penrose highlights that for resources to provide a service valuable to a firm it is important to yield the right service from the resource, on its own, in combination and this service may need to change over time. The identification and utilisation of the services valuable to the firm depend on the strategizing by the TMT. Priem and Butler (2001) found that RBV did not appear to meet the criteria to be a theory for strategic management. An industry/sector where theories such as the RBV are adopted widely are not operating on their efficient frontier and hence careful consideration needs to be given to this (Ryall, 1998).

The RBV assumes that firm's resources are heterogeneous to the firm and not easily transferable to another firm (Barney, 1991). Barney (1991) classified these firm resources into three broad categories: 'Physical' (technology or plant and equipment); 'Organisational' (planning, reporting and coordinating systems); and 'Human' (knowledge, experience and relationships). In order for a firm to have a sustained competitive advantage, it should employ a value-enhancing strategy that is not being adopted or cannot be replicated by an existing or potential competitor (Barney,1991).

Daft and Lengel (1983) defined firm's resources as "all assets, capabilities, organisational processes, firm attributes, information, knowledge…that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness". Amit and Schoemaker (1993:35), further differentiated capabilities from resources as "a firm's capacity to deploy resources." Firms may have similar resources but what helps them differentiate themselves from competitors is the manner in which these resources are then utilised within the production process. Lin and Wu (2014) further studied the dynamic capabilities of resources in the resources based view and explored the relationship of different resources, dynamic capabilities and firm performance. They argued that dynamic capabilities can lead to a firms VRIN resources to improve firm performance.

Pfeffer and Salancik (1978) developed the Resources Dependence Theory based on the key argument that the TMT can provide the firm with key resources. They stated that "when an organisation appoints an individual to a board, it expects the individual will come to support the organisation, will concern himself with its problems, will variably present it to others, and will try to aid it" (Pfeffer and Salancik, 1978, pg. 173). Non-executive directors can be viewed as a Valuable, Rare, Inimitable and Non-transferrable resource in their differing roles within the firm. They can be a valuable source of expertise, in terms of specific skills and provide advice and counsel in relation to firm strategy. Non-executive directors can provide contacts, information and relationships to support the management of the environmental uncertainties. Also, some individuals are able to increase reputation and perceived legitimacy of TMT in their role as a symbolic resource.

Roberts and Young (2005) highlight the relationship between Resource Dependence theory and the life-cycle of the firm i.e. a young firm will look to its non-executive directors for skill and expertise compared to a newly listed firm where the value of the non-executive director is beyond skills and includes reputation and networks that provide access to new markets or sources of finance. The authors also state that a more mature business where the non-executive directors provide relevant market and managerial experience (past experience) compared to formal independence. The resource dependence theory focuses on the TMT as providers of access to resources for the firm through their existing relationships within the external environment (Hillman et al., 2000).

The theory emphasises the relevance of outside directors as a means of gaining access to those resources available through the director (Johnson et al., 1996). Firms require access to a range of resources to function, perform and survive (Daily et al., 2003) and these resources can be in the form of but not limited to information, skills, access to suppliers, buyers, public policy makers, social groups and provide legitimacy (Hillman et al., 2000). Abdullah and Valentine (2009) categorises the TMT into four categories: Insiders (current and former executives of the firm), Business Experts (Current/Former senior executives of other larger firms), Support Specialists (lawyers, bankers, insurance company representatives, PR experts etc.) and Community Influentials (political leaders, university faculty, members of clergy, leaders of social or community organisations etc.).

Pfeffer and Salancik (1978) explained the relationship between the external resources of organizations and the behaviour of the organization through the Resource Dependence Theory. They state, "...to understand the behaviour of an organization you must understand the context of the behaviour – that is, the ecology of the organisations..." (Peffer and Salancik, 1978:1). The theory is integral in explaining why firms engage in mergers and acquisitions, Pfeffer (1976) suggested three reasons for firms engaging in Mergers and Acquisitions: to reduce competition by absorbing a key competitor, to manage interdependence with sources of input or purchasers of output by absorbing them and diversify operations to lessen dependence on the absorbed firm. Research on boards of directors has also involved the use of the theory although not as much as the agency theory. However, Hillman et al.

(2000) in a review of the Resource Dependence Theory, find that empirical evidence has suggested the theory to be a more successful lens for understanding boards than the agency theory.

Pfeffer (1972) found a relationship between the board size and the firm's environmental needs and firms with greater interdependence require a higher ratio of outside directors. Sanders and Carpenter (1998) further provided evidence to support the findings and concluded that board size depended on the firm's level of internationalisation. Pearce and Zahra (1992) however advocate that board composition and size are also contingent on the firm's current strategy and prior financial performance. Boyd (1990) further add that board size can be a hindrance and suggested that "resource-rich" directors should be the focus of board composition. Pfeffer and Salancik (1978) suggest directors provide four benefits: advice and counsel, channels of information between the firm and environmental contingencies, preferential access to resources and legitimacy.

2.6.2 Knowledge Based View

The Knowledge Based View of the firm is an extension of the Resource Based View where Knowledge is the most strategically significant resource of a firm (Grant, 1996; Hill and Deeds, 1996; Hoskisson et al., 1999; Sveiby, 2001; Huizing and Bouman, 2002; Balogun and Jenkins, 2003). Because Knowledge based resources are usually difficult to imitate and socially complex, it makes it a major determinant of sustained competitive advantage and superior corporate performance. This theory assumes that organisations are heterogeneously loaded with knowledge (Hoskisson et al., 1999) and that the resource base of the firm consists mainly of knowledge based assets (Roos et al., 1997; Stewart and Capital, 1997; Sveiby, 2001; Marr, 2004). Kogut and Zander (1992) and Spender (1996) stated that organisations exist to create, transfer and transform knowledge into a competitive advantage.

Chen et al. (2017) provide a framework combining scientific knowledge resources, technological capabilities and innovative performance and find that scientific knowledge influence innovative performance through the impact of technological capability. Cabrera-Suárez et al. (2018) develop their 2001 model for family-run firms where the successor acquires the predecessor's knowledge and skills to maintain and improve organisational performance. The authors argue that the successor must undertake an effective knowledge construction process which is influenced by building on their prior knowledge. Martin-de-Castro et al (2011) argue that firms are giving increasing importance to knowledge and intellectual assets when they face competition recognising that the effective implementation of these resources as production factors can help maintain a competitive advantage (Galende, 2006).

2.6.3 Stakeholder Theory

The stakeholder theory challenges the agency theory as it argues that a company should be managed in the interest of all its stakeholders. The theory suggests that there are stakeholders beyond shareholders that have a direct interest (employees, suppliers and customers) and indirect interests (local communities, the environment and society) in the firm's performance. One of the key arguments against the stakeholder theory is that it is hard to operationalise the proportion of interest for each of the key stakeholders and on occasions where executives were responsible to all key stakeholders they would be accountable to none.

Abdullah and Valentine (2009), state that the stakeholder theory is not so much a theory but a broad research tradition that incorporates philosophy, ethics, political theory, economics, law and organisational science. The stakeholder theory is different from the agency theory as it revolves around the relationships of the TMT with a range of stakeholders of the organisation as opposed to the relationship between the manager and shareholder. Donaldson and Preston (1995) show the wider range of stakeholders that have a relationship with the firm in Fig. 2.9. The importance of the broad range of relationships was argued as being more important than the narrow shareholder-manager relationship (Freeman, 1999). Academics and researchers have argued the relevance of the theory as groups of stakeholder deserve and require management attention (Sundaram and Inkpen, 2004), stakeholders participate in the organisation to benefit (Donaldson and Preston, 1995) and the purpose of the organisation is to create wealth for all its stakeholders (Clarkson, 1995). The theory is criticised for the impact of the large network of relationships on the decision-making process of the management (Freeman, 1984) and no sets of interest (from different stakeholders) are assumed to dominate (Donaldson and Preston, 1995).

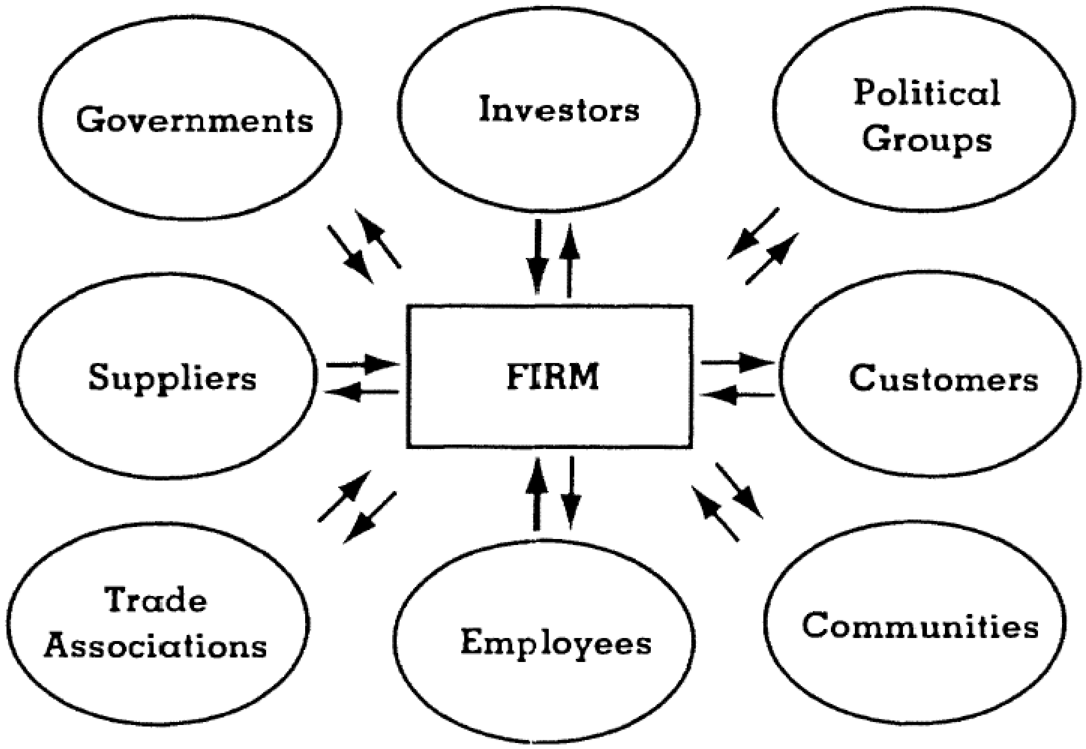

Fig. 2.9 The Stakeholder model (Source: Donaldson and Preston, 1995)

Coase (1937) described the nature of a firm as a middleman that is created to reduce transaction costs between the consumers and the suppliers of inputs. This is supported by many scholars and Cornell and Shapiro (1987), highlight that from this perspective, a firm's claimants go beyond stockholders and bondholders to include all stakeholders i.e. suppliers, customers, providers of complementary services and products, distributors and employees.

Academics have discussed and debated issues revolving around the costs associated with financial distress as these affect all stakeholders. Opler and Titman (1994) suggest that financial distress is seen as costly because it creates a tendency for firms to do things that are not in the best interest of the stakeholders and these tendencies arise due to the conflict of interest between borrowers and lenders (Jensen and Meckling, 1976; Myers, 1977; Stulz, 1990), between firms and their non-financial stakeholders and managers (Baxter, 1967; Titman, 1984; Maksimovic and Titman, 1990) and between shareholders and managers (Gilson and Vetsuypens, 1993).

The Stakeholder theory suggests that the costs of financial distress are likely to be more than the direct shortage of cash as it would make it difficult for a firm to sell implicit claims. Cornell and Shapiro (1987) focussed on the distinction between explicit contracts and implicit claims and how this would influence the financial policy of most firms i.e. if only explicit contracts are considered then the stakeholder will not play an important role in the financial policy of most firms whereas the prices stakeholders pay for implicit claims depends on the condition of the firm, including its financial policy. Later some scholars argued that financial distress can improve firm value by forcing managers to make difficult value maximising choices which they would otherwise avoid (Jensen, 1989; Wruck,1990).

Jensen (2017) argues that the stakeholder theory leaves managers with a theory that makes it impossible for them to make purposeful decisions and makes them unaccountable for their actions. He argues that the theory does not identify how the necessary trade-offs between different stakeholder interest should be made.

Opler and Titman (1994) in their study found that highly leveraged firms lose market share to their less leveraged counterparts in industry downturns and suggested the losses were customer-driven, competitor driven or manager driven. The evidence indicating manager driven losses supported the prior study by indicating that more leveraged firms were quicker to efficiently downsize in response to the industry downturn. But this could simply be due to the fact that a highly leveraged firm is required to make higher amounts of interest payments and in order to continue operating need to ensure quick availability of payments. The performance of a firm during financial distress can also be highly impacted by the number of creditors and its relationship with its creditors. Hoshi et al. (1990) found that financial distress is costlier when the claims are spread among many creditors and a financially distressed firm performs better than other financially distressed firms if its financial structure makes it relatively easier to renegotiate its liabilities.

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2.6.4 Social Identity Theory

Social Psychology deals with human relations and interactions by focusing on individuals (Gergen and Gergen, 1986). Social Identity Theory (Turner, 1982) and Social Categorisation Theory (Tajfel, 1979; Tajfel, 1981; Turner et al., 1987) state that based on personal and social identity individuals strive towards pride and self-esteem. Social Identity theory states that people categorise others into groups to differentiate between in groups and out groups based on observable attributes such as age, race etc. (Veltrop et al., 2015). The theory also suggests that individuals further classify themselves based on the organisation they work for which influences the individual's self-concept (Ashforth and Mael, 1989). Social Categorisation Theory further states that people view in group individuals positively and out-group individuals negatively (Goethals, 2003) creating discrimination (Eiser, 1986) leading to a negative effect on team functioning and performance.

The central focus of the theory is that individuals in a group will identify negative aspects of individuals out of a group, thus enhancing their self-image. Tajfel (1979) argued that stereotyping is part of normal cognitive processing and the tendency is to group things together. By grouping things together individuals exaggerate the difference between and similarities within groups. Turban and Greening (1997) argued, underpinning on the social identity theory and signalling theory, that a firm's corporate social performance is positively related to their reputation and attractiveness as an employer. Thus, allowing firms to attract applicants and giving them a competitive advantage. Carmelli et al. (2017) contributed to social identity theory by finding that identification within an organisation is a key socio-psychological mechanism.

Veltrop et al (2015) underpin their research on outside director task involvement and outside director tenure using the social identity theory. Ashforth et al. (2008) and Ashforth and Mael (1989) show that individuals that strongly identify with their organisation are highly motivated to contribute to the success of that organisation.

2.6.5 Hypotheses linked to TMT effectiveness

Hypothesis 3a *There is no relationship between TMT board level effectiveness and the likelihood of firm financial distress*

Hypothesis 3b *There is a positive relationship between TMT firm level effectiveness and the likelihood of firm financial distress*

2.7 UK Corporate Governance

A number of large UK public company failures in the late 1980s resulting from large-scale fraud by their directors led to a decline in public confidence in the existing financial reporting and auditing processes. This, in turn, led to an increasing demand for efficient and consistent corporate governance systems within the UK and the formation of the Cadbury Committee. The UK Corporate Governance code (summary of the key principles of the code is presented in appendix A.1) today has been influenced by a number of recommendations put forward by a range of committees over the years reflecting the need to develop the 'code' as firms and its directors develop. The 1998 combined code was a combination of the accepted principals of the Cadbury (1992), Greenbury (1995) and Hampel (1998) committees, these were then further influenced by the Turnbull, Higgs and Smith reports to give us the new combined code (revised in 2003, 2005, 2006, 2008, 2010, 2011, 2012, 2014, 2016 and 2018). The UK corporate governance code (main principles listed in the appendix) is a principal based approach rather than rules-based approach (Sarbanes-Oxley (SOX) in the US). Therefore, giving the freedom to the directors to 'comply' in their own way as best suited to the firm or 'explain' to their shareholders if they fail to implement the principles of the code. The SOX is a law that applies to all companies listed on the US stock exchange, this includes foreign companies and therefore has an impact on UK firms listed on the US stock exchange.

Whilst the revision in 2016 focussed on the changes needed for the implementation of the EU Audit Regulation and Directive the revision in 2014 focussed on the quality of information and the remuneration section. The 2014 revision focussed on the design of executive remuneration in order to promote the long-term success of the company and to demonstrate how this is being achieved to shareholders. Another key recent revision to the corporate governance code was in 2012 where the focus was on better reporting by Audit committees, confirmation by the board that the annual report and accounts are fair, balanced and understandable and most importantly the companies report on their policies on boardroom diversity.

2.7.1 Stewardship Code

The responsibility of stewardship within a public limited company is shared by the board of the company and the investors in the company. The Board oversees the tasks carried out by the management and the investors play an important role in holding the board accountable for the fulfilment of its responsibilities. The UK Corporate governance code outlines principles in order to have an effective board and the UK Stewardship Code sets out principles of effective stewardship by investors. The code originated from 'The Responsibilities of Institutional Shareholders and Agents: Statement of Principles' published by the Institutional Shareholders Committee (ISC) in 2002. In 2010 the first version of the stewardship code was published by the FRC which very closely mirrored the ISC code. This code is also applied on a 'comply or explain' basis as it is not a rigid set of rules but principles and guidance. Below is a brief summary of the key principles of the code, Institutional Investors should:

1. Publicly disclose how they will discharge their stewardship responsibilities
2. Have a robust policy to manage conflicts of interest and publicly disclose any
3. Monitor their companies
4. Establish clear guidelines to escalate their stewardship activities
5. Be willing to act collectively with other investors
6. Have a clear policy on voting and disclosure of voting activity
7. Report periodically on their stewardship and voting activities

2.8 Conclusion

This chapter reviewed key theories used in TMT research and critiqued them using theories from other disciplines to develop a theoretical framework. This framework identified three broad categories of TMT attributes namely: Motivation, Loyalty and Effectiveness. The theoretical framework utilised the Behavioural theory of the firm as the key underpinning theory for this research. The framework identified the Agency theory as the key theory for executive motivation which is critiqued in the light of the entrenchment theory and the stewardship theory. Seasons of tenure is identified as the key theory for TMT loyalty which is critiqued using the upper echelons theory and service profit chain. The Resource Based View and the Knowledge based view are identified as the key theories for TMT effectiveness which is critiqued through the understanding of stakeholder theory and the social identity theory. The chapter provides a link between these theories and the development of the hypotheses under each characteristic. Some other key theories reviewed in this study are presented in appendix A.2. These links and how the hypotheses further develop through the review of empirical literature is now discussed in the next chapter.

Chapter 3

Empirical Literature Review

3.1 Introduction

There is little research on the relationship between management attributes and firm default risk. Significant accounting scandals, such as Enron and WorldCom, have brought firm default risk into the more public light. The few studies linking Top Management Team (TMT) attributes and financial distress showed some interesting results. This chapter starts by reviewing background on TMT research, followed by a focus on the literature on the development of the role of the CEO and the role of the TMT. The chapter then reviews the literature on the relationship between Corporate Governance and Credit risk followed by a critical review of the relationship between TMT and Financial Distress. The focus is then on reviewing literature within the context of the TMT framework introduced in the earlier chapter i.e. within Executive motivation, TMT loyalty and TMT Effectiveness. Finally, the chapter focusses on critically reviewing corporate default prediction models and the UK Corporate Insolvency regime.

3.2 UK Corporate Insolvency

Since the recent global financial crisis (2007-08), the UK economy has witnessed a large number of companies undergo business failure, file for administration and become bankrupt. This is clear from Fig. 3.1 showing an increase in the number of corporate insolvencies in England and Wales from 2007 to 2012. The figures in appendix B, Fig. B.1, Fig. B.2 and Fig. B.3 provides some further evidence. These companies are no longer able to honour their loan commitments and hence have to start looking at restructuring, workouts or liquidation. The crisis has provided the economy with a consistent number of failures, if not increased the supply.

Company liquidations
England & Wales

	Not Seasonally Adjusted		
Period	Total	Compulsory Liquidations	Creditors' Voluntary Liquidations[2]
2004	12,192	4,584	7,608
2005	12,893	5,233	7,660
2006	13,137	5,418	7,719
2007	12,507	5,165	7,342
2008	15,535	5,494	10,041
2009	19,077	5,643	13,434
2010	16,045	4,792	11,253
2011	16,886	5,003	11,883
2012	16,156	4,261	11,895
2013	14,982	3,624	11,358

Fig. 3.1 Annual Company Liquidations in England and Wales (Source: The Insolvency Service, 2014)

According to the R3 Association of Business Recovery Professionals (2008:3), in the UK corporate insolvency is legally defined as follows:

"A company is insolvent (unable to pay its debts) if it either does not have enough assets to cover its debts (i.e. the value of assets is less than the amount of liabilities) or if it is unable to pay its debts as they fall due."

Statistics showing corporate insolvencies in the calendar year 2013 in England and Wales, published by the Insolvency Service, show that there were 14,982 compulsory liquidations and creditors voluntary liquidations in total. This was made up of 3,624 compulsory liquidations and 11,358 creditors voluntary liquidations. Additionally, there were 3,859 other corporate insolvencies, comprising 917 receiverships, 2,365 administrations and 577 company voluntary arrangements.

Fig. 3.2 also shows that in the 12 months ending Q3 2013, the highest number of total liquidations was in the construction sector followed by the wholesale and retail trade sector. This could be explained as the after effect of the global financial crisis that started in 2008. In order to analyse liquidation under different sectors some further work needs to be undertaken to adjust these figures based on the total number of companies liquidated under each sector compared against the total number of companies in each sector.

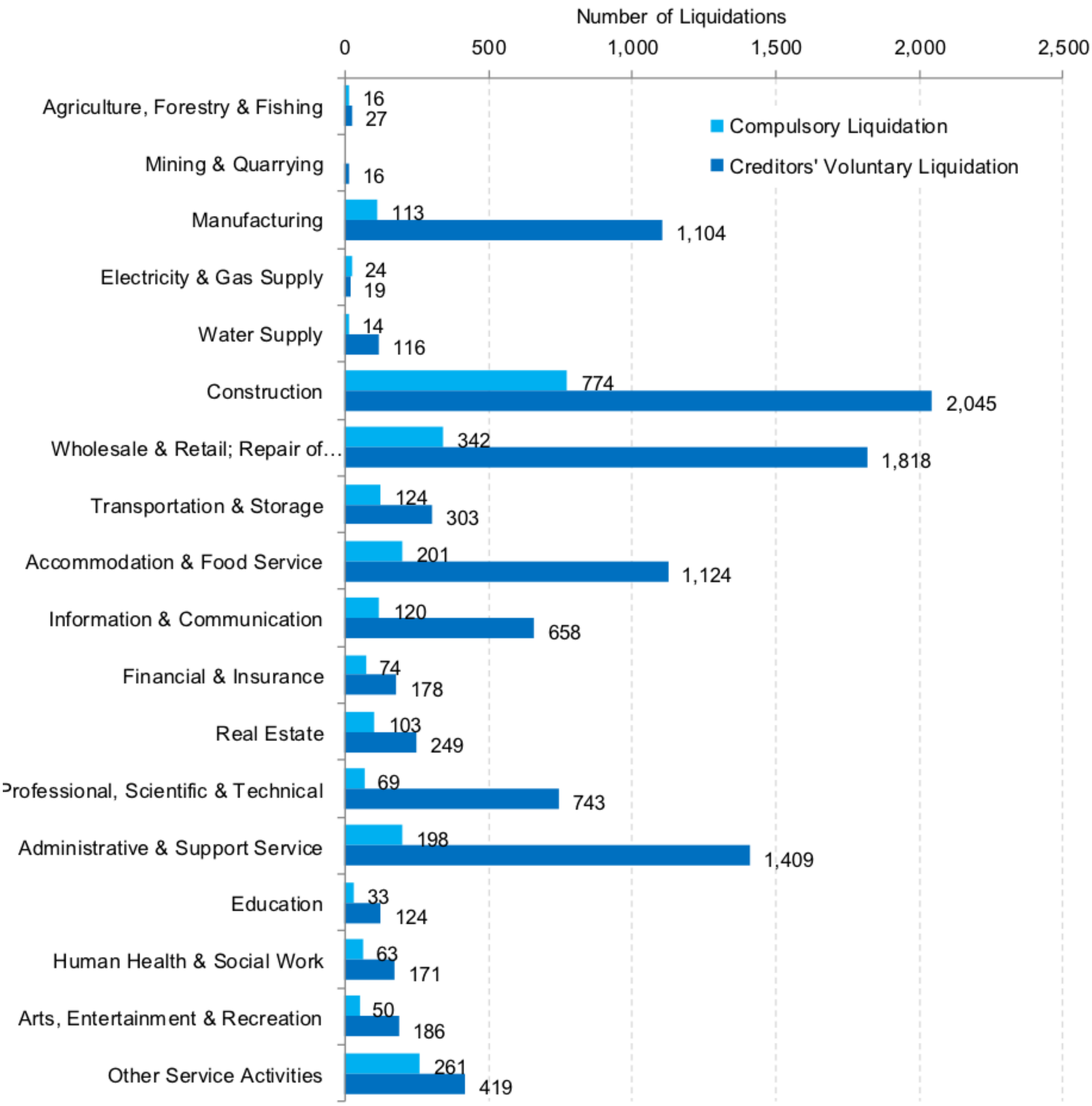

Fig. 3.2 Number of Liquidations by Sector in Q3 2013 (Source: The Insolvency Service, 2014)

Historically, regulatory and legal decisions have had a great impact on distressed debt hinting towards a strong relationship between the two. An example of this was The Enterprise Act 2002, which provided stronger regulatory support for the reorganisation of companies rather than liquidation. This resulted in an increase in opportunities to manage (distressed) debt.

There are various arrangements under which a company may choose to restructure, a few examples: Chapter 11 in the USA, London approach (administration/CVA) in the UK and in Japan the Hausbank model (the company's main banker assumes responsibility for putting in place a rescue package). In the UK secondary trading of distressed corporate debt is a fairly recent phenomenon, which provided lenders with the option to sell their holding if they did not wish to participate in a restructuring. Kent (1997) noted that banks wanted the Bank of England to ban distressed debt trading for good or at least during restructuring when it initially arrived in the UK.

Insolvency theorists such as Rasmussen (1992) and Schwartz (1998) in the past have argued against insolvency laws mandatorily imposing particular collective procedures on insolvent companies and suggested that companies should be free to contract ex-ante over how control rights will be allocated in the event of default. But this theory was strongly criticised by other scholars and LoPucki (1999) highlighted the scope this would give to concentrated lenders, like banks, to pursue their own interest at the expense of other stakeholders. In particular, critics are concerned that such a model may tend to result in outcomes biased against the continuation of insolvent companies and towards piecemeal liquidation, thus consistently failing to capture going concern value (Armour et al, 2008).

The Cork (1982) report highlighted the importance of a good modern corporate insolvency law in order to provide the means to preserve viable commercial enterprises capable of making a contribution to the economy essentially leading to the introduction of the Insolvency Act 1986. The introduction of this Act was expected to reduce the number of companies going into liquidation by allowing them to enter administration. But Armour et al. (2008) pointed out that the Insolvency Act 1986 was structurally biased towards concentrated lenders holding floating charge securities i.e. banks.

A study carried out by Liu and Wilson (2002), to analyse the impacts of the 1986 Insolvency Act on corporate failure rates, showed that whilst there was a decrease in the number of companies going into bankruptcy in the first few years the impact did not persist from a long-term point of view, pointing to the one time change in law levelling off over a period of time. They suggested alternative approaches (to insolvency laws) to reduce corporate failure i.e. by controlling interest rates and inflation. But this levelling off could also be due to the findings provided by Cuthbertson and Hudson (1996) i.e. higher level of start-ups eventually leads to higher level of company liquidations.

The Enterprise Act 2002, aimed further to improve the prospects of corporate rescue and make the formal rescue procedures fairer and more cost effective. Armour et al (2008) in their study on the impact of the Enterprise Act 2002 on corporate insolvency provided evidence that both gross realizations and direct costs were higher under the streamlined administration procedure than under receivership. Simply implying that concentrated creditor control of corporate insolvency (as in receivership) may be no worse for unsecured creditors than control by dispersed creditors (as in administration) due to the costs being controlled less effectively.

3.2.1 Creditors and Bank

A comparative study of US and UK corporate insolvency codes (Franks et al., 1996) found that corporate insolvency codes should remain essentially creditor controlled, the objective of corporate insolvency should be the maximisation of the value of the assets of a firm for the benefit of all its creditors and some consideration should be given to improving the possibility of a workout. Critics such as Adler (2004), argues that increased creditor control destroys corporate value and frequently forces entities to liquidate. But a study by Harner (2008) found that increased creditor control promotes efficiency in corporate reorganisations.

The main objective of the US Bankruptcy code and UK corporate insolvency code as described by Franks et al. (1996) is whilst the former is to maintain the business as a going concern even if that reduces the proceeds available to creditors the later aims at repayment of creditor claims. Under the UK code, the distressed firm comes under the control of an Insolvency practitioner who represents the interest of creditors. An insolvent firm may have both secured and unsecured creditors (also commonly known as trade creditors but there can be exceptions).

Many banks and debt funds are becoming major equity holders of corporates they previously were creditors to, due to corporates making debt to equity swaps as they are unable to meet their debt obligations (Euromoney,2009). This leads to heavily regulated institutions (banks, mutual funds etc.) wanting to offload the security, either before the swap or after, to remain within the regulatory requirements i.e. the likes of the Basel III or the U.S. Volcker Rule (Schultze, 2012).

Different corporate insolvency codes are tackled in different manners and this was noted by Davydenko and Franks (2008). Their findings showed that banks adjusted their lending and reorganisation practices to mitigate costly aspects of bankruptcy, but bank recovery rates in default remained sharply different across the sample countries. This reflected the different levels of creditor protection provided by the individual country corporate insolvency codes.

Objectives of Banks and Distressed Debt Investors as creditors are quite different and impact the distressed firm in differing manners. Franks et al. (1996) noted the problem with control rights when creditors have different incentives they keep the firm as a going concern and concluded that the UK code widely gave rise to 'inefficient liquidations'. A study by Franks and Sussman (2000a), found that 75% of companies survive through the corporate insolvency process in some form of a going concern but on many occasions, banks either encourage or force them to restructure.

3.2.2 Unsecured Creditors

The Insolvency Service defines unsecured creditors as "... creditors who are not secured and do not have preferential status...", although a preferential creditor who does not hold a security, in the strictest definition, can be classed as an unsecured creditor but for the purpose of this research they will be kept separately.

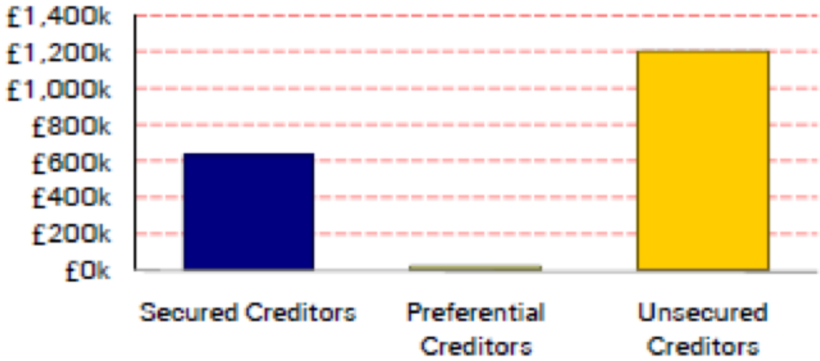

Fig. 3.3 Average Debt owed to different creditor groups (Source: Companies House, 2014)

The unsecured creditor group in the UK is a very important source of finance for businesses and the economy as a whole. This can be seen in the above Fig. 3.3, however, Fig. 3.4 below shows how little their average recovery rate is. In a study carried out by the OFT (2010), some unsecured creditors suggested they would extend more credit if their recovery rate from corporate insolvencies increased. The report also suggested that the current system of regulation is considered inconsistent and ineffective by a significant number of Insolvency Practitioners due to the harm that is caused to the unsecured creditors.

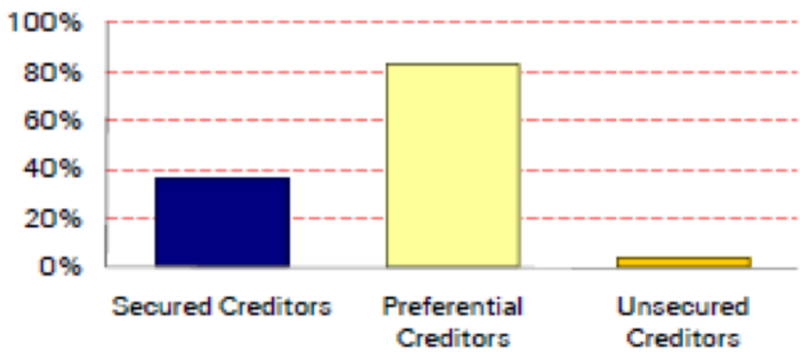

Fig. 3.4 Average recovery rate for different creditor groups (Source: Companies House, 2014)

3.2.3 Other Stakeholders

When a company becomes insolvent the shareholders have everything to lose and nothing to win and maybe the culture of maximisation of shareholder wealth in return has led to the management of companies not being keen to accept insolvency. It was noted in a study by Franks and Sussman (2000a), that bankruptcy is considered as an option of last resort by management. So when should a company's primary objective change from 'maximisation of shareholder wealth' to 'maximisation of creditor wealth'. This conflict has given rise to what Harner et al. (2014) call the 'Ostrich Syndrome'. They noted that management of troubled companies often bury their heads in sands until it is too late to remedy. But is this syndrome a result of the management trying all possible options to work towards its primary goal of shareholder wealth maximisation? This could also possibly be a conflict between the agency theory and the stakeholder theory i.e. when should the managers work towards the interest of the shareholders and when should they shift their focus to other stakeholder interest. Armour et al. (2008) noted that advocates of strong control rights for secured creditors point to the benefits that a single, concentrated lender holding all-encompassing security can bring to the governance of companies and in many ways help reduce the agency problem as this creditor will directly control the mangers.

3.3 Background on TMT research

Nielsen (2009) undertook a review of empirical research on TMT diversity. Early TMT research was dominated by organisational demography approach (Pfeffer,1983, pg302) and primarily focussed on TMT demographics and various organisational outcomes. Pfeffer (1985) claimed that the distribution of the firm's demographics (age and tenure) could significantly affect its functioning. Cannella et al. (2008) claimed that prior studies on TMT functional diversity and firm performance provided inconsistent results; hence, they studied the relationship between TMT diversity and firm performance for 207 U.S. firms from 11 different industries. Nielsen (2009) identified that studies on TMT demographics and firm performance found a positive relationship (Barsade et al. 2000; Carpenter, 2002), a negative relationship (Michel and Hambrick, 1992) and non-significant relationship (Ferrier, 2001; West and Schwenk, 1996).

There have been various studies investigating different management attributes and their relationship with the performance of a firm (Steinbach et al. 2016), such as the negative relationship between the probability of management turnover with firm performance and with stock returns (Kim, 1996; Warner et al., 1988; Weisbach, 1988; Coughlan and Schmidt, 1985). Performance of firms has been analysed using market-based measures (Tuch and O'Sullivan, 2007; Gregory, 1997; Agrawal et al. 1992) and accounting-based measures (Dickerson et al., 1997). Early upper echelons theory provided inconclusive results whether a more homogenous or heterogeneous team affected firm performance (Sun et al., 2016; Finkelstein et al., 1996; Pettigrew, 1992). Hambrick and Mason (1984) suggest that managers observable demographic attributes can be used as proxies for more complex psychological dimensions of their personality. Early empirical research focussed on firm's competitive behaviour (Hambrick et al. 1996), level of Diversification (Michel and Hambrick, 1992), innovativeness, (Bantel and Jackson, 1989) corporate strategic change (Wiersema and Bantel, 1992), and firm performance (Michel and Hambrick, 1992; Murray, 1989; Norburn and Birley, 1988) which did not reach conclusive findings with regards to TMT composition and firm performance.

TMT have mostly been defined as top executives of the firm (Finkelstein and Hambrick, 1996; Hambrick, 1994). Pitcher and Smith (2001) found that actual decision-making may not always lie with the top executives of the firm, which was supported by Roberto (2003) who argued that the TMT composition changed with the decision-making situation. However, Jackson (1992) argues that the TMT should only include individuals who are actually involved in decision making which may not include some executives and instead include managers and experts from other levels within the organisation. Pettigrew (1992) further highlighted that inconsistency in findings may be due to inconsistent definitions and size of TMTs.

This has led to emerging studies focussing on board influence on firm's strategic decisions (Rindova, 1999; Goodstein et al., 1994; Hillman et al., 2000; Judge and Zeithaml, 1992). It is rare for studies to include both the TMT and board of directors (Jensen and Zajac, 2004; Finkelstein and Hambrick, 1996) with the exception of entrepreneurial literature which has seen this research develop more actively.

Some studies have assumed that different demographic and other attributes (sex, age, tenure etc.) have uniform effects (Finkelstein and Hambrick, 1996; Hambrick and Mason, 1984), which was criticised by Jackson (1992) who stated that it is important to focus on these attributes at an individual level. This is also supported by group effectiveness and group diversity theories which conclude that the effects of individual dimensions should be studied separately. This was further criticised by Jackson et al. (2003) who stated that studying these attributes at an individual level assumes that the effects of each type of attribute are independent of the presence of other attributes (Jackson and Joshi, 2004). Based on these arguments and later findings, Carpenter et al. (2004) concluded that future research should consider multiple dimensions of TMT diversity simultaneously when studying firm-level decisions and behaviours.

3.4 Role of the CEO and the TMT

Early corporate executives gained considerable power economically and politically as regulation was lax and corruption was rife (Josephson 1962, pp,347-58). This was followed by the emergence of financial institutions as leaders in the US business community (Kotz, 1978; Moody, 1920) and further power within the hands of key executives such as J.P. Morgan who played a major role in ending the financial crisis of 1907 (Yue, 2015). These leaders were succeeded by their family or hand-picked successors who had the power but not the individual stature of their predecessors (Bertrand, 2009). The further increase of these firms in size led to the founding families increasingly finding it difficult to maintain majority ownership or key minority ownership in the business leading to the separation of ownership and control (Berle and Means, 1991). Executive tenure was long and CEO firing was rare(Herman, 1981). A study by Lieberson and O'Connor (1972), concluded that factors outside the control of leaders have much more of an effect on the organisational performance than the leadership has.

Useem (1993, pp. 20-21) highlights that declining firm performance in the early 1980s could no longer be attributed to excessive regulation or overly assertive unions and the cases were looked more inward towards management. The poor firm performance was attributed to entrenched managers who failed to pursue shareholder objectives and the solution was for shareholders to assert their authority. Manne (1965), a legal scholar, argued that a firms share price is a reflection of the firm's management skills and if a firm share price is weak compared to peers it is by definition poorly managed. He further argued that these managers should be replaced to increase firm's share price, which was further developed by Jensen and Meckling (1976) who argued that owners should align the objectives of the executives with their own and this should be done by aligning executive compensation with firm share price/performance. Corporate logic viewed firm executives as autonomous professionals' agency logic viewed them as mere "hired hands" (Khurana, 2010). During the 1980s, an increasing number of acquisitions, due to a change in regulation, of which a majority were hostile acquisitions changed the corporate structure in the US and the environment of the existing firm executives.

CEOs and managers were developing as celebrities popular to the larger public and investors. This led to firms searching for corporate saviours when recruiting CEO candidates and increasingly looking outside the firm. Khurana (2002b) found that between 1980 and 1996, 27% of CEO appointments went to outsiders, which was double the rate in the 1970s (Murphy and Zabojnik, 2004) and by 2000 this was nearly 50% of large public companies. Chatterjee and Hambrick (2007) found that narcissistic CEOs experienced greater fluctuations in performance presumably due to their efforts to take bold actions that attract attention.

Corporate CEOs play a very important role in developed societies; however, there is little sociological research on this topic. Prior to the 1980s corporate executives were hardly studied and most of the focus since then had been on executive tenure, the role of executives on firm performance and executive compensation. Corporate CEOs today are compensated at levels far beyond their predecessors; however, they experience less autonomy and more scrutiny from boards and investors than their processors. Mizruchi and Marshall (2016) argue that today's CEOs are able to gain favours for their firms but are less capable of acting collectively on issues that require collective solutions. Their research focuses on US corporate executives as most of the work by sociologists has focussed on US firms, however, some of the best work on corporate governance has been comparative research between different corporate governance regimes.

Hambrick and Mason (1984) argue under the upper echelons theory that top executives affect firm outcomes. An event study by Johnson et al. (1985) found a positive abnormal return after the death of a founder CEO and negative abnormal return after the death of a non-founder CEO. Bennedsen et al. (2006) found that the death of a CEO or relative of a CEO reduced firm operating performance. Executives have empire-building preferences (Baumol, 1959; Williamson, 1964) which could lead to poorly controlled managers and which could increase the firm size beyond that which is optimal for shareholders. Hicks (1935) argued that entrenched managers are likely going to prefer an easier life and would avoid difficult decisions. This view was supported by Bertrand and Mullainathan (1999, 2003) who found that there was little evidence of an increase in firm size after the introduction of antitakeover legislation, i.e. empire building, however, they found patterns of investment and divestment that are suggestive of the quiet life.

Malmendier and Tate (2005, 2008) categorised CEOs into rational and overconfident groups due to them not diversifying their personal portfolios by selling the company's shares and exercising options "in the money". They found that CEOs held on to "in the money" options beyond the vesting period and also often bought company shares rather than sell. The researchers found overconfident CEOs were unwilling to issue new shares (as they felt the company was undervalued) and used internal resources to finance new projects.

They also found that CEOs categorised as overconfident were more likely to undertake merger at any point in time and stock markets reacted negatively to announcements by such CEOs. One argument towards using CEO personal portfolio for this categorisation is that they may have access to private information which is why they are not exercising the options or purchasing more shares. However, Malmendier and Tate (2005, 2008) did not find any abnormal returns for CEOs who hold too much equity in their firms. Another measure for CEO overconfidence was the use of media portrayal of the CEO either as "confident/optimistic" or "cautious/conservative".

Bertrand (2009) argued that a broader profile of those who will eventually become CEOs is still needed. Are CEOs made or born? Oyer (2006) found that MBA graduates in a stock market boom are more likely to begin their career and continue working on the Wall Street many years after graduating. Are there specific personality traits related to becoming a corporate leader? The role played by overconfidence and charisma, the process through which boards select CEOs, how boards measure, identify and evaluate "talent", the role of third parties such as media analyst. Bertrand (2009) argues that a change in researcher attention to outside the US to various European countries should be undertaken.

3.5 Determinants of Default

Whitaker (1999) undertook a study to examine the early stages of financial distress and the causes of firm financial distress. According to Wruck (1990), firms enter financial distress due to economic distress, industry decline or incumbent management. Their research agreed with Jensen (1989) i.e. financial distress forces management to deploy efficiency enhancing actions which in return improves firm performance. However, well-managed firms entering financial distress due to industry decline or economic distress would not benefit from the corrective action. The author found poor management to be the most significant cause for a firm to enter financial distress. In addition, he also found that firm performance declines sharply in the distressed year and then has a significant recovery in the following year, however still remaining below pre distress levels.

Gonzalez-Aguado and Moral-Benito (2013), a US study, found four variables key in predicting corporate default, the standard deviation of firm stock return, the ratio of working capital to total assets, the ratio of retained earnings to total assets and the ratio of total liabilities to total assets. Memba and Job (2013) identified a number of causes of financial distress within companies which is presented in Fig. 3.5.

Rank	Financial Distress Cause	Weighted Mean Score
Most Significant Causes		
1.	Improper Capital Decision	4.5465
2.	Inadequate Financing	4.4884
3.	Lack of Access to Credit	4.4651
4.	Shortage of Skilled Manpower	4.3372
5.	Highly Geared	4.2558
6.	Poor Accounting Records	4.1860
7.	Poor Internal Management	4.1395
Significant Causes		
8.	High Turnover of Workers	3.9767
9.	Dividing Productivity & Profitability	3.7093
10.	Financial Indiscipline	3.3721
11.	Lack of Proper Keeping Financial Records	3.3488
12.	Poor Management Succession	3.1512
13.	Policy Changes of Government	3.0233
Insignificant Causes		
14.	Inadequate Financial Control & Lack of Awareness	2.8488
15.	The Business is in Price War	2.4651
16.	Low Price Overseas	2.1628
17.	Counter Party Defaults	2.1047
18.	Poor Customer Loyalty to the Product	2.0698
19.	Contingent Problem	1.8372

Fig. 3.5 Causes of Financial Distress (Source: Memba and Job, 2013)

The top seven (Most Significant) causes in Fig. 3.5 could easily be related to management decisions showing the strong relationship between financial distress and the TMT of a firm. Memba and Job (2013) further identified the effects of Financial Distress presented in Fig. 3.6.

Rank	Item likely to be affected	Mean Average Score
1.	Management Turnover / Management Replacement	4.6793
2.	Employees	4.5411
3.	Dividends	4.3588
4.	Corporate Social Responsibility	4.3248
5.	Lenders	4.1827
6.	Suppliers	4.0032
7.	Investors	3.9625
8.	Retained Earnings	3.8273
9.	Market Share	3.6772
10.	Government	3.4231
11.	Customers	3.1537
12.	Value Of The Firm	3.0299
13.	Ownership Structure	2.7321
14.	Shareholders	2.2719

Fig. 3.6 Items Likely to be affected by financial distress (Source: Memba and Job, 2013)

The Fig. 3.6 shows some important impacts of financial distress and at the top of the list is Management turnover/Management replacement. This strongly suggests that the responsibility and impact of financial distress lie with the TMT. This indicates that the TMT should help a financially distressed firm perform better (relative to another financially distressed firm). Research shows that firms facing financial distress not only had a higher probability of management turnover but there is an improvement in the firm's performance after a change in the TMT which in turn increases value. This was supported by the findings of Denis and Denis (1995) and Huson et al. (2004), who found a substantial improvement in firm performance after the TMT was replaced following a poor firm performance. Assessing performance with the probability of default or default risk, Ting (2011) found that the risk of default was higher prior to TMT turnover and lower than other firms after the replacement.

There is research associating management turnover with fraud and the probability of firm default. Sun and Zhang (2006) found that firms associated with fraud have higher management turnover than a matched sample of non-fraud firms. This could be down to managers of firms facing financial distress are likely to undertake accounting misrepresentation to show the firm in a better light. A study of financially distressed firms showed that the majority of the firms with TMT turnover were either in default on debt or declared bankrupt. (Gilson, 1989 and Ofek, 1993).

A majority of these studies only focused on financially distressed, bankrupt or fraudulent firms. For stakeholders, it is more important to be able to accurately predict the probability of non-financially distressed, bankrupt or fraudulent firms to default. And although there are well-established measures for the measurement of the default its relationship with the TMT is not clear.

Armour et al. (2008) noted that advocates of strong control rights for secured creditors point to the benefits that a single, concentrated lender holding all-encompassing security can bring to the governance of companies and in many ways help reduce the agency problem as this creditor will directly control the mangers. Jacobs et al (2010b), found that larger firms with higher liquidity and more secured debt in their capital structure are more likely to follow a public resolution process whilst firms with a higher Z score and more total leverage are less likely to follow a public resolution and attempt to resolve distress privately. The Fig. 3.7 below further highlights some of the financial distress latent factors and there is clear emphasis gained by the Finance factor, decisions relating to this are made directly by the CFO and at position 2 is the Management Factor. The management factor here is in its broadest sense across the organisation however, there is clear indication that this is intensified at the C-suite.

Position	Factor	Individual Score	Total Score	Average Score
1.	Finance Factor			
	i. Inadequate Financing	4.4884		
	ii. Lack of Access to Credit	4.4651		
	iii. Improper Capital Decision	4.5465	13.3000	4.500
2.	Management Factor			
	i. Management Succession	3.1512		
	ii. High Turnover of Workers	3.9767		
	iii. poor internal management	4.1395		
	iv. Productivity and Profitability	3.7093	14.9770	3.7443
3.	Accounting System Factor			
	i. Poor Accounting Records	4.1860		
	ii. Financial Indiscipline	3.3721		
	iii. Lack of Financial Records	3.3488		
	iv. Lack of Financial Control	2.8488	13.7557	3.4389
4.	Policy Changes			
	i. Shortage of Skilled Manpower	4.3372		
	ii. Policy Changes	3.0233		
	iii. High Cost Structure	4.2558		
	iv. Contingent problems	1.8372	13.4535	3.3634
5.	Liquidity Factor			
	i. Low Price Overseas	2.1628		
	ii. customer loyalty	2.0698		
	iii. Counter Party Defaults	2.1047		
	iv. Price Wars	2.4651	8.8024	2.2006

Fig. 3.7 Latent Factors for Financial Distress identified by Memba and Job (2013)

Memba and Job (2013), found that the most significant causes of financial distress in Kenya were an improper capital decisions, the inadequacy of capital, access to credit, shortage of skilled manpower, poor accounting records and poor internal management. They identified the Finance factor as the main cause of financial distress in comparison to Management, Accounting System, Policy Changes and Liquidity factors. Jahur and Quadir (2012), found that the common causes of financial distress and business failure are often a complicated mixture of problems and symptoms. The most significant cause in young companies is capital inadequacy where the business did not start with sufficient capital. In addition, they found that the probability that innovation will drive a firm to financial distress is high especially where the competitor introduces innovative and competitive products.

Kallunki and Pyykko (2013), found that CEO's and Director's past personal default entries increased the likelihood of the future financial distress of the firm in Finland. Kilborn (2005) and Sullivan et al (1999) reported some personal traits that play an important role in consumer's over-indebtedness and credit default. These personal traits which could play a role in the executive's personal default also impact the organisation as the executive carries the personal trait to work. Managerial traits such as overconfidence, over-optimism and illusion of control were found to account for incorrect strategic decisions (Roll, 1986; Malmendier and Tate, 2005; and Hackbarth, 2008). They also found that these personal traits resulted in the bad managerial decision, which led to declining financial ratios and then resulted in financial distress. The authors further claim that their results show traditional Altman (1968) and Ohlson (1980) models should include person related risk attributes of the TMT. However, the authors recognise that there is a possibility for reverse causality i.e. firms anticipating declining future prospects may appoint managers with personal traits, which are also reflected in their payment default entries.

It was found that firms in financial distress usually did not prepare for TMT succession (Galloway and Jones, 2006). Zwaig and Pickett (2001) highlighted the importance of managerial and operation signals as indicators of financial health. They found that many profitable businesses were in trouble due to the rapid expansion of a formidable competitor.

Bottazzi et al (2010), undertook a study to investigate the relevance of financial and economic variables as determinants of default in Italian firms. The findings show that firms experiencing default are more financially exposed, less productive and less profitable in all the years studied prior to default. The findings also show a positive relationship between size and growth with default. The authors conclude that it is possible to distinguish between firms to default and non-defaulting using non-financial variables. It is fair to assume that financial factors should be able to, a major extent, accurately predict the probability of default especially when the event is approaching closer in time. However, the authors highlight two key limitations of the Distance to Default (a market-based probability of default prediction model) model even though it is appealing theoretically. Firstly, the computation of the measure in practice is quite complicated and secondly, Distance to Default applies to publicly traded firms only, as it is based on the market value of equity.

Grunert et al. (2005), proposed an "augmented" version of a standard financial model of default prediction using German firms, which also includes two "soft" non-financial attributes (managerial quality and market position) among the regressors. The authors find that the combined use of financial and non-financial factors leads to a more accurate explanation of current and future default events than the single use of either one of the factors.

Non-Financial variables = Management Quality and Market Position

In the broader sense, some further variables related to the likelihood of default have also been studied. Sun and Cui (2014), undertook a study to examine the relationship through which Corporate Social Responsibility (CSR) helps firms reduce the risk of falling into default. The findings show that there is a strong negative relationship between CSR and the default risk of a firm. Jacobson et al. (2011), a Swedish study, examined the relationship between macroeconomic fluctuations and probability of corporate defaults. The study included both listed and private firms which the authors claim to provide results more significant than 'Merton-like' models that are limited to listed firms. The findings of the research show that a model with financial ratios augmented with macroeconomic factors is superior to models that exclude macro information. They further review key articles on predicting corporate default and identify the key features of their research design which is presented in Fig. 3.8. This summary shows that a majority of these articles included profitability and leverage ratios in predicting corporate default.

Paper	Year	Sample	Firms	Model	LHS variable	RHS variables: Liquidity	Profitability and efficiency	Solvency and leverage	Size	Other
Altman	1968	66	Listed	Discriminant	Bankruptcy	(CA-CL)/TA	RE/TA, EBIT/TA, TS/TA	MVE/TC		
Frydman et al.	1985	200	Listed	Discriminant	Bankruptcy	LA/TA, CA/TA, LA/CL, CA/CL	CF/TD, EBIT/TA, NI / TA	MVE/TC, Ln(IC)	Ln(TA)	
Shumway	2001	39,745	Listed	Panel Logit	Bankruptcy	(CA-CL)/TA CA/CL	RE/TA, EBIT/TA, NI / TA, TS/TA	MVE/TL, TL/TA	Ln(MVE/market)	r_E-r_M σ_E,σ_M
Pesaran et al.	2006	[2,219]	Listed	Merton	Default		r_E	MVE TE/TA		σ_E CR
Duffie et al.	2007	392,404	Listed	Hazard	Default		r_E			DtD
Bonfim	2008	113,119	Mixed	Probit/Hazard	Loan default	LA/CL	NI/TA TS/TA	TL/TA, TE/TA		IR TSG
Bharath, Shumway	2008	1.016m	Listed	Merton	Distance to default		NI/TA	MVE TD		σ_E
""	"			Hazard	Time to default		NI/TA	MVE TD		PD

Lists of variables reflect the main model presented in each paper. In cases where no preferred model" was presented, the list reflects variables with significant variables in any model.The number of observations in a paper can vary dependent on model specification. CA = Current Assets, CL = Current Liabilities, TA = Total Assets, RE = Retained Earnings, EBIT = Earnings Before Interest and Taxes, TS = Total Sales, MVE = Market Value of Equity, TC = Total Credit, LA = Liquid Assets, CF = Cash Flow, TD = Total Debt, NI = Net Income, IC = Interest Coverage, r_E = Return on Equity, r_M = Market Return on Equity, σ_E = Volatility of Stock Returns, σ_M = Volatility of Market Stock Returns, TE = Total Equity, CR = credit Rating, DtD = Distance to Default, IR = Investment Rate, TSG = Total Sales Growth, PD = Probability of default. The term quick assets has been named liquid assets in this table because no consensus on the exact difference between liquid and quick assets. Some sources include inventories in liquid assets, but exclude them from quick assets.

Fig. 3.8 Firm specific explanatory variables used in papers focusing on the development of models of default risk (Source: Jacobson et al., 2011)

3.6 Corporate Governance and Credit Risk

Schultz et al. (2017), an Australian study, investigate the relationship between corporate governance and the probability of default. The authors believe that studies exploring this relationship face one of three key concerns. They claim that studies (e.g. Lee and Yeh, 2004; Chen 2008; Aldamen et al, 2012; Platt and Platt, 2012; Brédart, 2013, 2014) that focus on firms that have failed as opposed to the likelihood of failure suffer from sample selection bias. They also claim that there are studies (e.g. Bhojraj and Sengupta, 2003; Ashbaugh-Skaife et al, 2006; Elbannan, 2009) that incorporate the likelihood of failure but fail to differentiate between firms and there are studies (e.g. Switzer and Wang, 2013a, 2013b) that do not employ econometric techniques that take account of all three endogeneity concerns identified by Wintoki et al (2012). Their research overcomes these problems by incorporating Merton's (1974) probability of default model and the Generalised Method of Moments ('GMM') econometric methodology. The authors find significant relationships, similar to prior studies, between the probability of default and executive pay, board structure and ownership structure using ordinary least squares regression and fixed-effects panel. However, none of these significant relationships remains when the GMM approach is employed. Concluding that there is not sufficient evidence to back a one-size-fits-all approach to corporate governance. Their research focused on three broad corporate governance mechanisms: board structure, remuneration and ownership structure.

Switzer et al. (2018), a US study, focussed on the relationship between default risk and corporate governance using a sample of 117 financial firms outside North America. The research used a 5-year CDS spread and the Black-Scholes-Merton type 5-year default probability as calculated and reported by the Bloomberg database to measure the default risk of the firms. In addition, the following five variables were used to measure the firm's governance mechanism: institutional ownership, insider ownership, board independence, board size and CEO duality. The results showed that institutional ownership is negatively related to the probability of default whereas insider ownership is positively related to the probability of default, therefore pointing to the benefit of monitoring managers by institutional investors. In addition, they also find that CEO duality is associated with higher default probabilities.

Switzer and Wang (2013a), a US study, explored the relationship between the credit risk of financial and non-financial firms and their corporate governance structures. The study used Credit Default Swap (CDS) spreads as a measure for the firm's likelihood of default and found that governance attributes have different effects across firm types. The authors found that board independence has a greater impact on financial firms than on industrial firms and ownership structure is more important for industrial firms than financial firms. The research also concludes that increased CEO ownership, for industrial firms, below 40% is associated with an increased likelihood of default and increased CEO ownership above 40% is associated with a decreased likelihood of default. This the authors claim is in agreement with the entrenchment theory as at lower levels of ownership the CEO interests are more aligned with shareholders than bondholders. However, for financial firms CEO ownership is associated with lower default probabilities only when the CEO has a large shareholding.

Switzer and Wang (2013b) undertook a study of US commercial and savings banks to explore the relationship between the credit risk and corporate governance structures of the banks. The study in particular focussed on this relationship from the perspective of the bank's creditors. The authors used the following variables to measure governance quality: board size, board independence, the separation between CEO and Chairman, Institutional Ownership, Insider holdings and directors with CEO positions in private and public organisations. The research found that corporate governance mechanisms affect commercial banks more than savings institutions. For commercial banks larger boards, more independent boards, lower ownership by institutional investors and older CFOs are associated significantly with lower probabilities of default.

Adusei et al. (2014), a study of Ghana banks, investigate the predictors of the probability of default in the universal banking sector. The authors use the argument provided by Hassan and Sackley, (1994) and Corsetti et al., (1998) who highlighted that changes in the external variables in the financial markets, regulations and economic conditions affect bank risk using the external variables theory. On the other hand, is the internal variables theory which puts forward the argument that internal variables are key determinants for the probability of default (Berger and DeYoung, 1997; and Angbazo, 1997).

Adusei et al. (2014) use the resource dependence theory, agency theory and stewardship theory to hypothesise the relationship between a range of TMT attributes and bank default risk. The findings of the research suggest that bank capital has no relationship to bank credit risk and the model suggested, shows that leverage, asset size, loan loss provision, board size, board independence, and the number of executives provide a strong predictor for bank credit risks in Ghana. The resource dependence theory and agency theory argue for the presence of independent directors. Researchers argue that outside directors provide a firm with an important link to the external environment and access to resources and information (Burt, 1983; Sutton and Callahan, 1987).

Daily and Dalton (1994), a US study, examined the relationship between various governance structures and corporate bankruptcy. Specifically, the authors examine the board composition (ratio of independent directors to total directors) and CEO Duality. The authors used the sample of firms used by Altman (1983) and used four indicators to assess TMT quality, namely the total number of corporate directorships by board members; total number of non-corporate directorships; number of CEO or Chairpersons on board; and educational prestige i.e. undergraduate or graduate degrees from elite institutions (Finkelstein, 1992). The findings showed that bankrupt firms had more dual structures and more affiliated directors. However, prior to this, Chaganti et al. (1985) found no relationship between board composition and bankruptcy in a study of 21 retail companies. Hambrick and D'Aveni (1992), argued that dominant CEOs (ratio of CEO remuneration to other directors) are more likely to be associated with bankruptcy than weaker CEOs. One important thing to note is the different measures of board composition used in many studies which could lead to very different results. Baysinger et al. (1991) and Goodstein and Boeker (1991) used the ratio of inside directors to total directors. Alternatively, other approaches are: the ratio of outside directors to total directors; a director who is not in direct employment of the firm (Kesner and Johnson, 1990a, 1990b; Kesner et al., 1986; Singh and Harianto, 1989a, 1989b); and, independent-interdependent distinction (Wade et al., 1990; Boeker, 1992).

The significant of corporate failure research and its relationship to the TMT is also key to strategy research. “the reason why firms succeed or fail is perhaps the central question in strategy” (Porter, 1991:95). Some of this key research was undertaken by D’Aveni (1990), Fizel and Louie (1990), Gilson (1989,1990), Gilson and Vetsuypens, (1993) and Wruck (1990). These papers focussed on the extent to which the officers and directors of a bankrupt firm are likely to resign or to be replaced. Bonnier and Bruner (1989) explored the reactions of investors to announced executive changes of bankrupt firms.

Corporate Governance argued in favour of separating the role of the CEO and Chairman to ensure there is no power concentration at the top level of the firm. Anderson and Anthony (1986) argued against separating the role of CEO and Chairperson as it would lead to confusion within the organisation and in relationships with boards. However, the concentration of the power would ensure there is no ambiguity in leadership or responsibility.

3.7 TMT and Financial Distress

Hambrick and D’aveni (1992), undertook a study of 57 bankruptcies and 57 matched corporate survivors and examined the TMT attributes associated with major corporate failure. They found that failing firms show significant annual, or cross-sectional, divergence from survivors on several indicators of TMT composition but also those divergences become more pronounced, even accelerated, over the last five years of the bankrupts lives. They suggest that team deficiencies bring about or aggravate corporate deterioration, either through strategic errors or stakeholder uneasiness with the flawed team and corporate deterioration brings about team deterioration, through a combination of voluntary departures, scapegoating and limited resources for attracting new executive talent. The study used the following variables to study TMT attributes: Team size, outside directors, core function, expertise, team compensation, average firm tenure, firm tenure heterogeneity and CEO Dominance. Hambrick and D'Aveni (1992) recommend that further study into the escape from a downward spiral should be undertaken to answer, "Is there no escape from the downward spiral?"

Organisational failure or bankruptcy has been viewed as a downward spiral i.e. as a weakness develops there is a tendency for additional problems to occur (Staw et al., 1981; Whetten, 1980; Starbuck et al., 1978). Hambrick and D'Aveni (1988) found that in a sample of large bankruptcies, financial weakness signs (compared to matched survivors) were present up to 10 years prior to failing and during these years the authors found that the firms engaged in behaviour that only aggravated the conditions. Whetten (1980) argued that managers behave erratically under stress and failure induces failure. Hambrick and D'Aveni (1992) provide an alternative to the downward spiral and suggest that one possibility is the composition of the TMT team of a failing organisation and their divergence from the composition of the TMT team of a successful organisation. Numerous studies have found support for the "upper echelons perspective" i.e. the relationship between executive attributes and complex business problems (Dearborn and Simon, 1958), organisational innovation (Hage and Dewar, 1973), structure (Miller and Toulouse, 1986), strategy (Boeker, 1989), subsequent company growth (Eisenhardt and Schoonhoven, 1990) and effectiveness in implementing specific types of strategy (Gupta and Govindarajan, 1984). TMT's of bankrupt firms have been found to be deficient in autocracy, to have uninvolved board of directors, and weak finance expertise (Argenti, 1976). Miller and Friesen (1977) studied the attributes of successful and unsuccessful businesses using cases and articles and found two of the four unsuccessful firms to have power-hoarding CEOs and one a very weak CEO.

Shahab et al. (2018) found that TMT gender diversity, foreign exposure and political connection for Chinese firms had a moderating effect on financial distress. Hambrick and D'Aveni (1992) examined the TMT attributes of 57 large corporate bankruptcies and 57 matched corporate survivors. The failing firms showed a significant divergence from surviving firms on several indicators of TMT attributes and these divergences were more pronounced and accelerating over the last five years of bankrupt firms lives. The authors propose a two-way process is in play: *(1) team deficiencies aggravate deterioration either through errors or stakeholder lack of trust in the team; and (2) corporate deterioration bring about team deterioration i.e. voluntary departures, scapegoating and lack of resources to attract executive talent.*

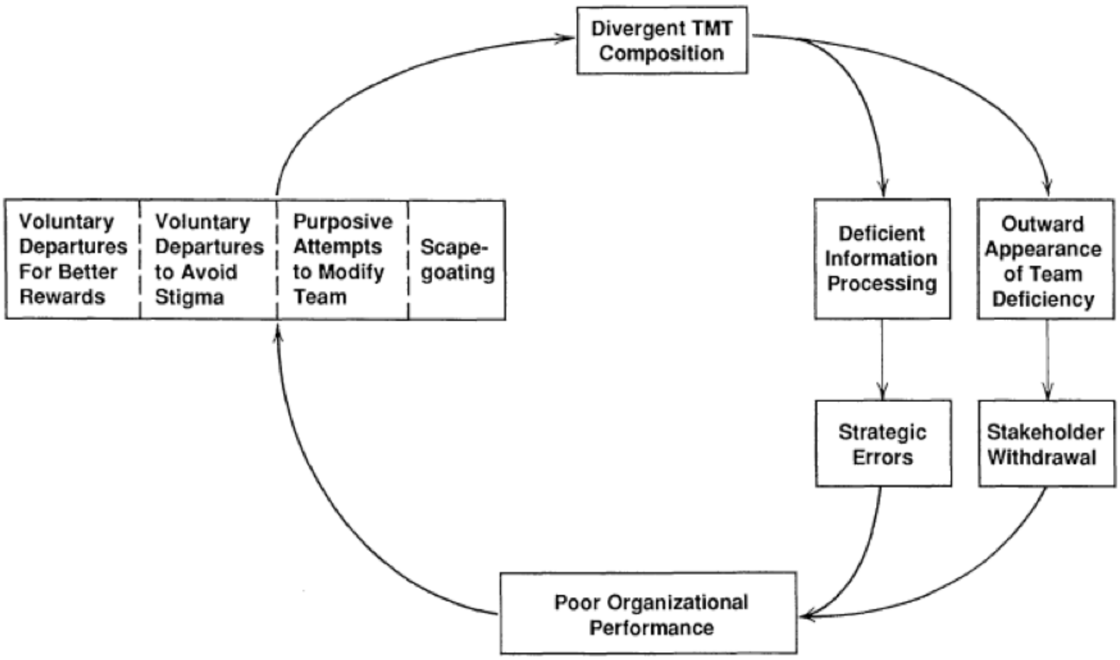

Fig. 3.9 The "Vicious Circle" of TMT Divergence and Poor Performance (Source: Hambrick and D'Aveni, 1992)

Meyer and Rowan (1977) suggested an alternative possibility of the relationship between TMT attributes and performance namely that the TMT deficiencies become visible to stakeholders (suppliers, customers and creditors) causing them to restrict their support to the organisation. Ashforth and Gibbs (1990) highlight that the stakeholders get uneasy with a TMT that is not 'normal' and may search for partners that are more conventional. Hambrick and D'Aveni (1992) argue that if TMT composition diverges from healthy firms then two forces may contribute to poor organisational performance as shown in the Fig. 3.9 above namely strategic errors and stakeholder withdrawal. Arora(2016) highlights the relevance of independent directors to firms, the author finds that financially linked independent directors enable firms to re-emerge from bankruptcy in the U.S.

The counter-argument, to TMT deficiencies, lead to organisational decline, is that poor firm performance causes TMTs to diverge from that of healthy firms. Researchers have recognised that financially declining firms have limited resource, difficulty competing with existing pay norms, to attract and retain executives (Hambrick and D'Aveni, 1988; Altman, 1983). In addition, as financial health declines, executive turnover is seen to increase which heightens the likelihood of deterioration of the team (Wagner et al., 1984). The increase in turnover is aligned to the more talented executives leaving for better pay and access to resources (Finkelstein and Hambrick, 1988; Hirschman, 1970) and some leaving to avoid the stigma of being linked to a failed firm (Sutton and Callahan, 1987). In additions, firms try to change the composition of the team when struggling with performance to bring in more financial and cost-saving skills and less marketing and operational skills (Whitney, 1998).

Hambrick and D'Aveni (1992) argue that the two arguments, i.e. TMT composition impacts firm performance and firm decline impact TMT composition, are not mutually exclusive. They identify two major classes of TMT attributes: (1) Team resources - team size, outside directors, functional expertise and team compensation (2) Team social structure - average tenure, tenure heterogeneity and CEO dominance

They liken TMT size with that of a sports team size and argue that a sports team is at a disadvantage if it has fewer than the number of allowed players. Steiner (1972) argued that team size has a positive association with effectiveness for divisible and additive tasks, which Hambrick and D'Aveni (1992) argue is an apt characterisation of TMT work. Goodman et al. (1986) found an inverted U-shaped relationship between group size and effectiveness and found that small and large team sizes had their disadvantages. This is why an expected relationship cannot be predicted. Hambrick and D'Aveni (1992) used the number of executives, with a title vice president and above, as a measure of team size. Hambrick and D'Aveni (1992) found that CEO Dominance (t-5, t-4 and t-3) was significantly higher for bankrupt firms, the average tenure was significantly shorter for bankrupt firms and there were no differences in team heterogeneity. In addition, the team compensation was substantially lower (from t-4) for bankrupt firms, the percentage of the team with core function was lower in the bankrupt firms and the failing firms had smaller teams with fewer outside directors.

Argenti (1976), a UK study of bankruptcies, found TMT deficiencies such as autocracy, the uninvolved board of directors, and weak finance expertise. Miller and Friesen (1977) studied the attributes of successful and unsuccessful businesses using cases and articles and found two of the four unsuccessful firms to have power-hoarding CEOs and one a very weak CEO.

3.8 Empirical Evidence relating to Executive Motivation

This section critiques the empirical evidence from the prior literature on executive motivation. It provides evidence on intrinsic and extrinsic motivation specifically exploring the relationship between executive compensation and executive motivation. The section commences by analysing the much-debated developments in executive compensation, followed by evidence on its relationship with firm outcomes and specifically failing firms. This section is then concluded by defining how executive motivation is operationalised within this study and how the hypotheses of this study are further developed.

3.8.1 Development of Executive Compensation

Much of the research on CEO compensation has been US focussed due to the extreme changes in CEO pay in the US and the availability of data. Conducting research on executive compensation over a very long period would be extensively time-consuming due to having to hand collect historical data on a company by company and year by year basis. Frydman and Saks (2007) undertook research on approximately 100 publicly traded firms with the largest value of total sales between 1936 and 1991 and hand collected the data on executive salary, bonus and long-term incentive payments, stock options and excluded pensions and other perks. They found that initially (the early 1950s) the pay declined, followed by a slow increase (1950s to 1970s) and only after the 1970s saw a sharp increase in pay. They also found that the growth of CEO pay was significantly more rapid than the other top-paid executives. Stock-options played a huge role in the sharp increase however cash remuneration was also found to have tripled since 1970 (Murphy and Zaobjnik, 2004).

Frydman and Saks (2010) show that TMT executive compensation remained steady between 1940 and early 1970s and then showed a sharp upward trend more than quadrupling between 1980 and 2000. DiPrete et al. (2010) found that between 1993 and 2005 real total CEO compensation more than doubled. This increase in compensation was attributable to market forces (Murphy and Zabojnik, 2004; Khurana, 2002b) and higher demand for more generic skills rather than firm-specific skills from CEO candidates. As the competition, for external candidates become intense this drove the compensation levels further.

It has been noted that CEO pay could be linked to the managerial power hypothesis (Bebchuck and Fried, 2005a, 2005b) or the rent extraction view. The hypothesis states that some members of the board (even if some members have significant ownership of the firm) prefer to work for the CEO rather than the shareholder. Shivdasani and Yermack (1999) found that CEOs were able to influence the board appointment process i.e. firms where the CEO was part of the nominations committee appointed fewer independent directors. Core et al. (1999) found greater CEO compensation where the CEO was involved in the nominations committee and large decrease in CEO compensation where legislation (e.g. Sarbanes Oxley) required majority independent directors to serve on the board (Chhaochharia and Grinstein, 2009). In addition, the role of external consultants in the pay-setting process was also studied. Jensen et al. (2004) identified external consultants were more likely to recommend CEO pleasing compensation to get more lucrative companywide business as these consultants are retained by the company management and not the remunerations committee.

Murphy and Zabojnik (2004) argue that CEOs may have always been interested in extracting rents, therefore, this view does not provide clear evidence for the sharp increase in compensation evidenced post-1970. In addition, as corporate governance improved

(Holmstrom and Kaplan, 2001; Hermalin, 2005) the influence of the CEO on the board should have reduced and therefore their capability to extract rent should have reduced. One argument is the relationship between tax laws and stock options which may have triggered its rapid expansion (Hall and Murphy, 2003).

The agency problem explains this increase in executive pay where part of the pay was aligned to performance to solve this principal-agent conflict. The argument was that as the incentive contract exposed executives to the risk they would need to be compensated for taking on the increased risk through base level compensation. The principal-agent relationship and its link to increased pay have been criticised for its causal relationship to CEOs exerting greater effort and their compensation for the additional effort. Bertrand and Mullainathan (2001) undertook a study of oil companies whose performance is strongly correlated to oil price. They compared the sensitivity of the CEOs compensation to the performance of their firm and to the performance of the firm that is only due to fluctuation in oil prices. They found that these two estimated sensitivities to be statistically the same clearly against the view of performance related pay. In addition, CEOs are given the freedom to sell the stock options they are given or hedge their positions negating the position as laid out by the board.

Murphy and Zabojnik (2004, 2007) and Frydman (2007) argued that as increasingly CEOs are appointed externally and as the demand has shifted from firm-specific skills to generic skills the market has played an increasing role in the increase of CEO compensation. Gabaix and Landier (2008) argue that the best managers should be appointed to the largest firm in the economy as the managerial talent has a multiplicative effect on firm performance. Whilst the findings fit the data they collected between 1980 and 2003 it was not a good fit for the period 1970 -1980 or the pre-1970 period. Jensen (1986) argues how executives strategically may alter firm size through acquisitions to increase compensation. This was supported by Harford and Li (2007) who found that large acquisitions were followed by a large increase in compensation at least one year following acquisition even when the bidding company stock price declines post-merger (Bliss and Rosen, 2001). This was further supported beyond just increase in firm size by acquisitions. Bebchuck and Grinstein

(2005) also found that CEO pay increased as the number of shares or number of employees increased, however, a reduction in size did not lead to a reduction in pay.

3.8.2 Executive compensation and firm outcomes

Kaplan (2008) found that CEO compensation is linked to firm performance and that the compensation of athletes and hedge fund managers has increased at a higher rate than that of CEOs. Sociologists view this high compensation as "rent extraction" by CEOs due to the information asymmetry and the power they have over boards (Bebchuck and Fried, 2005a, 2005b; Sörensen, 2000).

Gabaix and Landier's (2008) study found that a sharp increase in CEO compensation accounted for an increase in stock market valuations. This was interpreted by Bertrand (2009) and DiPrete et al. (2010) as being consistent with both the rent extraction and market forces arguments. O'Reilly et al. (1988) further found that there was a positive association between the pay levels of the executives on the compensation committee and the CEOs compensation. DiPrete et al. (2010) identified that CEO compensation setting was as a process of "leapfrogging" in which a CEO's pay tends to move to the right tail of the distribution. The authors explain that when setting CEO compensation the committee uses benchmarking by looking at aspiration peer groups and once this process is put in place this becomes self-perpetuating. Kim et al. (2015) further found that interlocking directorships have an impact on CEO compensation rejecting the market-based model. Critics of the market-based model, however, are reluctant to discount a key claim made by Kaplan (2008) i.e. today's CEOs are more vulnerable than their predecessors. CEO turnover has increased and this has been associated with poor performance. The rise in the CEO pay has been associated with increased intensity in shareholder monitoring.

MD-Rus et al (2013), a Malaysian study, found that ownership by executive directors, family or all directors has the expected negative relationship with the likelihood of distress. They found that Government Linked Indexed companies and Independent directors are not significant in explaining distress and ownership by Domestic Private Institutional Investors is positively significant at 1. They suggested some further research around the subject area was needed specifically: the effect of directors' education and qualification on distress; and the role of the audit committee i.e. the audit committee could foresee the financial condition of the company.

Tykvová and Borrell (2012) undertook a study investigating the financial distress risk of European companies around their buyout event. The findings supported the hypothesis that private equity investors selected companies with lower financial distress risk. In addition, they found that when buyouts were backed by experienced private equity investors their bankruptcy rates were even lower than those of comparable non-buyout companies. The findings also suggested that syndicates were better able to handle financially distressed companies than stand-alone investors. Finally, companies backed by experienced investors also had lower bankruptcy rates than companies that were financed by inexperienced investors. The authors suggested further research analysing the impact of investors types (i.e. independent private equity, bank related private equity etc.) on the bankruptcy rates, since different investors differing goals, know-how and governance structures may have important effects on the way in which they create value in their portfolio companies.

Corporate performance has been commonly studied in strategic management research (Rumelt et al., 1994) including different level determinants of corporate performance and differences between corporate and business unit effects (Adner and Helfat, 2003; Bowman and Helfat, 2001; McGahan and Porter, 1997). Research on firm performance has focussed on financial/accounting performance measures such as return on assets, return on equity and return on sales (Haleblian and Finkelstein, 1993; McNamara, Luce and Tompson, 2002; Keck, 1997; Michel and Hambrick, 1992). Some studies have focussed on single performance aspects such as firm growth (Peterson et al., 2003; Kor, 2003; Ferrier, 2001; Eisenhardt and Schoonhoven, 1990) or multiple dimensions within a single study such as stock market and accounting measures (Carpenter,2002) or accounting and growth (Smith et al., 1994).

Linking executive compensation to firm performance is a governance mechanism to mitigate agency problems (Fama and Jensen, 1983; Jensen and Mecking, 1976; Alchian and Demsetz, 1972) and studies have found a positive relationship between the level of CEO and executive compensation and firm performance (Tosi and Gomez-Mejia, 1989).

The presence of dominant CEOs has been criticised as the most common factor of an unsuccessful firm (Miller and Friesen, 1977; Argenti, 1976; Ross and Kami, 1973). Miller and Friesen (1977) found some of the failing firms had very 'weak CEOs' which would not make them dominant by definition. Hambrick and D'Aveni (1992) used the ratio of CEO cash compensation to that of average executive compensation of executives to measure CEO dominance.

3.8.3 Executive compensation and failing firms

Hambrick and D'Aveni (1992) argued that after controlling for industry and firm size, there is a relationship between executive calibre and pay (Frank, 1984; Becker, 1964). On the other hand, it could be argued that failing firms are led by executives who reward themselves heavily, taking resources from other uses and alienating employees and stakeholders (Sorge, 1984). Hambrick and D'Aveni (1992) used the total cash compensation paid to all executives including outside directors as team compensation. In order to get average team compensation, the authors removed the CEOs compensation and adjusted the compensation for inflation.

The presence of dominant CEOs has been criticised as the most common factor of an unsuccessful firm (Miller and Friesen, 1977; Argenti, 1976; Ross and Kami, 1973). Miller and Friesen (1977) found some of the failing firms had very 'weak CEOs' which would not make them dominant by definition. Hambrick and D'Aveni (1992) used the ratio of CEO cash compensation to that of average executive compensation of executives to measure CEO dominance. Hambrick and D'Aveni (1992) used t-tests for differences in yearly means, MANOVA statistics for overall differences, logistical regression (LOGIT), and calculated 5-year least-squares slopes for each variable for each firm and then examined the differences in the slopes on the bankrupts and survivors.

Vallascas and Hagendorff (2013), a US study using a sample of US and European banks, investigate the relationship between the probability of bank default and incentive mechanisms embedded in CEO cash bonuses. The analysis of the research shows that as CEO cash bonuses increase the default risk of the bank decreases. In addition, the authors find that the risk-reducing effect of the cash bonuses disappears as the bank moves closer to default. The authors use the Merton's (1974) distance to default model to measure bank risk as it has a high correlation (around 80) to the default frequency estimates by the commercially applied Moody's Kealhofer Merton Vasicek (KMV) model (Bharath and Shumway, 2008). The authors conclude that CEO cash bonuses incentivise them to avoid corporate failure and that payoffs from cash bonus plans are a linear function of firm performance, therefore not risk-rewarding.

Chen et al. (2014), a UK study, examined the influence of financial distress risk on the level and structure of executive compensation. In addition, they examine whether institutional investors, as major shareholders of a firm, engage in determining the compensation of executives of a firm with financial distress risk. The authors argue that the relationship between financial distress risk of a firm and executive compensation could be positive or negative, i.e. firms with a high financial distress risk will find it difficult to appoint new executives, therefore, requiring the firm to provide a higher compensation to the newly recruited executive. However, as the financial distress risk of the firm increases major shareholders and creditors are more likely to increase monitoring and therefore pressurise the firm to reduce the compensation of executives (Gilson, 1990). The authors also seek to answer the question 'Do firms offer a lower fraction of equity-based compensation if they have high financial distress risk?' (Chen et al., 2014; pg 5). The findings show that financial distress risk has a significant negative relationship with the level of executive compensation and that there is a negative relationship between financial distress risk and the fraction of equity-based compensation. The research also provides evidence to support the argument that institutional block holder concentration has a significant negative impact on executive compensation. In addition, they find that foreign institutional block holder has a bigger negative relationship than domestic institutional block holders. The study employs three measures of financial distress risk, first based on Black and Scholes (1973) and Merton (1974), second a discrete time hazard model by Chava and Jarrow (2004) and third the Altman (1968) Z-score model.

Aggarwal et al (2011) find that poor performing CEOs are more likely to be terminated from firms with higher institutional ownership. Hence, Croci et al (2012) and Fernandes et al (2012) find that executives are more likely to demand a higher risk premium at firms with higher institutional investors. Gilson and Vetsuypens (1993) find that incumbent management incurs significant personal losses when their firms are financially distressed.

Researchers have recognised that financially declining firms have limited resource, difficult competing with existing pay norms, to attract and retain executives (Hambrick and D'Aveni, 1988; Altman, 1983). The increase in turnover for failing firms is aligned to the more talented executives leaving for better pay and access to resources (Finkelstein and Hambrick, 1988; Hirschman, 1970) and some leaving to avoid the stigma of being linked to a failed firm (Sutton and Callahan, 1987).

Hambrick and D'Aveni (1992) argued that after controlling for industry and firm size, there is a relationship between executive calibre and pay (Frank, 1984; Becker, 1964). On the other hand, it could be argued that failing firms are led by executives who reward themselves heavily, taking resources from other uses and alienating employees and stakeholders (Sorge, 1984). Hambrick and D'Aveni (1992) used the total cash compensation paid to all executives including outside directors as team compensation. In order to get average team compensation, the authors removed the CEOs compensation and adjusted the compensation for inflation.

3.8.4 Operationalising Executive motivation

Jensen and Murphy (1990) argued that executive pay sensitive to firm performance might reduce the agency conflict that exists within the firm. Cable and Vermeulen (2016) highlight that it is not unusual for executives to receive 60-80% of their salary as bonuses however research on incentive and motivation does not clearly identify why such a large amount of their compensation would need to be variable. Ariely et al. (2009) found that the higher the reward, the more productive people were on routine jobs and variable pay can substantially enhance people's performance. Cable and Vermeulen (2016), however, argue that a top managers task is not a routine one and use the research by using research undertaken by Kanfer and Ackerman (1989). The authors undertook a lab experiment on Air Force personnel and found that when required to land a certain number of planes their effectiveness did not increase when learning was required however on routine tasks where learning was not required performance goals worked well.

Seijts et al. (2004) reviewed the literature on goal setting and orientation and concluded that employees performed better when they framed their goals on learning rather than around performance outcomes. Motivating CEOs through stock options could be counter-productive. Harris and Bromiley (2007) undertook a study on the influence of executive compensation and firm performance on financial misrepresentation. They found empirical evidence to support the hypothesis that TMT incentive compensation and poor organisational performance relative to aspirations increase the likelihood of financial misrepresentation. The emphasis here is on 'relative to aspirations' which acts as a motivational factor to achieve the targets that reward. Peng and Roell (2007) found that incentive pay for executives increased the probability of securities class litigation and gave executives incentives to focus excessively on the short-term share price. Wowak et al. (2014) undertook a study on the effect of CEO stock option pay on the incidence of product safety problems and found evidence to show that share options and incentive payments promote a lack of caution in CEOs that leads to a higher rate of product safety problems. Research on goal setting and ethical behaviour found that people with unmet goals are more motivated to engage in unethical behaviour (Schweitzer et al., 2004).

Executive salary, bonus, remuneration or compensation have been used in several TMTs and corporate governance studies. Schultz et al. (2017) use remuneration as one of the three broad types (board structure, remuneration and ownership structure) of internal corporate governance mechanisms in their study of board attributes and the likelihood of firm default. Corporate governance and default literature have commonly used the fixed pay (salary) and variable pay (bonus, share options etc.) for executives, non-executives or both in their study of corporate governance variables (e.g. Schultz et al., 2017; Cao et al., 2015; Platt and Platt, 2012; Fich and Slezak, 2008; Ortiz-Molina, 2006). Jensen and Murphy (1990) use CEO salary and bonus to assess the change in CEO wealth in relation to shareholder wealth. Wright et al. (2007) use salary, options, and common stock holdings of the TMT (CEO and next four highest paid executives) to analyse the influence of these incentives on firm risk-taking. Mehran (1995) uses percentage of total compensation in salary and bonus to study executive compensation structure and firm performance. Carpenter and Sanders (2004) used a natural log of the sum of all forms of compensation granted to the top four non-CEO executives in one year to study the effect of TMT team pay and MNC performance. Gilson and Vetsuypens (1993) used CEO cash compensation and CEO ownership of stock options and common stock to analyse the relationship between CEO compensation and firms facing financial distress. Balachandran et al. (2010), undertook a panel data analysis of 117 financial firms from 1995 to 2008 to study the role of executive compensation in creating excessive risk-taking.

3.8.5 Operationalising the hypothesexss linked to Executive motivation

Hypothesis 1a *There is no relationship between executive short-term motivation and the likelihood of firm financial distress*

H1a (i) There is no relationship between executive short-term motivation and the accounting measure for firm financial distress

H1a (ii) There is no relationship between executive short-term motivation and the short-term market measure for firm financial distress

H1a (iii) There is no relationship between executive short-term motivation and the long-term market measure for firm financial distress

Hypothesis 1b *There is a negative relationship between executive long-term motivation and the likelihood of firm financial distress*

H1b (i) There is negative relationship between executive long-term motivation and the accounting measure for firm financial distress

H1b (ii) There is negative relationship between executive long-term motivation and the short-term market measure for firm financial distress

H1b (iii) There is negative relationship between executive long-term motivation and the long-term market measure for firm financial distress

3.9 Empirical Evidence relating to TMT Loyalty

This section critiques the empirical evidence from the prior literature on TMT loyalty. This section starts with a broad overview of TMT demographics and its relationship to firm outcomes. This is then further narrowed down to TMT background, experiences and the firm performance. This empirical review further points towards the link between TMT tenure and firm outcomes. This section is then concluded by defining how TMT loyalty is operationalised within this study and how the hypotheses of this study are further developed.

3.9.1 TMT Demographics and firm outcomes

Rajan and Wulf (2006) studied organisational changes in the US between 1986 and 1999 and found that the number of managers reporting to the CEO has increased over time pointing to a flatter structure at the top and positions such as the COO were slowly being eliminated. The move towards an increased demand for generalists skills from CEO candidates have extended the search for these candidates external to the organisation (Frydman 2007; Murphy and Zabojnik 2004, 2007).

Khurana (2002a) views the CEO market as not being efficient and argues that a lot of managerial talent is being wasted. He states that the rise of the business press has meant that a candidate's ability to charm journalists and command their attention becomes a relevant factor to be considered and previous association with a highly reputable firm drives media admiration. Hence, firms are more likely to be fighting for the same limited pool of candidates. Kaplan (2008) used a sample of 300 CEO candidates for firms involved in private equity transactions, to study who gets selected and the successful candidate's subsequent performance as stated by the upper echelons theory by Hambrick and Mason (1984). They found that CEOs who score highly on "softer" skills are associated with negative subsequent performance. This, therefore, is an area for future research to gain a better understanding of the process by which boards measure talent and select CEOs.

Under-representation of female CEOs has been documented by various researchers (Bertrand and Hallock, 2001; Wolfers 2006; Bertrand, 2009). Bertrand and Hallock (2001) studied the five highest-paid executives in Execucomp's (S&P 1500) between 1992-1997 and found that only 2.5% of their sample executives were female and only 0.5% CEO or Chairman

Positions were held by women. Wolfers (2006) found that in a study, 1992 to 2004, the number of female CEOs was increasing however it had plateaued in the early 2000s and only represented 1.3% of the CEOs. Possible explanations have been provided for the low numbers i.e. participation by women in MBA programmes is a recent phenomenon, corporate and financial sectors are particularly prone to discriminating against women (shareholders/boards are willing to sacrifice some profits to avoid promoting women to the top echelons), male CEOs may prefer to groom other males as their potential successor, some systematically downward biased beliefs about the ability of female CEOs (Wolfers 2006) and career-family trade-off women face (Bertrand et al., 2008). Wolfers (2006) found large negative abnormal returns of -3% on average on the announcement of a new female CEO as compared to a negative abnormal return of -0.5% on announcement of a new male CEO. This is one area of further research as the recent study on female CEO performance has not been conclusive due to the small sample of women-led firms.

The relationship between family management and firm performance is not very clear (Bertrand and Schoar, 2006). Family member CEOs of a family-controlled business have more incentive to succeed because of higher financial stakes, longer-term views (caring about inheritance rather than image) (Stein, 1989) and superior business knowledge and assets including social networks between family members. However, nepotism could lead to the rejection of talented non-family members leading to the CEO not being the ideal candidate. This has been supported by findings showing a negative relationship between family management and firm performance when the CEO is a descendant of the business founder (Morck et al., 2000; Villalonga and Amit, 2006). Bertrand et al. (2008) found that multiple sons in the family business were associated with lower performance pointing to value-destroying conflicts that existed within families and Bloom and Reenan (2007) found that firms managed by descendants were poorly managed and practices correlated to lower performance. An event study undertaken by Perez-Gonzalez (2006) found that firms that announced non-family member CEO appointments experienced positive abnormal returns compared to the announcement of a family member CEO appointment that experienced no abnormal returns.

Kallunki and Pyykkó (2013), a Finnish study, found that CEO's and Director's past personal default entries increased the likelihood of the future financial distress of the firm. Kilborn (2005) and Sullivan et al (1999) reported some personal traits that play an important role in consumer's over-indebtedness and credit default. Roll (1986), Malmendier and Tate (2005) and Hackbarth (2008) found that managerial traits such as overconfidence, over-optimism and illusion of control accounted for incorrect strategic decisions. The authors found that these personal traits resulted in bad managerial decision, which led to declining financial ratios and then resulted in financial distress. The authors further claim that their results show traditional Altman (1968) and Ohlson (1980) models should include person related risk attributes of the TMT. The authors suggested that there is a possibility for reverse causality i.e. firms anticipating declining future prospects may appoint managers with personal traits, which are also reflected in their payment default entries.

Ting et al. (2015), undertook a study of Malaysian firms, to investigate the impact of CEO personal attributes on the financial leverage of firms. In addition, they also group certain CEO attributes to make further comparisons of their impact on financial leverage. The study uses the Upper Echelon Theory as an underpinning framework to explore this relationship. Specifically, the following personal CEO attributes are selected: CEO overconfidence level, Age, Education, Experience, Gender, Tenure, Network and Founder. The authors found that: *CEO overconfidence, measured by their profile photo, has a significant negative relationship to leverage; CEO age has a significant negative relationship to leverage; as CEO education increases the firm debt increases; CEO prior experience has a significant negative relationship to leverage; CEO tenure has a significant positive relationship to leverage; Female CEOs are greater risk takers than male CEOs; and Younger CEOs, female CEOs and longer serving CEOs are risk takers and more aggressive.*

3.9.2 TMT background, experience and firm performance

Bertrand (2009) found that most of the empirical evidence reviewed was US-based and a majority of the research had been centred on CEOs of US PLC (due to the availability of good quality data). Previous researchers have tried to research both personal and professional backgrounds of CEO using a range of directories ("who's who in Business", business press or through third parties involved in CEO selection process) however, the knowledge of "what" makes a CEO is still limited.

The average age of executives was found to reduce by approximately 4 years in a study by Cappelli and Hamori (2004) however the average age of a CEO did not show any specific trend in the study by Murphy and Zabojnik (2006).

Frydman (2007) used a list of the 50 largest public traded firms from 1960 and collected biographical data for the three highest-paid executives at these firms from 1936 to the early 2000s. She found that executives in firms with a MBA qualifications increased from 10% to more than 50% (this was also confirmed by a larger study covering all S&P 500 firms undertaken by Murphy and Zabojnik (2006) and CEOs in the early part of the study on average had worked in only one sector whereas this later changed to an average of two sectors. She also found that modern-day CEOs are more generalists similar to findings from Lazear (2002, 2004) and that only one in four top executives had worked at the same company their entire career.

Lindorff and Johnson (2013), an Australian study, found no relationship between CEO education and firm performance. The study analysed 3 and 5-year shareholder return measured by dividend and change in share price and CEO educational qualification. The authors suggest a multinational longitudinal study to be undertaken on the relationship between CEO business and other qualification and objective outcome. The study only focused on one country and a firms financial performance.

Hayes and Abernathy (1980) argued the importance of TMT expertise should represent core functional areas that involve the actual design, production and marketing of its goods and services. However, prior qualitative research of failed firms showed that these firms lacked financial expertise at the TMT level and therefore were unable to gauge the firm's difficulties, took on excessive risk and failed to deal with financial institutions appropriately. Hambrick and D'Aveni (1992) used the percentage of the team whose dominant function was marketing, sales, operations, production, research and development as functional expertise (Hayes and Abernathy, 1980).

Mousa et al. (2016), a study of US high-tech firms, study the TMT that is in the process of transforming their firms into public traded firms. They found that TMT choose to engage in acquisition activity that if unsuccessful could lead to damage the firm and the team. Specifically, it could lead to financial problems, divestiture, TMT turnover and affect the reputation of the firm and the team. The authors selected the following demographic variables to test the relationship between TMT attributes and acquisition activity for IPO firms: TMT Directorships, TMT Education, TMT functional background (Wiersema and Bantel, 1992; Zimmerman, 2008), TMT Organisational tenure (Hambrick et al 1996; Michel and Hambrick, 1992), TMT Industry tenure and TMT prior IPO Experience. The research found that executives' board experience, senior level management experience, organisational tenure and prior IPO experience have a significant impact on their firm's acquisition activity. The authors' claim that their findings help explain the high failure rate of IPO firms (Zeune 1993).

Nielsen (2010b), undertook a study to investigate TMT ability to deal with the challenges of managing firm foreign operations. The author uses the upper echelons theory to focus on individual rather than firm-level knowledge and experiences within an international business context. The author uses cross-cultural psychology literature (Triandis and Suh 2002) to suggest that national origin influences individual personality. The author further claims that TMT nationality provides them with the knowledge about economic and market factors and institutions, culture, behaviour and norms of foreign countries. The study finds that managers international backgrounds and experiences are positively related to foreign market entry of the firm. However, the relationship between firm internationalisation and performance is not clear. The results show that at high and low levels of internationalisation, the degree of internationalisation has a negative relationship with firm performance. In addition, at moderate levels of internationalisation, the degree of internationalisation has a positive relationship with firm performance.

Vo and Phan (2013), a Vietnamese study, found that female board members, the duality of CEO, boards working experience and boards compensation all have a positive correlation with firm performance. They further found that board size contributes negatively to firm performance and there is no link between independent directors and firm performance. They suggested that a non-linear relationship between corporate governance and board ownership existed. The authors identified that some further research exploring the relationship between other board attributes such as educational level of boards members and firm performance would need to be undertaken as these conclusions cannot be made from the study.

Hayes and Abernathy (1980) argued the importance of TMT expertise should represent core functional areas that involve the actual design, production and marketing of its goods and services. However, prior qualitative research of failed firms showed that these firms lacked financial expertise at the TMT level and therefore were unable to gauge the firm's difficulties, took on excessive risk and failed to deal with financial institutions appropriately. Hambrick and D'Aveni (1992) used the percentage of the team whose dominant function was marketing, sales, operations, production, research and development as functional expertise (Hayes and Abernathy, 1980).

3.9.3 TMT Tenure and firm outcomes

Kaplan and Minton (2012) found that 1 in 6 CEOs lost their job between 1998 and 2005 compared to 1 in 10 during the 1970s. Mizruchi (2013) found a decline in the average CEO tenure of between 24% and 30% between the early 1980s and the early 2000s. A number of studies (Ocasio, 1994; Allen and Panian, 1982; Boeker, 1992; Cannella and Lubatnik, 1993) indicate that CEO succession is a response to poor or declining firm performance. Thornton and Ocasio (1999) further show that the effect of performance on turnover increased over time. A long average tenure of the TMT reflects an acceptance of certain norms or perspectives and team members are willing or allowed to continue in position (Pfeffer, 1983), confers socialisation of teams and provides shared experiences

(Katz, 1982) and reduces interaction costs (Williamson, 1975). Thus indicating that short tenure could be associated with firm failure, alternatively longer tenures can be viewed as a rigidifying effect on team interaction (Katz, 1982). Hence, there is no clear association between tenure and corporate failure. Hambrick and D'Aveni (1992) used the mean number of years in the firm for all executives as average tenure.

The spread of tenures within the team is an important factor to consider. Members of a common tenure may have similar thinking (Wagner et al., 1984), may be prone to 'group think' (Gladstein, 1984; Janis, 1972). On the other hand, a very heterogeneous group may lack shared values to work as an effective problem-solving team unit. Hambrick and D'Aveni (1992) used the variance of member tenures divided by the mean tenure as a measure for tenure heterogeneity. Bergh (2001), a US study, found a positive correlation between target company executive tenure and post-acquisition performance, and the longer the term of the executive the less likely the target firm was to be disposed of by the acquirer and greater the retention rate of long-tenured executives than short-tenured executives. Bergh (2001) and Simsek et al. (2005) view CEO tenure as a positive effect on firm performance and in line with the Resource Based view theory.

Walsh (1988) noted that TMT turnover following a merger are significantly higher. Sharma and Ho (2002) explain this relationship as the replacement of inefficient management with efficient ones. Henderson et al. (2006), analysed firms in the computer and branded foods industry and found that the firm performance steadily improved with tenure in the branded food industry but started to deteriorate among CEOs in their tenure between 10-15 years. This relationship was further seen in the computer industry where the firms performed better under CEOs in the early phase of their tenure. Hambrick and Mason (1984) found that tenure of management influences strategic choice and performance. Bergh (2001) found tenure to be the strongest attributes amongst executives as it reflects unique knowledge and insights into the organisation (Haspeslagh and Jemison, 1991). Bergh (2001) further found that retaining long-tenure executives enhances the performance post-acquisition. Hubris (Roll, 1986) was found to influence managerial actions (Sharma and Ho, 2002; Gregory, 1997) and narcissism (Higgs, 2009) or animal spirits (Akerlof and Shiller, 2009) was found to be a more dominant influence than hubris on managerial behaviour.

Ting (2011), a Chinese study, focused on the relationship between TMT turnover and firm default risk. Previous studies have found that the likelihood of TMT turnover has a negative relationship with firm performance (Coughlan and Schmidt, 1985; Warner et al, 1988; Weisbach, 1988). The authors found that firms with a higher default risk are more likely to change their TMT and firms that change their TMT have a lower subsequent risk of default compared to other companies. Hambrick and D'Aveni (1992) in a study of corporate bankruptcies found that weak TMTs (short-tenured or few outside directors) fail to identify the seriousness of problems or fail to monitor the implementation plans. Bergh (2001), a US study, found a positive correlation between target company executive tenure and post-acquisition performance, and the longer the term of the executive the less likely the target firm was to be disposed of by the acquirer and greater the retention rate of long-tenured executives than short-tenured executives. Bergh (2001) and Simsek et al. (2005) view CEO tenure as a positive effect on firm performance and in line with the Resource Based view theory.

The counter argument to TMT deficiencies lead to organisational decline is that poor firm performance causes TMTs to diverge from that of healthy firms. In addition, as financial health declines, executive turnover is seen to increase which heightens the likelihood of deterioration of the team (Wagner et al., 1984). In additions, firms try to change the composition of the team when struggling with performance to bring in more financial and cost-saving skills and less marketing and operational skills (Whitney, 1987).

3.9.4 Operationalising TMT Loyalty

Cao et al. (2015) use CEO tenure as a measure for CEO power in a study on the relationship between corporate governance and default risk. Loveman (1998), tested the relationship between employee satisfaction and loyalty, customer satisfaction and loyalty, and financial performance using panel data from the branches of a large retail bank. The author uses the logic that enthusiastic employees deliver good customer satisfaction, which in turn makes customers loyal which results in an increased purchase of goods or services, which then, in turn, have an effect of financial performance. This research uses a similar logic to align TMT loyalty as an effect of aligning their objectives to that of the shareholders, reducing the agency problem, which in turn has the effect of reducing the probability of default. An increase in the average TMT tenure could also lead to patriotism towards the firm, which would, in turn, lead to them working towards reducing the likelihood of default. The service profit chain (Service Management Interest Group, Harvard Business School) proposes a theoretical concept that claims that employee loyalty and customer loyalty are primary drivers of profitability (Heskett et al., 1994).

In order to measure employee loyalty, Loveman (1998) used the length of employment as a variable. It is highlighted that the length of employment is possibly a function of other factors such as personal preferences and other opportunities, however, Loveman (1998) further highlights that loyalty is manifested in the variable. Hambrick and Fukutomi (1991), argued that there are specific phases (or seasons) within an executive's tenure which give rises to patterns in executive attention, behaviour and organisational performance. Executives are able to increase and solidify their power once in position (Pfeffer, 1981) and as their tenure increases so do their power generally (Hambrick and Fukutomi, 1991). Pfeffer (1981) and Hambrick and Fukutomi (1991) argue that as the CEOs tenure increases they may be able to create a "personal mystique or aura, including unquestioned deference or loyalty." It is the final season (Dysfunction) within which Hambrick and Fukutomi (1991) argue that the CEOs power is the strongest and continues to increase. In this stage, the CEO may begin to disengage psychologically as job mastery gives way to boredom however the power remains at an all-time high. Therefore, arguing that the season where the executive feels the most powerful they will also have a feeling of increased loyalty towards the firm as they receive increased loyalty from the firm.

Dunn (2004), in a study on the relationship between TMT duality and the decision to release false financial information, controlled for TMT attributes and corporate governance structures by using tenure of the directors. Daboub et al. (1995) argue that smaller tenured teams are more likely to actively participate in corporate crimes. Finkelstein and Hambrick (1990) used the average number of years of employment in the firm of TMT members, defined as all corporate officers who were also board members, in a specific year as a measure for tenure in their study of the effect of executive-team tenure on strategy and performance. Singh and Harianto (1989b) use the average tenure and relative tenure as measures of TMT (top five executives) tenure in a study of TMT tenure, corporate ownership and board composition as predictors of different aspects of golden parachutes. Vainieri et al. (2017) used the number of years spent by GM (CEO) in health organisations as a member of the TMT to measure tenure in order to study the relationship between TMT competencies and organisational performance in public health care system. Hambrick et al. (2015) controlled for TMT tenure by using average member (senior vice president or higher i.e. CEO, COO executive vice president and senior vice president) tenure.

3.9.5 Operationalising the hypothesis linked to TMT Loyalty

Hypothesis 2 *There is a negative relationship between TMT loyalty and the likelihood of firm financial distress*

H2 (i) There is a negative relationship between TMT loyalty and the accounting measure for firm financial distress

H2 (ii) There is a negative relationship between TMT loyalty and the short term market measure for firm financial distress

H2 (iii) There is a negative relationship between TMT loyalty and the long term market measure for firm financial distress

3.10 Empirical Evidence relating to TMT Effectiveness

This section critiques the empirical evidence from the prior literature on TMT effectiveness. This section starts with critiquing empirical evidence on the relationship between CEO duality, succession and firm performance. This highlights the changing role of TMT and the section that follows discusses the empirical evidence on their reduced autonomy and increased scrutiny. This then leads to the discussion of empirical work on board attributes and its relationship to firm performance and financial distress. This section is then concluded by defining how TMT effectiveness is operationalised at different levels within the organisation for the purposes of this study and how the hypotheses of this study are further developed.

3.10.1 CEO Duality, Succession and Firm Performance

Dalton et al. (1998) found that CEO duality had no systematic relationship with firm performance irrespective of using market or accounting based measures for firm performance. Coakley and Iliopoulou (2006), a UK study, found that CEOs received a higher level of performance-related pay in firms that had a higher number of the executive to non-executive directors. In addition, they found that large boards awarded significantly higher bonuses to the CEOs post-M&A completion. These findings were consistent with Core et al. (1999) who suggest that weak governance allows stronger power on the part of the CEO leading to a negative relationship between CEO remuneration and stock return performance.

Boyd (1995) undertook a study, using agency and stewardship theory to develop a framework, to get a better understanding of the relationship between CEO duality and firm performance. The author claims that a CEO-Chair would be able to respond quickly to external events, have greater knowledge of the firm and its industry and greater commitment than an external chair. The supporters of duality explain that the board chairman is relatively less powerful and more ceremonial and symbolic than the CEO (Harrison et al., 1988, pg214). Patton and Banker (1987, p12) undertook a survey of board members and corporate executives and concluded that board leadership would improve if the chairman were not part of the active management. Berg and Smith (1978), a study of fortune 200 firms, found a negative relationship between duality and ROI and no relationship with ROE or change in stock price. Chaganti et al. (1985), a US study of the retail industry, found no relationship with Duality and Corporate failure. Rechner and Dalton (1991) found a negative relationship between Duality and ROE, ROI and profit margin. In contrast, Donaldson and Davis (1991) found CEO duality was associated with significantly higher levels of ROE. Boyd (1995) hypothesize that the agency theory would propose that the combination of CEO and Chairman positions would weaken board control, and negatively affect firm performance. The author also hypothesizes that the stewardship theory proposes that CEO duality would facilitate effective action by the CEO, and consequently lead to higher performance. The author further hypothesizes that the Resource Dependence Theory (Pfeffer and Salancik, 1978) proposes that CEO duality might actually improve performance in certain contexts. The findings of the study by Boyd (1995) indicated that duality can help firm performance under the right circumstances. This is in contrast to the school of thought of complete separation of CEO and Chairman in all circumstances.

Georgakakis and Ruigrok (2017), a European study, analysed opposing perspectives on CEO succession and examined the conditions under which the benefits of outsider CEO succession outweighed the costs. The two opposing theoretical streams on whether or not appointing an outsider CEO is beneficial to the firm are organisational adaptation view (Helmich and Brown, 1972) and organisational disruption view (Vancil, 1987). The organisational adaptation view implies that outsider CEO's have more external knowledge and information and therefore are better equipped to improve firm performance through expansion, innovation and learning. The organisational disruption view advocates that outsiders lack firm familiarity and therefore result in low firm performance due to disrupting internal processes. The findings of the study show that the advantages of the organisational adaption view only materialise under individual, organisational-, industrial-level conditions that enable the outsider CEO to quickly familiarise with the firm and through effective transfer of external knowledge and information. The findings further implying that both views have merit and the adoption of one over the other depends on the succession context.

3.10.2 Reduced autonomy and Increased scrutiny

Dobbin and Zorn (2005) found that CEOs face increased pressure from financial analysts who issue quarterly profit projections for their firms. If the firm fails to meet the projections, the firm experiences a decline in market value pushing the CEOs to pursue more short-term goals to achieve the forecasts. CEOs are in the strongest position in their initial years immediately following their appointment when the shareholders and boards are more forgiving of their decisions. This was supported by the findings of Marquis and Lee (2013) who found that firm's philanthropic contributions were the highest in the CEOs first year of appointment and this then steadily declined. Walker (2013) further found that a firm's philanthropic contributions increased when the firms with which it shares board members increase their contributions however as the number of outside directors increases and a firms level of debt increases (pointing to increased monitoring) the CEO's discretionary spending decreases.

Another area that is influenced by the reduction in autonomy and increased scrutiny is Research and Development spending. When the CEO receives increased pressure to meet short-term profits they are less likely to make R&D expenditures. The CEOmyopia theory refers to the process where R&D spending was found to be negatively affected by increased pressure to increase shareholder value (Institute, 2010; Hirschey et al. 2012). Lundstrum (2002) concluded that the shareholders restrict long-term investments which require the continued employment of the CEO as they found that the older the CEO the less R&D expenditure they made. Graham et al. (2005) in a survey of CFOs found that these officers were preoccupied with reporting relatively smooth earnings across quarters and reduce uncertainty, which is consistent with Dobbin and Zorn (2005).

Are today's CEOs a part of the upper class whose interests are aligned with the owners of the property as opposed to hired bureaucratic managers of prior years (Freeland, 2012; Winters, 2011)? In addition, there is an increased urgency to compare the views of today's CEOs with those of earlier decades (Mizruchi and Marshall, 2016).

3.10.3 Board attributes, firm performance and financial distress

Pfeffer and Salancik (1978) argue that outside directors supplement the team's knowledge base by providing additional inputs, perspectives and links to external parties (Goodstein and Boeker, 1991; Vance, 1983; Pfeffer, 1972). On the other hand, outside directors may politically influence the governance process (Mace, 1971), dilute the effective leadership (Barnard, 1938) or have no material power and be merely a rubber stamp (Whisler, 1984; Mace, 1971). Hence, its association with corporate default cannot be predicted. Hambrick and D'Aveni (1992) used the number of executives that are not employees of the firm as outside directors.

In a review of literature on Board activities, Hermalin and Weisbach (2003) found composition of internal and external directors was not correlated to performance (finding also made by Byrd and Hickman (1992) and Dalton et al. (1998)), board independence declined as CEO performed exceptionally well, poor firm performance led to an increase in the probability of adding independent directors and board independence declined as CEO tenure increased.

Kiel and Nicholson (2003), an Australian study, found that on average non-executive directors made up 69% of the board and 23% of firms had CEO duality (role of chairman and CEO combined). Carson (2002), an Australian study, found that, 76% of firms had a non-executive chairman, 69% of firms have non-executive board directors, average number of executive directors was 1.97, 75% of firms were audited by ‘Big 6’, 84% of firms had an audit committee, 57% had a remuneration committee and 17% had a nominations committee. He concluded that the audit committee was a developed governance mechanism, remuneration committees were developing and nominations committee were underdeveloped. Collier and Gregory (1999) found that CEO duality and presence of executive directors on the audit committee had a negative effect on the audit committee activity. Garrow et al. (2015) identified that there was little to no research on the relationship of the joint tenure of Chairman and CEO and its effect on firm performance.

Fernau (2013), a German study, found that executive and director fixed effects are almost equally important in explaining the variance in firm performance. Interpretation of manager fixed effects as a proxy for the skills of an individual manager and the analysis on the firm level showed that the impact of manager fixed effects on firm performance could be attributed to the aggregate quality of the executive and supervisory board, but not to the dispersion of skills within or between the two boards. He suggested some further research on the impact of specific types of directors (former executives or employee representation) on firm performance should be undertaken. In addition, the absolute and relative importance of director fixed effects in explaining certain board actions such as executive and CEO turnover would be another interesting field.

Salloum et al (2012), a Lebanese study using 276 non-listed family firms, composed of 138 financially distressed firms (experimental group) and 138 healthy firms (Controlled group) conducted multiple logistics regression between the probability of financial distress and three attributes of board structure. They found that the presence of outside directors on the board of directors has no effect on financial distress, insiders' equity ownership reduces the likelihood of financial distress and the CEO-board chair duality increases the probability of financial distress. The findings relating to inside ownership concur with the predictions of the Convergence of Ownership and Management in the model of Jensen and Meckling (1976). Brunninge et al. (2007) could explain for the findings relating to outside directors i.e. in family businesses they lack real power and do not contribute to firm's strategy due to their friendship/professional ties with the owners and management. The authors suggested including other governance variables into their model to affect their findings.

In a review of literature on Board activities, Hermalin and Weisbach (2003) found composition of internal and external directors was not correlated to performance (findings also made by Byrd and Hickman (1992) and Dalton et al. (1998)), board independence declined as CEO performed exceptionally well, poor firm performance led to an increase in the probability of adding independent directors and board independence declined as CEO tenure increased. Dalton et al. (1998) also found that CEO duality had no systematic relationship with firm performance irrespective of using market or accounting based measures for firm performance. Coakley and Iliopoulou (2006), a UK study, found that CEOs received a higher level of performance-related pay in firms that had a higher number of the executive to non-executive directors. In addition, they found that large boards awarded significantly higher bonuses to the CEOs post-M&A completion. These findings were consistent with Core et al. (1999) who suggest that weak governance allows stronger power on the part of the CEO leading to a negative relationship between CEO remuneration and stock return performance.

Hambrick and D'Aveni (1992) argue that the two arguments, i.e. TMT composition impacts firm performance and firm decline impact TMT composition, are not mutually exclusive. They identify two major classes of TMT attributes:

(1) Team resources - team size, outside directors, functional expertise and team compensation (2) Team social structure - average tenure, tenure heterogeneity and CEO dominance

Hambrick and D'Aveni (1992) liken TMT size with that of a sports team size and argue that a sports team is at a disadvantage if it has fewer than the number of allowed players. Steiner (1972) argued that team size has a positive association with effectiveness for divisible and additive tasks, which Hambrick and D'Aveni (1992) argue is an apt characterisation of TMT work. Goodman et al. (1986) found an inverted U-shaped relationship between group size and effectiveness and found that small and large team sizes had their disadvantages. This is why an expected relationship cannot be predicted. Hambrick and D'Aveni (1992) used the number of executives, with a title vice president and above, as a measure of team size.

Pfeffer and Salancik (1978) argue that outside directors supplement the team's knowledge base by providing additional inputs, perspectives and links to external parties (Goodstein and Boeker, 1991; Vance, 1983; Pfeffer 1972). On the other hand, outside directors may politically influence the governance process (Mace, 1971), dilute the effective leadership (Barnard, 1938) or have no material power and be merely a rubber stamp (Whisler, 1984; Mace, 1971). Hence, its association with corporate default cannot be predicted. Hambrick and D'Aveni (1992) used the number of executives that are not employees of the firm as outside directors.

3.10.4 Operationalising TMT Effectiveness

The Resource Based view of the firm argues that human capital can be a source of key resource to a firm to gain a sustained competitive advantage (Barney, 1991; Wright et al., 1994; Huselid et al., 1997). This human capital can be broken down at board level and at the firm level. The effectiveness of the TMT at a board level and the firm level is dependent on the valuable, rare, inimitable and non-substitutable resource of human capital at board level and at the firm level. Platt and Platt (2012) use board size as a key variable in their study of corporate board attributes and bankruptcy. A larger board brings different views, skills, and experiences whereas a smaller board may benefit from its ability to move more quickly and to avoid lengthy debate (Daily et al., 2003; Fich and Slezak, 2008).

Guest (2009) found no evidence that firm attributes that determine board size in the UK have a positive board size-firm performance relation. In addition, it was found that larger board sizes had a negative relation to firm performance. Guest (2009) concludes that larger board sizes lead to problems of poor communication and decision making undermining its effectiveness. It has also been argued in the prior literature that initially larger board sizes facilitate key Board functions however eventually larger board sizes suffer from coordination and communication problems leading to an ineffective board (Lipton and Lorsch, 1992; Jensen 1993). Cao et al. (2015) also controlled for board size, defined by the number of directors on the board. The TMT (CEO, CFO and Chairman) are unable to operate effectively at a board level as coordination and communication problems increase. Hence, board size would be an appropriate measure for TMT board level effectiveness.

Schultz et al. (2017) use board structure as one of the three broad types (board structure, remuneration and ownership structure) of internal corporate governance mechanisms in their study of board attributes and the likelihood of firm default. Dunn (2004), a study on the relationship between TMT duality and the decision to release false financial information, controlled for TMT attributes and corporate governance structures by using a number of directors on the team/board. Large TMT are associated with ineffective decision-making (Bacon, 1993; Wiersema and Bantel, 1992).

Finkelstein and Hambrick (1990), a study on TMT tenure and organisational outcomes, use the number of employees as a measure of the size of the firm. Firms with many employees have difficulty effecting change (Aldrich, 1989) and face bureaucratic momentum (Mintzberg, 1978). O'Reilly III et al. (1988), a study examining economic and psychological factors influencing CEO compensation, use the number of employees for firm size. Richard and Johnson (2001) used the number of employees to control for firm size in a study of strategic human resource management effectiveness and firm performance.

Youndt et al. (1996) argue that large firms, as defined by a natural logarithm of the number of full-time employees, are more likely to have well-developed HR practices. However, an increase in firm size has also been associated with an increase in problems of coordination and communication (Blau, 1968, 1970, 1972; Klatzky, 1970; Blau and Schoenherr, 1971). It has also been argued that smaller board sizes can be more effective when a firm faces greater information asymmetry, as the cost of collecting, distributing and understanding information is greater (Cao et al., 2015; Boone et al., 2007; Linck et al., 2008).

3.10.5 Operationalising the hypotheses linked to TMT effectiveness

Hypothesis 3a *There is no relationship between TMT board level effectiveness and the likelihood of firm financial distress*

H3a (i) There is no relationship between TMT board level effectiveness and the accounting measure for firm financial distress

H3a (ii) There is no relationship between TMT board level effectiveness and the short term market measure for firm financial distress

H3a (iii) There is no relationship between TMT board level effectiveness and the long term market measure for firm financial distress

Hypothesis 3b *There is a positive relationship between TMT firm level effectiveness and the likelihood of firm financial distress*

H3b (i) There is a positive relationship between TMT firm level effectiveness and the accounting measure for firm financial distress

H3b (ii) There is a positive relationship between TMT firm level effectiveness and the short term market measure for firm financial distress

H3b (iii) There is a positive relationship between TMT firm level effectiveness and the long term market measure for firm financial distress

3.11 Predicting the likelihood of Default

Econometric studies of business defaults started in the 1960s with work by Altman (1968, 1971, 1973, 1984) and co-authors . These influential papers focus on explaining bankruptcies of publicly listed companies in a cross-sectional context using a small set of firm-specific variables. Later work by Shumway (2001) attempts to account for the dynamic nature of defaults for publicly listed firms. Bharath and Shumway (2008) evaluate the out-of-sample accuracy of the Merton (1974) model and find that the distance-to-default measure is not a sufficient statistic for the probability of default.

Altman and Hotchkiss (2006; pg 238), discuss the evolution of different credit scoring models (this can be seen in table 3.1)and highlight that a majority of the models today focus on quantitative measures however the importance of qualitative measures should not be underestimated. They identify that qualitative elements, such as the judgement on the part of the risk officer, provide 30 to 50 per cent of the explanatory power of the scoring model.

Table 3.1 Different Default scoring models (Source: adapted from Altman and Hotchkiss, 2006)

Number	Scoring System	Scoring system sub category	Specific Attribute
1	Qualitative		Subjective
2	Univariate		Accounting/Market Measures
3	Multivariate		Accounting/Market Measures
3a		Discriminant, Logit, Probit Models	Linear, Quadratic
3b		Non - Linear models - for example, Recursive Participating Analysis (RPA) and Neural Networks (NN)	
4	Discriminant and Logit Models in Use		
4a		Consumer Models (e.g., Fair Isaacs)	
4b		Z - Score- Manufacturing	
4c		Zeta Score - Industrials	
4d		Private Firm Models (e.g. Risk Calc [Moody's], Z"-SCore)	
4e		EM Score - Emerging Markets, Industrials	
4f		Other - Bank Specialised Systems	
5	Artificial Intelligence Systems		
5a		Expert Systems	
5b		Neural Networks (e.g., Credit Model [S&P]. Central dei Bilanci [CBI] Italy)	
6	Option/Contingent Claims Models		
6a		Risk of Ruin	
6b		KMV Creditor Monitor Model	
7	Blended Ratio/MArket Value Models		
7a		Moody's Risk Calc	
7b		Bondscore (CreditSights)	
7c		Z-Score (Market Value Model)	

3.11.1 Altman Z-score

Altman (1968) undertook a study to assess the quality of ratio analysis. He applied a set of ratios to approach the problem of corporate bankruptcy prediction. The findings provided academic literature with the Altman Z-score, which has since been widely used for predicting the probability of corporate default. The Z-score model provided weightings to ratios, such as Working capital/Total assets; Retained Earnings/Total Assets; Earnings before Interest and Tax/ Total Assets; Market Value of Equity/ Book Value of total debt and Sales/Total Assets, to predict the failure of firms. The findings showed promising results in predicting the probability of bankruptcy for firms 2 years prior to the event. However, the model is less useful when attempting to predict bankruptcy 3, 4 or 5 years prior to the event. Nevertheless, the Z-score of firms is widely used by academics and practitioners aiming to study corporate bankruptcies. One argument here is that by using such models for predicting default, practitioners and academics are forcing the firms into bankruptcy that would normally not have defaulted. The model showed an accuracy of 95% in predicting the default 1 year prior to the event, therefore the 5% of firms that did not actually fail, would they now be forced into a bankruptcy event due to the heavy reliance on prediction models.

The Altamn'z (1968) Z-score Model:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

$X_1 = WorkingCapital/TotalAssets$

$X_2 = RetainedEarnings/TotalAssets$

$X_3 = EarningsbeforeinterestandTaxes/TotalAssets$

$X_4 = MarketValueofEquity/BookValueofTotalLiabilities$

$X_5 = Sales/TotalAssets$

$Z = OverallIndexorScore$

Altman et al. (1977) undertook a study to develop and test a new bankruptcy classification model, which reflected developments with respect to business failures at the time. The findings produced the ZETA® model for bankruptcy classification, which accurately predicted failure up to 5 years prior to the event. The ZETA® model is a 7 variable model, using variables to measure: Overall profitability; stability in earnings; Debt service; Cumulative profitability; Liquidity; Capitalisation and Asset size, to predict bankruptcy for firms. The ZETA® Model provided better results to the results of the original Altman's (1968) model and to the Altman's (1968) model applied to the ZETA® sample. However, the findings of the Altman's (1968) model applied to the ZETA® sample did improve in comparison to the Altman's original sample results. This could be related back to an earlier argument on the application of prediction models on firms in practice and the probability of pushing firms that would normally not have defaulted into a bankruptcy event due to the reliance on the model's prediction.

A range of variations on the Z-score model (Altman, 1968) has been developed to reflect the varied firms being studied. For example, the original model has developed on a sample of manufacturing firms hence the model's accuracy to predict the probability of default would alter when applied to non-manufacturing firms. Altman and Hotchkiss (2010) suggest that ideally variations to the Z-score models should be developed for specific industries (i.e. retailers, telecoms, airlines etc.). Altman (1993) developed the Z' Score model for private firms as one of the variables in the original Z score model required market value of equity. This information is not available for private firms' hence practitioners simply replaced the market value of equity with the book value of equity. The author claims that this is not ideal and would need to be followed by developing a new model with different weightings for each of the original variables. Similarly, a revision to the Z' score model was made to adapt a probability of default model for non-manufacturing and Emerging Market firms. Altman et al. (1995, 1998) developed the Z" model for emerging market firms, specifically Mexican firms. This model was similar to the Z' model i.e. it used the book value of equity instead of market value of equity, however, the big difference was in the selection of the sales/total assets variable. The Z" model replaces this variable with a constant term +3.25 and changes the weightings applied to the other four variables.

3.11.2 Altman's Z-score vs Merton's probability of default

Black and Scholes (1973), developed a theoretical valuation formula for option pricing based on the Capital Asset Pricing model. They suggested that the formula could be used to derive the discount that should be applied to a corporate bond because of the possibility of default. Robert Merton then applied the continuous-time portfolio theory to show the results of the model as a consequence of ruling out arbitrage opportunities in the financial markets. The model that resulted is popularly known as the Black-Scholes or Black-Scholes-Merton Option Pricing model. Merton (1973) used the model to develop a basic equation for the pricing of financial instruments and then applied it to corporate debt.

Merton (1974) developed a model, based on Black and Scholes (1973) and Merton (1973), to assess the creditworthiness of corporate debt. This model is popular in the credit risk literature and more sophisticated credit risk models such as Moody's KMV (Leland, 2002; Huang and Huang, 2012). Gharghori et al. (2006) found that option-based default models significantly outperform accounting based default models however the difference in performance between the different option based models is little. Moody's purchased the KMV corporation that developed a default prediction model based on the Merton's (1974) bond valuation model. This model is popularly known as the Merton's distance to default model. The basic principle of the model is that when the market value of the firm drops below a certain liability level the firm will default on its obligations.

Altman and Hotchkiss (2006, pg 255) examined predictability of the Z-Score model and KMV's EDF for two popular US bankruptcies i.e. Enron and WorldCom. They found that in the Enron case study neither model actually predicted the bankruptcy, however, both models provided unambiguous early warnings that the rating agencies failed to provide. The authors relate the failure of the two models in predicting bankruptcy in Enron's case to the 'bogus' data provided by the firm. In addition, when the authors use the true liabilities of the firm they find that both models predict severe distress. In the case of Worldcom, Altman and Hotchkiss (2006, pg 257) applied the Z" model (more appropriate for non-manufacturing firms) and the KMV's EDF to predict the probability of the firm's failure.

They found that both models indicated a non-investment-grade company up to 18 months before the rating agencies downgrade, however, neither would have predicted its default based on available data and based on adjusted data for improper accounting techniques.

3.11.3 Merton's probability of default and the Bloomberg probability of default

Bloomberg provides daily data on the probability of firm default through its quantitative default model Bloomberg DRSK. The models provide data on the likelihood of default in 3 months, 6 months, 9 months, 1 year, 2 years, 3 years, 4 years and 5 years. The default probabilities calculated are categorised into Investment grade (1 to 10), high yield (1 to 6), Distressed securities (1 to 5) and Defaulted debt. The different categories and their respective default likelihoods are presented in appendix B, Fig. B.4.

In a case study by the data provider, the model compares the credit risk of Petrobas, a South American firm, as calculated by DRSK compared to the credit rating by Moody's on 24th February 2015. The date is important as on this day Moody's downgraded the firm to a speculative credit rating. Fitch put the firm on a negative watch from the lowest investment grade on 3rd February 2015. In comparison, DRSK indicated steep deterioration almost 1 year prior to the downgrades. This can be viewed in Fig. 3.10 where the bloomberg 1 year probability of default predicts default a lot earlier than the credit rating downgrade.

Fig. 3.10 Petrobas market capitalisation and Bloomberg 1 year probability of default (Source: Bloomberg Professional Service, 2018)

The Bloomberg default likelihood model is based on the Merton distance-to-default model in addition to relevant economic and statistical factors. The model also adjusts reported financials, such as operating leases and pensions or other post-employment benefits (OPEB), in order to provide comparability across different accounting/business models. Bloomberg Professional Service (2018) claims that as the model is globally calibrated and retains region-specific attributes users are able to predict credit risk of same sector peer firms across industries. The model defines default as *"... the first of any of the following: failure to pay interest/principal on an interest-bearing bond or loan, bankruptcy filing or, for banks, FDIC takeover or government bail-out" (Bloomberg Professional Service, 2018, pg 3).*

The Merton (1974) model views a firm as solvent as long as the firm's assets are larger than the value of its liabilities. As the firm's assets are not observable, the model assumes their value to be the market value of its shares and the debt of a firm. The key argument of the model is that the equity of the firm is a call option on its assets and the liabilities is the strike price, allowing the model to assume a value for the assets using the Black Scholes (1973) option pricing approach. The limitation of this model is that it assumes the firm can default only at the maturity of its debt, which in reality does not stand true as default on debt can occur anytime. The Bloomberg DRSK overcomes this limitation by treating the equity as a 1-year barrier call option, therefore incorporating the possibility of default before maturity. This allows the model to calculate the main output of the Merton model i.e. Distance to Default. Bharath and Shumway (2008), in their study, show that Distance to Default is not a sufficient statistic in predicting default; therefore, the DRSK model incorporates some other financials to improve the model performance.

Tudela and Young (2003), a UK study, undertook a research to show the usability of the Merton-model approach to developing measures of the probability of failure of UK public listed companies. The paper modifies an underlying assumption of the original Merton model i.e. the original model assumes default can only take place when the debt repayment is due however this is modified to default can occur at any point in time and not specifically at maturity. Kealhofer and Kurbat (2002) (KMV) in an attempt to replicate Moody's empirical results, as achieved by Sobehart et al (2000), on the Merton model find that the Merton model outperforms the rating agency and various accounting ratios. The authors developed a modified Merton model and applied it to UK non-financial quoted firms over the period of 1990-2001. The findings of the study show that the model provides a strong signal of failure one year in advance of default. The model compared to a reduced -form model (Geroski and Gregg, 1997) outperforms the later model.

Work by Duffie et al. (2007), Pesaran et al. (2006), Bonfim (2009), Lando and Nielsen (2010), and Tang and Yan (2010) provides empirical evidence that firm-specific factors alone appear unable to fully explain the variation in corporate default rates and credit spreads. Carvalho et al. (2014), undertook a study to see if there is a self-fulfilling prophecy in Credit Rating announcements. The authors use the relationship between credit ratings and credit default as an example to explain this. Credit Ratings are to predict the future payment behaviour of the rated firm however a negative announcement relating to the credit rating has an impact on the firm, which can then translate into the firm finding it difficult to keep its debt costs low, therefore pushing the firm closer to default. The research finds that "...some negative rating announcements are relevant enough to generate additional pressure for a default in the rated firm's obligations."

Fig. B.5, B.6 and B.7 (in appendix B) show how early on the Bloomberg default probability started to increase prior to the default of Eddie Bauer, Lehman Brothers and Oleo e Gas Partipacoes S.A. Fig. B.8 and B.9 (in appendix B) shows some further examples of North American and Asian companies that failed and their respective Bloomberg default probabilities.

3.11.4 Default prediction models in recent literature

Schultz et al (2017) is a key recent literature to this research, as they use the Merton's (1974) probability of default as a measure of the likelihood of firm default to characterise the relationship between corporate governance and the chance of the firm default. The research involved a study of a sample of the Australian ASX200 index between 2000 and 2007 (the final sample comprised an unbalanced sample of 932 annual firm-years for 222 unique observations). The research commenced with a pooled OLS and fixed-effects approaches to estimate the model of interest. The results of the testing suggested that the likelihood of firm failure decreases (increases) as inside ownership (executive fixed pay and the proportion of non-executive directors on the board) increases. For Robustness testing the authors employ GMM and they find that once endogeneity is controlled for, there is no evidence of a significant relationship between the probability of default and the corporate governance variables.

This research differs from the research by Schultz et al. (2017) as firstly this research uses the Altman Z-score (an accounting based default probability) and the Bloomberg measures of default at 1 year and 5 years (developed from the Merton's distance to default). The research collects data for the FTSE 100 in the UK between 2013 to 2016 as opposed to Schultz et al. (2017) focusing on the Australian index ASX200 from 2000 to 2007. The difference in corporate governance codes of conduct and bankruptcy laws could lead to different results between the UK and Australia. The corporate governance measures in the two studies are different as is the definition of the TMT. Finally, this research uses multilevel modelling for testing the relationship whereas Schultz et al. (2017) used GMM.

Brown et al. (2011), Christensen et al. (2015), Al-Maskati et al. (2015), Beekes et al. (2015) and Xu et al. (2015) are some of the many that focus on governance mechanisms and firms continuing as a going concern. Schultz et al (2017) point out that some of these research face a sample selection bias as they study the governance mechanisms of failed firms (e.g. Lee and Yeh, 2004; Chen 2008; Aldamen et al., 2012; Platt and Platt, 2012; Brédart, 2013, 2014) as opposed to the likelihood of firm default. This research uses the probability of default similar to Schultz et al. (2017) however does not just rely on the Merton's (1974) model but also includes the Altman Z-score as a measure of default prediction. In addition Schultz et al. (2017) point out that some of these research also use measures that are discrete in nature and can take on a very small number of values therefore lacking power to differentiate between firms (e.g. Bhojraj and Sengupta, 2003; Ashbaugh-Skaife et al. 2006; Elbannan, 2009) except for Switzer and Wang (2013a, 2013b) who also use the Merton's (1974) model to estimate default likelihood. However, Switzer and Wang (2013a, 2013b) fail to use econometric techniques that take account of endogeneity concerns identified by Wintoki et al. (2012) which Schultz et al. (2017) are able to address in their research.

3.11.5 Operationalising the probability of default

Bankruptcy prediction modelling using multivariate analysis commences with Altman's (1968) work. The demand from banks to measure non-performing loans, demand from investors, credit rating agencies, asset managers for failure prediction models, the introduction of capital adequacy for banks under Basel II requirements led to a boom in bankruptcy prediction models. Altman (1983, 1993) suggests that the Z-score model can be used by the management of distressed firms as a guide for a financial turnaround. The different bankruptcy prediction models developed using different modelling techniques; focus on different industries and countries. For example, Beaver (1966, 1968) used univariate analysis for selected ratios, Altman (1968) used multiple discriminant analysis modelling, Ohlson (1980) used logit modelling and Taffler (1984) developed Z-score model for the UK.

Altman et al. (2014) identify accounting-based models, market-based models and hazard models as the three key models prevailing in the finance literature. Agarwal and Taffler (2008), undertook a study on the efficacy of accounting based models and market-based models, found that there was little difference in the predictive power of the two. Bauer and Agarwal (2014) found that hazard models, that used both accounting and market information, were superior at bankruptcy prediction for the UK. The Z-score model has different versions depending on the nature of the firm i.e. Z-score model for public firms, Z'-score for private firms and Z"-score for non-manufacturing and manufacturing firms.

Altman et al. (2014), reviewed studies comparing accounting based models to market-based models and hazard models, found that the Altman's Z-score model generally underperformed in four studies, outperformed or provided similar results in two studies. Reisz and Perlich (2007) found the Altman Z-score model to be a better short-term measure for bankruptcy than market-based models and Das et al. (2009) found that the Altman Z-score model performed better than the Merton's market-based model for CDS spread estimation. However, it is important to note that the Altman Z-score model is not a pure accounting-based model as it utilises the market value of equity. Altman et al. (2014) identify over 30 articles (in their appendices) from leading academic journals that use the Altman Z-score in different academic contexts and its relevance in bankruptcy prediction.

Krom (2010) used Atman Z-score in a study on turnover of the TMT and board of directors. Lohrke et al (2004) recommend studying the role of TMT and performance measures beyond profit and loss, such as indicating proximity to bankruptcy (e.g. Altman Z-score). Mueller and Barker (1997) used the Altman Z-score as a measure for bankruptcy prediction in their study of upper echelons and board attributes of turnaround and non-turnaround declining firms. Barker III et al. (2001), a study on TMT replacement at a sample of declining firms attempting a turnaround, used Altman's (1983) bankruptcy prediction score to measure whether a firm was in imminent danger of bankruptcy. Dunn (2004), a study on the relationship between TMT duality and the decision to release false financial information, controlled for distress by using the company's Altman Z-score. This measure was also used by Summers and Sweeney (1998) in their study of fraudulent financial reporting. Mishra et al. (2000), a study on the effectiveness of CEO pay-for-performance, use the Altman Z-score as a measure for bankruptcy risk.

Schultz et al. (2017) undertook a study of corporate governance attributes and the probability of firm default. They use the Merton's (1974) probability of default as a measure of the likelihood of firm failure in order to characterise the relationship between corporate governance and the chance of default. Srivastav and Hagendorff (2016), a study on corporate governance and risk-taking, identify the Altman Z-score (also used by, Houston et al. 2010; Laeven and Levine, 2009; Pathan, 2009) and the Merton's distance to default (also used by, Hagendorff and Vallascas, 2011; Gropp et al. 2006) as measures for default risk in bank risk-taking. Bharath and Shumway (2004) critique the KMV measure of bankruptcy prediction. Bottazzi et al (2011) undertook a study on financial and economic determinants of firm default and use Distance to Default, developed from Black and Scholes (1973) and Merton (1974), as a measure of financial soundness. Ting (2011) used the KMV measure for default prediction in a study of the TMT compensation in China

This research uses the Bloomberg probability of default measure at 1 year and 5 years to predict the likelihood of firm default. This section provides a summary of a recent case study provided by Bloomberg Professional Services (2018), assessing a firm's credit default risk and supply impacts. The focus of the article is on one of the largest UK construction firms, Carillion PLC that entered compulsory liquidation on 15 January 2018. It was the UK's largest corporate default in a decade, which involved over 43,000 employees, and over £1.6bn in debts.

Fig. 3.11 Collapse of Carillion plc share price (Source: Bloomberg Professional Service, 2018)

The focus of the article is on identifying the value of using Bloomberg to measure the risk of default using Carillion as a case study. The Bloomberg 1 year probability of default showed that on 13 July 2017, there was a 4.85% probability of Carillion's default. Fig. 3.11 shows that the point at which the share price of Carillion collapsed the Bloomberg probability of default had categorised the firm as high yield (HY-5) which is only two categorises away from distressed. Further adding to its credibility in predicting default. This was identified because of low earnings and the first of three profit warnings. The article further identifies the current probability of default and the share price change of Carillion, selected competitors, suppliers and lenders, leading to Interserve PLC being monitored by UK government, which currently has a similar likelihood of default of 4.49% to that of Carillion in July 2017. This data is presented in Fig. B.10 (in appendix B) which clearly shows a competitor of Carillion in a similar position in January 2018 to that of Carillion six months prior. Balachandran et al. (2010) used data from the Bloomberg terminal in a study on the probability of default, excessive risk and executive compensation.

3.12 Conclusion

This chapter provided a review of the UK corporate insolvency system, a background on the empirical work undertaken in prior TMT literature. The changing role of the CEO and TMT from powerful individuals with high levels of freedom to heavily compensated individuals with reduced autonomy and increased scrutiny. Some of the most significant causes of default identified could be argued were due to weak or inefficient TMT. It was also found that TMT personal attributes, such as CEO's past personal default, had a link with default. Key literature on Corporate Governance and Credit Risk showed that when advanced statistical modelling is employed the relationship between these two either does not exists or is not very clear. The results from research in different countries, such as Australia and North America, also provided different results pointing towards different corporate governance mechanisms having different results on the firm outcomes. Empirical research showed organisational failure to be a downward spiral where as a weakness develops the tendency for additional problems to occur increases. In order to escape this downward spiral many researchers have looked to its relationship to the TMT composition. This chapter explored the concepts of executive motivation, TMT loyalty and TMT effectiveness within the context of existing empirical work, providing further development to the theoretical model and hypothesis identified in Chapter 2.

The review of empirical work on executive compensation, a key attribute of executive motivation, has increased over the years which has also seen the demand in executive skills changing from firm-specific to more generic skills. This increase in levels of compensation has been studied within the context of different firm outcomes, mostly firm performance. This chapter also reviews empirical work linking executive compensation and firm financial risk and identifies that declining firms have difficulty retaining talented executives. The study operationalises executive compensation by using executive salary as a short-term motivation variable and executive bonus as a long-term motivation variable.

Empirical studies focussing on TMT demographics, backgrounds and experiences have found some link with firm performance. TMT tenure, a key attribute of TMT loyalty, has witnessed a decline on average since the early 1980s. The spread of tenure within teams has also been explored to understand the strategic thinking process of TMT teams. Empirical work has found there to be a link between longer employee tenure, increased power and increased loyalty.

Attributes of power or effectiveness such as CEO Duality is found to be more common in some countries than others, specifically it is not very common within the UK listed companies' due to the corporate governance guidelines. The relationship between TMT effectiveness and firm outcomes has been studied through exploring concepts such as duality, succession and board attributes. Whilst the focus of some empirical work has been on specifically the CEO's effectiveness the rest has focussed on board attributes. The chapter critiques arguments around TMT effectiveness and hypothesises that in order for a TMT to be effective this has to be done at two levels i.e. the board level and the firm level.

The size of the board is viewed as a key attribute of TMT board level effectiveness and the number of employees is viewed as a key attribute of TMT firm level effectiveness.

Finally, this chapter reviewed existing default prediction models and identifies that some models are more sophisticated and complex and have continued to develop over the years as technological advancements allow for more real-time data to be incorporated in the calculations. However, empirical evidence defends the simpler models, such as the Altman Z-score, which continues to provide strong results. Hence, the Altman Z-score is used as a measure of the likelihood of firm default along with the Bloomberg default prediction models based on the original Merton's distance to default model.

Chapter 4

Research Methodology and Design

4.1 Introduction

This chapter discusses the key philosophical and methodological arguments within Top Management Team (TMT) research. It starts by critiquing the key research philosophical approaches followed by the variations in research strategy. The range of methodological choices is then discussed within the context of the philosophical and strategic choices. The chapter then provides an overview of the methodological approach adopted in this study followed by the research setting and design. A justification for undertaking multilevel analysis beyond traditional multiple regression is then provided. The population and sample selection technique are described followed by a review of the key variables in this study. Finally, the chapter concludes by providing a background on the method of data analysis and the generalisability, validity and reliability of the findings.

4.2 Research Philosophy

Research philosophy relates to the development of knowledge and the nature of knowledge. The nature of knowledge is referred to as Ontology and the development of knowledge is referred to as Epistemology. Saunders et al. (2012) present 'the research onion' to examine the different research philosophies and the underlying assumptions. The research philosophy adopted is important as it contains assumptions about the way in which the world is viewed.

4.2.1 Philosophical consideration

4.2.1.1 Ontological consideration

In order to understand Ontology, it is important to ask the question "What is reality?". Saunders et al. (2012) describe two aspects of ontology, nature of reality, as objectivism and subjectivism. The relationships and issues between ontology and epistemology emerge together (Crotty, 1998). Guba and Lincoln (1994, p108) argue that "if, for example, a 'real' reality is assumed, the posture of the knower will be one of objective detachment..." The debate between an objective or subjective ontology relates to how the world is viewed. Macquarrie (1973) argues that galaxies, trees, rocks etc. would continue to exist even if there were no human beings. However, Crotty (1998) suggests that the world becomes meaningful only when meaning-making beings make sense of it.

4.2.1.2 Epistemological consideration

In order to understand Epistemology, it is important to ask the question "What is acceptable knowledge in a particular field?" Epistemology put simply is how does one know what is reality. A positivist researcher may put more emphasis on measuring phenomena which may not be traditionally measurable (human feelings) however an interpretivist researcher may place more emphasis on the narrative provided to understand a phenomenon such as human feelings.

4.2.1.3 Relationship of ontology and epistemology - The paradigm debate

An understanding of the ontology and epistemology subscribed to gives rise to the theoretical perspective subscribed to for undertaking the chosen research. Theoretical Perspectives simply are what approach can be used to get knowledge? These perspectives or philosophy have been broadly categorised in management research as Positivism, Realism, Interpretivism and Pragmatism (Saunders et al., 2012). The table 4.1 below summarises the key points relating to each perspective and its underlying assumptions.

4.2.2 Philosophical approaches

Kamil (2011) provides a pictorial overview of philosophical standpoints in Management Research. This is presented in Fig. 4.1 which shows the link between the different research philosophies, approaches and methodologies.

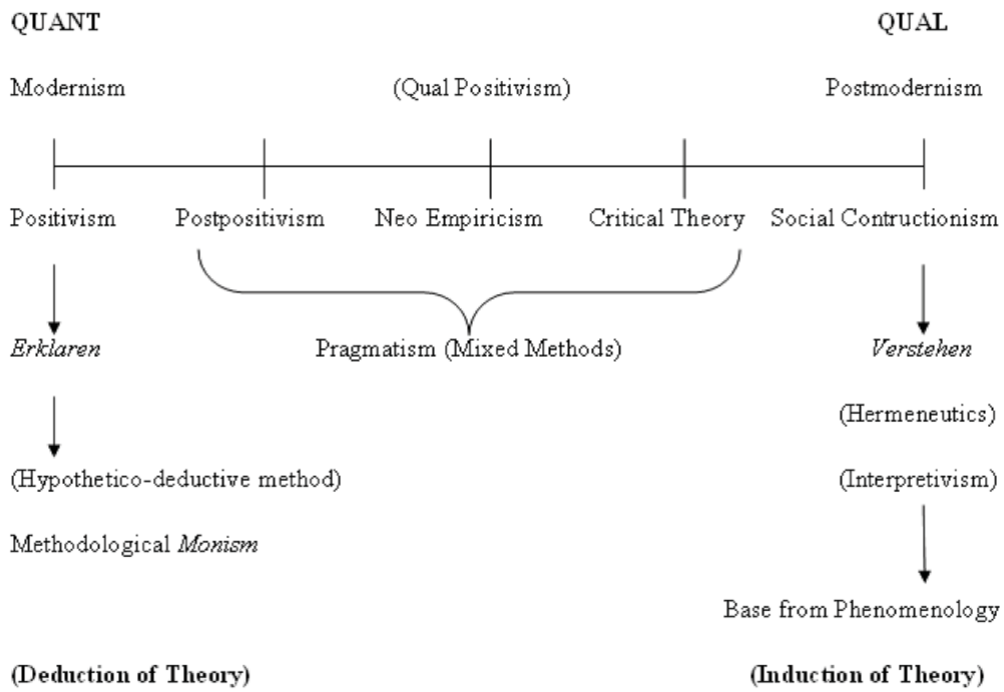

Fig. 4.1 Philosophical approaches in Management research (Source: Kamil, 2011)

The development of research philosophies through the combination of different epistemological and ontological stances are presented in table 4.1. It highlights the development of and the key points relevant to each research philosophy. In table 4.1, it is important to note that these boxes are not fixed and should be noted as being fluid. The terms 'Erklaren' and 'Verstehen' are German which translate as 'Explain' and 'Understand' respectively.

Table 4.1 Research Philosophy summary adopted from Crotty (1998) and Saunders et al. (2012)

Ontology (nature of reality)	**Epistemology (what constitutes acceptable knowledge)**	**Axiology**	**Theoretical Perspective**	**Key points**
Objective and Independent of social actors	Objectivism. Only observable phenomena can provide credible data and facts	Researcher is independent of data and maintains objective stance	Positivism (Francis Bacon, 1561-1626; Auguste Comte, 1798-1857). Post-Positivism (Werner Heisenberg, 1901-76; Niels Bohr, 1885-1962. Sir Karl Popper 1902-94)	That tree in the forest is a tree regardless of whether anyone is aware of its existence or not. Positivism today is closely linked to empirical science and a logical positivist is a lover of science. Objects in the world have meaning prior to, and independently of, any consciousness of them. Werner Heisenberg and the 'uncertainty principle' – impossible to know both the position and momentum of a subatomic particle. Niels Bohr. Schrodinger's cat
Objective and independent of human thoughts and beliefs but interpreted through social conditioning	Critical Insufficient data means inaccuracies in sensations. Phenomena create sensations which are open to misrepresentation	Researcher is biased by world views, cultural experiences and upbringing	Realism (Direct Realism and Critical Realism); Bhaskar (1989), Dobson (2002). Relativism	Direct Realism argues that what the researcher experiences portrays the world accurately Critical Realism argues that images of the things in the real world are experienced not the things directly. A researcher only understands the social world if they understand the social structures Relativism refers to 'the way things are' is really just 'the sense we make of them'
Subjective and reality may change	Constructionism Subjectivism Subjective meanings and social phenomena. Focus on the details of situations and reality behind the situations	Researcher is part of what is being researched and cannot be separated	Interpretivism (Max weber 1864-1920); Phenomenology; Hermeneutics; Critical Inquiry; Feminism; Postmodernism; Symbolic Interactionism	Constructionism rejects the view of human knowledge and there is no objective truth waiting to be discovered. Meaning is not discovered but constructed Different people may construct meaning in different ways even in relation to the same phenomena i.e. meaning is created out of something (the object) Interpretivism – Different ways of viewing the world influences different ways of researching the world Phenomology refers to how humans make sense of the world around them Symbolic Interactionism refers to the changing meaning of the world around by interacting with others and making meaning of those interactions Hermeneutics is the science of biblical interpretations
View chosen to best enable answering research question	Pragmatism Observable phenomena and subjective meanings can provide acceptable knowledge	Researcher adopting both objective and subjective points of view	Pragmatism	Most important determinant is the research question If positivism or interpretivism is not clearly identified then pragmatism argues that it is appropriate to use a variation in the epistemology, ontology and axiology

4.2.2.1 Research Philosophy adopted

In the area of research focused on the TMT, as with corporate governance and social science as a whole, there have been various research methods with different philosophical underpinnings. In order to select an appropriate research methodology, it is important to not just look at the research question or the area under investigation, but also consider the philosophical stance of the researcher. It is important to recognise the theoretical perspective used to answer this research question. This research uses an objectivist epistemology and a positivistic perspective through experimental design and sampling. This research embeds the philosophy of positivism to answer the research question similar to a majority of research within the field of financial distress and TMT attributes. The answer to this research question exists independent of the understanding of the researcher i.e. an objective reality and observable phenomena can provide meaningful data and facts. The phenomena of interest are converted to measurable variables, which provide meaningful results.

McAuly et al. (2007) argues that positivism is the dominant philosophical stance within organizational theory and not undertaking research using this philosophical stance requires the researcher to justify their decision. The positivist approach enables the collection of quantitative data from a larger sample of firms through secondary sources which is not affected by any human relationships. On the contrary using an interpretive approach may require an in-depth study of individual TMT's of listed organisations. This has been a frustration for researchers as gaining access to individual TMT's of listed organisations is extremely difficult and due to listing requirements around disclosure of information, these firms would not divulge information freely.

A positivist world today is a 'mathematised world' (Crotty, 1998) and Husserl (1970) attributes this mathematisation to the world of Galileo. Crotty (1998) summarises that the real world for a Galilean scientist is a quantifiable world. He further argues that positivism within the social sciences is a less arrogant form of positivism and it talks of probability rather than certainty and seeks to approximate truth rather than aspiring to grasp it in its totality or essence. The Heisenberg's 'uncertainty principle' argues that the laws of physics are relative statements and to some extent subjective perceptions rather than objective certainties. Popper finds scientific knowledge being established by scientists making guesses and failing to prove the guess wrong, despite efforts to do so (Crotty,1998). Therefore, challenging the traditional scientific method. Gill and Johnson (2010) further argue that a positivist researcher will most likely use a highly structured methodology in order to facilitate replication. A key advantage is “that there is a point at which an observer can stand back and objectively or neutrally observe what they understand to be an external reality” (McAuley et al. 2007:33).

Phenomenology or interpretivism, in contrast to positivism, argues that the world is socially constructed by the subjective interpretations of the people within. This philosophical approach requires the direct and practical involvement of the researcher with the phenomena under study, where the theory is developed inductively as elements appear through investigation (Stiles, 2003). Glaser and Strauss (2004) argue that under this philosophical approach, through the use of approaches such as grounded theory, a greater richness of data can be achieved as it allows discovery of new ideas and theories. However, compared to the positivist approach there is the possibility of generating unclear and less precise credible work, due to the possibility of distortion imposed and values imposed by the researcher (Evered and Louis, 1991; Easterby-Smith et al., 2012).

The neo-empiricism philosophical position is also known as that of qualitative positivism. Neo-empiricism accepts the concept of empiricism but rejects falsification to give way for the induction of theory. Johnson et al. (2006) highlight that the neo-empiricism is often used to generate a grounded theory that explains and predicts behaviour. Prasad and Prasad (2002) argue that qualitative positivism assumes reality to be concrete and independent of the researcher unlike that of phenomenology, however, non-quantitative methods are used to study the nature of reality.

The critical theory focuses on understanding and attaining "truth" or "reality" by focusing on social constructions and reflexive communications. Kamil (2011) highlights that critical realists are of the notion that truth or reality exists but it depends on the subject’s subjective knowledge in knowing that truth. Therefore, it is vital to start by viewing the world from the perspective of the subject, taking the subjects subjective knowledge into account, and then develop an inductive theory which is critical to the behaviour of the subject. Hence, requiring critical consciousness and participation of all members (Johnson et al., 2006) and it is given the name of critical theory.

The postmodernism movement developed as a response to modernism. Where modernism comprises the positivists philosophy, post modernism lacks clear central hierarchy or organising principles. Lyotard (1999, p3) argued that the status of knowledge alters and cannot remain unchanged. Gergen et al. (1992) critiqued most organisational research as its underlying principles were mechanical models of human behaviour. Therefore, in order to understand human behaviour a postmodern philosophy is more appropriate. However, it is difficult to define postmodernism. Best and Kellner (1991, p2) argued that there is no one definition of postmodern theory and Featherstone (1988, p207) suggested that there may be as many definitions of postmodern theory as there are post modernists. The central understanding is that there is no objective truth waiting to be discovered and meaning is not discovered but instead it is constructed.

To summarise I intend to carry out this research through the Positivistic philosophy using a deductive approach, secondary data and statistical techniques. This means that I will seek to make sense of the data objectively as I have an objectivist epistemology. I also have an objective ontology as I believe reality is out there, independent of the researcher.

4.3 Research strategy

The research aim, objectives and clarity on the theory all help identify the research approach or strategy that underpins the research. In simple terms, the two research approaches of deduction and induction are inverses of each other. A deductive research approach allows the researcher to design a strategy to test hypotheses developed from theory whereas an inductive research approach allows the researcher to design a strategy that helps develop theory from data analysed. Saunders et al. (2012) suggest that these research approaches could be aligned to specific research philosophies i.e. deduction to positivism and induction to interpretivism, however, doing so would be misleading and have no real practical value. Bryman and Bell (2007) argue that the choice of induction or deduction research strategy is key as it is a key factor regarding the relationship between theory and research.

4.3.1 Deductive approach and Quantitative method

A deductive research approach most commonly involves quantitative research methodologies. The deductive approach, as presented in Fig. 4.2, entails the development of a theoretical structure followed by its testing through empirical observations. The process of deduction commences through the review of the literature and theoretical reflections, which develops hypotheses. These concepts within the hypotheses are operationalised to ensure they are observable. The concepts then observed and measured allow for the testing of the hypotheses in order to either discard the theory or alternatively creation of unfalsified laws that explain the past and predict future observations. The observable concepts within quantitative research can be categorised as Independent variables, Dependent variables and extraneous variables. Blaikie (2009), identifies the stages of a deductive research approach as hypothesis setting, using existing literature provide conditions where the theory is expected to hold, examine and compare the arguments with existing theories, test the premises by collecting appropriate data and either reject and modify the theory or accept the theory based on results of the analysis.

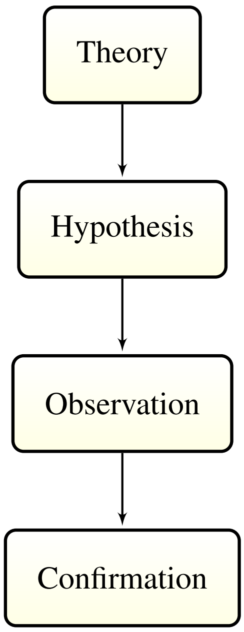

Fig. 4.2 Process of Deduction in research developed from Gill and Johnson (2010)

In the quantitative research process, measurement is a key step. The measurement step allows concepts to be made researchable and links theoretical concepts to empirical research. The focus of quantitative research involves attempting to establish a causal relationship between measures, which are indicative of the underlying concepts. These concepts are a general reflection of the social world, which are embedded in hypotheses. These hypotheses are formulated based on theoretical reflection and reviews of the literature. The concepts need to be made observable to formulate hypotheses in order to then accept or reject these hypotheses. The Fig. 4.2 provides a diagrammatic representation of the deduction research strategy.

Amaratunga et al. (2002) argue that the conducting of the research and research analysis for a quantitative approach is easier than a qualitative approach as the former is highly structured. Gill and Johnson (2002) highlight that there are some key criticisms of the deductive research strategy, as it tends to treat human beings separate from their social contexts. Secondly, it limits the data collection and results in ignoring interesting findings due to the highly structured nature of the strategy. Thirdly, the researcher is seen as independent and objective. Finally, measuring a complex phenomenon through a single variable could be misleading. Easterby-Smith (1991) highlights some of the many strengths of a quantitative approach:

- comparison and replication
- independence of the observer
- objective measures
- reliability and validity determined more objectively

4.4 Research methods and methodologies

Research methodology is the basis under which the research is carried out. Fig. 4.3 shows the link between the two extreme research philosophies with that of the different research methods. Whilst some methods show a clear alignment to a philosophical stance there are many that can be used by either. It is the selection and use of particular strategies and techniques to collect and analyse data (Remenyi et al. 1998). The research aim and objectives are key to determining the most appropriate methodology to undertake the research. Amaratunga et al. (2002) argue that there are a limitless number of tactics and variations to research methods and some may be seen as more scientific than others. A summary of some of the key methods is shown in the table below.

Research approaches	Positivistic (quantitative)	Phenomenological (qualitative)
Action research		Strictly interpretivist
Case studies	Have scope to be either	Have scope to be either
Ethnographic		Strictly interpretivist
Field experiments	Have scope to be either	Have scope to be either
Focus groups		Mostly interpretivist
Forecasting research	Strictly positivistic with some room for interpretation	
Futures research	Have scope to be either	Have scope to be either
Game or role playing		Strictly interpretivist
In-depth surveys		Mostly interpretivist
Laboratory experiments	Strictly positivistic with some room for interpretation	
Large-scale surveys	Strictly positivistic with some room for interpretation	
Participant observer		Strictly interpretivist
Scenario research		Mostly interpretivist
Simulation and stochastic modelling	Strictly positivistic with some room for interpretation	

Fig. 4.3 Research methods and philosophical base (Source: Amaratunga et al., 2002)

Bryman (2003) argues that archival research refers to documents with sources of data that are historic and present even though the name may suggest otherwise. Archival research undertaken to study TMT, corporate governance and finance usually takes the form of secondary data which is analysed using statistical techniques. The presence of present and historical documents and data allows the researcher to focus on the study over a period of time or compare between different periods of time.

A key weakness of this method is that the data may not be directly suitable to the focus of the study. It may also contain missing or inaccurate information as it may not have been produced for research purposes (Saunders et al., 2012). However, secondary data methods have the benefits similar to those of the survey methods i.e. its economical, quick and allow the researcher to generalise the results to the larger population. In addition, it also overcomes some of the weaknesses of survey methods i.e. the low response rate and different understanding of respondents. Amaratunga et al. (2002) further highlight that the outcome of such methods is a sizeable volume of information that is easily classified by type, frequency and central tendency. Hakim (2000) further argues that this data allows the researcher to study the reality relating to the phenomena.

Whilst it lacks the flexibility provided by interviews, participant observations and case studies a well valid and reliable secondary data approach would provide results that are generalisable to the larger population. The secondary data method is usually associated with deduction hence provides results independent of the subjective interpretations of the researcher and allows for comparison and replication of findings.

4.5 Methodological approach in this research

Nielsen (2010a) undertook a review of sixty TMT journal articles published over a twenty two year period. The results presented in Fig. 4.4 shows that Upper echelons theory was most often combined with social psychological theories, followed by strategy processes and firm internationalisation theory.

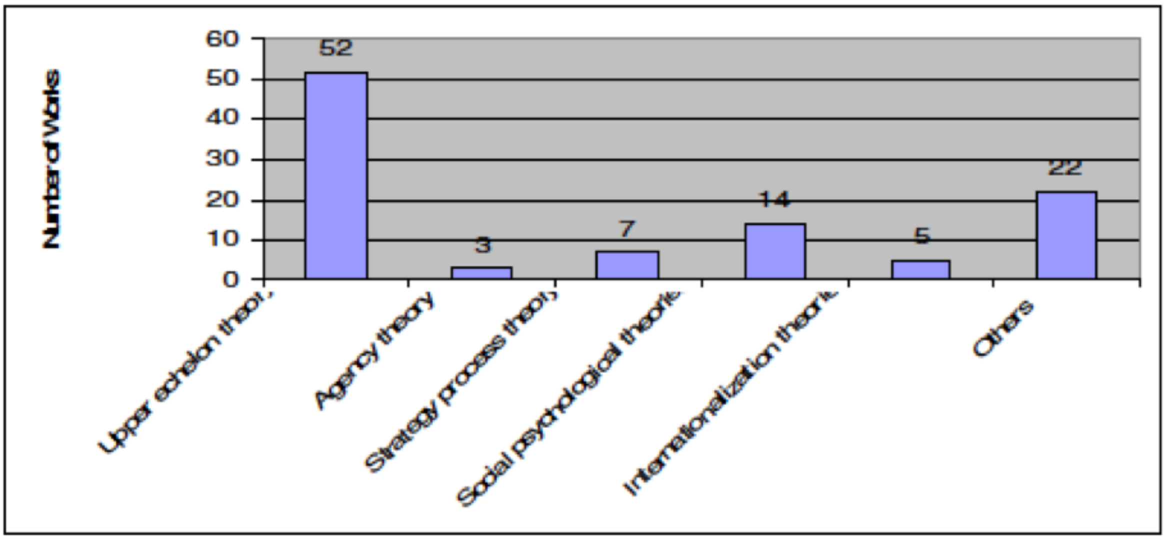

Fig. 4.4 Theories used in TMT research (Source: Nielsen, 2010a)

The focus of these studies, presented in Fig. 4.5, was the TMT followed by the TMT and CEO, TMT and Board; and Business Unit managers. This further emphasises the need for studying the independent and interacting effects of TMT, the board of directors and CEOs and management at lower levels.

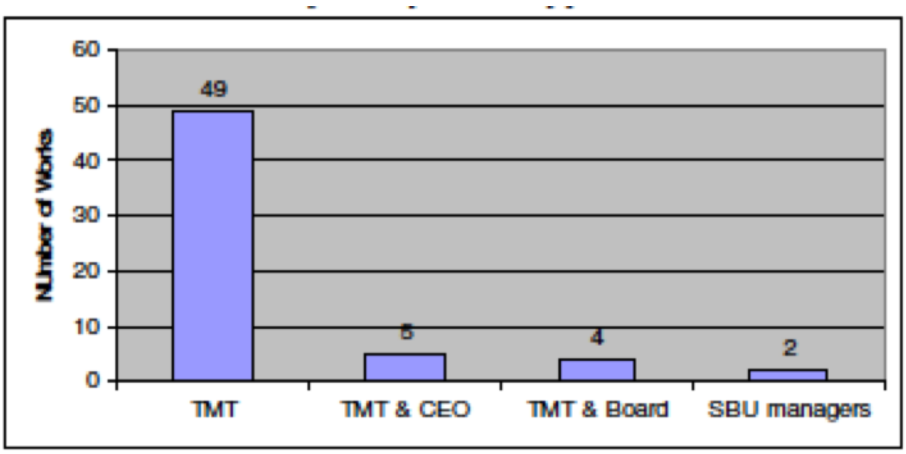

Fig. 4.5 Focus of TMT research (Source: Nielsen, 2010a)

In terms of diversity, presented in Fig. 4.6, the majority of studies focused on function, followed by team tenure, age, educational background, company tenure and elite education. Non-work related observable aspects, such as gender diversity and national diversity, were found to be far less studied.

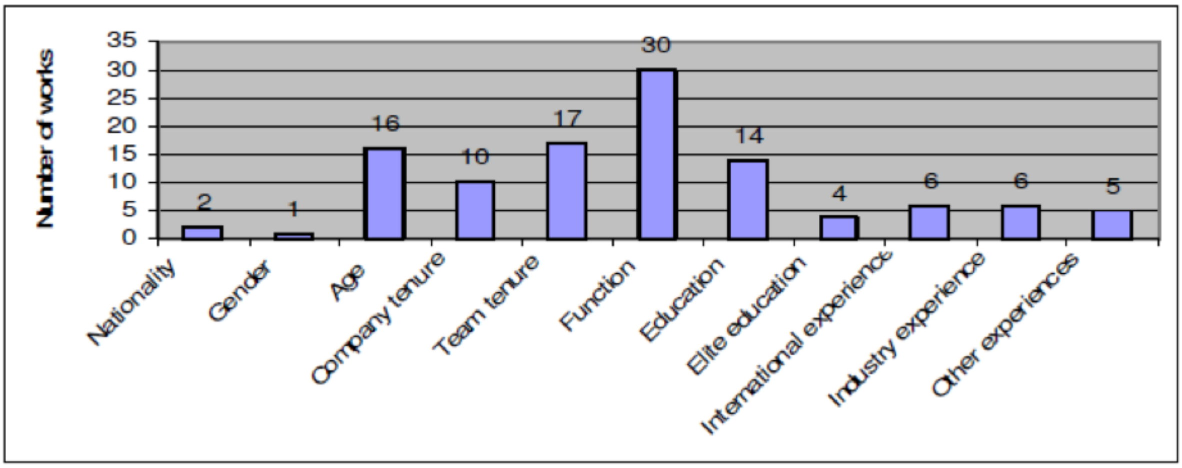

Fig. 4.6 Diversity variables studied in TMT research (Source: Nielsen, 2010a)

In terms of methodology, presented in Fig. 4.7, it was found that quantitative studies remained dominant with Archival and Survey methods being used for a majority of the studies and very few used case study or computer simulations.

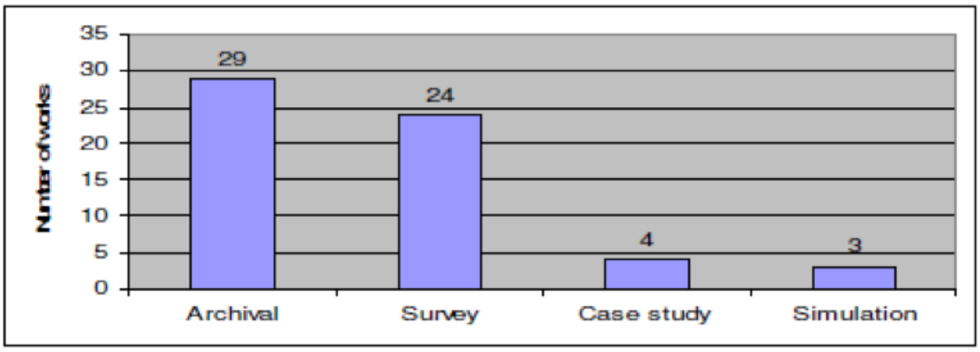

Fig. 4.7 Methodological approach employed in TMT research (Source: Nielsena, 2010a)

A majority of these studies used Databases such as Dun and Bradsheet or Standard and Poors or undertook a survey, followed by interviews with executives and collecting data from annual reports. This can be seen in Fig. 4.8 where databases were used in 31 studies followed by surveys in 26 studies.

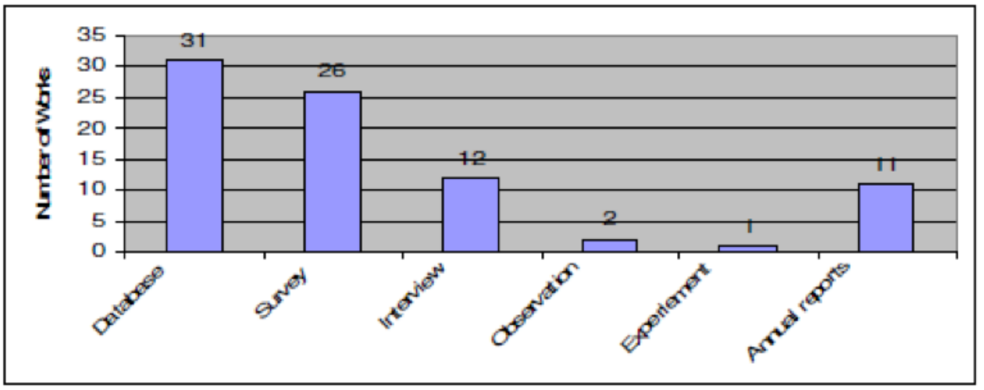

Fig. 4.8 Data collection method employed in TMT research (Source: Nielsen, 2010a)

In terms of statistical analysis, presented in Fig. 4.9, OLS was the most commonly used method, followed by structural equation modelling, correlation, Survival analysis, ANOVA and T-test. A number of studies used lagged dependent variable to ensure the direction of causality and only a small number of studies using panel datasets used fixed effects or random effects or pooled OLS.

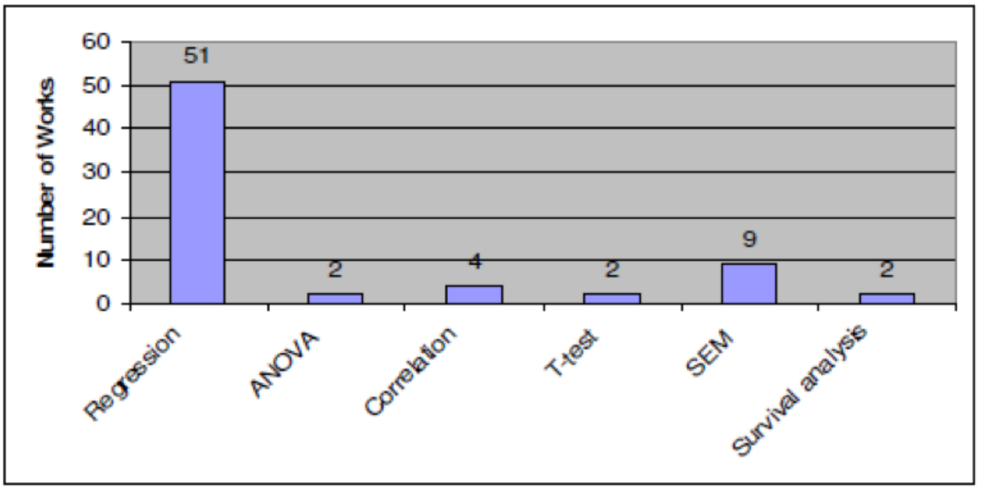

Fig. 4.9 Statistical techniques employed to analyse TMT research (Source: Nielsen, 2010a)

A majority of the studies attempted to collect data on all units of a specific industry or index and only a small number of studies used a random sampling approach. The sample size for studies undertaking quantitative research varied from 27 to 402 companies with a number of studies having a sample size of fewer than 100 firms. The investigated companies were a majority of US-based firms with the only exception of single studies on Canadian and Dutch firms. Blau index and coefficient of variation are accepted as the norm to study TMT diversity however, Bunderson and Sutcliffe (2002) found that different operationalisation of diversity may lead to different empirical results and false conclusions.

Whilst a few studies used ANOVA techniques, mixed coefficient models were rarely used in the upper echelons theory and Nielsen (2010a) recommended to pursue further research using these methods to analyse multilevel relationships and cross-level interactions between individual, team, firm and industry levels of analysis.

In terms of analysing environmental contexts, such as industry-specific conditions, they have been studied by splitting the sample according to different industries (Keck, 1997; Norburn and Birley, 1988) or industry dummies (Krishnan et al., 1997). Carpenter (2002), used an interaction variable between TMT attributes and environmental attributes. Nielsen (2010a) recommended that in a cross-sectional sample it would be interesting to use a random intercept (different intercept for each industry) and a random slope (different slope for the relationship between TMT attributes and firm-level outcome for each industry).

Finkelstein and Hambrick (1996) introduce the concept of "supra TMT", i.e. the aggregation of TMT and the board. However, Jensen and Zajac (2004) found no support for this concept and criticised the use of aggregate-level analysis. Nielsen (2010a) identifies challenges in TMT research and uses Webb and Coombs (2005) as recommendations to address these which is shown in Fig. 4.10. A key suggestion is to use hierarchical linear modelling to address the issues of multilevel analysis within TMT research.

Challenge	Suggestions
Data sources	Use of multiple data sources and triangulation Non-traditional data sources (observations, executive career histories)
Sampling	Use of random and stratified sampling Generalizability/ Non U.S. based samples Sample sizes adequate to defect Type I and Type II error
Measurement	Multiple indicators for constructs Reliability and validity to minimize the chance of Type I & II error
Time frame	Time-series to establish causality Longitudinal field work
Effect size	Report and discuss effect sizes Compare effect sizes across studies
Multilevel analysis	Use of hierarchical linear modeling Multilevel structural equation models

Fig. 4.10 Methodological challenges for TMT research (Source: Nielsen (2010a) adapted from Ireland, Webb and Coombs (2005))

It is important to note that a researcher may adopt a philosophy or a research may adopt different philosophies depending on the particular research question to be answered (Saunders et al., 2012). This is known as pragmatism, where the research question determines the epistemology, ontology and axiology to be adopted. In addition, where the research question does not clearly suggest the adoption of positivist or interpretivist philosophy then a pragmatist approach can be adopted which would further justify the use of mixed methods. According to the 'onion' (Saunders et al., 2012), this research adopts a positivism philosophy, through a deductive approach, utilising a mono experimental methodology on hierarchical data.

This research adopts a quantitative research methodology. In the quantitative research process, measurement is a key step. The measurement step allows concepts to be made researchable and links theoretical concepts to empirical research. The focus of quantitative research involves attempting to establish a causal relationship between measures, which are indicative of the underlying concepts. These concepts are a general reflection of the social world, which are embedded in hypotheses. These hypotheses are formulated based on theoretical reflection and reviews of the literature. The concepts need to be made observable to formulate hypotheses in order to then accept or reject these hypotheses.

This research undertakes a deductive research approach. A deductive research approach most commonly involves quantitative research methodologies. The deductive approach entails the development of a theoretical structure followed by its testing through empirical observations. The process of deduction commences through the review of the literature and theoretical reflections, which develops hypotheses. These concepts within the hypotheses are operationalised to ensure they are observable. The concepts then observed and measured allow for the testing of the hypotheses in order to either discard the theory or alternatively creation of unfalsified laws that explain the past and predict future observations. The observable concepts within quantitative research can be categorised as Independent variables, Dependent variables and extraneous variables. Blaikie (2009), identifies the stages of a deductive research approach as hypothesis setting, using existing literature provide conditions where the theory is expected to hold, examine and compare the arguments with existing theories, test the premises by collecting appropriate data and either reject and modify the theory or accept the theory based on results of the analysis.

4.6 Research Questions

- Is there a relationship between key TMT attributes and the likelihood of firm financial distress?
  - Is there a relationship between executive motivation and the likelihood of firm financial distress?

- Is there a relationship between TMT loyalty and the likelihood of firm financial distress?
- Is there a relationship between TMT effectiveness and the likelihood of firm financial distress?

4.7 Research Objectives

The key objectives of the research are:

1. To critically review and synthesise the literature on key TMT theories.
2. To critically review and synthesise the literature on the TMT and firm performance.
3. To critically review and synthesises literature: establishing the scope, conceptualising and classifying the determinants of the probability of firm default.
4. To develop a Theoretical model to test the relationship between TMT and the probability of firm default.
5. To empirically test the theoretical framework model using UK FTSE 100 listed companies and to test the empirical model on an out of sample case.
6. To identify future corporate governance recommendations for listed companies facing financial distress. And, to provide recommendations based on the analysis of the key findings.

4.8 Research Setting

The focus of this research is on the UK corporate climate. Companies listed in the UK are listed on the London Stock Exchange (LSE) through either membership of the main market or the alternative market. Companies listed on the LSE become constituents of either the FTSE 100, FTSE 250, FTSE 350, FTSE All Share and the AIM. This membership to an Index is based on the market capitalisation of the company. Companies listed on the FTSE 100 are the top 100 companies by market capitalisation listed on the LSE. Companies on the FTSE 250 are the 101st to 350th largest companies by market capitalisation listed on the LSE. The FTSE 350 index is a combination of companies on the FTSE 100 and the FTSE 250. The FTSE all share index constitutes all the companies listed on the main market of the LSE. The AIM is the Alternative Investment Market which constitutes companies that either does not qualify for a full listing on the main market or does not choose to be listed on the main market.

The first version of the UK corporate governance code was produced in 1992 by the Cadbury committee and is often referred to as the Cadbury report. The set of principles developed in this report became part of the LSE's listing rules and the code also introduced the principle of 'comply or explain'. The three basic recommendations of the report focussed on the separation of the CEO and Chairman roles, at least 3 non-executive directors on the board and the audit committee of each board should compose of non-executive directors.

There have been a number of revisions to the code over the years and 20 years later, in 2012, the Financial Reporting Council published a revised code UK Corporate Governance Code. The changes included quality of reporting by the Audit Committees, confirmation by the Board that the annual report and accounts are as a whole fair, balanced and understandable, and that companies report and explain progress on policies relating to boardroom diversity. This revised code applies to all companies with a listing on the main market from accounting periods beginning on or after 1 October 2012.

4.9 Research Design

This research uses secondary data collected from archival sources and analysed using multiple regression and multilevel modelling. A thorough literature review was undertaken to identify different relationships that may exist and have an impact on the TMTs of a firm and the likelihood of firm default. This led to the research focus on key TMT attributes and the identification of key independent, dependent and control variables. The control variables in this study are not physical controls such as in experiments where cases are assigned to a control group and experimental group. Instead, the control of extraneous variables is achieved at the data analysis stage through multiple regression (Gill and Johnson, 2010) and hierarchical or multilevel modelling (Field et al., 2012).

Undertaking simple multiple regression for data that is hierarchical in nature could lead to misleading or inconsistent results hence a justification for undertaking hierarchical or multilevel modelling is discussed below. Multilevel modelling is not undertaken as a replacement for multiple regression instead it is done after undertaking multiple regression to further understand the relationship within the hierarchical nature of the data and provides the analysis further robustness.

4.9.1 Justification for using multilevel modelling

Multilevel analysis is a methodology used where the data has a hierarchical structure. This method of modelling is also often referred to as Linear Mixed Effects modelling or Hierarchical modelling. The multilevel nature of the data can be as a result sampling (stratified random sampling) or natural nesting (teams within companies and companies within years). This type of data is not represented well by traditional multiple regression analysis and hence the hierarchical linear model is recommended (Hox, 2002; Snijders and Bosker, 1999; Raudenbush and Bryk, 2002). In the real world variables are clustered or nested within other variables i.e. for this research, variables clustered around or nested around sector, companies and time periods. The sector, company and time period are the contextual variables and the dataset can be described as hierarchical data. The hierarchical structure of the data can be seen in Fig. 4.11. This shows that the sector is a level 3 variable, company is a level 2 variable and the time period is a level 1 variable. However, the sector is a variable that is controlled for in the model design.

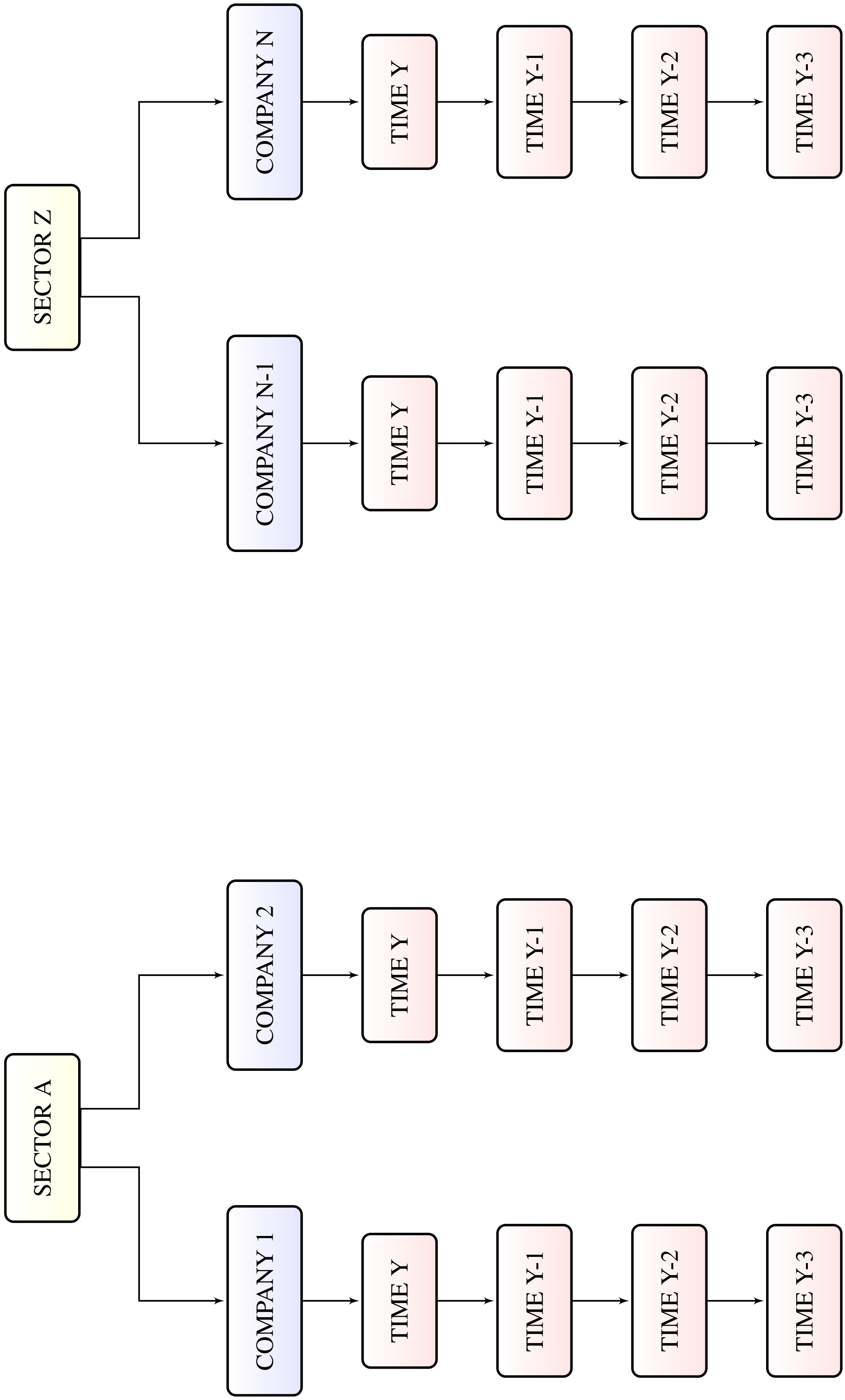

Fig. 4.11 Hierarchial structure of the Data (Source: Author's own collection)

Nielsen (2010b) argues that in longitudinal research, where company data is collected over a number of years, multilevel analysis allows to determine to what extent the observed effect is "true" between the dependent and independent variables. It is similar to panel methods where the variability within groups can me modelled and inferences about the relationship can be drawn from the differences within and between groups.

Field et al. (2012) highlights that contextual variables in the hierarchy introduce dependency in the data i.e. correlation between residuals. Therefore, companies within the same sector will be similar and time periods within the same company will be similar however this violates the independence assumption in linear regression.

The interclass correlation (ICC), is a gauge of whether a contextual variable has an effect on the outcome. The variability within sectors, for example, is small and variability between sectors is large so the ICC will be large. Conversely, if the variability within sectors is large and that the variability between sectors is small so the ICC will be small.

Field et al. (2012) highlights a few benefits of multilevel modelling:

- Multilevel modelling allows the modelling of variability in regression slopes, which allows to overcome the assumption of homogeneity of regression slopes
- Multilevel modelling allows to model for the violation of the assumption of independence where ordinary regression fails
- And, multilevel data does not require complete data, balanced dataset design, and parameters are estimated successfully with available data. Whereas, traditional designs require cases with missing observations to be omitted.

Field et al. (2012) further highlights that a vast majority of academic research treats variables as fixed effects. Fixed effects, however, can only be generalised to the situations in the experiment and Random effects can be generalised beyond the situations in the experiment (provided that the situations are representative). In ordinary regression, it is assumed that intercepts and slopes are fixed. However, multilevel modelling allows the introduction of the intercept and slope to be random i.e. to vary across contexts. In the random intercept model, the models within the different contexts have the same shape but are located in different geometric space (have different intercepts). This random intercept model is similar to the fixed effects approach in panel methods (Raudenbush and Bryk, 2002; Snijders and Bosker, 1999).

In the random slope model, when the regression assumption of homogeneity of regression slopes is not tenable, the models within the different contexts converge on a single intercept but have different slopes. However, it would be unusual to assume random slopes without random intercepts as variability in the slopes would create variability in the intercepts. Therefore, the most realistic situation is to assume that both intercepts and slopes vary around the overall model.

Nielsen (2010b) argues that multilevel analysis is more appropriate than traditional regression analysis for data with hierarchical (nested) structure. This allows the research to acknowledge that observations within a group (team, company or sector) are more similar to each other than observations from different groups.

4.10 Population, sample and sampling techniques

Polit and Beck (2004) population as the entire set of objects have some common characteristic. The population of this study is all publicly listed companies in the UK. They further argue that the population of interest to the researcher, to which the findings may be generalised, is known as the target population. The target population of this study is all publicly listed companies. The authors define an accessible population as a subsection of the population, fixed in time and space. The accessible population of this study is the publicly listed companies on the FTSE 100 index. As secondary data for the FTSE 100 companies are easily available from the Bloomberg database the census technique of sampling was employed for this study.

The research studies companies listed on the FTSE 100 index as of 31st December 2016. The data was collected for all sectors except the financial sector. The observations for the financial sector were not included in the study due to their unique nature, financing, regulation, minimum capital requirements, recent scandals/fines (PPI) and senior leader recruitment criteria etc. This is supported by studies undertaken by Shyam-Sunder and Myers (1999), Rajan and Zingales (1995), Kisgen (2006, 2009), Ozkan (2000, 2001 and 2002) and Bevan and Danbolt (2004) who also excluded financial firms, such as banks, insurance agencies and other financial firms. The period of the study is from 2013 to 2016 as the revision to the corporate governance code for 2012 applied to listed companies in their reporting from the financial year end 2013. Fig. 4.12 highlights key revisions to the UK Corporate governance code over the past 25 years. The data collection period for this study commences when the key revision relating to boardroom diversity was introduced and the data collection period ends when a consultation for a comprehensive code review commenced. The year 2013 also marks the end of a 20 year period since the initial introduction of the UK corporate governance code in 1992.

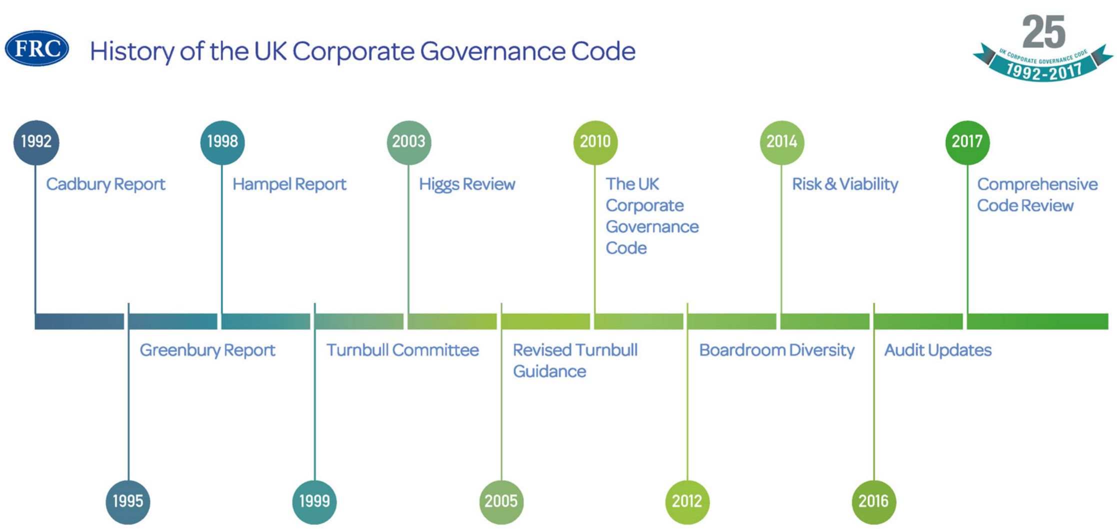

Fig. 4.12 Key revisions to the UK Corporate Governance Code (Source: FRC, 2018)

In addition the dataset prior to 2013 had many missing observations for multiple variables. The data for the study was collected from the Bloomberg database and a random check of this data was conducted with company annual reports to check its validity and reliability. A complete data set without any missing observations were available for the FTSE 100 firms with the oldest firm-year being 2013. A further filter was applied to remove financial firms, which takes the final number of firm-year observations to 259.

In comparison to previous studies, focusing on TMT and organizational outcomes (firm performance) this study covers a suitable database in terms of length of period and number of firms. Table 4.2 provides a summary of population, sample sizes and the period of the study for a few key articles.

Table 4.2 Sample sizes in previous studies (Source:Authors own collection)

Year	**Author**	**Number of Firms/Firm-years**	**Period of Study**	**Key features**
1993	Gilson and Vetsuypens	77 firms	1981 to 1987	Publicly traded firms
1993	Haleblian and Finkel-stein	47 firms	-	-
2000	Kilduff et al	35 firms	-	Simulated firms from 159 managers
2002	Carpenter	472 firm-years	1990 to 1997	-
2002	Carpenter and Sanders	199 firms	-	250 firms from S&P 500, final sample 199
2003	Collins and Clark	73 firms	-	High technology firms
2004	Carpenter and Sanders	224 firms	-	US multinationals
2008	Goll et al.	-	1972 to 1995	Longitudnal study
2008	Cannella et al.	207 firms	-	US firms from 11 industries
2009	Boone and Hendriks	33 firms	-	Information technology
2010b	Nielsen	165 firms	-	Swiss listed firms
2010	Annique	-	2007 to 2009	Western European firms
2011	Ting	433 firms	2001 to 2005	Chinese firms
2012	Dezsö and Ross	-	15 years	S&P 500 firms
2013	Nielsen and Nielsen	146 firms	2001 to 2008	Swiss firms from 32 industries
2016	Tanikawa and Jung	744 firms	-	Japanese manufacturing firms
2017	Georgakakis et al.	347 firm-years	2005 to 2009	International firms
2017	Tanikawa et al.	867 firms	-	Korean manufacturing firms
2017	Schultz et al.	222 firms	2000 to 2007	Australian firms

Large datasets could raise issues, as the variables under consideration may not remain consistent over the entire period of the study. The dataset was collected using Bloomberg add-in for excel and then sorted for individual companies over different periods.

4.11 Measures and justification of variables

This section focusses on highlighting the concepts, identifying and defining variables used to measure the concepts and specifying the models used in the study. The section starts by identifying, defining the dependent variables, followed by identifying, defining the independent variables, then identifying, and defining the control variables. The control variables are those, which have been identified in the prior literature, theoretically and empirically, to have an impact on firm outcomes and specifically the probability of default.

Schultz et al. (2017) quote that the relationship between the probability of default and corporate governance can be viewed as follows:

$$Probability\ of\ default = f(Corporate\ Governance\ Mechanisms, Control\ Variables)$$

The section below provides a discussion on the probability of default, the independent variables used in the study and the control variables. This section highlights the variables selected to measure the concepts underlying the research question and test the hypotheses.

4.11.1 Dependent Variables

This research uses the Altman Z-score, Bloomberg probability of default measure at 1 year and 5 years to predict the likelihood of firm default. As discussed earlier the Altman Z-score is the accounting based default prediction model and the two Bloomberg measures are based on the Merton (1974) default prediction model which is the market-based model. Here, the 1-year measure provides the likelihood of default in the short-term and the 5-year measure provides the likelihood of default in the longer term. The three measures for the likelihood of firm default are defined as follows:

$$Accounting\ measure\ of\ probability\ of\ default = Altman\ Zscore$$

$$Short\ Term\ market\ measure\ of\ probability\ of\ default =$$
$$Bloomberg\ 1year\ probability\ of\ default$$

$$Long\ Term\ market\ measure\ of\ probability\ of\ default =$$
$$Bloomberg\ 5year\ probability\ of\ default$$

The Altman Z-score is widely used as a measure for predicting firm default within corporate governance literature (Krom,2010; Lohrke et al., 2004; Mueller and Barker, 1997; and Barker III et al., 2001; Mishra et al., 2000). The Altman Z-score has also been used as a control variable by Dunn (2004) in financial reporting research and accounting fraud research by Summers and Sweeney (1998).

The Merton (1974) likelihood of default prediction has been used as a measure for risk-taking within the corporate governance literature (Srivastav and Hagendorff, 2016; Hagendorff and Vallascas,2011; Gropp et al. 2006). In addition, it has been used as a measure for default prediction within corporate governance (Schultz et al. 2017), TMT compensation in China (Ting, 2011) and studies on financial and economic determinants of default (Bottazzi et al. 2011). A majority of these studies calculate the Merton (1974) probability of default manually for the sample however there are studies such as the Schultz (2017) that use the Bloomberg probability of default measure as this is calculated based on the Merton's (1974) model and is readily available for individuals and institutions that subscribe to the Bloomberg terminal.

4.11.2 Independent Variables

The independent variables in this study are to measure the concept of executive motivation, TMT loyalty and TMT effectiveness. The executive motivation is broken down into short-term and long-term motivation and TMT effectiveness is broken down into board level effectiveness and firm-level effectiveness.

4.11.2.1 Executive Motivation

Executive salary, bonus, remuneration or compensation have been used in several TMTs and corporate governance studies. Schultz et al. (2017) use remuneration as one of the three broad types (board structure, remuneration and ownership structure) of internal corporate governance mechanisms in their study of board attributes and the likelihood of firm default. Corporate governance and default literature have commonly used the fixed pay (salary) and variable pay (bonus, share options etc.) for executives, non-executives or both in their study of corporate governance variables (e.g. Schultz et al., 2017; Cao et al., 2015; Platt and Platt, 2012; Fich and Slezak, 2008; Ortiz-Molina, 2006; Gilson and Vetsuypens, 1993). There have been some variations in the precise measure used in corporate governance and firm performance literature i.e. CEO salary and bonus (Jensen and Murphy, 1990), CEO and next four highest-paid executives salary, options, common stock (Wright et al., 2007), percentage of total compensation in salary and bonus (Mehran, 1995), natural-log of the sum of all forms of compensation granted to the top four non-CEO executives (Carpenter and Sanders, 2004).

This research breaks down executive motivation into short-term motivation and long-term motivation as follows:

$$Short\ Term\ Executive\ motivation = (CEO\ Salary + CFO\ Salary)/2$$

$$Long\ Term\ Executive\ motivation = (CEO\ Bonus + CFO\ Bonus)/2$$

4.11.2.2 Management Team Loyalty

Tenure is often used to measure and linked to attributes such as power (Cao et al., 2015), loyalty (Loveman, 1998), patriotism (Hambrick and Fukutomi, 1991; Pfeffer, 1981). Tenure is also often used as a key measure in financial fraud literature (Daboub et al., 1995), to assess TMT competency (Vainieri et al., 2017), to assess TMT golden parachutes (Singh and Harianto, 1989) and in corporate governance literature as a control variable (Dunn, 2004; Hambrick et al., 2015) to control for key TMT attributes.

This research measures TMT loyalty as follows:

$$Top\,Management\,Team\,loyalty = (CEO\,Tenure + CFO\,Tenure + Chairperson\,Tenure)/3$$

4.11.2.3 TMT Effectiveness

Several studies have used board size (number of directors on the board) as a measure of board effectiveness or board independence such as Schultz et al (2017), Yermack (1996), Jensen (1993) and Lipton and Lorsch (1992). In addition, similar measures in addition to the one above were also noted in corporate governance and default literature (Switzer and Wang, 2013a, 2013b; Brédart, 2013, 2014; Platt and Platt, 2012; Aldamen et al. 2012; Fich and Slezak, 2008; Ashbaugh-Skaife et al., 2006). Board size has also been used in corporate governance and default literature (Schultz et al. 2017), financial fraud literature (Dunn, 2004), to measure for board effectiveness (Guest, 2009, Cao et al., 2015) and board efficiency (Lipton and Lorsch, 1992; Jensen 1993)

The number of employees is often used as a measure for the operational size of the firm (Finkelstein and Hambrick, 1990; O'Reilly III et al. 1988; Richard and Johnson, 2001; Youndt et al., 1996). The number of employees has also been used as a measure for firm size when studying the effectiveness of coordination and communication (Blau, 1968; 1970; 1972; Klatzsky, 1970, Blau and Schoenherr, 1971). The number of employees in this research is not a measure of the size of the firm directly however as a measure of the TMT's effectiveness at the firm level. An increase in firm size leads to problems of coordination and communication, which in turn points to as the number of employees increases the TMT is likely going to be more ineffective at the firm level.

This research breaks down TMT effectiveness into effectiveness at board level and effectiveness at firm level as follows:

$$Top\ Management\ Team\ effectiveness\ at\ board\ level = \\ Number\ of\ directors\ on\ the\ board$$

$$Top\ Management\ Team\ effectiveness\ at\ firm\ level = \\ Number\ of\ Employees$$

4.11.3 Control Variables

This research includes variables shown in prior research (Cao et al., 2015; Wang and Lin, 2010; Klock et al., 2005; Bhojraj and Sengupta, 2003) to have an effect on the dependent and independent variables of interest. These variables are defined and discussed in the sections to follow.

4.11.3.1 Sector

Cao et al. (2015) control for macroeconomic variables and industry-level variables by adding year dummies to the regression model and industry dummies, defined by SIC codes. Previous literature has shown sector (Chava and Jarrow, 2004) and macroeconomic conditions (Duffie et al. 2007) to play an important role in corporate bankruptcy prediction models. Wang and Lin (2010), control for the industry in a study of corporate governance and risk of default. Schultz et al. (2017) include time and industry dummy variables to account for any correlations across firms such as business cycle effects. Klock et al. (2005)

control for industry effects by categorising the data into separate industries using the SIC code.

This research uses the Global Industry Classification Standard (GICS) to categorise firms in different sectors.

4.11.3.2 Profitability

Guest (2009) uses ROA to measure profitability, Barker III and Patterson Jr (1996), a study on the perception of organisational problems by long-tenured TMTs versus short-tenured teams, used return on assets as a control variable to measure profitability. Mishra et al. (2000), a study on the effectiveness of CEO pay-for-performance, use industry-adjusted return on equity as a measure of performance. O'Reilly III et al. (1988), a study examining economic and psychological factors influencing CEO compensation, use the return on equity as a measure of profitability. Klock et al. (2005) use return on assets (ROA) as a measure to control for profitability. Performance of firms has been analysed using market-based measures (Tuch and O'Sullivan, 2007; Gregory, 1997; Agrawal et al. 1992) and accounting-based measures (Dickerson et al., 1997).

This research measures profitability as follows:

$$Profitability = (Return\ on\ Assets + Return\ on\ Equity)/2$$

4.11.3.3 Firm Size

Guest (2009) uses market capitalisation as a measure of the firm's financial size. Cao et al. (2015) control for firm's equity size defined as a natural logarithm of the market capitalisation of a firm's equity divided by the total index market capitalisation. They expected the default risk to decrease with an increase in firm size. Wang and Lin (2010), control for firm size using market capitalisation in a study of corporate governance and risk of default. The book value of assets has also been used to control for firm size, which is also the book value of equity plus liabilities (Klock et al., 2005; Schultz et al., 2017). Hartzell and Starks (2003), a study investigating Institutional Investors and Executive Compensation, use the market capitalization as a measure of firm size.

This research uses the market value of equity as a measure for the financial firm size and shareholder influence. This is not a measure of physical firm size but the value of the firm or the size of the firm in monetary terms. Bhojraj and Sengupta (2003) indicate that economies of scale in underwriting credit would indicate that firm size would be positively associated with credit rating i.e. higher the credit rating the less likely the firm to default and hence they use size as a control variable.

This research measures firm size as follows:

$$Firm\ Size = (Number\ of\ Shares * Share\ Price)$$

4.11.3.4 Gearing

Guest (2009) uses Total Debt divided by Total Debt + Total Equity to measure gearing. Schultz et al. (2017) use debt to the total value of firm assets as a measure for leverage (total firms' assets is also the book value of equity). Klock et al. (2005) use long-term debt to total assets as a measure to control for leverage. This research uses the debt to market value of equity as a measure of gearing.

This research measures gearing as follows:

$$Gearing = Book\ value\ of\ Debt/Market\ value\ of\ Equity$$

4.12 Summary of variables and abbreviations

The dependent, independent, control and other variables in this study are presented below.

- Dependent Variables
  - Bloomberg 1 year probability of default
  - Bloomberg 5 year probability of default
  - Altman Zscore probability of default
- Independent Variables
  - Average CEO and CFO Salary
  - Average CEO and CFO Bonus
  - Average CEO, CFO and Chairman Tenure
  - Number of Employees
  - Size of Board
- Control Variables
  - Sector
  - Market Capitalisation
  - Gearing (Debt to Equity ratio)
  - Average Performance (Return on Asset and Return on Equity)
- Other Variables
  - CEO Shareownership
  - CFO Shareownership
  - Chairman Shareownership
  - CEO Gender
  - Chairman Gender
  - Number of female executives on the board and CEO Duality

Table B.1, in appendix B, provides a summary of variables used in the key literature and table B.2 provides a full list of variables and abbreviations used in this study. The table 4.3 below provides a list of the key variables and their abbreviations.

Table 4.3 List of key variables and their abbreviations (Source: Author's own collection)

Variable Code	Variable Name
bb1y	Bloomberg 1 year probability of default
bb5y	Bloomberg 5 year probability of default
altmanz	Altman Z-score probability of default
employees	Number of employees
mcap	Market Capitalisation
boardsize	Number of directors on the board
performance	Average profitability derived from Return on asset and Return on equity
gearing	Debt to Equity ratio
salarya	Average Salary of the Chief Executive Officer and Chief Finance Officer
bonusa	Average Bonus of the Chief Executive Officer and Chief Finance Officer
tenurea	Average Tenure of the Chief Executive Officer, Chief Finance Officer and the Chairman
sector	Sector classified as per GICS code
salarya22	Quadratic term for the average salary variable
bonusa22	Quadratic term for the average bonus variable
tenurea22	Quadratic term for the average tenure variable
boardsize22	Quadratic term for the number of directors variable

4.13 Method of data collection

This section provides an overview of the key lessons from the pilot study, the process and method for data collection and the justification for the variables used.

4.13.1 Learning from the pilot undertaken

A pilot study was undertaken early on in the research process which provided key lessons for the research. A summary of the pilot study is presented in the appendix A.3. Some detail on the pilot study process has been provided in the appendices. Below are some of the key learnings achieved from the pilot study:

- Calculation of key variables such as average salary, average bonus, average tenure etc.
- Selection of the time period and index for the study
- Consistency of the Bloomberg database and company annual report data
- Non-selection of some variables as they were not valid for the UK corporate climate such as the size of director's photograph in the annual report, FT press mentions etc.
- The choice of Boardex and CapitalIQ as a database for further research around director networks
- Complexity of including a failed firm with non-failed firms in the existing research design

This helped develop the research further and had an influence on the data collection and analysis process. This data collection process is discussed in further detail in the below section.

4.13.2 Data collection process

The basic relationship of interest in the study expressed as a simple formula is:

Bloomberg 1 year probability of default = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector

Bloomberg 5 year probability of default = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector

Altman Z-score probability of default = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector

This is the probability of a firm defaulting predicted by the salary paid to the CEO and CFO, the bonus paid to the CEO and CFO, the term of the CEO, CFO and Chairperson, the number of employees in the firm and the number of directors on the board of the firm. The set of independent variables or predictors can also be termed as 'the fixed effects' which becomes more useful during the analysis of the models.

The above simple formula includes the control variables that could also predict the probability of default but does not include other influencing factors that cannot be controlled. The factors that cannot be controlled for is represented by the error term epsilon (ε) in the below formula:

Bloomberg 1 year probability of default = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector + ε

Bloomberg 5 year probability of default = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector + ε

Altman Z-score probability of default = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector + ε

This epsilon allows the formula to capture for ’the random factors’. The formula is a depiction of the linear model that this study aims to develop and breaks the right into the ’structural’ or ’systematic’ part of the model (the fixed effects) and the ’random’ or ’probabilistic’ part of the model.

The following transformations were undertaken:

- Bloomberg 1 year was transformed to reduce the number of decimal places
- Bloomberg 5 year was transformed to reduce the number of decimal places
- Atlman Zscore was transformed to convert negative values to positive
- Total Bonus was transformed to amend any 0 to 1
- Performance was transformed to convert negative values to positive
- Company and Sector were defined as factors on R

The linear regression models were run on the dataset with missing data and on the dataset with listwise deletion of missing data for Robustness checking. The results are very similar with the significance of the gearing variable for model 1 (Bloomberg 1 year) becoming non-significant and the significance for the variable number of employees for model 2 (Altman Z-Score) becoming non-significant. The results below are based on the dataset without missing data (listwise deletion).

In the tables below, similar models are developed for each Dependent variable and the models are as follows:

Dependent Variables: Bloomberg 1 year probability of default; Bloomberg 5 year probability of default; and Altman Z-score

- Model (1):

  Control variables only: Market Capitalisation; Performance; Gearing; and Sector
- Model (2):

Predictor Variables only: Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (3):

  Contorl and Predictor Variables: Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (4):

  Introducing Quadratic term for Average Salary: Average Salary squared; Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (5):

  Introducing Quadratic term for Average Bonus: Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus squared; Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (6):

  Introducing Quadratic term for Average Tenure: Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure squared; Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (7):

  Introducing Quadratic term for Board size:Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size; Board Size squared.

bb1y2 = salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

bb5y2 = tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

altmanz2 = salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

The above equation represents a linear model. In this, the contextual variables are company and time periods. As it may be expected that the effect of the independent variables on the likelihood of default to vary as a function of which company the TMT belong to and which year the companies belong to. Therefore, it would be important to allow the model to represent the effect of the independent variables on the likelihood different across different companies and different time periods.

The overall fit of a multilevel model is tested using a chi-square ratio test similar to that in logistics regression. The higher the value of the log-likelihood the better the model. In addition, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) can be used to compare models. Field et al. (2012) explains AIC as a goodness-of-fit measure that takes into account how many parameters have been estimated and BIC as a measure similar to AIC that corrects more harshly for the number of parameters being estimated (which should be used for larger sample sizes and a small number of parameters). The lower the AIC and BIC the better the model.

It is recommended to start with a 'basic' model with all fixed parameters and then adding random coefficients as appropriate (Raudenbush and Bryk, 2002; Twisk, 2006). In addition, centring could help multilevel models to be more stable however there is no correct choice between not centring, group mean centring or grand mean centring (Kreft et al. 1995). Therefore, for Robustness the mixed models are developed and tested using the raw data and centred data.

The first step is to ascertain if there is variation over contexts. This is done by fitting a baseline model of the intercept only and a model is fitted to allow the intercepts to vary over contexts. A comparison of these two models shows whether the allowing the intercepts to vary improves the models.

The intercept only model is as follows:

bb1yinterceptonly<-gls(bb1y2 1,method="ML")

bb5yinterceptonly<-gls(bb5y2 1,method="ML")

altmanzinterceptonly<-gls(altmanz2 1,method="ML")

The model fitted to allow intercepts to vary over contexts is as follows:

bb1yintercept<-lme(bb1y2 1, random= 1|id2/t2,method="ML")

bb5yintercept<-lme(bb5y2 1, random= 1|id2/t2,method="ML")

altmanzintercept<-lme(altmanz2 1, random= 1|id2/t2,method="ML")

4.14 Research Hypotheses

The theoretical and empirical literature review provide justification for the development of the research hypotheses. Fig. 4.14 provides a simple diagrammatic representation. The hypotheses tested in the research are as follows:

Hypothesis 1a *There is no relationship between executive short-term motivation and the likelihood of firm financial distress*

H1a (i) There is no relationship between executive short-term motivation and the accounting measure for firm financial distress

H1a (ii) There is no relationship between executive short-term motivation and the short-term market measure for firm financial distress

H1a (iii) There is no relationship between executive short-term motivation and the long-term market measure for firm financial distress

Hypothesis 1b *There is a negative relationship between executive long-term motivation and the likelihood of firm financial distress*

H1b (i) There is negative relationship between executive long-term motivation and the accounting measure for firm financial distress

H1b (ii) There is negative relationship between executive long-term motivation and the short-term market measure for firm financial distress

H1b (iii) There is negative relationship between executive long-term motivation and the long-term market measure for firm financial distress

Hypothesis 2 *There is a negative relationship between TMT loyalty and the likelihood of firm financial distress*

H2 (i) There is a negative relationship between TMT loyalty and the accounting measure for firm financial distress

H2 (ii) There is a negative relationship between TMT loyalty and the short term market measure for firm financial distress

H2 (iii) There is a negative relationship between TMT loyalty and the long term market measure for firm financial distress

Hypothesis 3a *There is no relationship between TMT board level effectiveness and the likelihood of firm financial distress*

H3a (i) There is no relationship between TMT board level effectiveness and the accounting measure for firm financial distress

H3a (ii) There is no relationship between TMT board level effectiveness and the short term market measure for firm financial distress

H3a (iii) There is no relationship between TMT board level effectiveness and the long term market measure for firm financial distress

Hypothesis 3b *There is a positive relationship between TMT firm level effectiveness and the likelihood of firm financial distress*

H3b (i) There is a positive relationship between TMT firm level effectiveness and the accounting measure for firm financial distress

H3b (ii) There is a positive relationship between TMT firm level effectiveness and the short term market measure for firm financial distress

H3b (iii) There is a positive relationship between TMT firm level effectiveness and the long term market measure for firm financial distress

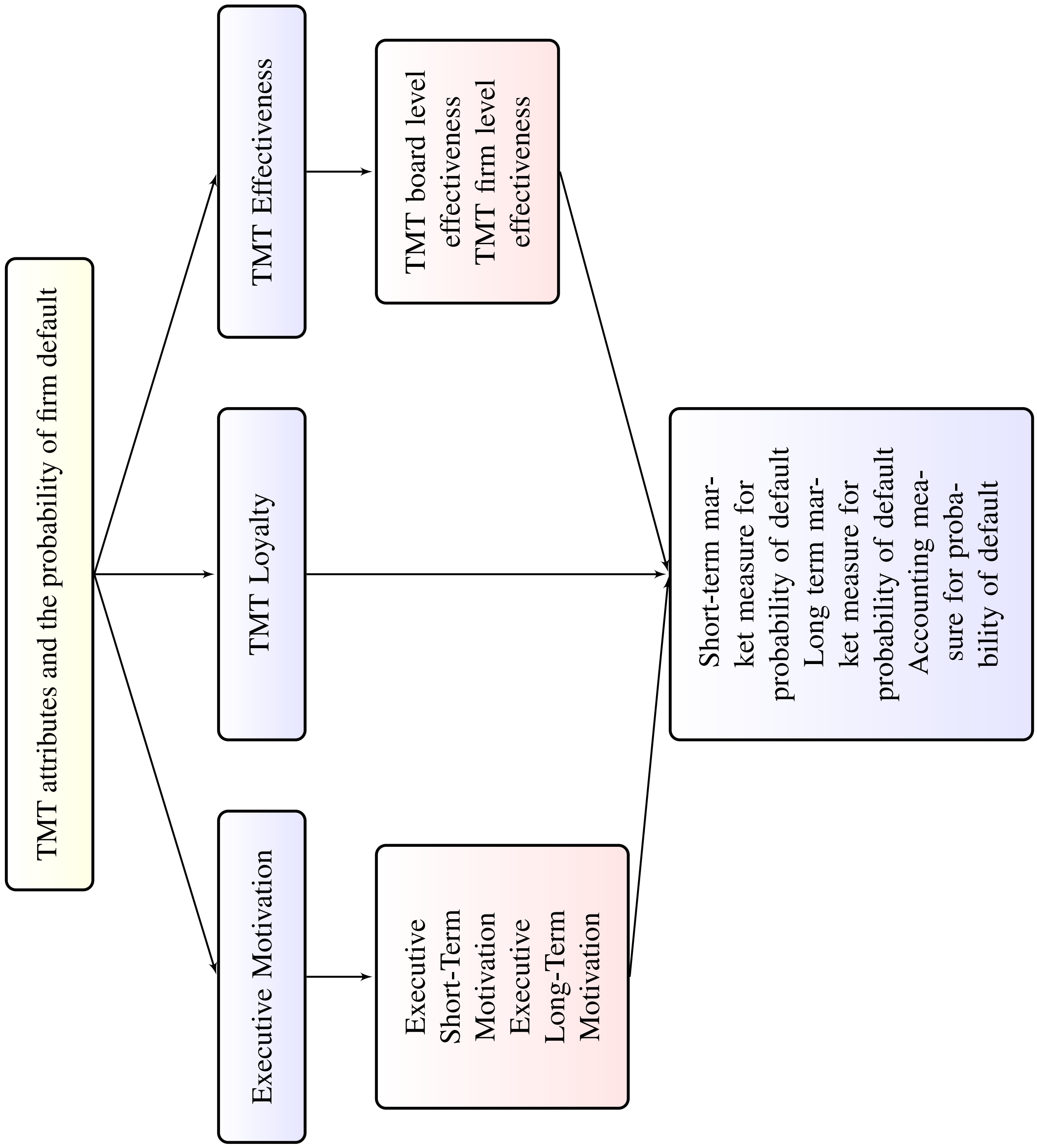

Fig. 4.13 Hypothesis Development (Source: Author's own collection)

4.15 Ethical consideration

The research uses secondary data available in the public domain and primarily collected through the Bloomberg database. Sheffield Hallam University subscribes to Bloomberg and has the permission to allow staff and students to use the data for research purposes. The research was approved by the Research Ethics Committee, Sheffield Hallam Universty, United Kingdom. The researcher also undertook the EPIGEUM research ethics and integrity online course to better undertake ethical consideration of the research.

4.16 Method of data analysis

This section provides a detailed discussion of the stages involved in the data analysis process for this research. The section summarises the key variables of interest followed by a discussion of the methodological approach employed. This is then followed by a discussion on the multiple regression model development processes and a discussion on multilevel modelling. Another key part of this section is the discussion of the regression assumptions. As the models developed through multiple and multilevel regression are 'models' there are a number of assumptions that have to hold in order for the results to be valid. The section provides an overview of these assumptions, their testing and the steps that were carried out if any assumptions were violated.

4.16.1 Stages of data analysis

The key variables in this study are presented in table 4.4. It is important to note that the three different default probability variables are not aggregated together but are used to develop three different models to allow the research to draw comparisons and further understand the relationship of interest in the short-term, long-term and with accounting information.

Table 4.4 Variables in this study (Source: Author's own collection)

Dependent Variables:	BB1y probability of default	BB5y Probability of Default	Altman Z-score probability of default
Independent Variables:	Average Salary Average Bonus Average Tenure Number of Employees Board Size	Average Salary Average Bonus Average Tenure Number of Employees Board Size	Average Salary Average Bonus Average Tenure Number of Employees Board Size
Control Variables:	Market Capitalisation Profitability Gearing Sector	Market Capitalisation Profitability Gearing Sector	Market Capitalisation Profitability Gearing Sector

The research analysis process, presented in Fig. 4.15, commences with a descriptive univariate and bivariate analysis. The univariate analysis allows the research to better understand the structure and nature of the data to ensure the multivariate analysis is robust. The bivariate analysis allows the research to understand key relationships that may exist between two variables of interest. This is then followed by multiple linear regression (OLS) with missing data and without missing data. A comparison of these models allows the research to provide robust results and not draw false conclusions due to missing data. Once the OLS model is established then the quadratic terms of interest are introduced to develop polynomial models. The quadratic terms allow the research to test for a curvilinear relationship within a linear model. This is then followed by testing key linear regression assumptions. The assumptions tested are homoscedasticity, the absence of collinearity, the linearity of residuals, correlations, homogeneity of variances, the normality of residuals, influential data points, outliers and independence of residuals. This is then followed by the testing for multilevel modelling using an intercept-only model and comparing it to a random intercept model. The significance testing between these models is done by using AIC, BIC and Loglik. This is followed by introducing the fixed effects to the model and then the random effects to the model.

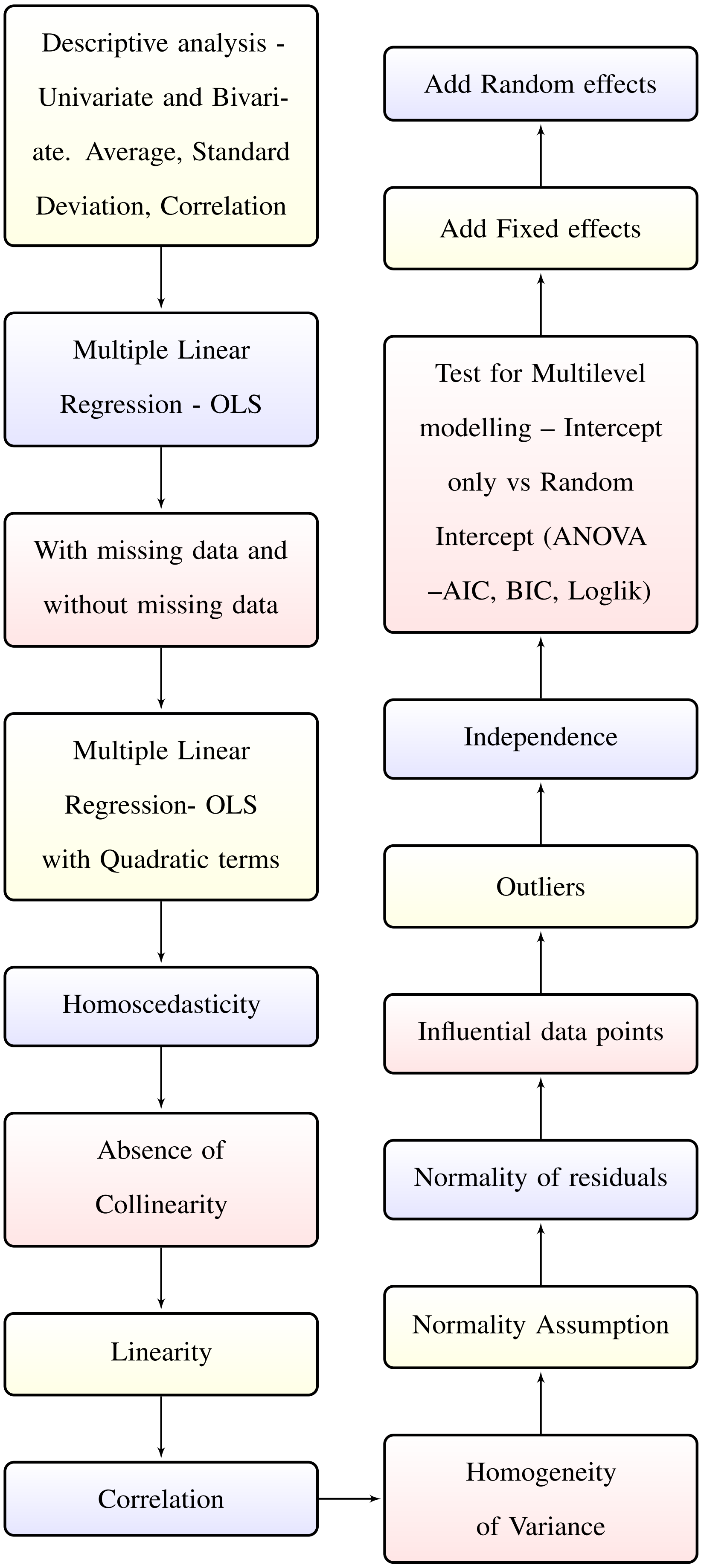

Fig. 4.14 Methodological Approach employed (Source: Author's own collection)

Once the above steps are completed then the models shown in table 4.5 are developed to ensure the multilevel analysis is robust. In model 1, 4, 7 and 10 only the time period is introduced as a random intercept. In model 2, 5, 8 and 11 only the company is introduced as a random intercept. And in models 3, 6, 9 and 12 both time period and company are introduced as random intercepts. This is initially done for the null model, followed by the control variables only model, predictor variables only model and the full model (i.e. the control and predictor variables introduced). These 12 models are developed separately for each dependent variable i.e. Bloomberg 1 year, Bloomberg 5 year and Altman z-score probability of default.

Table 4.5 Multilevel modelling approach (Source: Author's own collection)

Random Intercept	Null Model	Control Variables only Model	Predictor Variables only Model	Full Model
Time	1	4	7	10
Company	2	5	8	11
Time and Company	3	6	9	12

The research uses 4 distinct econometric approaches each involving a different set of assumptions to estimate the dependent variables. This is done separately for each of the dependent variables to allow comparison of estimates and findings between models. Some econometric models are employed to facilitate comparison with literature (e.g. Schultz et al., 2017; Aldamen et al., 2012; Fich and Slezak, 2008; Klock et al., 2005) whilst some other robust econometric models are employed to address independence concerns, the variability of intercepts and variability of slopes.

This research commences with an OLS model, followed by the introduction of quadratic terms to the OLS model. In addition, the random intercept model is introduced to allow intercepts to vary followed by a random intercept and random slope model to allow both intercepts and slopes to vary.

In the real world, variables are clustered and nested within other variables. In this research, the variables are clustered or nested around sector, companies and time periods. These being the contextual variables as the dataset is hierarchical. The sector is controlled for in the OLS models however different companies and time periods are difficult to control for in OLS. Therefore, multilevel modelling is used to allow for variability between companies and time periods. In OLS, it is assumed that intercepts and slopes are fixed, however, independent variables effect on the dependent variable may vary for different companies and time periods and the effect of specific variables of interest may be different for different companies and time periods. Multilevel modelling models this variability by allowing intercepts to vary and slopes to vary.

The linear models are constructed as follows:

Bloomberg 1 year probability of default = Average TMT Salary + Average TMT Bonus + Average TMT Tenure + Number of Employees Size of the board+ ε

Bloomberg 5 year probability of default = Average TMT Salary + Average TMT Bonus + Average TMT Tenure + Number of Employees Size of the board+ ε

Altman Z-score probability of default = Average TMT Salary + Average TMT Bonus + Average TMT Tenure + Number of Employees Size of the board+ ε

This is the relationship of interest for the research i.e. specific TMT attributes and the likelihood of the firm failing whilst controlling the effect of key variables.

In addition, to the above mentioned fixed effects quadratic terms for key fixed effects are introduced to the OLS model. This allows for the testing of a curvilinear relationship of key fixed effects within the OLS model. After constructing the final OLS models a test to see if the intercepts vary across contexts is undertaken. This is done by fitting a baseline model with an intercept only and a model where the intercept is allowed to vary across contexts. These two are compared to test if allowing the intercepts to vary across contexts improves the model. The fixed effects are introduced to the model allowing for intercepts to vary across contexts, specifically the companies and time periods. Winter (2013) argues that by undertaking a company-analysis (averaging over time), by-time variation is disregarded, and conversely, in the time-analysis, by-company variation is disregarded. Mixed models account for both sources of variation in a single model. Finally, key fixed effects of interests to each of the three dependent variables are modelled to have a random slope, this model is called the random intercept and random slope model.

4.16.2 Multiple Linear Regression assumptions

The multiple regression assumptions and multilevel modellign assumptions were tested as per the guidance provided by Field et al. (2012) and Winter (2013). The assumptions were tested using a combination of graphs and figures and the complete R-code for this is available in the appendix C. Winter (2013) highlights the key assumptions of multiple linear regression also apply to multilevel modelling and the assumptions are tested in the same manner. The findings of the assumptions test are discussed in this section.

4.16.2.1 Normality

The assumption of normality is the least important assumption as per Winter (2013). This assumption was tested with histograms, graphical plots and the skew and kurtosis values. In a normal distribution, the Skew and Kurtosis should be zero where a positive skew indicates a pile-up of a score to the left and a negative skew indicates a pile-up of a score to the right. Positive kurtosis indicates a pointy curve and negative kurtosis indicates a flat curve. The values show performance and average salary with a normal curve however only salary shows a normal point. The other variables are all positively skewed with a pointed curve. In a sample of more than 200, it is important to look at the shape of the distribution and to look at the value of skew and kurtosis rather than calculate their significance. In addition, breaking down the observations into the number of years shows a big reduction in skewness and kurtosis, reducing the positive skew and extreme peak. The Shapiro-Wilk test shows that all variables are not normal however in a large dataset the Shapiro-Wilk test will easily be significant (Field, 2012).

Field et al. (2012) further argues that according to the central limit theorem as the sample size becomes greater, the sampling distribution has a normal distribution with a mean close to the population mean. Therefore as the sample is 207 observations without missing data (greater than 30 or sometimes 40 for central limit theorem) the sampling distribution has a normal distribution with mean approximately similar to the population mean. Wilcox (2005) found that with heavy tailed distributions require larger samples (more than previous 40) to invoke the central limit theorem. Finally, the histogram of the residuals all shows a near normal distribution.

4.16.2.2 Homogeneity of variance or Homoskedasticity or absence of hetroskedasticity

In order to test the homogeneity of variance the Levene's test is used across the year, the company and the sector. The test shows that for the BB1y dependent variable, the sector does not have a significant Levene's score, therefore, variances are not significantly different and the assumption of homogeneity of variance is tenable. However, for the company and the year, the Levene's test is significantly different and the assumptions of homogeneity of variance have been violated.

For the BB5y dependent variable, the year does not have a significant Levene's score, therefore, variances are not significantly different and the assumption of homogeneity of variance is tenable. However, for the company and the sector, the Levene's score is significantly different and the assumptions of homogeneity of variance have been violated.

For the Altman Z-score dependent variable, the sector, the year and the company do not have a significant Levene's score, therefore, variances are not significantly different and the assumption of homogeneity of variance is tenable. This was also done for other variables in the study. Where this assumption is violated log transformation may help, however, in a large sample Levene's test can be significant even when group variances are not very different therefore it should be interpreted in conjunction with the variance ratio. Field (2012) recommends that multilevel modelling allows the modelling of variability in regression slopes which overcomes the assumption of homogeneity of regression slopes.

4.16.2.3 Transformation of data

Transformation of the data represents a more normal distribution and may help overcome the violation of the homogeneity of variance assumption, however, this may not be useful in modelling. Glass et al. (1972) argued that "the payoff of normalising transformations in terms of more valid probability statements is low, and they are seldom considered to be worth the effort" (p241) (Field et al., 2012, p193). In addition, by transforming the data the hypothesis being tested changes and the consequence of applying the wrong transformation could be worse than the consequence of analysing untransformed scores.

4.16.2.4 Absence of collinearity and Correlations

If fixed effects are correlated then the research could focus on a few meaningful fixed effects and drop the others or undertake dimension reduction techniques such as principal component analysis. A correlation matrix was undertaken for all key variables used in the regression modelling to test for collinearity. The Pearson correlations, Kendall and Spearman's correlations were used for this purpose. The signs of the effect size between variables for parametric (Pearson) and non-parametric (Kendall and Spearman) is the same for all relations but the following: bonus-Altman, gearing-salary, boardsize-tenure, mcap-gearing, boardsize-performance, boardsize-gearing. The correlation matrix and the findings of key correlations between variables have been discussed in chapter 5.

4.16.2.5 Linearity

The traditional multiple regression models and the multilevel models are in effect linear models and hence it is important to test for linearity. If the linearity assumption is broken then it may indicate that an important fixed effect has been missed. The linearity assumptions hold as per the residual plot for all regression models.

4.16.2.6 Absence of influential data points

The presence of influential data points or outliers can have an influence on the models and the analysis of the findings. Whilst it is not recommended to remove the influential data points from the study one way to overcome this assumption is to run the models with the data points and without the data points. A comparison of the two would provide a more robust analysis of the findings and an understanding of the effect of the influential data points. In order to identify influential data points the Cook's D-value was used and for outliers the Bonferonrti p-value was used. Running regression again without influential data points improves the regression models or increases the significance of particular variables or agrees with regression with influential data points.

4.16.2.7 Independence

Finally, as per Winter (2013), the most important assumption of linear regression is the assumption of Independence. The Durbin Watson test was used to check if this assumption is violated. The nature of the data collected shows that this assumption is violated and this is also shown through the Durbin Watson test. The recommendation is that if this test is violated then using multilevel modelling helps resolve this query.

4.17 Generalisability, Validity and Reliability

The section below discusses the generalisability, validity and reliability of the methodological process and the findings to the research setting.

4.17.1 Generalisability

Saunders et al. (2012) argue that in order for the findings to be generalisable the sample should be selected carefully and of sufficient size. A study is externally valid if it describes the true state of affairs outside its own setting. This study focuses on the FTSE 100 firms and hence the findings should, in theory, be only generalisable to the FTSE 100 firms. Whilst there may be some similarities between the FTSE 100 and non-FTSE 100 listed firms the key difference would lie in their market capitalisation. This study controls for the effect of market capitalisation on the dependent variable and hence the findings may also be relevant to non-FTSE 100 listed firms. However, the findings should not be generalised to financial firms as these have specifically not been studied in this research due to their unique regulatory structure.

4.17.2 Validity

Validity is important in quantitative research as only valid results can be interpreted and generalised (Newton, 2009). A study is internally valid if it describes the true state of affairs within its own setting (Saunders et al., 2012). The validity of the results helps avoid findings down to chance. This is done by ensuring a representative sample is used for the study. The study uses all non-financial FTSE 100 firms since the introduction of the board diversity revision to the Corporate Governance Code. This helps the study ensure that the findings remain valid to the research setting of interest. The sample selection process was free from bias as all the firms of interest were selected and only those firm-years with missing data have been omitted.

In addition, it is important to ensure that the variables employed in the study are also valid. The measure that an instrument measures what it is supposed to (Black and Champion, 1976,p232-234). In other words, validity also refers to the accuracy of the measurement process (Gill and Johnson, 2010). The variables used in this study have been selected through precedence i.e. they have been employed in previous studies to measure similar phenomena to that of interest in this study. This discussion is provided in Chapter 3 where operationalising each of the phenomena of interest is presented through a detailed literature review.

A pilot study was also undertaken on a random selection of 10 companies from the FTSE 100 index outside the period of study to ensure the data collection process was suitable. The learnings from this were highlighted in section 4.12.1 and helped strengthen the process. It also provided confirmation that the data available from the Bloomberg database was accurate as the pilot study data was collected manually from annual reports and compared to the data on the Bloomberg database.

4.17.3 Reliability

Gill and Johnson (2010) argue that the research should use a highly structured methodology to facilitate replication to ensure reliability. Reliability is the ability to measure consistently (Black and Champion, 1976, p232-234) however it does not imply validity i.e. a reliable measure is measuring something consistently but it may not be measuring what it is meant to be. The findings in this study are compared to previous studies to provide reliability to the results. This ensures that where multiple researchers have shown a measure to consistently measure a phenomenon this research provides similar results in a different setting. In addition, the pilot study also provides a check of the reliability of the measures as the data was collected for a random sample of 10 FTSE 100 firms prior to 2012.

4.18 Conclusion

This chapter discussed the key philosophical and methodological arguments within TMT research. A review of the ontological and epistemological consideration provides an understanding of the different philosophical approaches. This research employs the positivism philosophy using a deductive research strategy. It is then concluded that a quantitative research methodology would be the most appropriate approach to testing the research hypotheses. This chapter provides a review of the most common research methodologies employed in management research and archival study through the use of secondary data proves to be the most appropriate approach. A key literature to this research that undertakes a review of previous literature on corporate governance and TMT shows that the most common statistical technique employed is that of regression. The literature provides a strong argument for multilevel analysis (hierarchical linear modelling) as the most appropriate statistic technique to understand the different levels present within the modern complex organisation.

This chapter further provides a justification for multilevel modelling and sets the background for the data collection processes i.e. population, sample, time period and a justification of the variables selected to measure the key attributes in the research. The dependent variables selected are: Bloomberg 1-year probability of default, Bloomberg 5-year probability of default and the Altman Z-score. The Independent variables selected are: Executive Salary (short-term motivation), Executive Bonus (long-term motivation), TMT Tenure (TMT loyalty), Size of the board (TMT board level effectiveness) and number of employees (TMT firm level effectiveness). The control variables selected are: Sector, Profitability, Firm size and Gearing. In addition, this chapter detailed the stages undertaken in the data collection process, the model development process and the data analysis process. Finally, the basic assumptions of multiple linear regression are tested and reviewed in this chapter to ensure a more valid, robust and generalisable results are achieved.

Chapter 5

Presentation of results

5.1 Introduction

This chapter presents the findings of the research. It starts by providing the results of the descriptive analysis of the dataset. This is then followed by a correlation matrix of the key variables. The chapter then provides the results of the descriptive analysis of the categorical variables. This is followed by the linear regression models. For each of the dependent variables, there are respective sections that discuss in detail the model development process and present the results of the final multiple regression models. These are then further analysed through multilevel analysis. Initially, the test for multilevel modelling is presented followed by the random intercept model. The chapter then provides significance testing of the random intercept model followed by the final random intercept and random slope model and its significance.

5.2 Descriptives

This section presents the descriptive findings of all the variables of interest first sorted by year and then by sector. The initial discussion is of the descriptives of the raw variables i.e. where no further transformations or changes to the variables were employed. The section on the transformed descriptives presents the descriptive statistics of the transformed variables i.e. the variables were transformed for the purpose of this study.

5.2.1 Descriptives by year

Table 5.1 provides the average mean statistic for all the variables sorted by each year in the study. This allows the study to understand any yearly trends that may be present within the data and if the year of data collection has any abnormal effect on the data. The average salary of the CEO (£928,957) is much higher than the average salary of the CFO (£571,550) within the sample. However, this trend is not visible for the average compensation. The average compensation received by the CFO (£2,060,681) is almost the same as the average compensation of the CEO (£2,026,490). This indicates the presence of high bonuses being paid to the CFO. The compensation of the CFO is only higher than the CEO for 2013 and 2014. In the period 2015 and 2016 the compensation of the CEO is higher than the CFO. The actual salary of the CEO is volatile whereas that of the CFO grows year on year for the final three years. Both the CEO and CFO salary declined from 2013 to 2014.

The average tenure of the CEO, CFO and Chairman for the entire sample is very close between 4.7 and 5 years. However, between 2014 and 2016 the tenure of the CEO was higher than the tenure of the CFO and the tenure of the Chairman.

The share ownership by the CEO, CFO and Chairman within the sample showed a clear divide between the level of ownership between the Chairman and the other two executives. The data was only available for the two most recent years and this showed that the Chairman on average (1.5%) held a higher percentage of shares than the CEO (0.1%) and CFO (0.6%). However, an interesting observation in 2016 was that the CFO held an equal number of shares to the Chairman and higher than the CEO.

A comparison of the change in the average number of employees and the market capitalisation year on year shows an interesting trend. A change in the average number of employees for a year compared to the average for the sample did not relate to a simultaneous change in the average market capitalisation for the year compared to the average for the sample. In 2013, the average number of employees was lower than the sample average whereas the average market capitalisation for 2013 was much higher than the sample average. In 2016, the average market capitalisation was similar to the sample average, however, the average number of employees was much higher.

The average board size and the average number of female executives remained constant over the period of the study. The average probability of default as predicted by the Bloomberg measure showed an increase in the likelihood of default of the firm (as predicted by the 1 year and 5 year measures) however the likelihood of default as predicted by the Altman Z-score showed a decrease in the likelihood from 2013 to 2014 followed by a similar trend to the Bloomberg measure. The Debt to Equity ratio is a measure of the firms gearing and the Return on Assets (ROA) and Return on Equity (ROE) are measures of firm performance.

Table 5.1 Descriptive statistics split by each year (Source: Author's own collection, created using data collected from Bloomberg)

Statistic	2013 Mean	2014 Mean	2015 Mean	2016 Mean	Total Mean
Salary_CEO	936,930.50	900,174.70	926,571.60	951,481.10	928,957.70
Comp_CEO	1,997,353.00	1,955,408.00	2,099,455.00	2,046,782.00	2,026,490.00
Salary_CFO	582,960.00	553,724.80	560,554.10	589,261.90	571,550.20
Comp_CFO	2,247,577.00	2,012,734.00	2,029,582.00	1,974,289.00	2,060,681.00
Tenure_CEO	4.756	5.137	4.83	5.359	5
Tenure_CFO	4.73	4.905	4.823	4.98	4.9
Tenure_Chair	4.829	4.468	4.586	4.995	4.7
Share_CEO	N/A	N/A	0.126	0.119	0.1
Share_CFO	N/A	N/A	0.06	0.88	0.6
Share_Chair	N/A	N/A	2.172	0.883	1.5
No_Employees	58,219.76	55,885.22	55,826.84	68,376.17	59,160.30
Market_Cap	31,779.56	29,741.38	25,855.31	28,492.11	28,885.30
Board_Size	10.78	10.625	10.567	10.522	10.6
No_female_exec	1.086	1.078	1.254	1.217	1.2
BB_1Y	0.0005	0.0005	0.001	0.001	0.001
BB_5Y	0.01	0.01	0.012	0.013	0.01
Altman_Zscore	4.289	4.575	4.436	3.997	4.3
Debt_Equity	81.454	128.215	119.331	107.858	110.3
ROA	7.443	7.157	6.196	5.196	6.5
ROE	19.016	17.54	18.979	16.86	18.1

5.2.2 Descriptives by Sector

Table 5.2 provides the average mean statistic for all the variables sorted by each sector in the study. This allows the study to understand any trends within sectors that may be present. The sector breakdown shows that the CEO and CFO receive the highest average salary and compensation within Energy whereas the lowest CEO salary and compensation are within Real Estate and the lowest CFO salary and compensation are within Information Technology. The average salary and compensation for the CEO and CFO were also quite low within these two sectors. The Information Technology sector also saw the shortest average individual tenures for the CEO and CFO. The shortest average Chairman tenure was in the Healthcare sector. Whilst the longest average CEO tenure was in Real Estate (interesting as the lowest salary and compensation for the CEO is in this sector), longest average CFO tenure within Energy and the longest average Chairman tenure within Information Technology.

The least number of shares owned by the CEO and CFO was within the Energy sector (the highest remunerated, salary and compensation, sector) which was also very low for the Chairman. The least number of shares owned by the CEO and CFO was within the Telecommunications sector. The CEO within the Materials sector owned the most number of shares within their firm and the Top Management Team (TMT) within the Consumer Discretionary sector had high levels of share ownership within their firm, the highest levels for the CFO and Chairman.

A comparison of the average number of employees and the firm market capitalisation shows some further interesting results. From the above results it would be incorrect to assume that there is a direct relationship between the size of the firm (market capitalisation) and the number of employees. The sector with the highest number of employees was Consumer Staples and the sector with the highest market capitalisation was Energy. Whereas the sector with the smallest number of employees was Real Estate and the lowest average market capitalisation was Information Technology.

The board size for most of the sectors remained around an average of 10, however, the highest number of members on a board was within the Energy sector and the lowest within the Information Technology sector (a similar trend to market capitalisation).

The average number of female executives remained low throughout with the least being in the Energy sector (highest market capitalisation and highest remunerated sector) and the most in the Health Care sector.

The probability of default as measured by the Bloomberg 1 year (the higher the measure the higher the likelihood of default) measure shows a stable average across industries (the score for individual companies, however, is to 10 decimal places) with the lowest probability of default being within Health Care sector. This was also consistent (very low for Health Care) with the Bloomberg 5 year (the higher the measure the higher the likelihood of default) measure where the lowest probability of default was within the Real Estate sector. The highest probability of default as per this measure was the Telecommunication Services. The Altman Z-score probability of default (the lower the measure the higher the likelihood of default) put the Consumer Discretionary at the highest score indicating the safest sector comparatively and showed similar results to the previous two measures for the Health Care sector. The Altman Z-score also put Telecommunication sector as the riskiest sector similar to the Bloomberg measures.

The telecommunications sector was also the highest geared (measured by Debt/Equity) sector followed by Utilities and the least geared sector was the Energy sector. The ROA and ROE show on average the most profitable sector as Telecommunications and Health Care whereas the least profitable as the Energy sector.

Table 5.2 Descriptive statistics split by each sector (Source: Author's own collection, created using data collected from Bloomberg)

Statistic	Consumer Discretionary	Consumer Staples	Energy	Health Care	Industrials	Information Technology	Materials	Real Estate	Telecommunication Services	Utilities	Total Mean
Salary_CEO	859,707.70	1,009,177.00	1,249,244.00	1,032,133.00	930,399.20	707,500.00	1,029,779.00	668,125.00	1,111,375.00	859,720.00	928,957.70
Comp_CEO	1,864,091.00	2,404,543.00	3,552,441.00	2,502,948.00	1,826,786.00	1,575,925.00	1,982,776.00	1,469,500.00	2,485,500.00	1,731,990.00	2,026,490.00
Salary_CFO	543,254.00	636,851.20	777,407.60	571,448.30	536,355.40	415,250.00	626,053.70	453,812.50	672,000.00	586,535.00	571,550.20
Comp_CFO	2,193,811.00	1,790,178.00	2,484,672.00	1,577,125.00	1,347,068.00	1,043,438.00	3,818,350.00	2,025,438.00	2,192,500.00	2,271,800.00	2,060,681.00
Tenure_CEO	5.811	5.013	3.333	4.104	4.25	2.51	5.673	7.083	4.323	5.088	5
Tenure_CFO	5.897	3.901	5.945	3.011	4.815	2.99	4.02	5.417	5.375	4.967	4.9
Tenure_Chair	5.687	4.697	4.917	3.573	3.746	6.665	5.097	4.003	5.915	3.746	4.7
Share_CEO	0.207	0.043	0.003	0.019	0.087	0.124	0.316	0.059	0.037	0.026	0.1
Share_CFO	1.64	0.05	0.01	0.02	0.09	0.15	0.04	0.07	0.02	0.04	0.6
Share_Chair	5.706	0.004	0.003	0.283	0.015	0.226	0.017	0.009	0.001	0.005	1.5
No_Employees	73,362.75	127,992.50	89,200.00	45,251.00	42,670.56	7,769.43	34,727.96	829.357	99,858.62	19,260.61	59,160.30
Market_Cap	10,876.54	41,257.77	175,846.20	52,042.50	11,509.33	4,976.44	38,886.91	6,046.71	56,564.63	15,752.71	28,885.30
Board_Size	10.55	10.929	12.25	11.688	10.365	8.143	10.591	10.5	11.5	9.824	10.6
No_female_exec	1.119	1.464	0.25	2.25	1.192	0.714	0.682	0.714	1.375	1.353	1.2
BB_1Y	0.001	0.001	0.001	0.0003	0.001	0.0004	0.001	0.0004	0.001	0.001	0.001
BB_5Y	0.011	0.011	0.012	0.009	0.014	0.01	0.012	0.007	0.015	0.012	0.01
Altman_Zscore	5.31	4.134	2.402	5.023	5.079	3.828	4.708	1.867	0.96	2.602	4.3
Debt_Equity	66.23	133.646	39.107	106.133	110.893	105.962	133.026	56.025	245.274	236.394	110.3
ROA	7.719	6.819	2.322	8.702	4.925	8.111	5.124	7.469	8.875	5.944	6.5
ROE	16.302	25.709	4.906	33.157	13.816	19.461	15.448	12.134	23.879	25.636	18.1

5.2.3 Transformed Descriptives by year

The variables were transformed to create company and team level variables. Table 5.3 provides the average mean statistic for the transformed variables sorted by each year in the study. The variables performance is an average of the ROA and ROE, the gearing is the Debt to Equity ratio, the average salary is an average of the combined salary of CEO and CFO, the average bonus is an average of the difference between combined compensation and the combined salary of the CEO and CFO, and the average tenure is the average of the combined tenure of the CEO, CFO and Chairperson. The variables only include observations with data available for the full firm-year and where there is missing data the firm-year has been removed from the dataset.

The average probability of default as predicted by the Bloomberg 1 year likelihood of default remains constant and the Bloomberg 5 year probability of default shows a steady increase (however the measure is to 10 decimal places). The Altman Z-score probability of default shows a volatile trend over the four years with the likelihood of default increasing in 2013 and 2015. The average number of employees and market capitalisation shows a consistent trend to the findings earlier i.e. in 2013 the average number of employees was below the sample average, however, the market capitalisation for the same year was above the sample average. The average number of employees for the period between 2014 and 2015 shows a very big increase whereas the average market capitalisation continues to fall. The average number of executives on the board remains constant year on year to the sample average. The average performance of the firms remains constant for the first two periods with a small decline followed by a big increase in the final year. The average gearing shows an increasing trend over the period of the study. The increasing trend is also visible for the average salary and average bonus, however, in the 2016 period, there is a decline from the previous year. This is interesting as this is the period where the performance on average has increased, the average number of employees has decreased, the market capitalisation has increased the likelihood of default (Altman Z-Score) remains constant, indicating that the salary and bonus may be a reflection of the previous period's performance. This may also indicate that firms heavily reduce the number of employees

Table 5.3 Descriptive statistics of transformed variables split by each year (Source: Author's own collection, created using data collected from Bloomberg)

Statistic	Total Mean	2013 Mean	2014 Mean	2015 Mean	2016 Mean
bb1y2	0.001	0.001	0.001	0.001	0.001
bb5y2	0.01	0.011	0.01	0.012	0.012
altmanz2	4.3	3.912	4.716	4.037	4.274
employees2	62,163.40	47,792.98	74,423.18	76,010.35	48,027.73
mcap2	31,745.20	41,290.49	33,199.09	22,977.31	31,290.16
boardsize2	10.6	10.523	10.611	10.648	10.691
performance2	12.7	12.551	12.286	11.352	14.366
gearing2	97	78.854	93.196	104.524	111.642
salarya2	1,023,741.00	978,798.40	1,000,732.00	1,081,499.00	1,025,577.00
bonusa2	1,102,989.00	1,013,434.00	1,070,234.00	1,212,841.00	1,098,938.00
tenurea2	5	4.906	4.837	5.358	4.826

after a period of declined performance and declined market capitalisation. The average tenure shows a volatile trend over the period, however, the period from 2015 to 2016 shows a much bigger decline following the similar trends discussed earlier.

5.2.4 Transformed Descriptives by sector

Table 5.4 provides the average mean statistic for the transformed variables sorted by each sector in the study. A sector breakdown of the likelihood of default as predicted by the Bloomberg 1 year probability of default shows that the least likely firms to default on average belong to the real estate sector, followed by Health Care and Utilities. The results for the other sector remain consistent (however the score is measured to 10 decimal places). The Bloomberg 5-year probability of default shows consistent results to the Bloomberg 1 year probability of default i.e. the Real Estate industry to be the least likely firm to default and Telecommunication Services the most likely firm to default. The Altman Z-score probability of default puts the firms in the Energy sector followed by Telecommunication Services as the most likely to default and the firms in the Industrials (with similar average scores for Real Estate and Utilities) as the least likely to default.

The average number of employees is the lowest in the Materials sector (whereas the lowest market capitalisation is in the Information Technology sector) and the highest number of employees and market capitalisation in the Telecommunication Services sector. An interesting finding is that the two sectors with the lowest average market capitalisation, Information Technology and Health Care, has a much higher than the average number of employees (2nd and 3rd highest average number of employees).

The smallest board size is within the Health Care sector (2nd lowest market capitalisation) and the biggest board size is in the Energy sector (2nd highest market capitalisation). The least profitable sector on average was the Telecommunication services (followed closely by the Materials and Industrials sectors) and the most profitable sector was the Real Estate Sector (followed by Energy and Utilities sectors). The average gearing was the lowest in the Consumer Discretionary and Materials sectors and the highest gearing was in the Information Technology and Energy sectors.

The sector, Information Technology, with the lowest average salary (CEO and CFO) and lowest average bonus (CEO and CFO) also had the lowest average tenure (CEO, CFO and Chairman). The Energy sector had the highest average salary (CEO and CFO) and the highest average bonus (CEO and CFO) whereas the Health Care had the highest average tenure (CEO, CFO and Chairman) which had a similarly average to sample average salary (CEO and CFO) and average bonus (CEO and CFO).

Table 5.4 Descriptive statistics of transformed variables split by each sector (Source: Author's own collection, created using data collected from Bloomberg)

Statistic	Total Mean	Consumer Discretionary	Consumer Staples	Energy	Health Care	Industrials	InformationTechnology	Materials	Real Estate	Telecommunication Services	Utilities
bb1y2	0.001	0.001	0.001	0.001	0.0004	0.001	0.001	0.001	0.0003	0.001	0.0004
bb5y2	0.01	0.012	0.012	0.013	0.01	0.011	0.012	0.011	0.009	0.014	0.01
altmanz2	4.3	4.139	3.834	2.072	4.205	4.923	3.711	4.078	4.726	2.537	4.656
employees2	62,163.40	65,284.54	53,011.70	61,603.00	85,914.38	47,466.16	84,737.62	39,523.94	87,558.73	117,520.30	53,436.21
mcap2	31,745.20	38,094.71	33,125.81	55,296.71	17,861.35	24,359.56	9,841.13	34,329.03	37,858.78	58,196.45	24,725.64
boardsize2	10.6	10.589	11.565	13.8	9.692	10.22	10.625	10.5	10.6	11.143	10.286
performance2	12.7	12.241	13.266	17.931	13.27	10.254	12.897	9.097	20.919	8.89	16.327
gearing2	97	67.477	114.033	124.647	111.273	122.589	132.552	69.707	96.194	78.905	108.219
salarya2	1,023,741.00	1,058,133.00	1,110,567.00	2,025,497.00	1,027,706.00	854,855.90	851,771.50	959,923.40	960,307.80	1,759,144.00	856,700.20
bonusa2	1,102,989.00	1,144,328.00	1,295,838.00	1,746,219.00	1,210,502.00	897,819.20	798,891.80	1,007,626.00	1,163,356.00	1,563,692.00	1,011,729.00
tenurea2	5	4.749	5.552	4.311	6.344	5.099	3.65	5.991	3.763	4.965	4.502

5.3 Correlation matrix

Pairwise and Listwise deletion provide similar results for correlation between variables (Table 5.5 presents the correlation matrix created through pairwise deletion). The correlation matrix shows a significant association between the three measures of the probability of firm default. The association between Altman Z-score and the two Bloomberg measures is a significant moderate to low negative association as the score is inverse i.e. a higher Altman Zscore refers to a lesser likelihood of default but a higher Bloomberg score is a higher likelihood of default. The average salary (CEO and CFO) does not have a significant correlation to the Bloomberg likelihood of default measures however it has a significant weak to low negative association with the Altman Z-score i.e the higher the average salary (CEO and CFO) the higher the likelihood of that firm defaulting as measured by the Altman Z-score. The average bonus (CEO and CFO) does not have a significant association to the Altman Z-score but has a significant weak to low negative association to the Bloomberg likelihood of default measures i.e. The higher the average bonus (CEO and CFO) the lower the likelihood of default of that firm as measured by the Bloomberg probability of default.

The average tenure (CEO, CFO and Chairman) has a similar association (significant weak to low negative) as average bonus to the Bloomberg and Altman Zscore i.e. the higher the average tenure (CEO, CFO and Chairman) the lower the likelihood of default as predicted by the Bloomberg likelihood of default measures. The board size has a weak to low association with all three measures of the likelihood of default and the association is a significant positive association with the Bloomberg probability of default and a significant negative association with the Altman Z-score probability of default. The significance of the association with the long-term (bb5y) probability of default is not as strong as the short term (bb1y) probability of default. The association states that the bigger the size of the board the higher the likelihood of default. The average number of employees has a weak to low association with all three measures of the likelihood of default and the association is a significant positive association with the Bloomberg probability of default and a significant negative association with the Altman Z-score probability of default. The association states that the higher the average number of employees in the firm the higher the likelihood of default.

Market capitalisation does not have a significant association with the Bloomberg probability of default measures. However, the association with the Altman Z-score is a significant weak to low association i.e. the higher the market capitalisation of the firm the higher the likelihood of default for the firm. The average firm performance has a weak to low association with all three measures of the likelihood of default and the association is a significant negative association with the Bloomberg probability of default and a significant positive association with the Altman Z-score probability of default. The association states that the higher the average firm performance the lower the likelihood of default.

The average salary (CEO and CFO) has a significant moderate to low positive association with average bonus (CEO and CFO), size of the board and market capitalisation and a significant weak to low positive association with the number of employees i.e. firms with higher average salaries (CEO and CFO) are more likely to pay higher average bonuses, have bigger average board sizes, have more average number of employees and have a larger market capitalisation. The average bonus (CEO and CFO) has a significant moderate to low association with the size of the board and the market capitalisation and a significant weak to low positive association with the average tenure (CEO, CFO and Chairman), firm performance and the number of employees i.e. firms paying higher bonuses are more likely to have bigger board sizes, larger market capitalisations, and longer average tenure (CEO, CFO and Chairman). The average size of the board has a significant positive moderate to low association with the market capitalisation of the firm and a significant weak to low association with the average number of employees in a firm i.e. firms with large board sizes are more likely to have larger market capitalisations and larger average number of employees. The average number of employees has a significant positive weak to low association to market capitalisation i.e. firms with a larger number of employees are more likely to have larger market capitalisations.

Table 5.5 Correlation Matrix (Source: Author's own collection, created using data collected from Bloomberg)

	bb1y2	bb5y2	altmanz2	salarya2	bonusa2	tenurea2	boardsize2	employees2	mcap2	performance2	gearing2
bb1y2	1										
bb5y2	0.898***	1									
altmanz2	-0.354***	-0.432***	1								
salarya2	0.031	0.046	-0.199***	1							
bonusa2	-0.132***	-0.099**	0.004	0.455***	1						
tenurea2	-0.142**	-0.167***	0.106	-0.133	0.188***	1					
boardsize2	0.152**	0.114*	-0.178***	0.369***	0.466***	0.089	1				
employees2	0.216***	0.171**	-0.153**	0.187***	0.115*	-0.036	0.191***	1			
mcap2	-0.019	-0.050	-0.172**	0.309***	0.415***	-0.076	0.342***	0.161***	1		
performance2	-0.209***	-0.208***	0.161**	-0.055	0.149***	0.082	0.055	-0.057	-0.005	1	
gearing2	0.057	0.136	-0.239***	-0.042	-0.013	-0.083	-0.005	0.068	-0.079	0.147	1

Note:

*** Correlation is significant at the <.01 level. ** Correlation is significant at the <.05 level. * Correlation is significant at the <.10 level.

5.4 Categorical Variables Descriptives

This section provides a descriptive analysis of the categorical variables collected in this study. The below Table 5.6 shows a breakdown of the average number of firm-years per company in the study, therefore it would be incorrect to draw strong conclusions from analysing particular sectors specifically Information Technology and Telecommunication Services.

Table 5.6 Number of firm year observations in each sector (Source: Author's own collection, created using data collected from Bloomberg)

Sector	Number firm years
Consumer Discretionary	68
Consumer Staples	31
Energy	12
Health Care	16
Industrials	54
Information Technology	8
Materials	25
Real Estate	16
Telecommunication Services	8
Utilities	20

The Table 5.7 below shows that the gender of the CEO and the gender of the Chairman for a vast majority of the firm years is male, identifying a clear underrepresentation of females at the TMT level of a firm.

Table 5.7 Gender of the CEO and the Chairman (Source: Author's own collection, created using data collected from Bloomberg)

Gender	Number of firm years (CEO)	Number of firm years (Chairman)
Male	222	228
Female	13	8
Missing	23	22

This under-representation is further visible at the board level of the firm, as shown in Table 5.8, for over half the firm years there is only one female board member or none.

Table 5.8 Number of female executives on the board (Source: Author's own collection, created using data collected from Bloomberg)

Number of female executives on board	Number of firm years
0	94
1	65
2	45
3	16
4	8
5	5
6	2
Missing	23

An analysis of the CEO duality variable in Table 5.9 shows that the role of the CEO and Chairman is only combined for 2 firm years.

Table 5.9 Duality of CEO (Source: Author's own collection, created using data collected from Bloomberg)

CEO Duality	Number of firm years
CEO and Chairperson role separate	234
CEO and Chairperson role combined	2
Missing	22

A breakdown, in table 5.10, of the number of female executives by sector shows that female representation at board level is highest in the Consumer Staples and Utilities sector and the lowest in Energy and Materials sector.

Table 5.10 Number of female executives on the board in each sector (Source: Author's own collection, created using data collected from Bloomberg)

Sector	.00	1.00	2.00	3.00	4.00	5.00	6.00	Total
Consumer Discretionary	54.2%	10.2%	16.9%	10.2%	5.1%	3.4%		100.0%
Consumer Staples	25.0%	46.4%	7.1%	10.7%	3.6%	3.6%	3.6%	100.0%
Energy	75.0%	25.0%						100.0%
Health Care	6.3%	12.5%	43.8%	25.0%	12.5%			100.0%
Industrials	30.8%	34.6%	26.9%	1.9%	3.8%	1.9%		100.0%
Information Technology	57.1%	14.3%	28.6%					100.0%
Materials	59.1%	22.7%	9.1%	9.1%				100.0%
Real Estate	50.0%	28.6%	21.4%					100.0%
Telecommunication Services	62.5%	37.5%						100.0%
Utilities	29.4%	47.1%	11.8%			5.9%	5.9%	100.0%
	40.0%	27.7%	19.1%	6.8%	3.4%	2.1%	0.9%	100.0%

A breakdown of the number of female executives on the board by specific years, shown in Table 5.11, points to a slow but steady decline in the number of firm-years that has no female representation at the board level.

Table 5.11 Number of female executives on the board split by each year (Source: Author's own collection, created using data collected from Bloomberg)

.00	1.00	2.00	3.00	4.00	5.00	6.00		
2013	43.1%	24.1%	20.7%	6.9%	3.4%	1.7%		100.0%
2014	43.8%	29.7%	10.9%	9.4%	3.1%	3.1%		100.0%
2015	38.8%	28.4%	19.4%	4.5%	3.0%	3.0%	3.0%	100.0%
2016	32.6%	28.3%	28.3%	6.5%	4.3%			100.0%
Total	40.0%	27.7%	19.1%	6.8%	3.4%	2.1%	0.9%	100.0%

The correlation between the number of female executives and the variables of the study, presented in Table 5.12, shows that there exists a significant weak to low negative association with the Altman Z-score probability of default, the average bonus (CEO and CFO) and the average tenure (CEO, CFO and Chairman) i.e. as the number of female executives increases there is a higher likelihood of a higher probability of default (measured by the Altman Z-score), lower average bonus and lower average tenure. These results are consistent for both pairwise and listwise deletion.

Table 5.12 Correlation of variables with the number of female executives on the board (Source: Author's own collection, created using data collected from Bloomberg)

Number of female executives on the board	1
Bloomberg 1 year probability of default	0.06
Bloomberg 5 year probability of default	0.083
Altman Zscore probability of default	$-.146^{**}$
Average CEO and CFO Salary	0.058
Average CEO and CFO Bonus	-0.116^{*}
Average CEO, CFO and Chairman Tenure	$-.161^{**}$
Board of Directors size	0.006
Number of Employees	-0.032
Market Capitalisation	-0.031
Performance	0.001

Note: ** Correlation significant at 0.05 level. * Correlation significant at 0.10 level

5.5 Linear Model

The basic relationship of interest in the study expressed as a simple formula is:

bb1y = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector

bb5y = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector

altmanz = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector

This is the probability of a firm defaulting predicted by the salary paid to the CEO and CFO, the bonus paid to the CEO and CFO, the term of the CEO, CFO and Chairperson, the number of employees in the firm and the number of directors on the board of the firm. The set of independent variables or predictors can also be termed as ’the fixed effects’ which becomes more useful during the analysis of the models.

The above simple formula does not include the control variables that could also predict the probability of default but it also does not include other influencing factors that cannot be controlled. The factors that cannot be controlled for is represented by the error term epsilon (ε) in the below formula:

bb1y = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector + ε

bb5y = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector + ε

altmanz = salary + bonus + tenure + employees + boardsize + mcap + performance + gearing + sector + ε

This epsilon allows the formula to capture for ’the random factors’. The formula is a depiction of the linear model that this study aims to develop and breaks the right into the ’structural’ or ’systematic’ part of the model (the fixed effects) and the ’random’ or ’probabilistic’ part of the model.

The following transformations were undertaken:

- Bloomberg 1 year was transformed to reduce the number of decimal places
- Bloomberg 5 year was transformed to reduce the number of decimal places
- Atlman Zscore was transformed to convert negative values to positive
- Total Bonus was transformed to amend any 0 to 1
- Performance was transformed to convert negative values to positive
- Company and Sector were defined as factors on R

The linear regression models were run on the dataset with missing data and on the dataset with listwise deletion of missing data for Robustness checking. The results are very similar with the significance of the gearing variable for model 1 (Bloomberg 1 year) becoming non-significant and the significance for the variable number of employees for model 2 (Altman Z-Score) becoming non-significant. The results below are based on the dataset without missing data (listwise deletion).

Dependent Variables: Bloomberg 1 year probability of default; Bloomberg 5 year probability of default; and Altman Z-score

- Model (1):

  Control variables only: Market Capitalisation; Performance; Gearing; and Sector

- Model (2):

  Predictor Variables only: Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (3):

  Contorl and Predictor Variables: Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (4):

  Introducing Quadratic term for Average Salary: Average Salary squared; Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (5):

  Introducing Quadratic term for Average Bonus: Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus squared; Average

Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (6):

  Introducing Quadratic term for Average Tenure: Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure squared; Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size

- Model (7):

  Introducing Quadratic term for Board size:Market Capitalisation; Performance; Gearing; Sector; Average Salary (CEO and CFO); Average Bonus (CEO and CFO); Average Tenure (CEO, CFO and Chairman); Number of Employees; Board Size; Board Size squared.

5.6 Bloomberg 1 year probability of default linear regression

The linear regression model for the Bloomberg 1 year probability of default is presented in Table 5.13. The variables were entered using a forward and backward selection criteria and this process is presented in Table 5.14. The results for each individual model are presented in Table B.3 (appendix B). The multiple R-squared shows that 12.6%, 12.6% and 24% of the variance in the data is explained by the model (1), model (2) and model (3) respectively. The adjusted R-squared shows that 7.1%, 10.4% and 17.1% of the variance in data is explained by the model (1), model (2) and model (3) respectively after accounting for the different predictor variables. The models are significant with a p-value<0.01, i.e. this shows that the null hypothesis (the predictors have no effect on the dependent variable) is rejected and the predictor variables affect the dependent variable is more likely and hence the results are statistically significant.

A linear model of the control variables, predictor variables and all variables as a function of the probability of the firm defaulting is constructed. The model (1) is significant ($F(12,194)=2.321$, $p<0.01$), model (2) ($F(5,201)=5.809$, $p<0.01$) and ($F(17,189)=3.508$, $p<0.01$).

The coefficients for the model (1) shows that the control variable market capitalisation ($p<0.05$) and firm performance ($p<0.01$) are significant and negative. The level of firm gearing does not have a significant effect on the short-term likelihood of firm default. As the market capitalisation and firm performance increases, the short-term likelihood of firm default reduces.

The coefficients for the model (2) shows that the predictor variables average bonus (CEO and CFO), the number of employees and the size of the board are significant ($p<0.01$). The effect of the average bonus is negative and the effect of the number of employees and the size of the board is positive for the short-term likelihood of firm default. An increase in the average bonus has an effect of reducing the short-term likelihood of firm default and an increase in the number of employees and the size of the board has an effect of increasing the likelihood of firm default.

This relationship continues in the full model (control and predictor variables) where average salary and average tenure does not have a significant effect on the short-term likelihood of firm default. Introducing a quadratic term for average salary has an interesting effect in the model (4). The coefficients show that the quadratic term for average salary ($p<0.05$), average salary ($p<0.10$), average bonus ($p<0.01$), number of employees ($p<0.01$) and board size ($p<0.01$) are significant predictors of the bloomberg 1 year probability of default and only market capitalisation is a significant control variable ($p<0.01$). The average salary and average bonus have a negative effect on the short-term likelihood of default i.e. as the salary and bonus increases the short-term likelihood of default decreases. However, the quadratic term for average salary has a positive effect on the short-term likelihood of default i.e. as the salary further increases the likelihood of default increases. The effect of average salary prior to introducing the quadratic term was positive. The number of employees and the size of the board has a positive effect on the short-term likelihood of default a relationship consistent with the previous models.

Introducing a quadratic term for the bonus to the full model and for tenure to the full model does not have any significant effect on the dependent variable. Introducing a quadratic term for board size to the full model has a significant effect on the short-term likelihood of default however the board size has a non-significant effect, which points to a curvilinear relationship. This model has a Multiple R-squared of 25.8% and an Adjusted R-squared of 18.7%. In this model, average bonus ($p<0.05$), average tenure ($p<0.1$), number of employees ($p<0.01$) and the quadratic term for board size ($p<0.05$) are significant.

The final model for the dependent variable Bloomberg 1 year probability of default through backward selection criteria is:

The multiple R-squared shows that 26.71% of the variance in the dataset is explained by the model and the Adjusted R-squared shows that 19.69% variance in the dataset, accounting for the predictor variables, (or population) is explained by the model. The model is significant, ($F(18,188)=3.806$, $p<0.01$), this shows that the null hypothesis (the predictors have no effect on the dependent variable) is rejected and the predictor variables affect the dependent variable is more likely and hence the results are statistically significant. The coefficients shows that the quadratic term for average salary ($p<0.05$), average salary ($p<0.10$), average bonus ($p<0.01$), number of employees ($p<0.01$) and quadratic term for board size ($p<0.10$) are significant predictors and market capitalisation ($p<0.01$) and firm performance ($p<0.10$) are a significant control variables. The average salary and average bonus have a negative effect on the short-term likelihood of default i.e. as the salary and bonus increases the short-term likelihood of default decreases.

However, the quadratic term for average salary has a positive effect on the short-term likelihood of default i.e. as the salary further increases the likelihood of default increases. The number of employees has a positive effect on the short-term likelihood of default a relationship consistent with the previous models. However, board size has a negative effect and the quadratic term for board size has a positive effect on the short-term likelihood of

Table 5.13 Bloomberg 1 year probability of default linear model (Source: Author's own collection, created using data collected from Bloomberg)

	Dependent variable:
	bb1y2
salarya22	0.00000000003**
	(0.00000000001)
salarya2	−0.00006877825*
	(0.00004099092)
bonusa2	−0.00002747005***
	(0.00000922038)
employees2	0.00021047920***
	(0.00006307133)
boardsize2	−19.77452000000
	(16.47660000000)
mcap2	−0.00071369280***
	(0.00025322820)
performance2	−0.61283790000*
	(0.36170870000)
gearing2	0.05121867000
	(0.05716328000)
sector2Consumer Staples	29.83848000000
	(19.89414000000)
sector2Energy	172.52690000000***
	(47.81197000000)
sector2Health Care	15.86751000000
	(24.47906000000)
sector2Industrials	38.95238000000**
	(16.15355000000)
sector2Information Technology	−7.04648200000
	(35.37228000000)
sector2Materials	18.93932000000
	(25.72511000000)
sector2Real Estate	−1.13484900000
	(26.47722000000)
sector2Telecommunication Services	85.64431000000**
	(34.50114000000)
sector2Utilities	23.94857000000
	(23.26272000000)
boardsize22	1.22696400000*
	(0.65105530000)
Constant	223.29290000000**
	(101.66870000000)
Observations	207
R^2	0.26707950000
Adjusted R^2	0.19690620000
Residual Std. Error	72.78631000000 (df = 188)
F Statistic	3.80600200000*** (df = 18; 188)
Note:	*p<0.1; **p<0.05; ***p<0.01

default. This points to a curvilinear effect of the board size on the short-term likelihood of default. An initial increase in the board size has an effect of reducing the likelihood of default however eventually as the board size further increases it has the effect of increasing the likelihood of short-term default.

Table 5.14 Variables entered in each linear model for Bloomberg 1 year probability of default (Source: Author's own collection, created using data collected from Bloomberg)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market Capitalisation	*		*	*	*	*	*	*	*
Firm Performance	*		*	*	*	*	*	*	*
Gearing	*		*	*	*	*	*	*	*
Sector	*		*	*	*	*	*	*	*
Average Salary		*	*	*	*	*	*	*	*
Average Bonus		*	*	*	*	*	*	*	*
AverageTenure		*	*	*	*	*	*	*	
Number of Employees		*	*	*	*	*	*	*	*
Size of Board		*	*	*	*	*	*	*	*
Quadratic Average Salary				*				*	*
Quadratic Average Bonus					*			*	
Quadratic Average Tenure						*		*	
Quadratic Size of Board							*	*	*

5.7 Bloomberg 5 year probability of default linear regression

The linear regression model for the Bloomberg 5 year probability of default is presented in Table 5.15. The variables were entered using a forward and backward selection criteria and this process is presented in Table 5.16. The results for each individual model are presented in Table B,4 (appendix B). The multiple R-squared shows that 18.3%, 8.8% and 26% of the variance in the data is explained by the model (1), model (2) and model (3) respectively. The adjusted R-squared shows that 13.3%, 6.5% and 19.4% of the variance in data is explained by the model (1), model (2) and model (3) respectively after accounting for the different predictor variables. The models are significant with a p-value<0.01, i.e. this shows that the null hypothesis (the predictors have no effect on the dependent variable) is rejected and the predictor variables affect the dependent variable is more likely and hence the results are statistically significant.

A linear model of the control variables, predictor variables and all variables as a function of the probability of the firm defaulting is constructed. The model (1) is significant (F(12,194)=3.636, p<0.01), model (2) (F(5,201)=3.874, p<0.01) and (F(17,189)=3.91, p<0.01).

The coefficients for the model (1) shows that the control variable market capitalisation (p<0.05), firm performance (p<0.01) and firm gearing (p<0.05) are significant. Market capitalisation and firm performance have a negative effect and firm gearing has a positive effect on the long-term probability of firm default. As the market capitalisation and firm performance increases, the long-term likelihood of firm default reduces and as the firm gearing levels increase the long-term probability of default decreases.

The coefficients for the model (2) shows that the predictor variables average bonus (CEO and CFO), average tenure (CEO, CFO and Chairman), the number of employees and size of the board are significant (p<0.05). The effect of average bonus and average tenure is negative and the effect of the number of employees and the size of the board is positive for the long-term likelihood of firm default. An increase in the average bonus and average tenure has an effect of reducing the long-term likelihood of firm default and an increase in the number of employees and the size of the board has an effect of increasing the long-term likelihood of firm default.

This relationship continues in the full model (control and predictor variables) however average bonus and average salary does not have a significant effect on the long-term likelihood of firm default. The coefficients show that the quadratic term for average salary, a quadratic term for the average bonus to the full model and for tenure to the full model does not have any significant effect to the dependent variable. Introducing a quadratic term for board size to the full model has an interesting effect on the model. This model has a multiple R-squared of 28.91% and an Adjusted R-squared of 22.11% i.e. 22.11% of the variance in the dataset is explained by the model after adjusting for the predictors. The model is significant with a p-value<0.01 (F(18,188)=4.248).

The coefficients for average salary and average bonus are not significant predictors. Average tenure (p<0.05), number of employees (p<0.05), size of the board (p<0.05) and a quadratic term for board size (p<0.01) are significant. Average tenure and the size of the board have a negative effect on the long-term likelihood of default and the number of employees and the quadratic term for the size of the board has a positive effect of the long-term likelihood of the firm. This effect for board size was positive prior to introducing the quadratic term. An increase in the average tenure and the size of the board has an effect of decreasing the long-term likelihood of the firm default. An increase in the number of employees has an effect of increasing the long-term likelihood of firm default. The significant relationship of the quadratic term for board size shows that initially as the board size increases there is an effect of decreasing the long-term likelihood of firm default however as the board size further continues increases it has an effect of increasing the long-term likelihood of firm default.

The final model for the dependent variable Bloomberg 5 year probability of default through backward selection criteria is:

The multiple R-squared shows that 28.39% of the variance in the dataset is explained by the model and the Adjusted R-squared shows that 22.36% variance in the dataset, accounting for the predictor variables, (or population) is explained by the model. The model is significant, (F(16,190)=4.707, p<0.01), this shows that the null hypothesis (the predictors have no effect on the dependent variable) is rejected and the predictor variables affect the dependent variable is more likely and hence the results are statistically significant.

Table 5.15 Bloomberg 5 year probability of default linear model (Source: Author's own collection, created using data collected from Bloomberg)

	Dependent variable:
	bb5y2
tenurea2	−36.09553000000***
	(12.13332000000)
employees2	0.00074315720**
	(0.00035266070)
boardsize2	−224.89810000000**
	(94.10512000000)
mcap2	−0.00333510500**
	(0.00133753300)
performance2	−5.56615600000***
	(2.03897300000)
gearing2	0.54003820000
	(0.33138470000)
sector2Consumer Staples	48.43210000000
	(111.76850000000)
sector2Energy	641.68170000000**
	(250.61740000000)
sector2Health Care	−64.79212000000
	(138.38920000000)
sector2Industrials	189.33860000000**
	(92.46182000000)
sector2Information Technology	−125.83120000000
	(207.05820000000)
sector2Materials	87.04490000000
	(131.40540000000)
sector2Real Estate	−296.91350000000*
	(151.67140000000)
sector2Telecommunication Services	569.52110000000***
	(195.05800000000)
sector2Utilities	128.76880000000
	(135.68790000000)
boardsize22	10.85706000000***
	(3.78705900000)
Constant	2,775.89500000000***
	(587.54070000000)
Observations	207
R^2	0.28386590000
Adjusted R^2	0.22355980000
Residual Std. Error	423.07150000000 (df = 190)
F Statistic	4.70708900000*** (df = 16; 190)
Note:	*p<0.1; **p<0.05; ***p<0.01

The coefficients show that the average tenure (p<0.01), number of employees (p<0.05), board size (p<0.05) and quadratic term for board size (p<0.01) are significant predictors of the bloomberg 5 year probability of default and market capitalisation (p<0.05) and firm performance (p<0.01) are significant control variables. Average tenure and board size have a negative effect on the long-term likelihood of the firm and the number of employees has a positive effect on the long-term likelihood of firm default. An increase in the average tenure and board size has an effect of decreasing the long-term likelihood of firm default and an increase in the number of employees has the effect of increasing the long-term likelihood of firm default. However, the quadratic term for board size has a positive effect on the long-term likelihood of default i.e. as the board size further increases the likelihood of default increases.

Table 5.16 Variables entered in each linear model for Bloomberg 5 year probability of default (Source: Author's own collection, created using data collected from Bloomberg)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market Capitalisation	*		*	*	*	*	*	*	*
Firm Performance	*		*	*	*	*	*	*	*
Gearing	*		*	*	*	*	*	*	*
Sector	*		*	*	*	*	*	*	*
Average Salary		*	*	*	*	*	*	*	
Average Bonus		*	*	*	*	*	*	*	
AverageTenure		*	*	*	*	*	*	*	*
Number of Employees		*	*	*	*	*	*	*	*
Size of Board		*	*	*	*	*	*	*	*
Quadratic Average Salary				*				*	
Quadratic Average Bonus					*			*	
Quadratic Average Tenure						*		*	
Quadratic Size of Board							*	*	*

5.8 Altman Z-score probability of default linear regression

The linear regression model for the Bloomberg 1 year probability of default is presented in Table 5.17. The variables were entered using a forward and backward selection criteria and this process is presented in Table 5.18. The results for each individual model are presented in Table B.5 (appendix B). The multiple R-squared shows that 22.9%, 9% and 31.34% of the variance in the data is explained by the model (1), model (2) and model (3) respectively. The adjusted R-squared shows that 18.13%, 6.83% and 25.17% of the variance in data is explained by the model (1), model (2) and model (3) respectively after accounting for the different predictor variables. The models are significant with a p-value<0.01, i.e. this shows that the null hypothesis (the predictors have no effect on the dependent variable) is rejected and the predictor variables affect the dependent variable is more likely and hence the results are statistically significant.

A linear model of the control variables, predictor variables and all variables as a function of the probability of the firm defaulting is constructed. The model (1) is significant ($F(12,194)=2.321$, $p<0.01$), model (2) ($F(5,201)=5.809$, $p<0.01$) and ($F(17,189)=3.508$, $p<0.01$).

The coefficients for the model (1) shows that the control variable market capitalisation ($p<0.05$), firm performance ($p<0.01$) and firm gearing ($p<0.01$) are significant. Market capitalisation and firm gearing have a negative effect on the Altman Z-score probability of default and firm performance has a positive effect on the Altman Z-score probability of default. An increase in the market capitalisation and firm gearing has the effect of increasing the probability of default as predicted by Altman Z-score and an increase in the firm performance decreases the probability of default as predicted by Altman Z-score.

The coefficients for the model (2) shows that the predictor variables average salary (CEO and CFO), average bonus (CEO and CFO) and the size of the board are significant ($p<0.01$).

The effect of average salary and size of the board has a negative effect and average bonus has a positive effect on Altman Z-score probability of firm default. An increase in the average salary and board size has an effect of increasing the likelihood of a firm defaulting as predicted by the Altman Z-score and an increase in the average bonus has an effect of reducing the likelihood of firm default as predicted by Altman Z-score.

This relationship continues in the full model (control and predictor variables) where market capitalisation, average tenure (CEO, CFO and Chairman) and the number of employees does not have a significant effect on the probability of default as predicted by the Altman Z-score. Introducing a quadratic term for average salary, average bonus and average tenure to the full model does not have any significant effect on the dependent variable. However, Introducing a quadratic term for board size to the full model has an interesting effect on the probability of default predicted by Altman Z-score. This model has a multiple R-squared of 33.1% and an Adjusted R-squared of 26.7% i.e. 26.7% variance in the dataset is explained by the model adjusted for the number of predictors. The coefficients show that the control variable market capitalisation does not have a significant effect on the probability of default and firm performance and firm gearing have a significant effect on the probability of default. However, average salary ($p<0.01$), average bonus ($p<0.05$), board size ($p<0.05$) and the quadratic term for board size ($p<0.05$) are significant predictors. The coefficient for average salary has a negative effect on the Altman Z-score i.e. an increase in the average salary has the effect of increasing the likelihood of default as predicted by Altman Z-score. The coefficient for bonus has a positive effect on the Altman Z-score i.e. an increase in the bonus has the effect of reducing the likelihood of default. Board size has a positive effect on the Altman Z-score, however, the quadratic term for Board size has a negative effect on the Altman Z-score. The effect of board size prior to introducing a quadratic term was negative. This shows that as the board size initially increases it has the effect of reducing the likelihood of default and a further increase in the board size has the effect of increasing the likelihood of default.

The final model for the dependent variable Altman Z-score probability of default through backward selection criteria is:

Table 5.17 Altman Z-score probability of default linear model (Source: Author's own collection, created using data collected from Bloomberg)

	Dependent variable:
	altmanz2
salarya2	−0.00000262429***
	(0.00000061212)
bonusa2	0.00000083736**
	(0.00000037508)
boardsize2	1.30471300000*
	(0.66782120000)
mcap2	−0.00000668868
	(0.00001017278)
performance2	0.03603481000**
	(0.01455350000)
gearing2	−0.01002075000***
	(0.00230397100)
sector2Consumer Staples	−0.50844460000
	(0.80112020000)
sector2Energy	−2.32954900000
	(1.92069800000)
sector2Health Care	−0.35762990000
	(0.99187040000)
sector2Industrials	−0.45308040000
	(0.64339310000)
sector2Information Technology	−1.10054400000
	(1.42648100000)
sector2Materials	2.56904600000***
	(0.97234290000)
sector2Real Estate	−4.31732600000***
	(1.05571400000)
sector2Telecommunication Services	−4.25384300000***
	(1.40325300000)
sector2Utilities	−0.73645750000
	(0.92445200000)
boardsize22	−0.05763511000**
	(0.02644429000)
Constant	−0.29671320000
	(4.10686100000)
Observations	207
R^2	0.32652020000
Adjusted R^2	0.26980620000
Residual Std. Error	2.96421700000 (df = 190)
F Statistic	5.75730400000*** (df = 16; 190)
Note:	*p<0.1; **p<0.05; ***p<0.01

The multiple R-squared shows that 32.65% of the variance in the dataset is explained by the model and the Adjusted R-squared shows that 26.98% variance in the dataset, accounting for the predictor variables, (or population) is explained by the model. The model is significant, ($F(16,190)=5.757$, $p<0.01$), this shows that the null hypothesis (the predictors have no effect on the dependent variable) is rejected and the predictor variables affect the dependent variable is more likely and hence the results are statistically significant. The coefficients show that average salary ($p<0.001$), average bonus ($p<0.05$), board size ($p<0.1$ and the quadratic term for board size ($p<0.05$) are significant predictors of the Altman z-score probability of default and firm performance ($p<0.05$) and firm gearing ($p<0.001$) are significant control variables. The average salary has a negative effect on the likelihood of default and average bonus and board size has a positive effect on the likelihood of default i.e. an increase in the average salary has the effect of increasing the likelihood of default and an increase in the average bonus and board size has the effect of decreasing the likelihood of default. However, the quadratic term for board size has a negative effect on the likelihood of default i.e. a further increase in the board size has an effect of increasing the likelihood of default increases.

Table 5.18 Variables entered in each linear model for Altman Z-score probability of default (Source: Author’s own collection, created using data collected from Bloomberg)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Market Capitalisation	*		*	*	*	*	*	*	*
Firm Performance	*		*	*	*	*	*	*	*
Gearing	*		*	*	*	*	*	*	*
Sector	*		*	*	*	*	*	*	*
Average Salary		*	*	*	*	*	*	*	*
Average Bonus		*	*	*	*	*	*	*	*
AverageTenure		*	*	*	*	*	*	*	
Number of Employees		*	*	*	*	*	*	*	
Size of Board		*	*	*	*	*	*	*	*
Quadratic Average Salary				*				*	
Quadratic Average Bonus					*			*	
Quadratic Average Tenure						*		*	
Quadratic Size of Board							*	*	*

A summary of the three dependent variables final polynomial models’ coefficient effects are presented in Table 5.19 as follows:

Table 5.19 Variables entered in final linear regression models (Source: Author's own collection, created using data collected from Bloomberg)

Variables	BB1Y	BB5Y	Altman Z-score
Market Capitalisation	-	-	-
Firm Performance	-	-	+
Gearing	+	+	-
Sector	*	*	*
Average Salary	-		-
Average Bonus	-		+
AverageTenure		-	
Number of Employees	+	+	
Size of Board	-	-	+
Quadratic Average Salary	+		
Quadratic Average Bonus			
Quadratic Average Tenure			
Quadratic Size of Board	+	+	-

The variables where the effect on the dependent from Bloomberg's likelihood of default and Altman Z-score's likelihood of default changes is when a quadratic term for that variable is introduced.

5.9 Multilevel Linear Modelling (Linear Mixed Effects)

bb1y2 = salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

bb5y2 = tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

altmanz2 = salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

The above equations represent a linear model. In this, the contextual variables are company and time periods. As it may be expected that the effect of the independent variables on the likelihood of default to vary as a function of which company the TMT belong to and which year the companies belong to. Therefore, it would be important to allow the model to represent the effect of the independent variables on the likelihood of default across different companies and different time periods.

The overall fit of a multilevel model is tested using a chi-square ratio test similar to that in logistics regression. The higher the value of the log-likelihood the better the model. In addition, AIC and BIC can be used to compare models. Field et al. (2012) explains AIC as a goodness-of-fit measure that takes into account how many parameters have been estimated and BIC as a measure similar to AIC that corrects more harshly for the number of parameters being estimated (which should be used for larger sample sizes and a small number of parameters. The lower the AIC and BIC the better the model.

It is recommended to start with a 'basic' model with all fixed parameters and then adding random coefficients as appropriate (Raudenbush and Bryk, 2002; Twisk, 2006). In addition, centring could help multilevel models to be more stable, however, there is no correct choice between not centring, group mean centring or grand mean centring (Kreft et al. 1995). Therefore, for Robustness the mixed models are developed and tested using the raw data and centred data.

The first step is to ascertain if there is variation over contexts. This is done by fitting a baseline model of the intercept only and a model is fitted to allow the intercepts to vary over contexts. A comparison of these two models shows whether the allowing the intercepts to vary improves the models.

The intercept only model is as follows:

bb1yinterceptonly<-gls(bb1y2 1,method="ML")

bb5yinterceptonly<-gls(bb5y2 1,method="ML")

altmanzinterceptonly<-gls(altmanz2 1,method="ML")

The model fitted to allow intercepts to vary over contexts is as follows:

bb1yintercept<-lme(bb1y2 1, random= 1|id2/t2,method="ML")

bb5yintercept<-lme(bb5y2 1, random= 1|id2/t2,method="ML")

altmanzintercept<-lme(altmanz2 1, random= 1|id2/t2,method="ML")

A comparison of the above two models shows that a model allowing intercepts to vary over contexts significantly improves the intercept-only model. This can be seen in Tables 5.20, 5.21 and 5.22, where the models allowing the intercepts to vary is significantly better than the model of the intercept only for all three dependent variables. Therefore, it can be concluded that intercepts vary significantly across different companies and time periods and multilevel modelling should be pursued.

Table 5.20 Bloomberg 1 year: intercept only model vs intercept varying across company and time model (Source: Author's own collection, created using data collected from Bloomberg)

	call	Model	df	AIC	BIC	logLik	Test	L.Ratio	p-value
bb1yinterceptonly	gls(model = bb1y2 ~ 1, method = "ML")	1	2.00	2410.87	2417.53	-1203.43			
bb1yrandominterceptonly	lme.formula(fixed = bb1y2 ~ 1, random = ~1 | id2/t2, method = "ML")	2	4.00	2371.48	2384.82	-1181.74	1 vs 2	43.38	0.00

Table 5.21 Bloomberg 5 year: intercept only model vs intercept varying across company and time model (Source: Author's own collection, created using data collected from Bloomberg)

	call	Model	df	AIC	BIC	logLik	Test	L.Ratio	p-value
bb5yinterceptonly	gls(model = bb5y2 ~ 1, method = "ML")	1	2.00	3146.50	3153.16	-1571.25			
bb5yrandominterceptonly	lme.formula(fixed = bb5y2 ~ 1, random = ~1 | id2/t2, method = "ML")	2	4.00	3072.84	3086.17	-1532.42	1 vs 2	77.66	0.00

Table 5.22 Altman Z-score: intercept only model vs intercept varying across company and time model (Source: Author's own collection, created using data collected from Bloomberg)

	call	Model	df	AIC	BIC	logLik	Test	L.Ratio	p-value
altmanzinterceptonly	gls(model = altmanz2 ~ 1, method = "ML")	1	2.00	1105.39	1112.05	-550.69			
altmanzrandominterceptonly	lme.formula(fixed = altmanz2 ~ 1, random = ~1 | id2/t2, method = "ML")	2	4.00	790.71	804.04	-391.36	1 vs 2	318.67	0.00

5.10 Random Intercept model

bb1y2 = salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

bb5y2 = tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

altmanz2 = salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + ε

In the equation above, the variables to the right of '=' are the fixed effect (systematic) and 'ε' is the error term that represents the deviations from the predictions due to random factors that are not controlled. Winter (2013) call this random part also the 'probabilistic' or 'stochastic' part of the equation. The next step is to break the 'ε' down and add complexity to it. In the Linear Mixed Effects modelling the systematic part of the model remains unchanged from the linear models and only the random aspects of the model are changed.

In the data collected, there were multiple responses from each company. This violates the independence assumption for linear modelling as multiple responses from the same company cannot be regarded as independent of each other. Each company's probability of default is slightly different and this is a unique factor that affects all responses from the same company thus making the different responses inter-dependent rather than independent.

This is addressed by adding a 'random effect' for each company, which assumes a different 'baseline' likelihood of default value for each company. Therefore, a company may have a mean likelihood of default different from the mean likelihood of default from another company.

In addition, there were multiple responses for each time period. This also violates the independence assumption of linear modelling as multiple responses from the same year cannot be regarded as independent from each other. Each year's likelihood of default is slightly different and this is a unique factor that affects all responses from the same time period thus making the different responses inter-dependent rather than independent.

This is addressed by adding a ‘random effect’ for each year, which assumes a different ‘baseline’ likelihood of default value for each year. Therefore, a time period may have a mean likelihood of default different from the mean likelihood of default from another time period.

These individual differences are modelled by assuming a different intercept for each company and each time period. The mixed model assigns a different intercept value for each company and each time period and estimates these intercepts. These random effects give structure to the error term ‘ε’, which in the linear model was something that could not be controlled or understood and was a constant across the board. This combination of ‘fixed effects’ and ‘random effects’ in the model is referred to as mixed models.

This updates the formula to (summary of the model is in the appendices):

bb1y2   salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (1|id2) + (1|t2) + ε

bb5y2   tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (1|id2) + (1|t2) + ε

altmanz2   salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (1|id2) + (1|t2) + ε

The ‘(1|id2) + (1|t2)’ tells the model to assume a different intercept for each company and each time period. The error term ‘ε’ still remains as there still remains ‘random’ differences that cannot be controlled. Winter (2013) argues that by undertaking a company-analysis (averaging over time), by-time variation is disregarded, and conversely, in the time-analysis, by-company variation is disregarded. Mixed models account for both sources of variation in a single model.

5.11 Significance test of Random Intercept model

In order to test the significance of the model, attaining the p-value is not as straightforward as a linear model. Winter (2013) recommends using the Likelihood Ratio Test as a means to attain p-values. The logic of the likelihood test is to compare two models with each other i.e. the model without the factor of interest (null model) and the model with the factor of interest. A fixed effect is significant if the difference between the likelihood of the two models is significant.

In order to show model development and to test model significance, we start with the null model, followed by the control model and compare these to the final model. The results of the comparison of these models to ascertain the significant improvement in the model is presented in Tables 5.23, 5.24 and 5.25. The results show that the control models and the full models are a significantly better fit than the null model for all three dependent variables.

The null model:

bb1y2   1 + (1|id2) + (1|t2) + ε

bb5y2   1+ (1|id2) + (1|t2) + ε

altmanz2   1 + (1|id2) + (1|t2) + ε

The control model:

bb1y2   mcap2 + performance2 + gearing2 + sector2 + (1|id2) + (1|t2) + ε

bb5y2   mcap2 + performance2 + gearing2 + sector2 + (1|id2) + (1|t2) + ε

altmanz2   mcap2 + performance2 + gearing2 + sector2 + (1|id2) + (1|t2) + ε

The final model:

bb1y2 salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (1|id2) + (1|t2) + ε

bb5y2 tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (1|id2) + (1|t2) + ε

altmanz2 salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (1|id2) + (1|t2) + ε

An additional argument, REML=FALSE is included, as it is necessary to compare models using the likelihood ratio test (Pinheiro and Bates, 2000; Bolker et al., 2009). This final model can also be called a Random intercept model.

Table 5.23 Bloomberg1 year Random Intercept: Null vs Control vs Final model (Source: Author's own collection, created using data collected from Bloomberg)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
bb1y.null	4	530.39	543.72	-261.20	522.39			
bb1y.null2	16	538.06	591.39	-253.03	506.06	16.33	12	0.1766
bb1y.model2f	22	523.43	596.75	-239.72	479.43	26.63	6	0.0002

Table 5.24 Bloomberg5 year Random Intercept: Null vs Control vs Final model (Source: Author's own collection, created using data collected from Bloomberg)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
bb5y.null	4	493.64	506.97	-242.82	485.64			
bb5y.null2	16	491.42	544.74	-229.71	459.42	26.23	12	0.0100
bb5y.model2f	19	487.52	550.84	-224.76	449.52	9.90	3	0.0195

Table 5.25 Altman Zscore Random Intercept: Null vs Control vs Final model (Source: Author's own collection, created using data collected from Bloomberg)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
altmanz.null	4	267.41	280.74	-129.70	259.41			
altmanz.null2	16	257.91	311.24	-112.96	225.91	33.50	12	0.0008
altmanz.model2f	20	258.34	325.00	-109.17	218.34	7.57	4	0.1087

5.12 Random Intercept and Random Slope model

The random intercept model accounts for baseline-difference in the likelihood of default but assumes the effect of the fixed effects is going to be the same for all companies and the different time periods.

In the BB1Y dependent variable model, the average bonus is a fixed effect of interest due to the significance of its coefficient in the linear model.

bb1y2 salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (bonusa2|id2) + (bonusa2|t2) + ε

In the BB5Y dependent variable model, average tenure is a fixed effect of interest due to the significance of its coefficient in the linear model.

bb5y2 tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (tenurea2|id2) + (tenurea2|t2) + ε

In the AltmanZ dependent variable model, the average salary is a fixed effect of interest due to the significance of its coefficient in the linear model.

altmanz2 salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (salarya2|id2) + (salarya2|t2) + ε

The assumption from the above is that average bonus (for bb1y), average tenure (bb5y) and average salary (AltmanZ) does not have a different effect for different companies and different time periods. In the random slope model, company and time periods have different intercepts and the above variables are allowed to have different slopes in their respective models.

5.13 Significance test of Random Intercept and Random Slope model

Once again, we compare the final random slopes model, to the null random slope model and the control random slope model using the likelihood test ratio to get p-values.

The null model:

bb1y2   1 + (bonusa2|id2) + (bonusa2|t2) + ε

bb5y2   1+ (tenurea2|id2) + (tenurea2|t2) + ε

altmanz2   1 + (salarya2|id2) + (salarya2|t2) + ε

The control model:

bb1y2   mcap2 + performance2 + gearing2 + sector2 + (bonusa2|id2) + (bonusa2|t2) + ε

bb5y2   mcap2 + performance2 + gearing2 + sector2 + (tenurea2|id2) + (tenurea2|t2) + ε

altmanz2   mcap2 + performance2 + gearing2 + sector2 + (salarya2|id2) + (salarya2|t2) + ε

The final model:

bb1y2   salarya22 + salarya2 + bonusa2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (bonusa2|id2) + (bonusa2|t2) + ε

bb5y2   tenurea2 + employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (tenurea2|id2) + (tenurea2|t2) + ε

altmanz2   salarya2 + bonusa2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22 + (salarya2|id2) + (salarya2|t2) + ε

The results of the comparison of these models to ascertain the significant improvement in the model is presented in Tables 5.26, 5.27 and 5.28. The results show that the control models and the full models are a significantly better fit than the null model for all three dependent variables. Research in fields such as ecology (Schielzeth and Forstmeier, 2009) and psycholinguistics (Barr et al. 2013) have shown via simulations that mixed models without random slopes are anti-conservative or they have relatively high type I error, i.e. find a lot of significant results that are actually due to chance. Barr et al. (2013) also recommend including random slopes for all fixed effects that are important for the overall interpretation of the study.

Table 5.26 Bloomberg 1 year Random Intercept and Random Slope: Null vs Control vs Final model (Source: Author's own collection, created using data collected from Bloomberg)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
bb1y.nullr	8	498.43	525.09	-241.22	482.43			
bb1y.controlr	20	504.73	571.38	-232.36	464.73	17.71	12	0.1249
bb1y.model2fr	26	482.15	568.80	-215.07	430.15	34.58	6	0.0000

Table 5.27 Bloomberg 5 year Random Intercept and Random Slope: Null vs Control vs Final model (Source: Author's own collection, created using data collected from Bloomberg)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
bb5y.nullr	8	493.21	519.88	-238.61	477.21			
bb5y.controlr	20	491.80	558.45	-225.90	451.80	25.42	12	0.0130
bb5y.model2fr	24	484.99	564.97	-218.49	436.99	14.81	4	0.0051

Table 5.28 Altman Zscore Random Intercept and Random Slope: Null vs Control vs Final model (Source: Author's own collection, created using data collected from Bloomberg)

	Df	AIC	BIC	logLik	deviance	Chisq	Chi Df	Pr(>Chisq)
altmanz.nullr	8	260.03	286.69	-122.02	244.03			
altmanz.controlr	20	255.23	321.88	-107.61	215.23	28.81	12	0.0042
altmanz.model2fr	24	244.87	324.85	-98.43	196.87	18.36	4	0.0010

5.14 Conclusion

This chapter provided the results of the descriptive analysis of the dataset followed by a correlation matrix of the key variables. The average executive salary and average executive bonus showed an increasing trend each year with a sharp decline in 2016. This is an interesting period as the number of employees decreased the profitability and market capitalisation increased. A descriptive of the sectors showed that Information Technology, Energy and Health Care are sectors deviating from the mean. The correlation matrix identified a significant correlation between executive bonus and the short-term and long-term probability of default. Whereas salary has a significant correlation to the accounting probability of default. The TMT tenure also has a significant correlation to the short-term and long-term probability of default. The board size and the number of employees have a significant correlation to all three measures of the likelihood of default. The descriptive of the categorical variables showed that there is significant under representation of females on the top two positions and on the board within the UK FTSE 100 companies. And it is extremely rare for the role of the CEO and Chairman to be combined into a single position within these firms.

The final OLS linear regression models were developed through a forward and backward selection criterion. The key finding within the final OLS regression models for each of the three dependent variables was the existence of a curvilinear relationship with key predictors. The the board size of a firm showed a significant curvilinear relationship to all three measures of default prediction. The executive salary showed a significant curvilinear relationship to the short-term market probability of default only. This chapter provided results to conclude that multilevel modelling should be pursued as it is found that the intercepts vary significantly across different companies and different time period for all three dependent variables. The random intercept model, which models for a different intercept for each company and each time period, developed was a significant improvement to the null model. The random intercept and slope model further developed showed that allowing executive bonus (for the short-term probability of default), top management tenure (for the long-term probability of default) and executive salary (for the accounting probability of default) to have different slopes for each company and each time period further improved the models significantly.

Chapter 6

Analysis and Discussion

6.1 Introduction

This chapter provides an analysis of the findings presented in chapter 5 within the context of findings in the previous academic work. It starts by providing a summary of key features from the literature reviewed previously and comparing these key features to the existing study. It then summarises the key models developed in this study and provides a background to the analysis undertaken. This is followed by an analysis of the findings of the Top Management Team (TMT) attributes of interest in this study i.e. executive motivation, TMT loyalty and TMT effectiveness. In order to achieve a more robust analysis of these findings, the findings of the control variables are also analysed and compared to that of previous literature.

Table 6.1 Summary of hypotheses and key findings (Source: Author's own collection)

Hypotheses Number	Hypotheses	Random Intercept and Random Slope model relationship finding
Hypothesis 1a	**There is no relationship between executive short-term motivation and the likelihood of firm financial distress**	
H1a (i)	*There is no relationship between executive short-term motivation and the accounting measure for firm financial distress*	*Negative*
H1a (ii)	*There is no relationship between executive short-term motivation and the short-term market measure for firm financial distress*	*Curvilinear*
H1a (iii)	*There is no relationship between executive short-term motivation and the long-term market measure for firm financial distress*	*No*
Hypothesis 1b	**There is a negative relationship between executive long-term motivation and the likelihood of firm financial distress**	
H1b (i)	*There is a negative relationship between executive long-term motivation and the accounting measure for firm financial distress*	*Positive*
H1b (ii)	*There is a negative relationship between executive long-term motivation and the short-term market measure for firm financial distress*	*Negative*
H1b (iii)	*There is a negative relationship between executive long-term motivation and the long-term market measure for firm financial distress*	*No*
Hypothesis 2	**There is a negative relationship between TMT loyalty and the likelihood of firm financial distress**	
H2 (i)	*There is a negative relationship between TMT loyalty and the accounting measure for firm financial distress*	*Positive*
H2 (ii)	*There is a negative relationship between TMT loyalty and the short-term market measure for firm financial distress*	*No*
H2 (iii)	*There is a negative relationship between TMT loyalty and the long-term market measure for firm financial distress*	*Negative*
Hypothesis 3a	**There is no relationship between TMT board level effectiveness and the likelihood of firm financial distress**	
H3a (i)	*There is no relationship between TMT board level effectiveness and the accounting measure for firm financial distress*	*Curvilinear*
H3a (ii)	*There is no relationship between TMT board level effectiveness and the short-term market measure for firm financial distress*	*Curvilinear*
H3a (iii)	*There is no relationship between TMT board level effectiveness and the long-term market measure for firm financial distress*	*Curvilinear*
Hypothesis 3b	**There is a positive relationship between TMT firm level effectiveness and the likelihood of firm financial distress**	
H3b (i)	*There is a positive relationship between TMT firm level effectiveness and the accounting measure for firm financial distress*	*No*
H3b (ii)	*There is a positive relationship between TMT firm level effectiveness and the short-term market measure for firm financial distress*	*Positive*
H3b (iii)	*There is a positive relationship between TMT firm level effectiveness and the long-term market measure for firm financial distress*	*Positive*

6.2 Summary of Key Literature

This section is a summarised journal of key literature relevant to this study and where relevant similarities exist these have been highlighted. Further detail on the findings within these academic pieces of work is presented in appendix A.4.

Schultz et al. (2017) provide an Australian study that uses the Merton's (1974) distance to default measure the probability of firm default similar to this study. Once endogeneity issues are addressed by econometric models they find no relationship between probability of default and corporate governance mechanisms

Wright et al. (2007) provide a US study of TMT incentives and firm risk-taking. The authors measure risk-taking as a lagged standard deviation of quarterly return on assets (ROA) and lagged standard deviation of monthly total return to shareholders. The models developed by the authors have a low R-squared similar to this study. They conclude that managerial incentives do matter as they significantly impact subsequent corporate risk-taking

Balachandran et al. (2010) provide a US study on the relationship between equity-based incentive and the probability of default. The results find that equity-based pay increases the probability of default while non-equity based pay decreases the probability of default.

Ting (2011) provide a Chinese study on the relationship between TMT turnover and firm default risk. The study uses the KMV model to measure the probability of default which is based on the Merton's (1974) model similar to this study. The models developed by the authors have a low R-squared similar to this study.

Loveman (1998) undertook a US Study on Retail Banking on employee satisfaction, customer loyalty and firm performance. He argued in favour of tenure as a proxy for loyalty similar to this study and used tenure to measure both employee and customer loyalty.

Dunn (2004) undertook a US study on the impact of Insider power on fraudulent financial reporting. The author uses the Altman Z-score to predict the likelihood of default similar to this study. In addition, the models developed by the author has a low adjusted R-squared similar to this study.

Nielsen and Nielsen (2013) provide a Swiss study on the relationship between TMT diversity and firm performance. The authors use p-value <.10 for significance testing similar to this study and the models developed have a large intercept and small coefficients similar to this study. The study also uses the hierarchical linear model similar to this study.

Cao et. al (2015) provide a US study on the relationship between corporate governance and default risk. The study uses an unbalanced sample of firms per year and sector similar to this study. The authors use distance to default developed from the work of Merton (1974) similar to this study. The study uses CEO tenure as a measure for CEO power and finds that the percentage of female directors has a significant negative correlation to CEO Tenure

Platt and Platt (2012) provide a US study on corporate board attributes and bankruptcy using an unbalanced data set categorised by the number of years and sector which is similar to this study.

Fich and Slezak (2008) provide a US study on governance attributes ability to avoid bankruptcy and the power of financial/accounting information to predict bankruptcy. The authors use an unbalanced panel data similar to this study. The models developed by the authors has a low R-squared similar to this study. Finally, the authors use the Altman Z-score to predict bankruptcy similar to this study

Guest (2009) undertook a UK study on the impact of board size on firm performance. This is a large study that spans a large number of years. The study has a low adjusted R-squared similar to this study.

Finkelstein and Hambrick (1990) provide a US study focussing on the TMT tenure and organisational outcomes. The author's developed models have a low R-squared similar to this study.

O'Reilly III et al. (1988) provide a US study examining economic and psychological factors that influence the setting of CEO compensation. The models developed by the authors have a low adjusted R-squared similar to this study.

Richard and Johnson (2001) provide a US study that tests whether strategic human resource management effectiveness significantly affects firm performance. The study employs a hierarchical regression analysis to test a hypothesis similar to this study. The regression models developed by the authors has a low R-squared similar to this study.

Boone et al. (2007) provide a US study of industrial firms examining the determinants of corporate board size and composition. The models developed by the authors has a low adjusted R-squared similar to this study.

Kallunki and Pyykö (2012) provide a Finnish study on the relationship between director personal default and firm financial distress. The authors use two different default probabilities (Altman and Ohlson) and develope two different models similar to this study.

Switzer et al. (2018) provide a study of non-North American financial firms looking at the relationship between corporate governance and default risk. The study uses CDS spreads and the Bloomberg probability of default (similar to this study) two different measures to develop different models similar to this study. The study has a low R-squared similar to this study. The authors collected the data from the Bloomberg database similar to this study.

Switzer and Wang (2013a) undertook a US study exploring the relationship between credit risk and corporate governance structures. The models developed by the author had a low adjusted R-squared similar to this study. The authors use the Merton (1974) model similar to this study. This is one of the few studies that collect data for the CFO (similar to this study) however this is the CFO's age. The authors use the Bloomberg database to collect the data similar to this study.

Table 6.2 summarises the above journal of key literature into key themes relevant to this research.

Table 6.2 Summary of key literature (Source: Author's own collection)

Elements in this research	Supported by key literature
Merton's Distance to Default/ KMV/ Bloomberg probability of default	Schultz et al. (2017); Ting (2011); Cao et al. (2015); Switzer et al. (2018); Switzer and Wang (2013a); Switzer and Wang (2013b)
Altman Z-score probability of default	Fich and Slezak (2008); Kallunki and Pyyko (2012)
Use two default prediction methods in same study	Kallunki and Pyyko (2012); Switzer et al. (2018)
TMT elements and different variants of Default - Corporate Governance - TMT Incentives -TMT Turnover - Director personal default - Probability of Default - Firm Risk taking - Credit Risk - Bankruptcy -Major corporate failure	Schultz et al. (2017); Wright et al. (2007); Balachandran et al. (2010); Platt and Platt (2012); Cao et. al (2015); Kallunki and Pyyko (2012); Switzer et al. (2018); Switzer and Wang (2013a); Switzer and Wang (2013b); Daily and Dalton (1994); Hambrick and D'Aveni (1992)
TMT elements and different variants of firm performance - TMT Diversity -TMT Internationalisaton - TMT competencies - Board Size -TMT Tenure - CEO Compensation - HR effectiveness - Board size/structure - Power Dimensions - Executive pay	Nielsen and Nielsen (2013); Nielsen (2010b); Vainieri et al. (2017); Guest (2009); Finkelstein and Hambrick (1990); O'Reilly III et al. (1988); Richard and Johnson (2001); Boone et al. (2007); Linck et al. (2008); Finkelstein (1992); Bebchuck and Grinstein (2005)
Low Rsquare or adjusted Rsquare (TMT research) <.10 p-values used in study Small Coefficients Large Intercepts	Wright et al. (2007); Dunn (2004); Fich and Slezak (2007); Guest (2009); Finkelstein and Hambrick (1990); O'Reilly III et al. (1988); Richard and Johnson (2001); Boone et al. (2007); Switzer et al. (2018); Switzer and Wang (2013a) Nielsen and Nielsen (2013); Nielsen (2010b); Switzer et al. (2018) Nielsen and Nielsen (2013)
Unbalanced firms per year and sector Hierarchical regression analysis	Cao et al. (2015); Platt and Platt (2012); Fich and Slezak (2007) Richard and Johnson (2001)
Tenure as Power/Loyalty CFO included in study	Loveman (1998); Cao et al. (2015) Switzer and Wang (2013a)

6.3 Summary of Key models

The 4 econometric models developed for each of the three dependent variables (Bloomberg 1 year, Bloomberg 5 year and Altman Z-score) are presented in tables 6.3, 6.4 and 6.5. In each of the tables, the Pooled OLS model is the final Ordinary Least Square regression model. The Polynomial OLS model is the final Ordinary Least Square regression model which includes any additional significant quadratic terms for variables with a curvillinear relationship. The Random Intercept Model is a development to the Polynomial model, using hierarchical/multilevel modelling, where only the intercepts are allowed to vary for each year and each company. The Random Intercept and Random Slope model is a developement to the Random Intercept model where key variables of interest are allowed to have different slopes. The Rsquared and the adjusted Rsquared show how the fit of the model improves from the Pooled OLS to the Polynomial OLS.

The signicant improvement in AIC, BIC and LogLik scores shows that the Random Intercept model is a better fit than the null model and the Random Intercept and Random Slope model is a better fit than the Random Intercept model.

Table 6.3 Bloomberg 1 year probability of default linear regression and multilevel models (Source: Author's own collection)

Regressor	Pooled OLS	Polynomial OLS	Random Intercept Model (standardised)	Random Intercept and Random Slope Model (standardised)
Intercept	2.9748e+01	+2.233e+02**	-0.30758	-0.16918
Salary	+7.087e-06	-6.878e-05*	-0.48653*	-0.53290*
Bonus	-2.422e-05**	-2.747e-05***	-0.22571***	-0.17680
Tenure	-3.280e+00			
Employees	+1.729e-04***	2.105e-04***	+0.27317***	+0.28532**
Boardsize	+1.006e+01***	-1.977e+01	-0.60979	-0.98265***
Mcap	-6.946e-04***	-7.137e-04***	-0.45198***	-0.43390***
Performance	-6.439e-01*	-6.128e-01*	-0.06885	-0.08967*
Gearing	+4.105e-02	+5.122e-02	+0.01668	+0.03705
Sector	Y	Y	Y	Y
Salary^2		+2.565e-11**	+0.65933**	+0.82431**
Boardsize^2		+1.227e+00*	+0.82858**	+1.16087
Random Intercept Company (Variance)			.23562	0.0603298
Random Intercept Year (Variance)			.09394	0.0509499
Random Slope Bonus and Random Intercept Company (Variance)				0.6451031
Random Slope Bonus and Random Intercept Year (Variance)				0.0007412
R^2	.2399	.2671		
adjustedR^2	.1715	.1969		
AIC			523.4***	482.1***
BIC			596.7***	568.8***
logLik			-239.7***	-215.1***

*p<0.1. **p<0.05. ***p<0.01

Table 6.4 Bloomberg 5 year probability of default linear regression and multilevel models (Source: Author's own collection)

Regressor	Pooled OLS	Polynomial OLS	Random Intercept Model (standardised)	Random Intercept and Random Slope Model (standardised)
Intercept	+1.113e+03***	+2.776e+03***	-0.18920	-0.17279
Salary	+6.075e-05			
Bonus	-7.556e-05			
Tenure	-2.613e+01*	-3.610e+01***	-0.16017**	-0.16907***
Employees	+6.436e-04*	+7.432e-04**	+0.18857*	+0.13731
Boardsize	+4.6121e+01***	-2.249e+02**	-0.88027**	-0.90205**
Mcap	-4.439e-03***	-3.335e-03**	-0.44167***	-0.44283***
Performance	-4.633e+00**	-5.566e+00***	-0.08660*	-0.07939
Gearing	+5.657e-01*	+5.400e-01	+0.06282	+0.08452
Sector	Y	Y	Y	Y
Boardsize^2		+1.086e+01***	1.00456**	+1.06175***
Random Intercept Company (Variance)			0.37587	0.3616916
Random Intercept Year (Variance)			0.07057	0.0734619
Random Slope Tenure and Random Intercept Company (Variance)				0.0255790
Random Slope Tenure and Random Intercept Year (Variance)				0.0004561
R^2	.2601	.2839		
adjustedR^2	.1936	.2236		
AIC			483.3***	485***
BIC			549.9***	565***
logLik			-221.6***	-218.5***

*p<0.1. **p<0.05. ***p<0.01

Table 6.5 Altman Z-Score probability of default linear regression and multilevel models (Source: Author's own collection)

Regressor	Pooled OLS	Polynomial OLS	Random Intercept Model (standardised)	Random Intercept and Random Slope Model (standardised)
Intercept	+8.154e+00***	-2.967e-01	+0.12721	+0.3093*
Salary	-2.459e-06***	-2.624e-06***	-0.09720	-0.22128***
Bonus	+9.160e-07**	+8.374e-07**	+0.01520	+0.04563
Tenure	-2.855e-02			
Employees	-2.456e-06			
Boardsize	-2.741e-01	+1.305e+00*	-0.19517	-0.03438
Mcap	-1986e-06	-6.689e-06	+0.09127	+0.09332
Performance	+3.240e-02**	+3.603-02**	+0.06651***	+0.06211***
Gearing	-9.698e-03**	-1.002e-02***	-0.15583***	-0.15579***
Sector	Y	Y	Y	Y
Boardsize^2		-5.764e-02**	+0.11315	-0.07930
Random Intercept Company (Variance)			0.716502	0.605794
Random Intercept Year (Variance)			0.005922	0.004122
Random Slope Salary and Random Intercept Company (Variance)				0.150481
Random Slope Salary and Random Intercept Year (Variance)				0.002035
R^2	.3134	.3265		
adjustedR^2	.2517	.2698		
AIC			258.3*	244.8***
BIC			325*	324.9***
logLik			-109.2*	-98.4***

*p<0.1. **p<0.05. ***p<0.01

6.4 Background to the analysis

Multilevel models are also known as hierarchical models from the structure of the data and the hierarchy of the model. In addition, data that is not fully ordered or in a clear hierarchy can also be modelled through non-nested models. Multilevel models can be used for causal inference, prediction and descriptive modelling. For certain kinds of predictions, multilevel models are essential, as classical regression would fail to make predictions for a new individual within a new group as there would be no indicator for the new group in the model however multilevel model handles this seamlessly. Key difference between classical linear regression and hierarchical/multilevel modelling are presented in table 6.6.

Table 6.6 Classical Linear Regression modelling vs Multilevel/Hierarchial Modelling (Source: Adapted from Gelman (2008))

Classical Regression	**Multilevel/Hierarchical Modelling**
Not wise to use many predictors as estimates would be unreliable	All the predictors can be included
Necessary to address any collinearity	Coefficients to each batch of indicators are fit to a probability distribution
Estimates of varying effects can be noisy, especially when there are few observations per group	Allows to estimate these interactions to the extent supported by the data
Classical estimation just using local information can be essentially useless if the sample size within groups is small	Allows estimation of group averages and group-level effects compromising between the overly noisy within-group estimate and the oversimplified regression estimate that ignores group indicators
If a model ignores group effects and it will tend to understate the error in predictions for new groups. If a model includes group effects, there is no automatic way of getting predictions for new groups. A two-stage regression can be used to forecast for a new group however it can be difficult or even impossible if sample sizes are small in some groups	Allows forecasting even if sample sizes are small in some groups and fully accounts for uncertainty at both levels in a two-stage regression
Problems of overfitting by using ordinary least squares or maximum likelihood for datasets collected with inherent multilevel structure	Satisfies statistical theory – sampling or Bayesian - which states that inference about dataset inherently multilevel should include the factors used in the design of data collection
No pooling ignores information within datasets and can give unacceptably variable inferences. Complete pooling supresses variation that can be important	Allows modelling through partial pooling which is preferred
Including predictors at two different levels is extremely difficult specially when the sample sizes for some groups is small	Provides a coherent model which simultaneously incorporates both individual and group level models.

The models presented in tables 6.3, 6.4 and 6.5 are presented below as equations.

OLS (Full Model)

OLS Model 1

Bb1y = – 2.9748e+01 + 7.087e-06.salary – 2.422e-05.bonus – 3.280e+00.tenure + 1.729e-04.employees + 1.006e+01.boardsize – 6.946e-04.mcap – 6.439e-01.performance + 4.105e-02.gearing + factor.(sector) + error

OLS Model 2

Bb5y = 1.113e+03 + 6.075e-05.salary – 7.556e-05.bonus – 2.613e+01.tenure + 6.436e-04.employees + 4.6121e+01.boardsize – 4.439e-03.mcap – 4.633e+00.performance + 5.657e-01.gearing +factor.(sector) + error

OLS Model 3

Altmanz = 8.154e+00 – 2.459e-06.salary + 9.160e-07bonus – 2.855e-02.tenure –2.456e-06.employees –2.741e-01. boardsize – 1.986e-06.mcap + 3.240e-02.performance – 9.698e-03.gearing + factor.(sector) + error

Polynomial (Forward/Backward Selection)

Polynomial Model 1

Bb1y = 2.233e+02 – 6.878e-05 . salary+ 2.565e-11 . salaryq – 2.747e-05 . bonus + 2.105e-04 . employees + 1.227e+00 . boardsizeq – 1.977e+01 . boardsize – 7.137e-04 . mcap – 6.128e-01 . performance + 5.122e-02 . gearing + factor . (sector) + error

Polynomial Model 2

Bb5y = 2.776e+03 – 3.610e+01 . tenure + 7.432e-04 . employees – 2.249e+02 . boardsize + 1.086e+01 . boardsizeq – 3.335e-03 . mcap – 5.566e+00 . performance + 5.400e-01 . gearing + factor . (sector) + error

Polynomial Model 3

Altmanz = -2.967e-01 – 2.624e-06 . salary + 8.374e-07 . bonus + 1.305e+00 . boardsize – 5.764e-02 . boardsizeq – 6.689e-06 . mcap + 3.603e-02 . performance – 1.002e-02 . gearing + factor . (sector)

The Intercepts: If a company has a value of 0 for all its predictors then the predicted probability of default for the company as per each of the polynomial models will be its intercept in the model, respectively 2.233e+02%, 2.776e+03% and -2.967e-01 Z-score. This would be a meaningless prediction as a company with a value of 0 for all the predictors included in the model would fail to exist.

In order to undertake Linear Mixed Effects (LME), all the variables were scaled to provide a mean of 0 and a standard deviation of 1. A robustness check of the scaled variables and raw variables OLS regressions were compared and the results were consistent. Whilst the coefficients differed as expected the significance and the sign of the relationship remained consistent.

The research used R (R Core Team, 2012) and lme4 (Bates et al., 2014) to perform a linear mixed effects analysis of the relationship between the probability of default and the Executive motivation, TMT loyalty and TMT Effectiveness. The complete R code developed by the author for this study is presented in appendix C. As Fixed Effects, Salary, Bonus, Tenure, Board Size and Number of employees were entered with their quadratic terms. As Random effects, there were intercepts for companies and years, as well as by-company and by-years random slopes for the effect of probability of default. Visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality. The model significance (p-values) was obtained by the likelihood ratio test of the full model with the effects in question against the model without the effect in question (Winter, 2014).

Allowing regression coefficients to vary across companies and time periods (Random Intercept Model – RIM)

RIM Model 1

BB1y = – .30758 – 0.48653.Salary + 0.65933.Salaryq – 0.25571.bonus + 0.27317.employees – 0.60979.boardsize + 0.82858.boardsizeq – 0.45198.mcap – 0.06885.performance + 0.01668.gearing + factor(sector) + (1|company) + (1|year)

RIM Model 2

BB5y = – 0.18920 – 0.16017.tenure + 0.18857.employees – 0.88027.boardsize + 1.00456.boardsizeq– 0.44167.mcap – 0.0860.performance + 0.06282.gearing + factor(sector) + (1|company) + (1|year)

RIM Model 3

Altmanz = 0.12721 – 0.09720.salary + 0.01520.bonus – 0.19517.boardsize + 0.11315.boardsizeq + 0.09127.mcap + 0.06651.performance – 0.15583.gearing + factor(sector) + (1|company) + (1|year)

The random intercept and random slope models below are models where the subjects are not only allowed to have differing intercepts but also where they are allowed to have different slopes for the effect of Bonus (for Bloomberg 1 year), Tenure (for Bloomberg 5 year) and Salary (for Altman Z-score). These specific variables were selected to allow them to have different slopes for each subject due to the significance of their effect in the Ordinary Least Square and Polynomial regression models.

RISM Model 1

BB1y = – .16918 – 0.53290.Salary + 0.82431.Salaryq – 0.17680.bonus + 0.28532.employees – 0.98265.boardsize + 1.16087.boardsizeq – 0.43390.mcap – 0.08967.performance + 0.03705.gearing + factor(sector) + (bonus|company) + (bonus|year)

RISM Model 2

BB5y = – 0.17279 – 0.16907.tenure + 0.13731.employees – 0.90205.boardsize + 1.06175.boardsizeq – 0.44283.mcap – 0.07939.performance + 0.08452.gearing + factor(sector) + (tenure|company) + (tenure|year)

RISM Model 3

Altmanz = 0.30923 – 0.22128.salary + 0.04563.bonus – 0.03438.boardsize – 0.07930.boardsizeq + 0.09332.mcap + 0.07211.performance – 0.15579.gearing + factor(sector) + (salary|company) + (salary|year)

6.5 Motivation

This section analyses the findings of the relationship between executive motivation and the likelihood of default. The section discusses the findings of short-term (Salary) and long-term (Bonus) motivation, highlights they key significant relationships found in this study and discusses this within the context of findings from the previous key literature.

6.5.1 Short-term motivation (Salary)

This section analyses the findings of salary as a short-term measure of motivation and discusses them within the context of findings from previous studies. Table 6.7 summarises these findings and identifies key literature in support of or against these findings. The CEO and CFO average salary show a significant negative correlation with the accounting probability of default. This relationship is interesting as an increase in the average salary increases the probability of default predicted by the Altman Z-score. This could indicate that poor performance is being rewarded by paying the CEO and CFO higher salaries or pointing towards the inefficient market for executive salaries. However, it is more likely that firms that are struggling are more likely to pay higher salaries to attract talent in order to turnaround the business. There is a significant positive correlation between CEO and CFO salary and CEO and CFO Bonus. This shows that the higher paid CEO and CFO also received higher bonuses. Firms paying higher salaries to executives for their talent were also rewarding them with higher bonuses or higher paid executives were demanding higher bonuses. There is a significant positive correlation between the board size and the average salary paid to the CEO and CFO. Nielsen (2010b) found similar results (significant positive correlation) between average executive compensation (salary and bonus) and TMT size. This is interesting as with an increase in board size one would expect increased scrutiny of the executive compensation levels.

However, this relationship could also indicate that firms that are able to afford an increased number of directors on their board were also able to afford higher salaries or with an increased number of directors on the board it is likely to be more inefficient in scrutinising executive reward. The number of employees has a significant positive correlation to the average CEO and CFO salary. Nielsen (2010b) found a similar significant positive correlation between executive compensation and the number of employees and O'Reily III et al. (1988) found a similar significant correlation between CEO salary and the number of employees. Firms that require a larger number of employees operationally were paying their CEO and CFO higher salaries as an indicator for a larger representation. However, some sectors do require a larger number of employees such as retail which could affect this correlation. Finally, the correlation matrix shows a significant positive correlation between market capitalisation and the average salary of the CEO and CFO. This result would be expected as larger firms by market capitalisation paid the executives higher salaries to reflect the added responsibility.

O'Reilly et al. (1988) found CEO salary to have a significant positive correlation to ROE which is inconsistent to the results of this research which indicates a non-significant negative relationship of CEO and CFO salary with performance. This is consistent with the findings of Finkelstein (1992) who found structural power (where compensation was a key latent variable) had a non-significant correlation to ROE. The research also finds that the CEO and CFO salary has a non-significant negative correlation to CEO CFO and Chairman tenure. O'Reilly et al. (1988) also found a non-significant correlation between CEO salary and tenure, however, the relationship was positive. They also found the number of employees, ROE and CEO tenure to be non-significant predictors of CEO compensation where the number of employees had a negative relationship and the other two a positive relationship. Bebchuck (2005) found ROA to be a significant positive predictor of CEO compensation, CEO non-equity based compensation and executive non-equity based compensation. However, they find that the ROA is a non-significant positive predictor of executive compensation.

The *OLS models* show that the average salary of the CEO and CFO is only a significant predictor for the accounting probability of default. It is not a significant predictor for the short-term and long-term market probability of default. The *OLS model 3* shows that a £1 increase in the average salary of the CEO and CFO would increase the accounting probability of default by 2.459e-06 units. This points to the significance of the salary to the historic performance of the firm and that the salary does not act as a significant motivation for the CEO and CFO to influence the likelihood of default. Schultz et al. (2017) found executive fixed pay to be a significant positive predictor of default in the *OLS model*. However, once catering for endogeneity through econometric modelling found this relationship to be non-significant. Nielsen (2010b) found executive compensation to be a significant positive predictor of firm performance. However, she included both salary and bonus within the measure of compensation. The significance of CEO and CFO salary as a predictor of default is also supported by Wright et al. (2017), Balachandran et al. (2010) and Hambrick and D'Aveni (1992).

However, they found the predictor to have a negative relationship to default whereas this research finds salary to have a positive relationship to the accounting probability of default. Wright et al. (2017) found average TMT salary to be a significant negative predictor to risk-taking. Balachandaran et al. (2010) found non-equity pay to be a significant negative predictor for default. Hambrick and D'Aveni found compensation to be a significant negative predictor up to 4 years prior to bankruptcy. Schultz et al. (2017) found executive fixed pay to have a non-significant positive relationship with default within the Pooled Dynamic OLS and Fixed Effects panel models and then found the executive fixed pay to have a non-significant negative relationship within the GMM and Dynamic Sys. GMM models. This helps argue the need to explore a curvilinear relationship between executive salary and default rather than a linear relationship.

Polynomial model 1 shows that comparing companies with the same value for other predictors, a £1 increase in CEO and CFO average salary would decrease the short-term market probability of default by 6.878e-05 units. However, due to the curvilinear relationship of salary in *polynomial model 1*, after a point, a £1 increase in CEO and CFO average salary would have a 2.565e-11 units increase in the short-term market probability of default. This relationship is also highlighted in *polynomial model 3* which points to a 2.624e-06 units increase in the accounting probability of default for every £1 increase in average CEO and CFO salary.

The average CEO and CFO salary and its quadratic term is a non-significant positive predictor for the Bloomberg 5-year probability of default which is consistent with the findings of Schultz et al. (2017). Hence, it can be concluded that average CEO and CFO salary do not have an effect on the long-term probability of default.

The *Random Intercept Models (RIM)* show that average CEO and CFO salary (standardized) maintains a significant curvilinear relationship to the short-term market probability of default however average salary is no longer a significant predictor for the accounting probability of default. *The RIM Model 1* shows that comparing companies with the same value for other predictors, a 1 standard deviation increase in average salary would decrease the short-term market probability of default by 0.48653 standard deviations. This relationship is curvilinear, therefore eventually a 1 standard deviation increase in average salary would increase the short-term market probability of default by 0.65933 standard deviations. The *RIM Model 2* shows that a 1 standard deviation increase in salary increases the accounting probability of default by .09720 standard deviations.

The *Random Intercept and Slope Model (RISM)* shows that the average CEO and CFO salary is a significant predictor for the short-term market probability of default and the accounting probability of default. *RISM Model 1* shows a significant curvilinear relationship whereas *RISM Model 3* shows a significant linear relationship. *RISM Model 1* shows that, comparing companies with the same value for other predictors, a 1 standard deviation increase in the average salary would decrease the short-term probability of default by 0.53290 standard deviations and after a certain point a further 1 standard deviation increase in the average salary would increase the short-term probability of default by 0.82431 standard deviations. *RISM Model 3*, shows that a 1 standard deviation increase in the salary would increase the accounting probability of default by 0.22128 standard deviations.

Table 6.7 Key literature linked to findings relating to salary in this study (Author's own collection)

Variable	Significant Relationship	Literature Support	Literature Against
Altman Z	Negative correlation		
CEO CFO Bonus	Positive correlation		
Board size	Positive correlation	Nielsen (2010b);	
Employees	Positive correlation	Nielsen (2010b); O'Reilly III et al. (1988)	
Market Capitalisation	Positive Correlation		
Altman Z OLS, Polynomial, RISM	Negative Predictor	Schultz et al. (2017); Nielsen (2010b)	Wright et al. (2017); Balachandran et al. (2010); Hambrick and D'Aveni (1992)
BB1y Polynomial, RIM and RISM	Curvilinear predictor		
BB5y	Non-significant positive	Schultz et al. (2017)	

6.5.2 Long-term Motivation (Bonus)

This section analyses the findings of bonus as a long-term measure of motivation and discusses them within the context of findings from previous studies. Table 6.8 summarises these findings and identifies key literature in support of or against these findings. CEO and CFO average bonus has a significant negative correlation with the short-term market probability of default and the long-term market probability of default. The correlation with the Altman Z-score is non-significant positive. All these three measures indicate that as the average CEO and CFO bonus increases the probability of default of the firm decreases. This would support the argument that executives are rewarded for good performance and reducing the firm's exposure to default. However, the results are not consistent with Wright et al. (2017) who found a non-significant positive correlation between the probability of default and TMT bonus. There is a significant positive correlation between CEO and CFO salary and CEO and CFO Bonus. This shows that the higher paid CEO and CFO also received higher bonuses. Firms paying higher salaries to executives for their talent were also rewarding them with higher bonuses or higher paid executives were demanding higher bonuses.

The CEO CFO and Chairman average tenure have a significant positive correlation to the CEO and CFO average bonus. This indicates that as the average tenure increases the bonus paid to the CEO and CFO increases as well. The tenure of the TMT would increase as the firm continues to perform each year leading to the TMT achieving the targets and bonus being paid. With each bonus met the next bonus would traditionally have to be higher to act as a motivational factor to ensure future targets are continuously met.

The correlation matrix also shows a significant positive correlation between CEO and CFO average bonus and the board size. As the number of directors on a board increases the bonus paid to the CEO and CFO increases. Nielsen (2010b) found similar results (significant positive correlation) between average executive compensation (salary and bonus) and TMT size. This is interesting as with an increase in board size one would expect increased scrutiny of the executive compensation levels.

However, this relationship could also indicate that firms that are able to afford an increased number of directors on their board were also able to afford higher salaries or with an increased number of directors on the board it is likely to be more inefficient in scrutinising executive reward.

The number of employees has a significant positive correlation to the average CEO and CFO bonus. Nielsen (2010b) found a similar significant positive correlation between executive compensation and TMT and O'Reily III et al. (1988) found a similar significant correlation between executive compensation and the number of employees. Firms that require a larger number of employees operationally were paying their CEO and CFO higher bonuses as an indicator for a larger representation. However, some sectors do require a larger number of employees such as retail which could affect this correlation.

The correlation matrix also shows a significant positive correlation between market capitalisation and the average bonus of the CEO and CFO. This result would be expected as larger firms by market capitalisation paid the executives higher salaries to reflect the added responsibility.

In addition, the results show a significant positive correlation of CEO and CFO bonus to the firm performance which is supported by findings from Nielsen (2010b), O'Reilly III et al. (1988) and Bebchuck and Grinstein (2005). The results indicate that as the firm performance increases CEO and CFO are rewarded with higher bonuses for providing the improved performance. Alternatively, a higher bonus is provided as a motivational factor to ensure improved performance. Nielsen (2010b) found a significant positive correlation between executive compensation to ROA. O'Reilly III et al. (1988) found a significant correlation between CEO salary and ROE. Bebchuck and Grinstein (2005) find ROA to be a significant positive predictor of CEO compensation. However, they find that ROA is not a significant predictor of Executive compensation. This is supported by the findings of Finkelstein (1992) who found that structural power, which includes compensation as a key latent variable, has a non-significant correlation to ROE.

An interesting finding of the correlation matrix is the significant negative correlation between the number of female executives on the board and CEO and CFO bonus. This variable is not explored further in the modelling as the number of missing observations were considerably higher than that of all other variables. This points towards a relationship where if the number of female members of the board increased it led to a decline in the bonuses paid to the CEO and CFO. A board that actively pursues to increase a wider representation, by including more female directors, is aiming to be an efficient board. And as the board tries to operate more efficiently they are able to scrutinise the performance of the firm and that portion influenced by the CEO and CFO. This could lead to key strategic decisions on executive compensation scrutiny.

The *OLS model* shows that the average CEO and CFO bonus is a significant predictor for the short-term market and accounting probability of default. *OLS model 1* shows that a £1 increase in the average CEO and CFO bonus would decrease the short-term market probability of default by 2.422e-05 units and decrease the accounting probability of default

(OLS model 3) by 9.1600e-07 units. This highlights that bonus is significant to the short-term performance of the firm and the historic performance of the firm but not significant to the long-term performance of the firm. This is supported by Hambrick and D'Aveni (1992), who found compensation to be a significant negative predictor of the probability of default up to 4 years prior to bankruptcy. Balachandran et al. (2010) found non-equity pay is a significant negative predictor and equity-based pay is a significant positive predictor of the probability of default. However, Wright et al. (2007) also found the average TMT bonus to have a non-significant positive relation to risk-taking. Fick and Slezak (2008) found CEO bonus to not be a statistically significant predictor of the probability of default. Schultz et al. (2017) found similar results where executive variable pay was a non-significant predictor of the probability of default. These results could indicate that the executives were taking on more risk to increase firm performance and as firm performance increases the likelihood of default decreased.

Nielsen (2010b) found executive compensation, which included both salary and bonus, to be significant positive predictors of firm performance. Indicating that an increase in executive compensation would lead to an increase in the firm's performance. Bebchuck and Grinstein (2005) found ROA to be a significant positive predictor for CEO and Executive non-equity based compensation. However, O'Reilly et al. (1988) found that the number of employees, ROE and CEO tenure were not significant predictors of CEO compensation.

Polynomial model 1 shows that comparing companies with the same value for other predictors, a £1 increase in the average bonus of the CEO and CFO decreases the short-term market probability of default by 2.747e-05 units. This relationship is also seen in the *polynomial model 3* where a £1 increase in the average bonus of the CEO and CFO decreases the accounting probability of default by 8.374e-07 units.

Polynomial model 2, excludes both average CEO and CFO salary and bonus as they are not significant predictors of the long-term market probability of default. This shows that whilst Salary and Bonus are significant to motivate the executive in the short-term there is no significant long-term effect of these on the probability of default. In addition, the accounting measure of the probability of default is significantly influenced by the salary and bonus of the executives. This highlights that historical performance of the firm influences the probability of default and the motivation provided to the CEO and CFO.

The *Random Intercept Models (RIM)* show that average CEO and CFO bonus (standardized) maintains a significant relationship to the short-term market probability of default however average bonus is no longer a significant predictor for the accounting probability of default. *The RIM Model 1* shows that comparing companies with the same value for other predictors, a 1 standard deviation increase in average bonus would decrease the short-term market probability of default by 0.25571 standard deviations. This relationship is supported by RIM Model 3, where a 1 standard deviation increase in average bonus increases the accounting probability of default by 0.01520 standard deviations.

The *Random Intercept and Slope Model (RISM)* shows that the average CEO and CFO bonus is not a significant predictor for the short-term market probability of default and the accounting probability of default. *RISM Model 1* shows that comparing companies with the same value for other predictors, a 1 standard deviation increase in the average bonus would decrease the short-term probability of default by 0.17680 standard deviations. *RISM Model 3*, shows that a 1 standard deviation increase in the bonus would decrease the accounting probability of default by 0.04563 standard deviations.

Hambrick and D'Aveni (1992) found the team compensation was substantially lower (from t-4) for bankrupt firms, the percentage of the team with core function was lower in the bankrupt firms and the failing firms has smaller teams with fewer outside directors.

Table 6.8 Key literature linked to findings relating to bonus in this study (Author's own collection)

Variable	Significant Relationship	Literature Support	Literature Against
BB1y	Negative correlation		Wright et. al (2017)
BB5y	Negative correlation		Wright et. al (2017)
CEO CFO Salary	Positive correlation		
CEO CFO Chairman Tenure	Positive correlation		
Board Size	Positive correlation	Nielsen (2010b)	
Number of Employees	Positive correlation	Nielsen (2010b); O'Reilly III et al. (1988)	
Market Capitalisation	Positive correlation		
Firm Performance	Positive correlation	Nielsen (2010b); O'Reilly et al. (1988); Bebchuck and Grinstein (2005)	
Female Executives on Board	Negative correlation		
BB1y OLS, Polynomial, RIM and RISM	Negative predictor	Balachandran et. al (2010); Hambrick and D'Aveni (1992)	Schultz et. al (2017); Wright et al. (2017); Balachandran et al. (2010); Fich and Slezak (2008)
BB5y	Non-significant negative predictor	Schultz et. al (2010)	
Altman OLS, Polynomial	Positive predictor	Balachandran et. al (2010); Hambrick and D'Aveni (1992)	

6.6 Loyalty

This section analyses the findings of the relationship between TMT loyalty and the likelihood of default. The section discusses the findings of tenure as a measure of loyalty, highlights they key significant relationships found in this study and discusses this within the context of findings from the previous key literature.

6.6.1 Tenure

This section analyses the findings of tenure as measure of loyalty and discusses them within the context of findings from previous studies. Table 6.9 summarises these findings and identifies key literature in support of or against these findings.

CEO, CFO and Chairman tenure have a significant negative correlation with the short-term market probability of default and the long-term market probability of default. This shows that as the average tenure of the CEO, CFO and Chairman increases the probability of default decreases. Indicating either that the TMT gained experience within the firm helps reduce the likelihood of default. Alternatively, it indicates that with an increase in tenure the TMT work towards making the firm safer in return making their jobs safer and not working towards maximising shareholders wealth.

The CEO CFO and Chairman average tenure have a significant positive correlation to the CEO and CFO average bonus. This indicates that as the average tenure increases the bonus paid to the CEO and CFO increases as well. The tenure of the TMT would increase as the firm continues to perform each year leading to the TMT achieving the targets and bonus being paid. With each bonus met the next bonus would traditionally have to be higher to act as a motivational factor to ensure future targets are continuously met.

The research finds a significant negative correlation between TMT tenure and firm gearing level. This indicates that the firm relies less on debt finance to finance their activities as the average tenure of the CEO, CFO and Chairman increases. This was supported by the findings of Nielsen and Nielsen (2013) who found a significant negative correlation between TMT tenure and leverage. The TMT is relying more on equity finance to reduce the risk associated with debt financing. However, the cost of debt is cheaper than the cost of equity and therefore could adversely affect shareholder wealth.

An extremely interesting finding is, the number of female executives on the board has a significant negative correlation to the TMT tenure. Cao et al. (2015) had similar findings where they found a significant negative correlation between the percentage of female directors and CEO tenure. Whilst the number of observations with missing data is high, however, a similar finding to previous literature provides this result with relevance. This shows that as the number of female executives on the boards increases the tenure of the CEO, CFO and Chairman decreased. A board that actively pursues to increase a wider representation, by including more female directors, is aiming to be an efficient board. And as the board tries to operate more efficiently they are able to scrutinise the performance of the firm and that portion influenced by the CEO, CFO and Chairman. This could lead to key strategic decisions influencing efficient TMT appraisals and replacement.

The correlation matrix shows a non-significant positive correlation between CEO, CFO and Chairman tenure and the size of the board. However, Nielsen and Nielsen (2013) and Cao et al. (2015) found this relationship to be a non-significant positive correlation.

In addition, the research finds the correlation between tenure and market capitalisation to be non-significant negative which is inconsistent with the results of Boone et al. (2007) who found a significant positive correlation. Nielsen and Nielsen (2013) find a significant negative correlation between TMT tenure and the number of employees, which was inconsistent with the results, non-significant positive correlation, in this study. However, Finkelstein and Hambrick (1990) did provide similar results where they found a significant positive correlation between the number of employees and TMT tenure.

Finally, the correlation matrix shows a non-significant positive correlation between tenure and firm performance, which is consistent with the findings of Vainieri et al. (2017). Loveman (1998), used tenure as a proxy for employee satisfaction and found a slight relationship with firm performance. However, Nielsen and Nielsen (2013) and Finkelstein and Hambrick (1990) found TMT tenure and firm performance to have a significant positive and significant negative correlation respectively.

Finkelstein and Hambrick (1990) also found that TMT tenure was a significant positive predictor of strategic persistence i.e. as the tenure increased the strategic persistence of the firm increased. This supports the findings of Nielsen and Nielsen (2013) who found TMT tenure to be a significant positive predictor of firm performance. Dunn (2004) also found that as Director tenure increased the likelihood of fraud within the firm decreased.

The *OLS models* show that average CEO, CFO and Chairman tenure is a significant predictor for only the long-term market probability of default. *OLS model 2* shows that a 1-year increase in the average CEO, CFO and Chairman tenure would decrease the long-term market probability of default by 2.613e+01 units. This highlights that the TMT tenure does not have a significant impact on the historical probability of default and the short-term probability of default. However, as the TMT tenure increases, they are able to have a significant effect on the probability of default in the longer term. This finding is supported by Fich and Slezak (2008) who found CEO tenure to be a significant negative predictor of the probability of default. Hambrick and D'Aveni (1992) also found TMT tenure to be a significant negative predictor 4 years, 3 years and 2 years prior to bankruptcy. However, Cao et al. (2015) found CEO tenure to be a non-significant positive predictor of the probability of default in the *OLS model*. They find this relationship becomes significant positive when they undertake a Hazard analysis.

Polynomial model 2 shows that comparing companies with the same value for other predictors, a 1-year increase in the average tenure of the CEO, CFO and Chairman decreases the long-term market probability of default by 3.610e+01 units. The variable tenure is not a significant predictor for the short-term market probability of default *(polynomial model 1)* and the accounting probability of default *(polynomial model 3)*. This shows that loyalty measured by tenure does not significantly affect the short-term market measure for the probability of default. The TMT is not able to significantly affect the performance of the firm in the short-term however, they are able to affect the long-term market measure for the probability of default. In addition, the historic performance of the firm does not have a significant effect on the tenure of the TMT.

The *Random Intercept Models (RIM)* show that average CEO, CFO and Chairman tenure (standardized) maintains a significant relationship to the long-term market probability of default. The *RIM Model 2* shows that comparing companies with the same value for other predictors, a 1 standard deviation increase in average tenure would decrease the long-term market probability of default by 0.16017 standard deviations.

The *Random Intercept and Slope Model (RISM)* show that average CEO, CFO and Chairman tenure (Standardized) is a significant predictor of the long-term market probability of default. The *RISM Model 2* shows that comparing companies with the same value for other predictors, a 1 standard deviation increase in the average CEO, CFO and Chairman tenure would decrease the long-term market probability of default by 0.16907 standard deviations.

Kiel and Nicholson (2003), an Australian study, found that on average non-executive directors made up 69% of the board and 23% of firms had CEO duality (role of chairman and CEO combined). Carson (2002), an Australian study, found that, 76% of firms had a non-executive chairman, 69% of firms have non-executive board directors, average number of executive directors was 1.97, 75% of firms were audited by ‘Big 6’, 84% of firms had an audit committee, 57% had a remuneration committee and 17% had a nominations committee. He concluded that the audit committee was a developed governance mechanism, remuneration committees were developing and nominations committee were underdeveloped. Collier and Gregory (1999) found that CEO duality and presence of executive directors on the audit committee had a negative effect on the audit committee activity. Garrow (2012) identified that there was little to no research on the relationship of the joint tenure of Chairman and CEO and its effect on firm performance.

Hambrick and D’Aveni (1992) found that CEO Dominance (t-5, t-4 and t-3) was significantly higher for bankrupt firms, the average tenure was significantly shorter for bankrupt firms and there were no differences in team heterogeneity.

Table 6.9 Key literature linked to findings relating to tenure in this study (Author's own collection)

Variable	Significant Relationship	Literature Support	Literature Against
BB1y	Negative correlation		
BB5y	Negative correlation		
CEO CFO Bonus	Positive correlation		
Gearing	Negative correlation	Nielsen and Nielsen (2013)	
Female executives on board	Negative correlation	Cao et al. (2015)	
BB5y OLS, Polynomial, RIM and RISM	Negative predictor	Fich and Slezak (2008), Hambrick and D'Aveni (1992)	Cao et al. (2015)

6.7 Effectiveness

This section analyses the findings of the relationship between TMT effectiveness and the likelihood of default. The section discusses the findings of Board-level effectiveness (Board Size) and Firm-level effectiveness (Number of employees), highlights they key significant relationships found in this study and discusses this within the context of findings from the previous key literature.

6.7.1 Board Level Effectiveness (Board Size)

This sub-section analyses the findings of board size as a measure of board level effectiveness and discusses them within the context of findings from previous studies. Table 6.10 summarises these findings and identifies key literature in support of or against these findings. Cao et al. (2015) and Platt and Platt (2015) found the mean number of directors on boards in their study to be similar to this study i.e. between 10 and 11.

The number of directors on the board has a significant positive correlation with the short-term market probability of default, the long-term market probability of default. This relationship is also seen with the accounting probability of default, where board size has a significant negative correlation to the Altman Z-score. This shows that for all three measures of default as the size of the board increases it correlates to an increase in the likelihood of default. This indicates that bigger board sizes could lead to inefficiencies leading to a decline in the firm causing an increase in the probability of default.

The results also show a significant positive correlation of the board size to the CEO and CFO salary and CEO and CFO bonus. As the number of directors on a board increases the average salary and bonus paid to the CEO and CFO increases. Nielsen (2010b) found similar results (significant positive correlation) between average executive compensation (salary and bonus) and TMT size. This is interesting as with an increase in board size one would expect increased scrutiny of the executive compensation levels. However, this relationship could also indicate that firms that are able to afford an increased number of directors on their board were also able to afford higher salaries or with an increased number of directors on the board it is likely to be more inefficient in scrutinising executive reward.

The board size has a significant positive correlation to the number of employees. This result is supported by the findings of Nielsen and Nielsen (2013) and Nielsen (2010b). Both these studies find that the TMT size has a significant positive correlation to the number of employees. This shows that as the number of employees in a firm increases they increase the number of directors on the board. The board size has a significant positive correlation to the market capitalisation. This result was supported by Boone et al. (2007) who found firm size to be a significant positive predictor of board size. This helps to argue that firms that are larger in size operationally (number of employees) and as per investment (market capitalisation) employ a larger number of directors.

The results also show a non-significant positive correlation between board size and firm performance. Similar results were found by Nielsen (2010b). She found a significant positive correlation between TMT size and ROA. Switzer and Wang (2013a) found board size has a significant positive correlation to ROA. However, they found TMT size to be a non-significant positive predictor of firm performance. However, Nielsen and Nielsen (2013) found the TMT size to be a significant positive predictor of firm performance and a significant positive correlation between the two. Guest (2009) found board size to be a significant negative predictor of firm performance (ROA, Tobin's Q and Share return). Switzer et al. (2018) found board size to have a significant negative correlation to ROA. Interestingly, Boone et al. (2007) find ROA to be a significant negative predictor of board size. This shows that as firms improve performance, the number of directors on the board reduces and as the firm performance declines, the firm employs more directors on the board to help turn it around. However, a positive correlation between performance and number of directors points towards larger board sizes help improve firm performance.

The correlation matrix also finds a non-significant negative correlation between board size and gearing. The direction of the relationship in this finding is supported by Switzer et al. (2018) and Switzer and Wang (2013a). They found gearing to have a significant negative correlation with board size. Interestingly, Linck et al. (2008) find gearing to be a significant positive predictor of board size. As firms employ greater use of debt financing the size of the board increases. This could relate to the agency problem where firms with a larger board size will work towards ensuring shareholder wealth is maximised and hence employing a larger amount of debt finance for investment. Alternatively, this could relate to covenants or monitoring devices employed by providers of debt finance that require their representation on the board in return for the investment. However, a negative correlation between board size and gearing indicates that larger board sizes prefer the reduction in debt financing and increase in equity financing, which is more expensive for the firm leading to possibly a reduction in shareholder wealth but also reducing the risk of the firm. The board size has a non-significant positive correlation to the average CEO, CFO and Chairman Tenure. However, Nielsen and Nielsen (2013) find a significant negative correlation between TMT size and TMT tenure and Cao et al. (2015) finds a significant negative correlation between board size and CEO tenure.

Finally, the findings show a non-significant positive correlation between board size and the number of female executives on the board. This finding is supported by Cao et al. (2015) who found a significant positive correlation between board size and percentage of female directors. This indicates that large boards are more inclusive and more likely to have increased female representation.

The *OLS models* show that the number of directors on the board has a significant effect on the short-term and long-term market probability of default. However, it is not a significant predictor for the accounting probability of default. *OLS model 1* shows that an increase in the size of the board by 1 director increases the short-term market likelihood of default by 1.006e+01 units and this relationship is stronger in the long-term. The *OLS model 2* shows that an increase in the size of the board by 1 director increases the long-term market likelihood of default by 4.612e+01 units. This shows that the size of the board influences the likelihood of default for the firm in the short-term and long-term, however, the historic performance of the firm is not affected by the size of the board. This result is supported by the findings of Cao et al. (2015), who found that whilst in the *OLS model* board size was a significant negative predictor however once employing hazard analysis (econometric modelling) board size becomes a significant positive predictor. This is also supported by Fich and Slezak (2008), who found the board size to be significantly positively related to the probability of default and Switzer et al. (2018).

Switzer et al. (2018) found board size to be a significant positive predictor to the probability of default (Bloomberg 5 year). However, Schultz et al. (2017) found board size to be a non-significant predictor of default across all their models. This was supported by Ting (2011); Platt and Platt (2012); Switzer and Wang (2013a); Switzer and Wang (2013b); Hambrick and D'Aveni (1992). Ting (2011) found board size to have a significant negative relationship, Platt and Platt (2012) found smaller board sizes were associated with bankrupt firms, Switzer and Wang (2013a) found board size to be a significant negative predictor of credit risk, Switzer and Wang (2013b) found board size to be a significant negative predictor for financial firms' probability of default and Hambrick and D'Aveni (1992) found board size to be a significant negative predictor 1 year prior to bankruptcy. These results provide a strong rationale to explore a curvilinear relationship of board size with the probability of default rather than a traditional linear relationship.

In the *polynomial models*, Board Size is a key predictor of the likelihood of default as evidenced by it being a significant predictor in all three *polynomial models*. In addition, all three *polynomial models* show that the size of the board has a curvilinear relationship to the likelihood of default.

Polynomial model 1 shows that comparing companies with the same value for other predictors, an increase in the board size by 1 director initially increases the short-term likelihood of default by 1.227e+00 units and after a point, a further increase in the board size by 1 director decreases the short-term likelihood of default by 1.977e+01 units. However, this relationship is reversed when we focus on the long-term market probability of default. This is visible in *polynomial model 2*, where an initial increase in the board size by 1 director decreases the market probability of default by 2.249e+02 units and after a point, an increase in the board size by 1 director increases the long-term market probability of default by 1.086e+01 units. *Polynomial model 3*, provides similar results to the long-term market probability of default. An Increase in the board of director size by 1 director, in *polynomial model 3*, decreases the accounting probability of default by 1.305e+00 units and after a point, an increase in the board of directors by 1 director increases the accounting probability of default by 5.764e-02 units.

The *Random Intercept Models (RIM)* show that board size (standardized) maintains a significant curvilinear relationship to the short-term and long-term market probability of default. However, the relationship with the accounting probability of default is no longer significant. *RIM Model 1* shows that, comparing companies with the same value for other predictors, a 1 standard deviation increase in the board size initially would decrease the short-term probability of default by 0.60979 standard deviations and after a certain point an increase in the board size by 1 standard deviation would increase the short-term probability of default by 0.82858 standard deviations. This relationship is further emphasised in *RIM Model 2*, where a 1 standard deviation increase in board size initially would decrease the long-term market probability of default by 0.88027 standard deviations and after a certain point a further increase in the board size by 1 standard deviation would increase the long-term market probability of default by 1.00456 standard deviations.

The *Random Intercept and Slope Models (RISM)* show that board size (standardized) maintains a significant curvilinear relationship to the short-term and long-term market probability of default. However, the relationship with the accounting probability of default is no longer significant. The *RISM Model 1* shows that, comparing companies with the same value for other predictors, a 1 standard deviation increase in the board size initially would decrease the short-term market probability of default by 0.98265 standard deviations and after a certain point a further 1 standard deviation increase in the board size would increase the short-term market probability of default by 1.16087 standard deviations. This relationship further continues in the *RISM Model 2*, where initially a 1 standard deviation increase in the board size would decrease the long-term market probability of default by 0.90205 standard deviations and after a certain point a further 1 standard deviation increase in the board size would increase the long-term market probability of default by 1.06175 standard deviations. The relationship of board size with the accounting probability of default is not a significant curvilinear relationship. The *RISM Model 3*, shows that this relationship is now negative i.e. a one standard deviation increase in the board size would increase the accounting probability of default initially by 0.03438 standard deviations and after a certain point by 0.07930 standard deviations.

Table 6.10 Key literature linked to findings relating to board size in this study (Author's own collection)

Variable	Significant Relationship	Literature Support	Literature Against
BB1y	Positive correlation		
BB5y	Positive correlation		
AltmanZ	Negative correlation		
CEO CFO salary	Positive correlation	Nielsen (2010b)	
CEO CFO Bonus	Positive correlation	Nielsen (2010b)	
Number of employees	Positive correlation	Nielsen and Nielsen (2013); Nielsen (2010b)	
Market Capitalisaiton	Positive correlation	Boone et al. (2007)	
BB1y OLS	Positive predictor	Cao et al. (2015); Fich and Slezak (2008); Switzer et al. (2018)	Schultz et al. (2017); Ting (2011); Cao et al. (2015); Switzer and Wang (2013a); Switzer and Wang (2013b); Hambrick and D'Aveni (1992); Platt and Platt (2012);
BB1y Polynomial, RIM and RISM	Curvilinear predictor		
BB5y OLS	Positive predictor	Cao et al. (2015); Fich and Slezak (2008); Switzer et al. (2018)	Schultz et al. (2017); Ting (2011); Cao et al. (2015); Switzer and Wang (2013a); Switzer and Wang (2013b); Hambrick and D'Aveni (1992); Platt and Platt (2012);
BB5y Polynomial, RIM and RISM	Curvilinear predictor		
Altman Polynomial	Curvilinear predictor		

6.7.2 Firm Level Effectiveness (Number of Employees)

This section analyses the findings of the number of employees as a measure of firm-level effectiveness and discusses them within the context of findings from previous studies.

Table 6.11 summarises these findings and identifies key literature in support of or against these findings.

The number of employees has a significant positive correlation to the short-term market probability of default and the long-term market probability of default. This relationship is also seen with the accounting probability of default i.e. a significant negative correlation to the Altman Z-score. This shows that as the number of employees in a firm increases the probability of the firm defaulting across all measures of default increases. This provides support to the argument that as the number of employees increases the TMT may struggle to be effective due to inefficiencies resulting from the large employee base to manage which may lead to an increase in the likelihood of default.

The number of employees has a significant positive correlation to the average CEO and CFO salary and average CEO and CFO Bonus. Nielsen (2010b) found a similar significant positive correlation between executive compensation (salary and bonus) and the number of employees and O'Reily III et al. (1988) found a similar significant correlation between executive compensation (salary and bonus) and the number of employees. Firms that require a larger number of employees operationally were paying their CEO and CFO higher salaries as an indicator for a larger representation. However some sectors do require a larger number of employees such as retail, which could affect this correlation.

The board size has a significant positive correlation to the number of employees. This result is supported by the findings of Nielsen and Nielsen (2013) and Nielsen (2010b). Both these studies find that the TMT size has a significant positive correlation to the number of employees. This shows that as the number of employees in a firm increases they increase the number of directors on the board.

Finally, market capitalisation has a significant positive correlation to the number of employees. This indicates that as firms increase in investment size the number of employees increases. Market capitalisation is a reflection of a firms financial size as the higher the market capitalisation the bigger the company financially. The number of employees is a reflection of the operational size of firm. The higher the number of employees the bigger the firms operations. The findings here shows that there is a significant positive correlation between a firms financial size and a firms operational size.

CEO, CFO and Chairman Tenure have a non-sig positive correlation with the number of employees. This is consistent with the findings of Finkelstein and Hambrick (1990) who found the number of employees has a significant positive correlation to the TMT tenure. This indicates that the tenure of the executives is longer in firms that are operationally larger. However, Nielsen and Nielsen (2013) found a significant negative correlation between TMT tenure and the number of employees. The findings of this research also show a non-significant negative correlation between firm performance and the number of employees.

In addition, Finkelstein and Hambrick (1990), found the number of employees to be a non-significant positive predictor of strategic persistence i.e. as the number of employees increased the firm was increasingly more persistent with their strategy. Nielsen and Nielsen (2013), Nielsen (2010b) and Richard and Johnson (2001) all found evidence to support a positive correlation between measures of firm performance (ROA and ROE) with the number of employees. Therefore, indicating an increase in firm performance correlated with an increase in the number of employees.

The *OLS models* show that the average number of employees has a significant effect on the short-term and long-term market probability of default. This finding is supported by Memba and Job (2013) found employees to be the second highest ranked item likely to affect financial distress within a firm. Richard and Johnson (2001) found the number of employees to be a non-significant negative predictor of firm performance. Therefore, indicating an increase in the number of employees leads to a decrease in firm performance. However, Nielsen (2010b) and Nielsen and Nielsen (2013) found the number of employees to be a significant positive predictor of firm performance. The number of employees is not a significant predictor for the accounting probability of default. *OLS model 1* shows that an increase in the average number of employees by 1 increases the short-term market likelihood of default by 1.729e-04 units and this relationship is stronger in the long-term.

The *OLS model 2* shows that an increase in the number of employees by 1 increases the long-term market likelihood of default by 6.436e-04 units. This shows that the number of employees influences the likelihood of default for the firm in the short-term and long-term, however, the historic performance of the firm is not affected by the number of employees. Wright et al. (2007) found a significant negative relationship between different measures of risk-taking and the number of employees which is inconsistent with the findings of this research.

In the *polynomial models*, the number of employees is a significant predictor for the short-term market probability of default only and it is not a significant contributor to the long-term market probability of default and the accounting probability of default.

Polynomial model 1 shows that, comparing companies with the same value for other predictors, an increase in the average number of employees by 1 increases the short-term market probability of default by 2.105e-04 units. This shows that in the short-term TMT effectiveness firm-wide measured by the number of employees has an effect on the short-term market probability of default.

The Random Intercept Models, show that the number of employees is a significant predictor for the short-term and long-term market probability of default. *RIM Model 1*, shows that a 1 standard deviation increase in the number of employees would increase the short-term probability of default by 0.27317 standard deviations. This relationship is further emphasised by the *RIM Model 2*, where a 1 standard deviation in the number of employees would increase the probability of default by 0.18857 standard deviations.

The *Random Intercept and Slope models (RISM)* show that the number of employees is a significant predictor for the short-term market probability of default however not a significant predictor for the long-term market probability of default. The RISM Model 1, shows that a 1 standard deviation increase in the number of employees would increase the short-term market probability of default by 0.28532 standard deviations. The *RISM Model 2*, shows a similar relationship where a 1 standard deviation increase in the number of employees would increase the long-term market probability of default by 0.13731 standard deviations.

Table 6.11 Key literature linked to findings relating to the number of employees in this study (Author's own collection)

Variable	Significant Relationship	Literature Support	Literature Against
BB1y	Positive correlation		
BB5y	Positive correlation		
AltmanZ	Negative correlation		
CEO CFO Salary	Positive correlation	Nielsen (2010b); O'Reilly III et al. (1988)	
CEO CFO Bonus	Positive correlation	Nielsen (2010b); O'Reilly III et al. (1988)	
Boardsize	Positive correlation	Nielsen and Nielsen (2013); Nielsen (2010b)	
Market Capitalisation	Positive correlation		
BB1y OLS, Polynomial, RIM, RISM	Positive predictor	Memba and Job (2013); Richard and Johnson (2001)	Wright et al. (2007)
BB5y OLS, Polynomial, RIM	Positive predictor	Memba and Job (2013); Richard and Johnson (2001)	Wright et al. (2007)

6.8 Control Variables

This section analyses the findings of the control variables and discusses them within the context of findings from previous studies. Table 6.12 summarises these findings and identifies key literature in support of or against these findings.

The Market capitalisation has a significant negative correlation to the Altman Z-score and a significant positive correlation to the executive salary, exceutive bonus and the size of the board. Boone et al. (2007) found market capitalisation to be a significant positive predictor of board size. This shows that the larger the firm financial size the probability of default is higher. The correlation also shows that the larger the firm financial size the higher the executive salary, bonus and bigger the board size. The regression models show that market capitalisation is a significant negative predictor for the Bloomberg 1 year and Bloomberg 5 probability of default across all regression models. Cao et al (2015) however find market capitalisation to be a significant positive predictor of default. This is consistant with the findings by Schultz et al. (2017) who initially found firm size to give inconsistent findings i.e. it was a negative predictor in the OLS and GMM and positive predictor in the Dynamic OLS and Dynamic GMM. However, once they controlled for endogneity in the fixed panel model the results show market capitalisation to be a significant negative predictor of default. This is consistent with the findings of this study. This indicates that an increase in the market capitalisation decreases the short-term and long-term market probability of default.

This research finds firm performance to have a significant negative correlation to the Bloomberg 1 year and Bloomberg 5 year probability of default and a significant positive correlation to the Altman Z-score and executive bonus. This is consitent with the findings of Daily and Dalton (1994) Ting (2011), Switzer and Wang (2013a) and Switzer and Wang (2013b) who found firm performance to be a significant negative predictor of default. Switzer et al. (2018) also found ROA to be a significant negative predictor of the Bloomberg 5 year probability of default similar to this study. This shows that as firm performance improves the probability of the firm's default predicted by all measures decreases. This relationship continues in to the regression models where firm performance is a significant negative predictor for the Bloomberg 1 year and 5 year probability of default and a significant positive predictor for the Altman Z-score.

The level of the firm's gearing has a significant positive correlation to the Bloomberg 5 year probability of default and firm performance and a significant negative correlation to the Altman Z-score and TMT tenure. This is consistent with previous literature that has found gearing to have a significant positive relationship to default (Balachandran et al., 2010; Ting, 2011; Cao et al., 2015; and Schultz et al., 2017). This shows that as the tenure of the TMT increases the gearing level decreases indicating that the TMT are showing more preference to equity to finance projects than debt. This behaviour could be explained by the relationship gearing has in turn with the likelihood of default i.e. as the level of gearing increases the long-term probability of default and the accounting probability of default indicate an increase in default risk. This could point towards the existence of the agency problem as the increase in TMT tenure leads to their preference for a safer working enviornment at the expense of reduced risk and return. The relationship between gearing and long-term market probability of default and accounting probability of default continues into the regression models. However, Schultz et al. (2017) find that the relationship between gearing and default is not significant once they control for endogeneity.

Table 6.12 Key literature in support or against Control Variable findings

Variable	Significant Relationship	Literature Support	Literature Against
Market Capitalisation and AltmanZ	Negative correlation		
Market Capitalisation and CEO CFO Salary	Positive correlation		
Market Capitalisation and COE CFO Bonus	Positive correlation		
Market Capitalisation and board size	Positive correlation	Nielsen and Nielsen (2013); Nielsen (2010b); Boone et al. (2007)	
Performance and BB1y	Negative correlation	Daily and Dalton (1994)	
Performance and BB5y	Negative correlation	Daily and Dalton (1994)	
Performance and AltmanZ	Positive correlation	Daily and Dalton (1994)	
Performance and CEO CFO Bonus	Positive correlation		
Gearing and BB5y	Positive correlation		
Gearing and AltmanZ	Negative correlation		
Gearing and CEO CFO Chairman Tenure	Negative correlation		
Gearing and Performance	Positive correlation		Nielsen and Nielsen (2013); Nielsen (2010b); Guest (2009)
Market Capitalisation and BB1y	Negative predictor	Schultz et al. (2017)	Cao et al. (2015)
Performance and BB1y	Negative predictor	Ting (2011); Switzer et. al (2018); Switzer and Wang (2013a); Switzer and Wang (2013b); Daily and Dalton (1994)	
Market Capitalisation and BB5y	Negative predictor	Schultz et al. (2017)	Cao et al. (2015)
Performance and BB5y	Negative predictor	Ting (2011); Switzer et. al (2018); Switzer and Wang (2013a); Switzer and Wang (2013b); Daily and Dalton (1994)	
Gearing and BB5y	Positive predictor	Schultz et al. (2017); Balachandra et al. (2010); Ting (2011); Cao et al. (2015); Switzer et. al (2018)	
Performance and AltmanZ	Positive predictor	Ting (2011); Switzer et. al (2018); Switzer and Wang (2013a); Switzer and Wang (2013b); Daily and Dalton (1994)	
Gearing and AltmanZ	Negative predictor	Schultz et al. (2017); Balachandra et al. (2010); Ting (2011); Cao et al. (2015); Switzer et. al (2018)	

6.9 Conclusion

This chapter undertook an analysis of the findings presented in chapter 5 within the context of findings in the previous academic work. This chapter provided a comparison of Classical Regression and Multilevel/Hierarchical modelling which showed that where the data is nested within different levels undertaking just classical regression does not provide accurate results and it is more appropriate to undertake multilevel modelling.

The findings for executive salary, a measure of short-term motivation, showed that the results are consistent with a majority of prior literature and provides a unique contribution regarding its curvilinear relationship to the short-term probability of default which had not been document before. Executive bonus, a measure of long-term motivation, provided results consistent with a majority of existing empirical work however a key contribution was the non-existence of a significant relationship of this measure to the long-term market probability of default which is similar to the findings of Schultz et al. (2010; 2017). TMT tenure, a measure of loyalty, showed a significant relationship to the long-term market probability of default consistent with a majority of existing literature however the lack of a significant relationship to the short-term market and accounting probability of default was a significant contribution. The effect of board size of the firm, a measure of the TMT board level effectiveness, was a significant finding as it helped explain the inconsistent findings and debates in existing empirical work. The number of employees, a measure of the TMT firm level effectiveness, showed a significant relationship to the market based measures of the probability of default, which was consistent with a majority of the existing empirical work. However, the lack of a significant relationship to the accounting probability of default was interesting as it helps understand the relevance of this to market sentiment. Finally, this chapter provided a discussion of the findings of the control variables within the context of prior academic findings as robustness checks. This provided further evidence on the validity and reliability of the findings discussed.

Chapter 7

Conclusion and Recommendations

7.1 Introduction

This chapter begins by restating the research aim and the research hypothesis. The previous chapter discusses the findings of this research and the implications of the findings within the existing literature. This chapter presents the contributions of the research with a focus on its key findings, the limitations of this research and recommendations for further research.

7.2 Research aim and hypotheses

7.2.1 Aim

The overall aim of the research is to explore the relationship between the Top Management Team (TMT) attributes and the probability of firm default.

7.2.2 Hypotheses

Hypothesis 1a *There is no relationship between executive short-term motivation and the likelihood of firm financial distress*

Hypothesis 1b *There is a negative relationship between executive long-term motivation and the likelihood of firm financial distress*

Hypothesis 2 *There is a negative relationship between TMT loyalty and the likelihood of firm financial distress*

Hypothesis 3a *There is no relationship between TMT board level effectiveness and the likelihood of firm financial distress*

Hypothesis 3b *There is a positive relationship between TMT firm level effectiveness and the likelihood of firm financial distress*

7.3 Contribution of this research

The literature review in chapter 2 provides the background to the development of a theoretical framework and shows how existing theories fit together to provide a theoretical model. The literature review in chapter 3 identifies many gaps in the current state of knowledge and understanding of the relationship between key TMT attributes and the probability of the firm default in the UK, in contrast to the advanced state of literature in the US. This research attempts to reduce this gap in the literature by undertaking an empirical research on the relationship between TMT attributes and the probability of firm default. This is an important contribution to the field of TMT research and firm outcomes and specifically the inclusion of the CFO within the definition of the TMT. The role of the CFO has rarely been studied within Corporate Governance and this is rarer within the UK Corporate Governance literature. The literature review identifies the most studied firm outcomes within corporate governance and TMT literature are financial outcomes. Hence, it is vital that the executive that has direct responsibility for the firm finances should be included within the definition of the TMT when studying financial outcomes. This study is the first of its kind to focus on the relationship between TMT attributes and the probability of firm default where the CFO is included in the TMT definition.

The development of the theoretical model will contribute significantly to the development of theory within corporate governance. Corporate governance and TMT theories have been slow to update and reflect on the global financial crisis of 2007. This trigger has shown behaviours and attributes routinely criticised within the press and media which has brought about a new decade of executives and non-executives within publicly listed companies. The model provides a framework that focuses on attributes of individuals within the TMT but also on the team as a whole which has rarely been done for the UK. The theoretical model developed provides a framework from where further developments can be made to reflect the relationship between firm outcomes and key TMT attributes.

The contribution of this thesis can be viewed from various perspectives. It presents an overview of how the TMT of a firm influence firm outcomes through the theoretical framework, and provides a comprehensive examination of the relationship of specific attributes on the probability of firm default. The major contribution of this research is this default prediction model using TMT attributes. The empirical work is validated by an out of sample test on a recently defaulted firm and the success of this model at predicting a higher default probability than existing market and accounting based models one year prior to the default.

The empirical work uses both market and accounting-based measures for default prediction which is rarely undertaken unless specifically for the purposes of comparing the performance of the different default prediction models. This allows this research to understand the specific relationship of TMT attributes to accounting measures of default prediction and compare and contrast this to the relationship to market-based measures of default prediction.

The model provides a new and unique tool for shareholders to assess the default likelihood of the firm using management characteristic. This allows the shareholders to make an informed judgement on the risk appetite of their portfolios. In addition, the model would also provide a framework which the remuneration committee and nominations committee of the firm can use to set executive remuneration contracts and appointments. The significance of the role of the CFO identified in this research and the model allows firms and future corporate governance codes to specifically focus on this executive.

In summary, the research makes the following contributions:

- The proposed theoretical framework brings existing theories together and provides a framework for the further development of future theories, which has been validated by the empirical evidence;
- The inclusion of the CFO within the definition of the TMT and their specific impact on the default probability of the firm;
- The inclusion of both market based and accounting-based measures of default prediction to compare and contrast the relationship of TMT attributes to each of these measures;
- The combination of specific individual executive and non-executive attributes and overall team attributes, which shows how individual and team attributes affect the default probability of the firm;
- The findings of this study provide listed firms outside the FTSE 100 in the UK with a framework to examine their TMT remuneration and appointments by undertaking an out of sample test of the model on a recently failed UK FTSE 350 firm;
- The findings provide the shareholders, the remuneration committee and nominations committee with a framework to predict the default probability of the firm using TMT attributes;

- The research findings make an important contribution to literature within corporate governance and provides a strong case for future corporate governance regulations to specifically address the role of the CFO.

7.4 Summary of key findings

This section summarises some of the key findings of this research on the relationship between TMT motivation, loyalty and effectiveness with the probability of firm default.

7.4.1 Motivation

The research shows that salary as a short-term motivator for the executives is significant for the accounting and short-term market probability of default. The increase in salary shows an increase in the accounting probability of default. The relationship to the short-term market probability of default is interesting as there is a curvilinear relationship. This shows that an initial increase in salary leads to a decline in the short-term market probability of default however as the rate of salary increases the short-term market probability of default starts to increase. The research also finds that for the long-term market measure of default salary does not have any significant effect.

Bonus as a long-term motivator for the executives is significant for the accounting and short-term market measure of default. The increase in bonus shows a decrease in the accounting probability of default and the short-term market probability of default. In addition, results for the long-term market probability of default does not show any significant relationship. This, therefore, requires careful attention from shareholders and non-executive directors as executive bonus fail to achieve the objective of aligning executive objectives with longer-term objectives of the shareholder and the organisation. Executives are ensuring that the likelihood of default for the firm reduces to ensure that it continues to remain in existence and they are able to achieve their bonuses.

7.4.2 Loyalty

A key finding of this research is that tenure as a measure of loyalty has a significant relationship to the long-term market measure of default. It does not show any significant relationship to the accounting likelihood of default and the short-term market likelihood of default. This shows that as the tenure of the TMT increases they were able to reduce the long-term market likelihood of default of the firm. This is interesting as longer tenure TMT's were strategically focussing on the long-term health of the organisation. This also shows that the TMT need to be in tenure for sometime before being able to affect the likelihood of default and that being in a short or long-tenured TMT fails to affect the accounting probability of default or the short-term market probability of default.

7.4.3 Effectiveness

A significant finding of the research is the relationship of the size of the board as a measure of TMT board level effectiveness with all three measure of default prediction. There is a significant curvilinear effect of the size of the board to all the default predicting models i.e. accounting, short-term and long-term. This is interesting as it does not show that large board sizes were able to use the varied experience and expertise to reduce the likelihood of default or increase the likelihood of default. Instead, it shows that for the short-term market probability of default increase in the board size led to an increase in the probability of default however at higher levels of increase in the board size decreased the likelihood of default. This was inverse for the long-term market probability of default which showed that an initial increase in the size of the board decreased the likelihood of default and at higher levels, an increase in the board size increased the likelihood of default. The findings for the long-term market probability of default supported the findings of the accounting probability of default which had similar results.

This is interesting as this shows that as board sizes get bigger and gain a wider range of expertise and experience they focus more on ensuring the long-term health of the organisation which may be at the expense of the short-term health of the organisation. However, there comes a time where the board is too large and the focus then turns to the short-term health of the organisation at the expense of its long-term health. The may also point to the effectiveness the TMT have when the board size is increasing but smaller, as they effectively use the resource (experience and expertise) available however they find it difficult when this gets too large and possibly supporting the argument that then getting decisions through the board is more inefficient.

The number of employees is a significant positive predictor for the short-term and long-term market probability of default. This shows that as the number of employees increases it has the effect of increasing the likelihood of default. This could point toward firms that are operationally larger in size have a higher probability of default. The argument here is that as the number of employees increases the firm becomes more complex to run and it is harder for the TMT to be effective at the firm level. The TMT is not able to run the organisation more efficiently possibly due to the increase in the number of levels within the organisation and decisions may take longer to be made and implemented due to the number of employees that have to support the implementation or planning. Whilst, the number of employees is not a significant predictor of the accounting probability of default however, a significant negative correlation does indicate. Pointing to a similar relationship that as the number of employees increases the likelihood of default of the firm increases.

7.4.4 Probability of default measures

Another key finding of this research appears from the use of three different measures of default prediction allowing for a comparison across the different results. The different measures of probability of default used in this study i.e. Bloomberg 1 year probability of default, Bloomberg 5 year probability of default and the Altman Z-score all show similar results for a majority of the variables. However, they show very interesting results for the short-term motivation of the executives and the board level effectiveness of the TMT.

The short-term motivation of the executives measured by the average salary shows a significant curvilinear relationship to the short-term market probability of default whereas it is a non-significant positive predictor for the long-term market probability of default. The short-term motivation of the executives also has a negative effect on the accounting probability of default. This is interesting as it shows that in the short-term a constant increase in salary does not have an effect of always reducing the likelihood of default. Whereas an increase in short-term motivation has the effect of increasing the accounting probability of default and the long-term probability of default shows a similar sign, whilst not significant. One could argue that as executives receive higher salaries they take on more risky investments or are able to manipulate the accounting information to portray riskier investments. However, a constant increase in the default likelihood also points to firms paying the executives higher salaries to turn a firm around when the accounting information points to higher default likelihood. The short-term probability of default further shows that this higher salaries will only help up to a point after which a higher salary is detrimental.

As pointed out earlier the board size has a curvilinear relationship to all three measures of default i.e. the TMT effectiveness at board level has a curvilinear relationship to the likelihood of default. However, the relationship to the accounting probability of default and the long-term market probability of default is inverse compared to the short-term market probability of default. In the short-term, an increase in the board size increases the likelihood of default and after a point, a further increase in board size decreases the likelihood of default. This is inverse for the long-term and accounting probability of default. An initial increase in the board size decreases the likelihood of default, however, a further increase in board size increases the likelihood of default. This shows that when a firm is in difficult larger board sizes are beneficial which allows the utilisation of a wide range of expertise on the board to turn the firm around. However, a larger board size causes inefficiencies in decision making in the long-term as indicated by the other two measures. This measure and variable need careful attention from regulators and shareholders as for the long-term success of the organisation there is an ideal number of directors on the board for each individual organisation. Which is opposed to popular belief that more directors on the board are more beneficial.

7.5 Limitations of the research

This study recognises a number of limitations as any other research. The study was limited to the UK FTSE 100 firms and hence caution must be exercised when generalising its findings. The theoretical model identifies key TMT attributes that influence the firm outcome and specifically default probability of the firm, however, there are potentially other attributes which could change over time such as management fads.

The study has some methodological limitations. The quantitative approach provides a wide scope for investigation, but perhaps far less detailed, whereas qualitative research could provide a narrower but more exhaustive scope. A quantitative study was the most suited methodology for this study for the purpose and aim of the research. The lack of sufficient literature within the UK context further favours the use of quantitative methods to get a wider overview. Although every effort was made to ensure a wide range of theories were reviewed when developing the theoretical framework, it could be those other theories which should have formed part of the framework had been overlooked. However, a number of theories that were reviewed have not been included in the theoretical framework as they are not directly relevant to the scope of the study and these are evidence in the section "other theories".

7.6 Recommendations for further research

The limitations discussed in the previous section identify the way to further research. Specifically, related research that can build on these research findings can be undertaken in a number of ways in order to overcome the limitations outlined above. Further research to extend the scope of this study in order to gain a wider understanding is recommended.

This research fills the gap in the literature on the relationship between TMT attributes and the likelihood of default for UK listed firms. It is recommended that future research is undertaken on the comparative study between countries with differing corporate governance regimes to further develop on the findings of this study. Specifically, a comparative study between the US (a rules bases corporate governance approach such as the Sarbanes Oxley) and the UK (a principal based corporate governance approach such as 'comply or explain').

It is further recommended that the theoretical model developed is tested on a sample of failed firms vs a matched sample of non-failed firms to further the findings of this research. This would also allow the model to be further revised and developed to more accurately predict the likelihood of default using TMT attributes. The aim of this study was to understand the relationship and hence it was more appropriate to use default probabilities, however, to further develop the model into default prediction it is recommended to test the model on failed firms vs non-failed firms.

Future research should also specifically focus on key relationships and the combined attributes of the CEO, CFO and Chairperson. This will allow for a further understanding of how the CFO specifically influences the CEO and Chairperson and how their combined relationship affects firm outcomes.

A study comparing the performance of the accounting based default prediction, market-based default prediction and the management based default prediction (presented in this study) should be undertaken to identify the performance of each of these models in predicting default.

Methodologically, some further work through a survey by the TMT would provide a good understanding of the findings of the study. However, it would be extremely difficult to get a reasonable response rate to the survey from the TMT of a listed firm. Additionally, focusing on behavioural aspects of the TMT by undertaking a factor analysis through the creation of factors by combining a number of variables would further aid in the understanding of the findings of this research.

7.7 Thesis summary

This PhD research investigates the effects of the key TMT attributes on the probability of a firm's default. The study is motivated by the main research question: Is there a relationship between the key TMT attributes and the likelihood of firm financial distress? Specifically, the study pursues motivation, loyalty and effectiveness as the key attributes to analyse. It was hypothesised that there is: no relationship between executive short-term motivation and firm financial distress, a negative relationship between executive long-term motivation and firm financial distress, a negative relationship between TMT loyalty and firm financial distress, no relationship between TMT board level effectiveness and firm financial distress, no relationship between TMT firm level effectiveness and firm financial distress. Synthesising the Behavioural theory of the firm, Upper Echelons theory, Resource Based View, Agency theory, Stewardship theory, Stakeholder theory and Seasons of tenure this research built and tested a theoretical model. The Literature on TMT and financial distress has focussed almost exclusively on the role of the CEO or different definitions of the TMT however; the role of the CFO is very rarely studied. This research argues that the role of the CFO is extremely important when a firm faces financial difficulties and is key to the definition of TMT that influence the financing decisions of the firm. In addition, this research uses both accounting based measures and market based measures for predicting the likelihood of default whereas a majority of the literature in this field has used either accounting based measures or market based measures.

Previous research indicates that the effect of TMT remuneration and tenure on firm performance is positive and this relationship is clear when focussing on bonuses, however, the literature on cash remuneration provides mixed results. The effect of board size and the size of the firm has also provided mixed results within the literature. The model addresses major gaps in the literature by defining executives as the CEO and CFO and by defining the TMT as the CEO, CFO and Chairman. In addition, there is very little literature on the effect of TMT attributes on financial distress or the likelihood of financial distress for the UK, which is addressed by this research. This research uses multilevel modelling on a hierarchical dataset to address some of the limitations of previous research by modelling for the variability of regression intercepts and slopes and addressing the violation of the independence assumption. The most important contribution is the contribution of the research to the UK corporate governance code to ensure a better understanding of the effect of the key attributes and the role played by the CFO. Using a sample of UK listed companies, on the FTSE 100, excluding the financial sector, for the period 2013 to 2016, this research uses OLS regression, Polynomial regression, Random Intercept model and Random Intercept and Random slope models as robustness checks to test the theoretical model developed. The independent variables in the study are Salary, Bonus, Tenure, Board Size and Number of employees. The dependent variables in the study are Altman Z-score, Bloomberg 1 year probability of default (BB 1Y) and Bloomberg 5-year probability of default (BB5Y). The control variables in the study are Sector, Market Capitalisation, Gearing and Performance. In addition to these variables, a select number of variables were studied at the descriptive stage that emerged from prior literature: Share ownership, Gender, Number of female executives on the board and CEO Duality.

The findings from the research illustrate that for the short-term market measure for the probability of firm default (BB 1Y): Salary and Board Size have a significant curvilinear relationship, the bonus has a significant negative relationship and number of employees has a significant positive relationship. Tenure is not a significant predictor for the short-term market measure for the probability of default. For the long-term market measure for the probability of default (BB 5Y): Salary and Bonus are not significant predictors, tenure has a significant negative relationship, number of employees has a significant positive relationship and board size has a significant curvilinear relationship. For the accounting measure for the probability of default (Altman Z-score): Salary has a significant negative relationship to the probability of default, bonus has a significant positive relationship to the probability of default, board size has a significant curvilinear relationship to the probability of default and tenure and numbers of employees are not significant predictors. The study concludes that there is a relationship between key TMT attributes and the likelihood of default. The effect of the attributes varies for the short-term, long-term and accounting measures of the probability of firm financial distress. The study provides models that will be key to future governance to ensure a financially healthier corporate environment, designing optimal executive contracts and remuneration, and timely response to signs of financial weakness.

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Appendix A

Supporting Material

A.1 UK Corporate Governance

The UK corporate Governance code is divided into Leadership, Effectiveness, Accountability, Remuneration and Relations with Shareholders. The Financial Reporting Council (2014) highlighted the following key changes to the most recent ‘revised code’: Going concern, risk management and internal control; Remuneration; Shareholder engagement; and Other issues which included the ‘tone from the top’ of the company in terms of its culture and values. Below is a summary of the UK Corporate Governance Code (2014):

Section A Leadership

- The company should be headed by an effective board which is responsible for its long-term success
- There should be clear division of responsibility between the running of the board and the executive responsibility of running the company’s business
- The chairman is responsible to lead the board and ensuring its effectiveness
- Non-executive directors should constructively challenge and help develop strategy

Section B Effectiveness

- The board and its committees should have the appropriate balance of skills, experience, independence and knowledge of the company
- There should be a formal, rigorous and transparent procedure to appoint new directors
- Directors should be able to allocate sufficient time to the company
- Directors should receive an induction and regularly update and refresh their skills and knowledge
- The Board should be supplied with information in a timely manner
- The Board should undertake a formal annual evaluation of its own performance
- All directors should be submitted for re-election at regular intervals

Section C Accountability

- The Board should present a fair, balance and understandable assessment of the company's position and prospects
- The Board is responsible in determining the principle risk it is willing to take to achieve its objective
- The Board should establish formal and transparent arrangement for considering how they should apply the corporate reporting, risk management and internal control principles and for maintaining an appropriate relationship with the auditor

Section D Remuneration

- The remuneration should be designed to promote the long-term success of the company and performance-related pay should be transparent, stretching and rigorously applied
- The procedure for developing policy on executive remuneration and fixing of individual directors' remuneration should be formal and transparent

Section E Relations with Shareholders

- The Board as a whole has responsibility for ensuring that a satisfactory dialogue with shareholders takes place
- General meetings should be used to communicate with investors and encourage their participation

A.2 Other Theories

This section discusses some of the other Management and Leadership theories reviewed for the purposes of this research.

A.2.1 Development of Leadership theories

The initial leadership theories commence with the Trait Approach. This can be traced back to the early 1900s to 1940s which argues that leaders are born and individuals that possessed the correct qualities and traits are better suited to the role (Fleenor, 2006). Gardner (1989) undertook a study of a large number of leaders and concluded that some attributes appear to make leaders successful in any situation. However, the problem with such traits was that they were often perceived as "male" traits. This is supported by the 19th-century idea of the great man theory argued by Thomas Carlyle in the early 1840s. He argued that the history of the world is a biography of great men and these individuals shaped history through their personal attributes. Leaders have certain traits which make them good leaders e.g. intelligence, persistence, confidence which further implied that people with these traits can lead in any situation. However, Herpet Spencer in the 1860s argued that these individuals were products of their social environment. In addition, there is no clear agreement on what these traits are.

The Ohio State University undertook a series of studies on leadership styles in the 1950s and narrowed leadership behaviour into two dimensions, Consideration and Initiating Structure (Stogdill, 1974). The level of consideration is the sensitivity to the relationship and the social needs of employees and the level of Initiating Structure is the emphasis on task performance and achieving goals. Burnes (2004) highlights the leadership styles as categorised by Kurt Lewin in 1939. These are authoritarian/autocratic, democratic and Laissez-Faire (Lewin et al. 1939). The authoritarian/autocratic is where the power is with the manager who makes most of the decisions himself, Democratic is where the employees have more freedom and participate in the decision making and Laissez-Faire is where the leader does not interfere in the decision making but is available for advice.

Fiedler (1967) proposed the contingency theory of leadership. Miner (2005) explains the two major stages of development in the contingency theory i.e. the exploration stage in the early 1950s to 1960s and the second stage which began with the statement of the contingency theory. The early stage argued that different situations require different leadership styles and the leader must change his behaviour to suit the situation. Fidler's (1967) contingency theory proposed that the leadership effectiveness was influenced by three key variables i.e. if the task is structured or unstructured, the leader's power position and the nature of the leader and follower relationship.

However, criticism of the theory states that it fails to consider other factors that affect a situation such as culture and stress. In addition, it is argued that it is not reasonable to assume that leaders can adapt their styles to different contexts. A leader that changes styles may not inspire confidence or trust.

Hersey and Blanchard (1969) developed a lifecycle theory of leadership which was renamed to the situational leadership in 1977. The theory categorises leadership styles based on four behaviours i.e. Telling, Selling, Participating and Delegating. This is contrasted by the transformational leadership theory from the 1980s. Hucynski (2013:673) defines transformational leadership as a behaviour where the leader treats the relationship with employees in terms of motivation and commitment, influencing and inspiring them to give more compliance to improve organisational performance. The four components of transformational leadership are intellectual stimulation, idealised influence, individualised consideration and inspirational motivation. However, this has been criticised by some as a variation to the great man theory, it ignores context and may promote organisation change at a too rapid pace as there should be a balance between change and continuity.

Distributed leadership emerged in the early 2000s. Huczynski (2013, p675) describes distributed leadership as an informal and spontaneous collective exercise of leadership behaviours by staff at all levels of an organisation. It may involve many people, shared, be impermanent and move from one individual to another. It is better suited to flatter structures that hierarchical structures which move away from command and control and moving towards creating a vision, coaching, teamwork and empowerment.

A.2.2 Narcissism, Hubris and Animal Spirits

"The leader himself need love no one else; he may be of a masterful nature, absolutely narcissistic, self-confident and independent." (Freud [Translator Strachey], 2011)

Agency theory argues that the objectives of the principal (shareholder) and the agent (manager) are not aligned and mechanisms need to be in place to provide protection to shareholders (Eisenhardt, 1989). However, stewardship theory argues that the objectives of the managers as stewards of the shareholders are aligned (Donaldson and Davis, 1991). Roll (1986) argues that managers intend to be honourable stewards for the shareholders however hubris, which is overconfidence, leads to managers making incorrect decisions. Gregory (1997) argues that within the M&A context, hubris and behavioural theories of management are possible explanations for M&A outcomes.

Narcissism is seen as a personality trait (Campbell et al., 2005), which has its origins in Greek mythology, characterised by a sense of personal superiority (Campbell et al. 2004), desire for power (Emmons, 1987) and confirmation of their superiority (Bogart et al., 2004). Oesterle et al. (2016), a study of German manufacturing firms, analysed the relationship between CEOs narcissistic tendency and their internationalisation decisions. They found that CEOs with a high degree of narcissism tend to increase business internationalisation. The authors highlight the use of Narcissistic Personality Inventory (NPI), a forty-item choice method, to measure narcissism in psychology, however the difficulties around response rates by CEOs and bias they choose an alternate method. An alternative to this method is the measurement technique adapted from Chatterjee and Hambrick (2007). The authors calculate the following four indicators to measure narcissism: size of the CEO's photograph in the company's annual report; number of times the CEO's name was mentioned in the press release divided by the number of words in the article; CEO's cash compensation divided by that of the next highest cash compensated executive; and the CEO's non-cash compensation divided by the next highest non-cash compensated executive. A similar index has also been used in research by Engelen et al (2015) and Gerstner et al (2013).

Bono and Ilies (2006) identified a positive link between leader emotions and follower mood and found that charismatic leadership is linked to organisational success. This positive firm performance linked to positive employees' mood emerging from positive leadership was also supported by Sy et al. (2005). Maccoby (2000) highlights that a CEO having narcissistic traits could be productive as long as they have trusted colleagues to help avoid the limitations and negatives of the trait. Chatterjee and Hambrick (2007) used an examination of the incidence of CEO photographs in annual reports, CEO prominence in company reports and a comparison of CEO compensation with the second highest paid executive to measure narcissism.

Hubris, like narcissism, has its origins in Greek mythology which refers to exaggerated self-confidence or pride (Hayward and Hambrick, 1997). Roll (1986), argues that 'hubris' or extreme self-belief leads to management paying higher for M&A targets. He further suggests that when acquisitions fail to create shareholder value, hubris explains why managers do not abandon this transaction. Chatterjee and Hambrick (2007, developed from Hayward and Hambrick (1997), distinguished between hubris and narcissism and suggest that narcissism is a more ingrained trait than hubris.

Garrow and Valentine (2012) list several studies that use an induction process to link CEO hubris as a possible contributor to poor M&A outcomes (Sharma and Ho, 2002; Gregory, 1997). Many researchers argued the difficulty with measuring hubris (Tichy, 2001; Sirower, 1997) and whilst Roll (1986) argued that confidence is a manifestation of Hubris some argued that overconfidence is better explained by the Agency theory. Billett and Qian (2008) found that acquirers with no acquisition history showed no sign of hubris.

Hubris (Roll, 1986) was found to influence managerial actions (Sharma and Ho, 2002; Gregory, 1997) and narcissism (Higgs, 2009) or animal spirits (Akerlof and Shiller, 2009) was found to be a more dominant influence than hubris on managerial behaviour.

Hambrick and D'Aveni (1992) in a study of corporate bankruptcies found that weak Top Management Teams (short-tenured or few outside directors) fail to identify the seriousness of problems or fail to monitor the implementation plans.

"Most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits – of a spontaneous urge to action rather than inaction and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities." (Keynes, 1936, p161)

Akerlof and Shiller (2009, p.13) focussed on confidence as a key component of animal spirits and argued that when people are confident they behave in a certain way. They argued that 'animal spirits' was a restless and inconsistent element in the economy. Garrow and Valentine (2012) applied the idea of a restless and inconsistent element in the economy to that of a firm. Akerlof and Shiller (2009, p132) further argue that the volatility in share prices was as a result of both rational and irrational behaviours.

Roll (1986), argues that 'hubris' or extreme self-belief leads to management paying higher for M&A targets. He further suggests that when acquisitions fail to create shareholder value, hubris explains why managers do not abandon this transaction. Chatterjee and Hambrick (2007, developed from Hayward and Hambrick (1997), distinguished between hubris and narcissism and suggest that narcissism is a more ingrained trait than hubris.

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A.3 Pilot study

The pilot study shows that the findings are consistent and free from measurement error. The test measures are consistent over time, equivalent (two items measure same concepts at same level of difficulty) and internally consistent (items assess same concept).

The pilot study commenced with all listed companies on the London stock exchange as on January 2007. The companies were then further filtered down to only focus on companies with a market capitalisation of over £50m in 2007 (some further filters applied were country of origin: UK and Market: UK Listed). Random numbers were assigned to the list and an initial sample of 10 companies were selected to undertake a pilot study. The period of the study was from 2007 (year selected as the year the global financial crisis was triggered) to 2012 (the date the doctoral study commenced). This highlighted that due to a few companies being acquired in this period there was only partial data available for some companies therefore the pilot sample was then increased to a further random sample of 5 companies making the original pilot sample of 15 companies. The list also included investment trust and other financial firms that are not structured from a governance perspective as a usual business (i.e. a CEO and CFO do not exist for these firms and they have an investment management firm running them). Hence, these companies were then dropped taking the final sample of the pilot to 8 companies.

After a discussion with the supervision team a further 3 companies that had failed during this period were included. These companies were selected by going through the random companies list and checking their status on the 'Companies House' website. A company would only be included in the final sample if it had failed in one of the years of the study except for in year T0 (i.e. 2007). This led to the final sample equating to 11 companies altogether with complete years' data for 8 and partial years' data for the 3 failed companies.

The measures selected for the variables identified through the theoretical framework (PHIMALE model) were identified using a mix of measures used in previous research and the researchers own subjective judgement. It was assumed that during the process of the pilot study some further measures may be identified to include in the final study and many measures may be dropped due to them not being relevant for the UK Corporate Governance environment. The data collected is from multiple secondary sources i.e. Bloomberg database, Bloomberg website (Capital IQ by S&P data), FT.com and the individual firm's annual reports for the 6 years. This has provided the pilot with a total of 48 observations (i.e. 8 companies for 6 years).

Theoretically, using a range of sources for data should not influence the study as all these databases access and provide only public information therefore they should be consistent however, practically there have been some discrepancies between databases and where possible data available through the company's website or annual report have been used in those instances. This nevertheless highlights a very commonly discussed demerit of using secondary data. However, this research would like to highlight the benefit of using multiple sources as being able to verify the data and be able to access some database proprietary measures which may not have been possible if relying on only one source.

The Bloomberg probability of default (at 3m, 6m, 9m, 1y, 2y, 3y, 4y and 5y) for each individual company were collected on a daily basis. The yearly average and standard deviation was then calculated in order to match the time interval of the dependent variable to the time intervals of the independent variables (which are annually). Some further alternatives to this method (calculating the yearly average) were considered and will be discussed at a later stage.

FT.com was used to identify number of press reports that contained the full name of the director combined with the name of the company. As some searches returned with 0 reports the validity of this data was checked by undertaking a 'Google' search for the same term during the same period and this also returned 0 results. This is used as one of a few measures of Hubris, along with the number of times their last name appears in the annual report and the relationship score as available through Bloomberg website (Accessed from Capital IQ). The FT article would help measure a director's overall hubris as a result of their popularity in the media and the annual report search would help measure their Hubris as a result of their popularity within the firm. Initially the size of the picture of the director in the annual report was also selected as a measure for Hubris (as this has been used in previous research), however the pilot very early on showcased that the size of the image and its existence within the annual report of the sample was the same for all directors irrespective of their role within the firm. Therefore, this measure will not be used within the final study.

Qualification which seems like a simple measure to use becomes more complex the further its looked into. An initial discussion with colleagues who are holders of professional qualifications from a range of professional bodies raised some key issues, namely (ranking of the professional bodies, time when the qualification was completed as more recently some may debate the exams are less challenging than they have been previously, standing of the University where a Masters or MBA was gained, what would a professional qualification equate to i.e. a Masters or a doctorate or in between and a professional qualification in a relevant field vs a doctorate in a completely irrelevant field etc.). One other difficulty with this measure is that in a majority of the cases this is unlikely to change on a year on year basis.

The measure Team Tenure was calculated as the maximum time the three individuals in their roles simultaneously were a team within that company. i.e. Individual A, B and C were individually in term for 2,3, and 5 years therefore the team tenure was calculated to be the 2 years.

Director transaction as a variable was added to see the relationship between the position change of the director and the likelihood of default. This data is available on a quarterly basis and specifically makes available the quarter in which there was a change to the directors holding. This could be compared to the respective quarters default rate for the company.

The directors ages were collected from the Bloomberg executive profile webpages as of 2016 and then manually calculated to give their ages in the years between 2007 to 2012.

A downside of the measure Relationship (as measured through Capital IQ) is that the CEO CFO and Chairman could have relationships with each other and therefore impacting the data in addition this data is as of the current year and not for the respective years in study. Therefore, their relationships/networking would most likely have been very different back in the period of the study.

Ethnicity/Place of birth initial data was collected from the Bloomberg database; however, data was only available for 3 directors from the sample.

Data Preparation

Overall, there were 55 observations of 11 companies.

ChMBC (Chair is a Member of a board committee) - This variable was removed as the response was a ’yes’ for the entire sample

CFOMBC (CFO is a Member of a board committee) - This variable was removed as there were only 3 observations where this was a ’yes’

No_CFOMBC (Number of committee CFO is a member) - This variable was removed as there were only 3 observations

Outside Directorship, variables were removed, as currently the data for this is unaccessible. This data is accessible via BOARDEX

CFOCBC (CFO Chair of a board committee) - This variable was removed as there was only one observation where this was a ’yes’

FInt - This variable was removed, as it is not very useful in a longitudinal study

Chair/CEO/CFO Ethnicity - This variable was removed as data was only available for 3 executives via Bloomberg and will be included again when access to Boardex is available.

Number of years International Experience - This variable data was not collected, as it requires trolling through the CVs of each individual executive

Chair/CEO/CFO Acquisition Experience - This variable data was not collected as it requires trolling the CVs of each individual executive and after discussion will be replaced with the variable Firm Acquisition Experience

ChGen (Chair Gender) - This variable was removed, as there were only two observations where the executive was female

CEOGen (CEO Gender) - This variable was removed, as there were only three observations where the executive was female

CFOGen (CFO Gender) - This variable was removed, as there were only two observations where the executive was female

Chair/CEO/CFO/Team Relationship Capital IQ measure - This variable has been retained for the pilot study however, this will be replaced by Boardex networking score when access to that database is available. The Capital IQ score is for the executive in 2016 only and not for each of the respective years in study. In addition, the networking score only takes into account each individual's current network with other executives on all boards

Coding completed and values assigned to CEO Duality, CEOMBC, ChCBC, CEOCBC, Maj_TBC, Maj_TBC_List, ChQual, CEOQual and CFOQual

A.4 Findings in the literature

(2) Schultz et al. (2017)- Australian study using Merton's distance to default Once endogeneity issues are addressed by econometric models they find no relationship between probability of default and corporate governance mechanisms – This finding is rejected by the study Executive fixed pay significant positive relationship (OLS) Executive variable pay non-significant negative relationship (OLS, Pooled Dynamic OLS, Fixed Effects, Dynamic sys. GMM) Executive fixed pay non-significant positive relationship (Pooled Dynamic OLS, Fixed Effects panel) Executive fixed pay non-significant negative relationship (GMM, Dynamic sys. GMM) Board Size non-significant positive relationship (OLS, Pooled Dynamic OLS, Fixed Effects, GMM, Dynamic sys. GMM) Firm size non-significant negative (OLS, GMM) Firm size non-significant positive (Pooled Dynamic OLS, Dynamic sys. GMM) Firm size significant negative (Fixed Effects Panel) Leverage significant positive relationship (OLS, Fixed Effects) Leverage non-significant positive relationship (Pooled Dynamic OLS, GMM, Dynamic sys. GMM)

(4*) Wright et al. (2007) – A US study of Top Management Team incentives and firm risk taking Risk taking was measured as a lagged standard deviation of quarterly return on assets (ROA) and lagged standard deviation of monthly total return to shareholders. Initial models have a low R-squared similar to the study. They conclude that managerial incentives do matter as they significantly impact subsequent corporate risk taking Average Top Management Team bonus has a non-significant positive relationship to both measures of risk taking Total Number of employees has a significant negative relationship to both measures of risk taking Average Top Management Team Salary has a significant negative relationship to both measures of risk taking

(Columbia business school research paper) Balachandran et al. (2010) – A US study on the relationship between equity-based incentive and the probability of default. The results find that equity based pay increase the probability of default while non-equity based pay decreases probability of default. Equity pay has a significant positive relationship Non-equity pay has a significant negative relationship Leverage has a significant positive relationship

(2) Ting (2011) – A Chinese study on the relationship between Top Management Team turnover and firm default risk. The study uses the KMV model to measure the probability of default. A low R-squared similar to the study Debt Equity ratio has a significant positive relationship ROA has a significant negative relationship Board of Directors Size has a significant negative relationship

(4) Loveman (1998) – A US Study within Retail Banking on employee satisfaction, customer loyalty and firm performance. Argue in favour of tenure as a proxy for loyalty similar to the study Find a slight relationship between employee satisfaction and firm performance

(4*) Dunn (2004) – A US study on the impact of Insider power on fraudulent financial reporting. Adjusted R-squared low similar to this study Director Tenure has a significant negative relationship Number of directors on boards non-significant positive relationship Altman Z-score non-significant positive relationship

(4*) Nielsen and Nielsen (2013) – A Swiss study on the relationship between Top Management Team diversity and firm performance. P-value used to <.10 similar to the study and large intercept and small coefficients similar to the study. The study uses hierarchial linear model similar to this study TMT Tenure significant negative correlation with leverage TMT Tenure significant negative correlation with number of employees TMT Size significant positive correlation with number of employees Return on Assets (ROA) significant negative correlation with leverage ROA significant positive correlation with number of employees TMT size significant negative correlation with TMT Tenure ROA significant positive correlation with TMT Size ROA significant positive correlation with TMT Tenure

Leverage is a significant negative predictor in all models Number of employees is a significant positive predictor in final model TMT Size significant positive predictor in final model TMT Tenure significant positive predictor in final model

(3) Nielsen (2010b) – A Swiss study on the effects of Top Management Team internationalisation and firm performance. TMT Size has a significant correlation to number of employees Average Executive Compensation has a significant positive correlation to TMT Size Average Executive Compensation has a significant positive correlation to the number of employees Average Executive Compensation has a significant positive correlation to ROA Return on Assets has a significant positive correlation to TMT Size Return on Assets has a significant positive correlation to number of employees Leverage has a significant negative correlation to ROA

TMT size is a non-significant positive predictor Executive compensation (Salary+Bonus) is a significant positive predictor Number of Employees is a significant positive predictor Return on Assets is a significant positive predictor Leverage is a non-significant positive predictor

(3) Cao et. al (2015) – A US study on the relationship between corporate governance and default risk. The study uses unbalanced sample of firms per year and sector similar to this study. Use distance to default developed from the work of Merton (1974). The study uses CEO tenure as a measure for CEO power Average board size similar to this study Board

Size has a significant negative correlation to CEO Tenure Board Size has a significant positive correlation to percentage of female directors Percentage of female directors has a significant negative correlation to CEO Tenure Board size is a significant positive predictor (Hazard analysis) CEO Tenure is a significant positive predictor (Hazard analysis) Gearing is a significant positive predictor (Hazard analysis and OLS) Market Capitalisation is a significant positive predictor (Hazard analysis) Boardsize is a significant negative predictor (OLS) CEO tenure is a non-significant positive predictor (OLS) Industry include as factor in the regression similar to the study

(3) Platt and Platt (2012) – A US study on corporate board attributes and bankruptcy using an unbalanced data set categorised by number of years and sector which is similar to this study. Board size – Average board size similar to this study Smaller board size are significantly associated with bankrupt firms

(3) Fich and Slezak (2008) – A US study on governance attributes ability to avoid bankruptcy and the power of financial/accounting information to predict bankruptcy – Unbalanced panel data similar to this study- Low R-squared similar to the study. Use Altman Z-score to predict bankruptcy similar to this study Board size significantly positively related to probability of bankruptcy CEO Bonus is not statistically significant CEO Tenure is a significant negative predictor

(1.921 IF) Vainieri et al. (2017) – An Italian study of the healthcare industry, investigated the relationship between top management competencies and organisational performance TMT Tenure has a non-significant positive relationship

(3) Guest (2009) – A UK study on the impact of board size on firm performance. This is a large study that spans a large number of years – The study has a low adjusted R-squared similar to this study Board Size is a significant negative predictor of firm performance (ROA, Tobin's Q, Share return) Market Capitalisation is a significant positive predictor of firm performance (ROA, Tobin's Q, Share return) Gearing is a significant negative predictor of firm performance (ROA, Tobin's Q, Share return)

(4*) Finkelstein and Hambrick (1990) – A US study focussing on the top management team tenure and organisational outcomes. R-squared low similar to this study Top Management Team tenure significant negative correlation to ROE Number of employees significant positive correlation to Top Management Team tenure Top Management Team tenure is a significant positive predictor of strategic persistence Number of employees non-significant positive predictor of strategic persistence Return on Equity non-significant positive predictor of strategic persistence

(4*) O'Reilly III et al. (1988) – A US study examining economic and psychological factors that influence the setting of CEO compensation. Low adjusted Rsquared similar to this study CEO Salary significant positive correlation to ROE CEO Salary significant positive correlation to number of employees CEO salary non-significant positive correlation to CEO tenure Number of employees is a non-significant negative predictor of CEO compensation ROE non-significant positive predictor of CEO compensation CEO Tenure non-significant positive predictor of CEO compensation

(3) Richard and Johnson (2001) – A US study that tests whether strategic human resource management effectiveness significantly affects firm performance. Study employs hierarchical regression analysis to test hypothesis similar to this study. Low R squared similar to this study Non-significant positive correlation between ROE and number of employees Number of employees is a non-significant negative predictor of firm performance

(4*) Boone et al. (2007) – A US study of industrial firms examining the determinants of corporate board size and composition. Low adjusted Rsquared similar to this study. Market Capitalisation and gearing have a significant positive correlation Market Capitalisation has a significant positive correlation to CEO Tenure Firm size is a significant positive predictor of board size ROA is a significant negative predictor of board size

(4*) Linck et al. (2008) – A US study examining corporate board structure trends and determinants. Gearing is a significant positive predictor of board size

(4) Kallunki and Pyyko (2012) – A Finnish study on the relationship between director personal default and firm financial distress. Use two different default probabilities (Altman and Ohlson) in two different models similar to this study.

(Interdisciplinary) Memba and NyanumbaJob (2013) – A Kenyan study analysing the causes of financial distress and its effects on firms. Management Turnover and Management replacement highest rank item likely to affect financial distress. Employees second highest ranked item likely to affect financial distress.

(3)Switzer Tu Wang (2016) – A study of non-North American financial firms looking at the relationship between corporate governance and default risk. The study uses CDS spreads and the Bloomberg probability of default (similar to this study) two different measures in different models similar to this study. R squared very low similar to this study. Data collected from Bloomberg similar to this study. Rsquared is increased on baseline model by including dummy variables to address outliers Return on Assets has a significant (<.10) correlation to Gearing Gearing has a significant negative correlation to Board Size Board size has a significant negative correlation to ROA Board size is a significant positive predictor for BB5Y (OLS) ROA is a significant negative predictor for BB5Y (OLS) Leverage is a significant positive predictor for BB5y (OLS)

(3) Switzer and Wang (2013) – A US study exploring the relationship between credit risk and corporate governance structures. Adjusted Rsquared very low similar to this study. Uses the Merton (1974) model similar to this study. This study includes the CFO age as a variable Board size is a significant negative predictor ROA is a significant negative predictor Gearing is a non-significant positive predictor Older CFOs are associated with lower credit risk

(Non ranked theoretical journal) Switzer and Wang (2013) – A US study exploring the relationship between credit risk and corporate governance structures for financial and non-financial firms. Data collected from Bloomberg similar to this study. Board size has a significant positive correlation to ROA Board size has a significant negative correlation to gearing Board size is a significant negative predictor for Financial firms probability of default ROA is a significant negative predictor for industrial firms probability of default Leverage is a non-significant positive predictor

(4*) Daily and Dalton (1994) – A US study examining the relationship among corporate governance structures and bankruptcy. Performance has a significant negative correlation to bankruptcy Gearing has a non-significant positive correlation to bankruptcy Profitability is a significant negative predictor

(4*) Finkelstein (1992) – A US study on the power dimensions of the top management team. Structural power (including compensation as a latent variable) has a non-significant correlation to ROE

(4*) Hambrick and D'Aveni (1992) – A US study exploring top management team attributes associated with major corporate failure. Board Size is a significant negative predictor 1 year prior to bankruptcy Compensation is a significant negative predictor up to 4 years prior to bankruptcy Tenure is a significant negative predictor 4, 3 and 2 years prior to bankruptcy

(2) Bebchuck and Grinstein (2005) - A US study examining the growth of executive pay empirically and theoretically. ROA is a significant positive predictor for CEO compensation ROA is a non-significant positive predictor for Executive compensation ROA is a significant positive predictor for CEO equity based compensation ROA is a significant positive predictor for Executive equity based compensation ROA is a significant positive predictor for CEO non-equity based compensation ROA is a significant positive predictor for Executive non-equity based compensation

Appendix B

Graphs and Tables

Receiverships, Administrations and
Company Voluntary Arrangements
England & Wales

Period	Receivership Appointments	Administrations	Company Voluntary Arrangements
2004	864	1,602	597
2005	590	2,261	604
2006	588	3,560	534
2007	337	2,512	418
2008	867	4,822	587
2009	1,468	4,161	726
2010	1,309	2,835	765
2011	1,397	2,808	767
2012	1,222	2,532	839
2013	917	2,365	577

Fig. B.1 Annual Receivership, Administration and CVA in England and Wales (Source: The Insolvency Service, 2014)

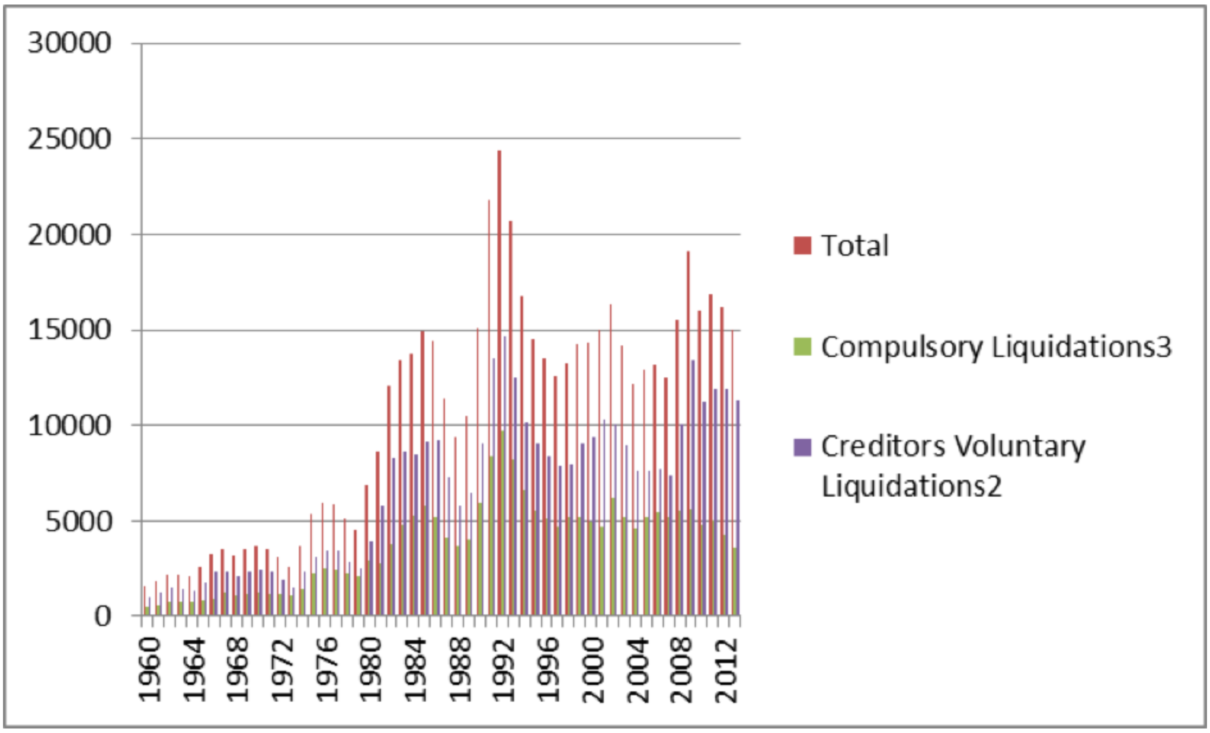

Fig. B.2 Compulsory Liquidations vs Creditors Voluntary Liquidations between 1960 and 2013 (Source: The Insolvency Service, 2014)

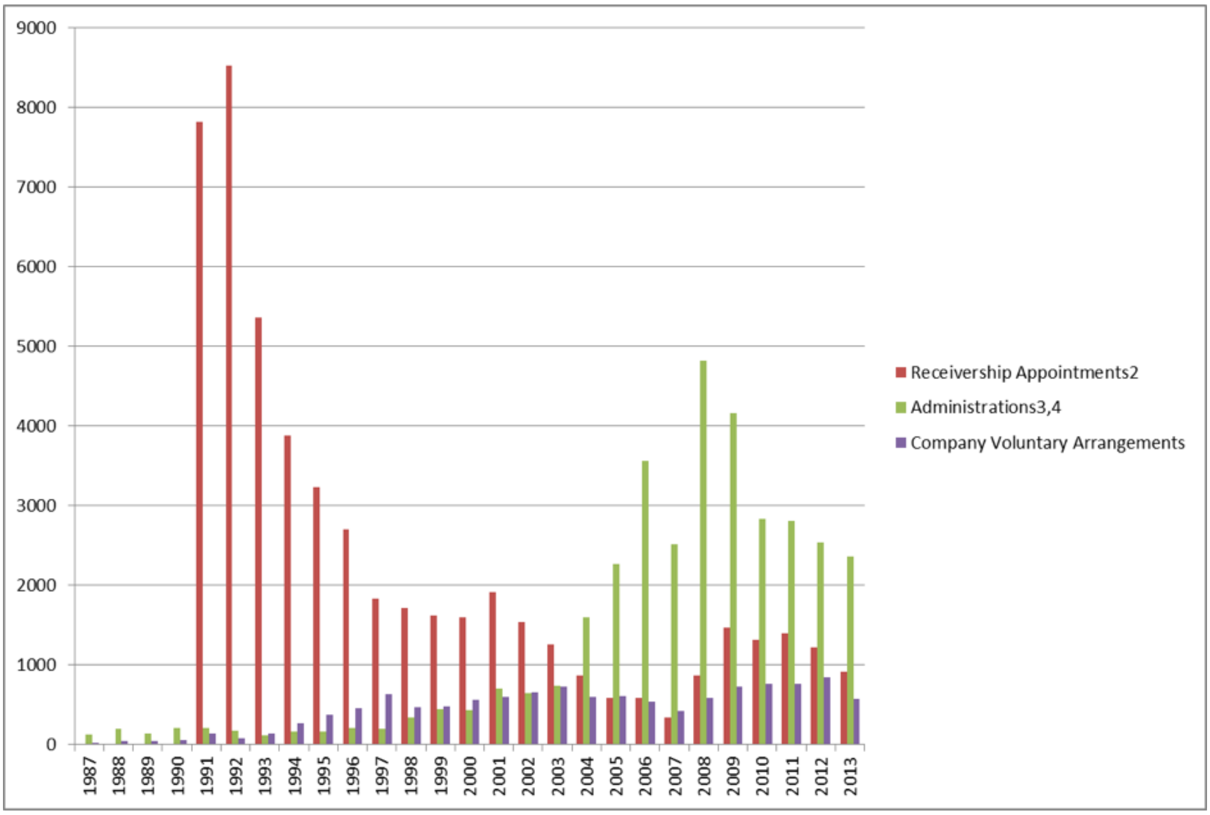

Fig. B.3 Receivership, Administration and CVA between 1987 and 2013 (Source: The Insolvency Service, 2014)

	Default Likelihood		Default Likelihood				
IG-1	0.0000%	-	0.0020%	HY-1	0.5200%	-	0.8800%
IG-2	0.0020%	-	0.0040%	HY-2	0.8800%	-	1.5000%
IG-3	0.0040%	-	0.0080%	HY-3	1.5000%	-	2.4000%
IG-4	0.0080%	-	0.0152%	HY-4	2.4000%	-	4.0000%
IG-5	0.0152%	-	0.0286%	HY-5	4.0000%	-	6.0000%
IG-6	0.0286%	-	0.0529%	HY-6	6.0000%	-	10.000%
IG-7	0.0529%	-	0.0960%	DS-1	10.000%	-	15.000%
IG-8	0.0960%	-	0.1715%	DS-2	15.000%	-	22.000%
IG-9	0.1715%	-	0.3000%	DS-3	22.000%	-	30.000%
IG-10	0.3000%	-	0.5200%	DS-4	30.000%	-	50.000%
				DS-5	50.000%	-	10.000%
				DDD	Defaulted		

Fig. B.4 Bloomberg default likelihood categorisation (Source: Bloomberg Professional Service, 2018)

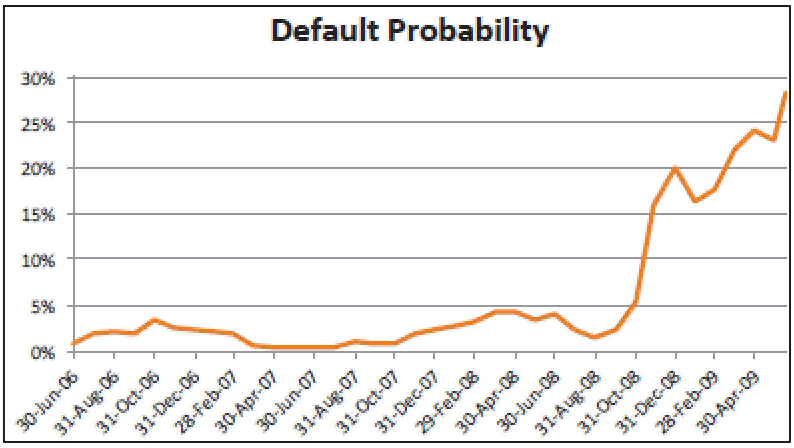

Fig. B.5 Eddie Bauer default probability (Source: Bloomberg Professional Service, 2018)

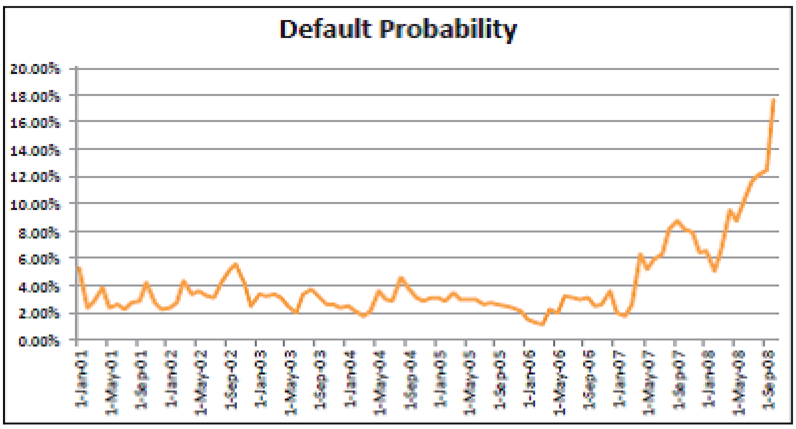

Fig. B.6 Lehman Brothers default probability (Source: Bloomberg Professional Service, 2018)

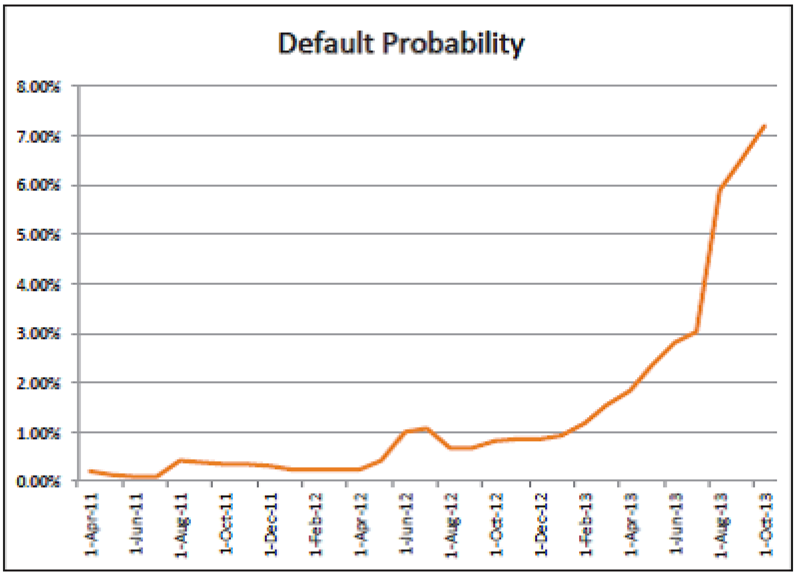

Fig. B.7 Oleo e Gas Partipacoes S.A default probability (Source: Bloomberg Professional Service, 2018)

Firm	Ticker	Default Probability	Corporate Action
Aemetis Inc.	AMTX	49.75%	Default, May 2009
Nova Biosource Fuels Inc.	NBFAQ	24.68%	Chapter 11 Bankruptcy, Mar 2009
Vineyard National Bancrop	VNBCQ	35.67%	Chapter 11 Bankruptcy, July 2009
Corus Bankshares	CORSQ	48.91%	FDIC arranged deposit sale, Sept 2009
Eimskipafelag Islands HF	HFEIM IR	8.09%	Filed for Composition on July 1, 2009

Fig. B.8 Examples of North American companies with high default probabilities and subsequent corporate actions (Source: Bloomberg Professional Service, 2018)

Firm	Ticker	Default Probability	Corporate Action
Shanghai Chaori Solar Energy/China	002506 CH	2.11%	Default, Mar 2014
Sino Forest Corp/China	TRE CN	6.89%	Default, Mar 2012
STX Corp/ Korea	011810 KS	2.84%	Creditor takeover, Jan 2014
Elpida Memory/ Japan	6665 JP	7.31%	Creditor capital injection, Aug 2009

Fig. B.9 Examples of Chinese, Japanese and Korean companies with high default probabilities and subsequent corporate actions (Source: Bloomberg Professional Service, 2018)

	1/19/2018				6/30/2017
Company	P(D) 1 Year	DRSK Risk Band	Price	% Price Change	Price
CARILLION PLC	18.71%	DS2	Suspended		186.8
Selected Competitors					
INTERSERVE PLC	4.49%	HY5	123.50	-46.6%	231.25
BALFOUR BEATTY PLC	0.15%	IG8	289.80	7.1%	270.60
GALLIFORD TRY PLC	0.25%	IG9	1,162.00	0.1%	1161.00
SERCO GROUP PLC	0.23%	IG9	97.15	-15.4%	114.90
COSTAIN GROUP PLC	0.12%	IG8	459.00	-0.5%	461.25
BABCOCK INTL GROUP PLC	0.09%	IG7	714.00	-18.9%	880.50
KIER GROUP PLC	0.16%	IG8	994.00	-18.9%	1226.00
Selected Suppliers					
MARTIFER SGPS SA	0.75%	HY1	0.39	8.6%	0.36
SEVERFIELD PLC	0.04%	IG6	82.00	5.8%	77.50
SPEEDY HIRE PLC	0.10%	IG7	57.80	-0.3%	58.00
PREMIER TECHNICAL SERVICES G	0.11%	IG8	196.50	54.7%	127.00
Selected Lenders					
BARCLAYS PLC	0.21%	IG9	200.50	-1.1%	202.75
LLOYDS BANKING GROUP PLC	0.07%	IG7	71.48	8.1%	66.15
ROYAL BANK OF SCOTLAND GROUP	0.16%	IG8	297.30	20.3%	247.20

Fig. B.10 Carillion plc's competitors, suppliers and lenders default probability (Source: Bloomberg Professional Service, 2018)

Table B.1 Variables used in key literature (Source: Authors own collection)

Focus	Author	Country	Salary (9)	Bonus (7)	Tenure (10)	Board Size (15)	Number of employees (5)	Market Cap (5)	Gearing (13)	Performance (13)
Board composition	Boone et al. (2007)	US			*	*		*	*	*
Board composition	Linck et al. (2008)	US				*			*	
CEO Compensation	O'Reilly III et al. (1988)	US	*				*			*
Default	Schultz et al. (2017)	Australian	*	*		*		*	*	
Default	Balachandran et al. (2010)	US	*	*					*	
Default	Ting (2011)	China				*			*	*
Default	Cao et al. (2015)	US			*	*		*	*	
Default	Platt and Platt (2012)	US				*				
Default	Fich and Slezak (2008)	US		*	*	*				
Default	Switzer et al. (2018)	non-North American				*			*	*
Default	Switzer and Wang (2013a)	US				*			*	*
Default	Switzer and Wang (2013b)	US				*			*	*
Default	Daily and Dalton (1994)	US							*	*
Default	Hambrick and D'Aveni (1992)	US	*	*	*	*				
Executive Pay	Bebchuck and Grinstein (2005)	US	*	*						*
Fraud	Dunn(2004)	US			*	*				
Organizational Outcome	Finkelstein and Hambrick (1990)	US			*		*			*
Performance	Loveman (1998)	US			*					
Performance	Nielsen and Nielsen (2013)	Switzerland			*	*	*		*	*
Performance	Nielsen (2010b)	Switzerland	*		*	*		*	*	*
Performance	Vainieri et al. (2017)	Italy			*					
Performance	Guest (2009)	UK				*		*	*	
Performance	Richard and Johnson (2001)	US					*			*
Power	Finkelstein (1992)	US	*	*						*
Risk Taking	Wright et al. (2007)	US	*	*			*			

Table B.2 Variable abbreviations (Source: Author's own collection)

Variable Code	**Variable Name**
bb1y	Bloomberg 1 year probability of default
bb5y	Bloomberg 5 year probability of default
altmanz	Altman Z-score probability of default
Salary_CEO	Salary of the Chief Executive Officer
Comp_CEO	Compensation of the Chief Executive Officer
Salary_CFO	Salary of the Chief Financial Officer
Comp_CFO	Compensation of the Chief Financial Officer
Tenure_CEO	Tenure of the Chief Executive Officer
Tenure_CFO	Tenure of the Chief Financial Officer
Tenure_Chair	Tenure of the Chairman
Share_CEO	Shareholding by the Chief Executive Officer
Share_CFO	Shareholding by the Chief Financial Officer
Share_Chair	Shareholding by the Chairman
No_Employees	Number of Employees
Market_Cap	Market Capitalisation
Board_Size	Number of Directors on the board
No_female_exec	Number of female executives on the board
Debt_Equity	Debt to Equity ratio
ROA	Return on Asset ratio
ROE	Return on Equity ratio

Table B.3 Bloomberg 1 year Linear Regression models - forward/backward selection (Source: Author's own collection)

	Dependent variable:								
	bb1y2								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
salarya22				0.000000000**				0.000000000**	0.000000000**
				(0.000000000)				(0.000000000)	(0.000000000)
mcap2	−0.000468014**		−0.000694632***	−0.000787205***	−0.000673807***	−0.000693910***	−0.000579541**	−0.000732111***	−0.000713693***
	(0.000228335)		(0.000248988)	(0.000249655)	(0.000252785)	(0.000249460)	(0.000252422)	(0.000261775)	(0.000253228)
performance2	−1.004169000***		−0.643952500*	−0.537611400	−0.618935600*	−0.585256500	−0.700478900*	−0.582253000	−0.612837900*
	(0.371246700)		(0.363358900)	(0.362476700)	(0.367350300)	(0.379977600)	(0.360912200)	(0.378636400)	(0.361708700)
gearing2	0.070874540		0.041051730	0.047521630	0.041642140	0.043282290	0.040388330	0.048531290	0.051218670
	(0.060706840)		(0.058060670)	(0.057504360)	(0.058186000)	(0.058316930)	(0.057516520)	(0.057354380)	(0.057163280)
sector2Consumer Staples	29.447560000		22.175520000	20.057170000	20.947260000	23.208690000	23.805620000	25.152780000	29.838480000
	(20.280640000)		(20.835310000)	(20.631420000)	(21.014160000)	(20.962320000)	(20.653730000)	(20.936270000)	(19.894140000)
sector2Energy	111.499000000**		148.224100000***	166.878100000***	145.314600000***	152.469800000***	139.533600000***	171.526800000***	172.526900000***
	(45.582680000)		(48.562990000)	(48.736780000)	(48.990400000)	(49.287720000)	(48.277550000)	(51.445000000)	(47.811970000)
sector2Health Care	2.785141000		−0.882047800	−2.375935000	−1.685228000	−1.003094000	5.527857000	5.622326000	15.867510000
	(24.520860000)		(25.851960000)	(25.581230000)	(25.950320000)	(25.901580000)	(25.783150000)	(25.690750000)	(24.479060000)
sector2Industrials	31.971170000**		31.235440000*	26.833430000*	30.905160000*	31.427860000*	38.511090000**	34.460590000**	38.952380000**
	(16.174500000)		(16.226050000)	(16.167610000)	(16.270720000)	(16.260510000)	(16.427910000)	(16.449630000)	(16.153550000)
sector2Information Technology	−22.829260000		−0.221495100	−8.495355000	−1.785143000	−2.335599000	−10.242690000	−18.260020000	−7.046482000
	(36.737390000)		(36.111040000)	(35.906640000)	(36.311090000)	(36.390940000)	(36.076020000)	(36.092970000)	(35.372280000)
sector2Materials	14.448610000		42.330120000*	23.913110000	42.550090000*	42.092070000*	39.378890000	17.364840000	18.939320000
	(23.676910000)		(24.850430000)	(25.887180000)	(24.902890000)	(24.901120000)	(24.655610000)	(26.174550000)	(25.725110000)
sector2Real Estate	−20.215130000		−8.386714000	−14.573620000	−7.254390000	−6.841427000	2.978013000	−5.203587000	−1.134849000
	(27.006440000)		(26.228610000)	(26.088210000)	(26.373360000)	(26.433870000)	(26.517390000)	(26.626630000)	(26.477220000)
sector2Telecommunication Services	80.915500000**		69.159290000**	73.269810000**	70.347860000**	71.827120000**	77.413690000**	81.973730000**	85.644310000**
	(35.878020000)		(34.911590000)	(34.582030000)	(35.057340000)	(35.325680000)	(34.797450000)	(34.844360000)	(34.501140000)
sector2Utilities	−1.033580000		15.148240000	17.472590000	15.266610000	15.206440000	18.307340000	20.811210000	23.948570000
	(24.202740000)		(23.669480000)	(23.436240000)	(23.717020000)	(23.714270000)	(23.493540000)	(23.349850000)	(23.262720000)
salarya2		0.000000733	0.000007087	−0.000078888*	0.000005466	0.000008754	0.000008190	−0.000085752**	−0.000068778*
		(0.000012693)	(0.000016629)	(0.000041303)	(0.000016960)	(0.000016945)	(0.000016480)	(0.000043064)	(0.000040991)
bonusa22					0.000000000			−0.000000000	
					(0.000000000)			(0.000000000)	
bonusa2		−0.000027735***	−0.000024217**	−0.000025399***	−0.000034074	−0.000026069**	−0.000022282**	−0.000002651	−0.000027470***
		(0.000009213)	(0.000009647)	(0.000009557)	(0.000021581)	(0.000010257)	(0.000009599)	(0.000024183)	(0.000009220)
tenurea22						0.232878900		0.213314500	
						(0.432002700)		(0.492618900)	
tenurea2		−3.392140000	−3.280125000	−3.010577000	−3.621311000	−6.534097000	−3.882380000*	−5.775141000	
		(2.148785000)	(2.290857000)	(2.269227000)	(2.390542000)	(6.457911000)	(2.286665000)	(6.866208000)	
employees2		0.000167991***	0.000172869***	0.000203522***	0.000169149***	0.000168921***	0.000181610***	0.000222031***	0.000210479***
		(0.000058645)	(0.000062486)	(0.000063270)	(0.000063031)	(0.000063031)	(0.000062034)	(0.000064714)	(0.000063071)
boardsize2		8.710722000***	10.063370000***	11.353240000***	9.884099000***	9.700694000***	−24.969960000	−23.851580000	−19.774520000
		(2.816538000)	(3.024321000)	(3.045180000)	(3.050504000)	(3.103808000)	(16.609170000)	(16.803900000)	(16.476600000)
boardsize22							1.414650000**	1.432825000**	1.226964000*
							(0.659679300)	(0.672946700)	(0.651055300)
Constant	135.943500000***	8.116001000	29.478420000	63.976420000	37.254240000	37.150630000	233.033500000**	264.605200000**	223.292900000**
	(31.738530000)	(28.574220000)	(42.934490000)	(45.109700000)	(45.632210000)	(45.308670000)	(104.014800000)	(104.267700000)	(101.668700000)
Observations	207	207	207	207	207	207	207	207	207
R^2	0.125554100	0.126259400	0.239895400	0.260160100	0.240949100	0.241068500	0.258044400	0.280313600	0.267079500
Adjusted R^2	0.071464700	0.104524600	0.171526200	0.189324300	0.168274000	0.168404900	0.187006100	0.198619500	0.196906200
Residual Std. Error	78.264680000 (df = 194)	76.858770000 (df = 201)	73.927490000 (df = 189)	73.129090000 (df = 188)	74.072460000 (df = 188)	74.066630000 (df = 188)	73.233580000 (df = 188)	72.708630000 (df = 185)	72.786310000 (df = 188)
F Statistic	2.321232000*** (df = 12; 194)	5.809079000*** (df = 5; 201)	3.508823000*** (df = 17; 189)	3.672723000*** (df = 18; 188)	3.315429000*** (df = 18; 188)	3.317594000*** (df = 18; 188)	3.632469000*** (df = 18; 188)	3.431258000*** (df = 21; 185)	3.806002000*** (df = 18; 188)

Note: *p<0.1; **p<0.05; ***p<0.01

Table B.4 Bloomberg 5 year Linear Regression models - forward/backward selection (Source: Author's own collection)

	Dependent variable:								
	bb5y2								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
salarya22				0.000000000				0.000000000*	
				(0.000000000)				(0.000000000)	
mcap2	−0.002922772**		−0.004438805***	−0.004749070***	−0.004429560***	−0.004430908***	−0.003579603**	−0.004418715***	−0.003335105**
	(0.001304226)		(0.001452098)	(0.001469280)	(0.001475258)	(0.001452019)	(0.001460584)	(0.001522689)	(0.001337533)
performance2	−6.240397000***		−4.632941000**	−4.276534000**	−4.621835000**	−3.990989000*	−5.054935000**	−4.312339000*	−5.566156000***
	(2.120518000)		(2.119110000)	(2.133267000)	(2.143865000)	(2.211715000)	(2.088336000)	(2.202446000)	(2.038973000)
gearing2	0.697270500**		0.565721100*	0.587405200*	0.565983200*	0.590116500*	0.560768500*	0.607934900*	0.540038200
	(0.346750500)		(0.338609900)	(0.338427600)	(0.339574900)	(0.339442200)	(0.332806200)	(0.333618000)	(0.331384700)
sector2Consumer Staples	91.807240000		62.236420000	55.136690000	61.691160000	73.536090000	74.405770000	103.211900000	48.432100000
	(115.840700000)		(121.511500000)	(121.421100000)	(122.639200000)	(122.014200000)	(119.508100000)	(121.781800000)	(111.768500000)
sector2Energy	600.807600000**		802.657400000***	865.177000000***	801.365800000***	849.091800000***	737.779100000***	939.113100000***	641.681700000**
	(260.363000000)		(283.219400000)	(286.828200000)	(285.909200000)	(286.886400000)	(279.347000000)	(299.244500000)	(250.617400000)
sector2Health Care	−56.544270000		−84.760140000	−89.766970000	−85.116690000	−86.084010000	−36.907510000	−28.333400000	−64.792120000
	(140.060400000)		(150.768600000)	(150.552000000)	(151.446700000)	(150.763900000)	(149.188300000)	(149.437500000)	(138.389200000)
sector2Industrials	148.486100000		137.059700000	122.306200000	136.913100000	139.164200000	191.375600000**	180.774700000*	189.338600000**
	(92.386900000)		(94.630350000)	(95.150460000)	(94.956310000)	(94.646660000)	(95.056360000)	(95.683970000)	(92.461820000)
sector2Information Technology	−108.298600000		−26.518140000	−54.248350000	−27.212280000	−49.639860000	−101.330500000	−136.698500000	−125.831200000
	(209.839800000)		(210.599600000)	(211.319600000)	(211.912400000)	(211.818800000)	(208.745700000)	(209.945000000)	(207.058200000)
sector2Materials	13.185410000		100.957800000	39.232360000	101.055500000	98.354290000	78.925650000	−15.462820000	87.044900000
	(135.239800000)		(144.927800000)	(152.352600000)	(145.333800000)	(144.940600000)	(142.664100000)	(152.251700000)	(131.405400000)
sector2Real Estate	−416.213500000***		−369.994100000**	−390.729800000**	−369.491500000**	−353.093500000**	−285.151700000*	−316.077200000**	−296.913500000*
	(154.257700000)		(152.965300000)	(153.535600000)	(153.915500000)	(153.862200000)	(153.436800000)	(154.881400000)	(151.671400000)
sector2Telecommunication Services	550.273200000***		516.218400000**	529.995000000***	516.746000000**	545.396100000***	577.840900000***	608.338800000***	569.521100000***
	(204.931200000)		(203.604500000)	(203.523900000)	(204.595500000)	(205.618300000)	(201.347500000)	(202.682100000)	(195.058000000)
sector2Utilities	50.564230000		104.129200000	111.919300000	104.181700000	104.765700000	127.713200000	137.305300000	128.768800000
	(138.243300000)		(138.040400000)	(137.928200000)	(138.413100000)	(138.032400000)	(135.940000000)	(135.821000000)	(135.687900000)
salarya2		0.000014881	0.000060752	−0.000227394	0.000060032	0.000078989	0.000068986	−0.000279695	
		(0.000076664)	(0.000096978)	(0.000243081)	(0.000098981)	(0.000098628)	(0.000095360)	(0.000250492)	
bonusa22					0.000000000			−0.000000000	
					(0.000000000)			(0.000000000)	
bonusa2		−0.000119088**	−0.000075556	−0.000079517	−0.000079932	−0.000095806	−0.000061109	0.000111427	
		(0.000055643)	(0.000056261)	(0.000056245)	(0.000125948)	(0.000059703)	(0.000055542)	(0.000140669)	
tenurea22						2.546971000		3.023270000	
						(2.514535000)		(2.865458000)	
tenurea2		−25.836870000**	−26.128320000*	−25.224910000*	−26.279780000*	−61.716650000	−30.624400000**	−64.680290000	−36.095530000***
		(12.978250000)	(13.360280000)	(13.354970000)	(13.951260000)	(37.589210000)	(13.231270000)	(39.939250000)	(12.133320000)
employees2		0.000768732**	0.000643583*	0.000746318**	0.000641932*	0.000600411	0.000708841**	0.000878657**	0.000743157**
		(0.000354206)	(0.000364421)	(0.000372362)	(0.000367850)	(0.000366880)	(0.000358946)	(0.000376425)	(0.000352661)
boardsize2		38.122860000**	46.121320000***	50.444380000***	46.041740000**	42.154740000**	−215.417200000**	−214.263800000**	−224.898100000**
		(17.011340000)	(17.637840000)	(17.921650000)	(17.802820000)	(18.066170000)	(96.105170000)	(97.744620000)	(94.105120000)
boardsize22							10.560950000***	10.717070000***	10.857060000***
							(3.817083000)	(3.914386000)	(3.787059000)
Constant	1,581.077000000***	905.830000000***	1,113.170000000***	1,228.792000000***	1,116.622000000***	1,197.081000000***	2,632.794000000***	2,757.551000000***	2,775.895000000***
	(181.286800000)	(172.582700000)	(250.394000000)	(265.481900000)	(266.310700000)	(263.725800000)	(601.857600000)	(606.502800000)	(587.540700000)
Observations	207	207	207	207	207	207	207	207	207
R^2	0.183595100	0.087900670	0.260186600	0.266700500	0.260192600	0.264202100	0.289131700	0.303176600	0.283865900
Adjusted R^2	0.133095900	0.065211630	0.193642500	0.196491000	0.189359900	0.193753300	0.221069800	0.224077700	0.223559800
Residual Std. Error	447.038900000 (df = 194)	464.212100000 (df = 201)	431.145200000 (df = 189)	430.383000000 (df = 188)	432.288600000 (df = 188)	431.115600000 (df = 188)	423.749400000 (df = 188)	422.930400000 (df = 185)	423.071500000 (df = 190)
F Statistic	3.635600000*** (df = 12; 194)	3.874147000*** (df = 5; 201)	3.909990000*** (df = 17; 189)	3.798638000*** (df = 18; 188)	3.673343000*** (df = 18; 188)	3.750274000*** (df = 18; 188)	4.248072000*** (df = 18; 188)	3.832882000*** (df = 21; 185)	4.707089000*** (df = 16; 190)

Note: *p<0.1; **p<0.05; ***p<0.01

Table B.5 Altman Z-score Linear Regression models - forward/backward selection (Source: Author's own collection)

	Dependent variable: altmanz2								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
salarya22				−0.000000000				−0.000000000	
				(0.000000000)				(0.000000000)	
mcap2	−0.000021546**		−0.000001986	−0.000001186	−0.000003865	−0.000002079	−0.000006821	−0.000005818	−0.000006689
	(0.000009157)		(0.000010107)	(0.000010265)	(0.000010233)	(0.000010055)	(0.000010237)	(0.000010727)	(0.000010173)
performance2	0.046215260***		0.032399560**	0.031480550**	0.030141610**	0.024853360	0.034774550**	0.028136430*	0.036034810**
	(0.014887970)		(0.014748940)	(0.014904250)	(0.014870070)	(0.015315460)	(0.014636810)	(0.015515600)	(0.014553500)
gearing2	−0.009839328***		−0.009698342***	−0.009754256***	−0.009751631***	−0.009985112***	−0.009670469***	−0.009927692***	−0.010020750***
	(0.002434505)		(0.002356715)	(0.002364454)	(0.002355327)	(0.002350534)	(0.002332586)	(0.002350243)	(0.002303971)
sector2Consumer Staples	0.501802900		−0.324207600	−0.305900700	−0.213348300	−0.457036300	−0.392697100	−0.472001000	−0.508444600
	(0.813307300)		(0.845716500)	(0.848319000)	(0.850638000)	(0.844911700)	(0.837613300)	(0.857917300)	(0.801120200)
sector2Energy	1.167701000		−2.683854000	−2.845064000	−2.421253000	−3.229694000	−2.318718000	−2.876052000	−2.329549000
	(1.827986000)		(1.971198000)	(2.003950000)	(1.983096000)	(1.986601000)	(1.957899000)	(2.108091000)	(1.920698000)
sector2Health Care	0.979956500		−0.197238100	−0.184327800	−0.124745300	−0.181675900	−0.466553800	−0.412160100	−0.357629900
	(0.983351700)		(1.049345000)	(1.051845000)	(1.050450000)	(1.043995000)	(1.045637000)	(1.052744000)	(0.991870400)
sector2Industrials	0.126686100		−0.266810400	−0.228767900	−0.237000400	−0.291549100	−0.572501300	−0.529068100	−0.453080400
	(0.648640400)		(0.658624300)	(0.664777000)	(0.658626900)	(0.655399400)	(0.666235000)	(0.674065900)	(0.643393100)
sector2Information Technology	−0.584683600		−1.673279000	−1.601776000	−1.532149000	−1.401481000	−1.252233000	−1.050979000	−1.100544000
	(1.473267000)		(1.465767000)	(1.476403000)	(1.469846000)	(1.466781000)	(1.463065000)	(1.479002000)	(1.426481000)
sector2Materials	1.717129000*		2.201638000**	2.360799000**	2.181784000**	2.232242000**	2.325635000**	2.433130000**	2.569046000***
	(0.949506800)		(1.008693000)	(1.064424000)	(1.008051000)	(1.003670000)	(0.999910000)	(1.072569000)	(0.972342900)
sector2Real Estate	−3.291920000***		−4.046708000***	−3.993240000***	−4.148908000***	−4.245376000***	−4.524203000***	−4.583872000***	−4.317326000***
	(1.083030000)		(1.064634000)	(1.072690000)	(1.067574000)	(1.065449000)	(1.075414000)	(1.091095000)	(1.055714000)
sector2Telecommunication Services	−3.137551000**		−3.868943000***	−3.904467000***	−3.976220000***	−4.211930000***	−4.215757000***	−4.457220000***	−4.253843000***
	(1.438804000)		(1.417081000)	(1.421938000)	(1.419096000)	(1.423844000)	(1.411213000)	(1.427837000)	(1.403253000)
sector2Utilities	−0.532352700		−0.836687000	−0.856774200	−0.847371000	−0.844168900	−0.969418200	−0.971409200	−0.736457400
	(0.970594000)		(0.960757000)	(0.963647300)	(0.960047700)	(0.955832200)	(0.952781800)	(0.956819900)	(0.924452000)
boardsize22							−0.059437290**	−0.052066280*	−0.057635110**
							(0.026753330)	(0.027575720)	(0.026444290)
salarya2		−0.000001273**	−0.000002459***	−0.000001716	−0.000002313***	−0.000002674***	−0.000002506***	−0.000002194	−0.000002624***
		(0.000000553)	(0.000000675)	(0.000001698)	(0.000000687)	(0.000000683)	(0.000000668)	(0.000001765)	(0.000000612)
bonusa22					−0.000000000			−0.000000000	
					(0.000000000)			(0.000000000)	
bonusa2		0.000000814**	0.000000916**	0.000000926**	0.000001806**	0.000001154***	0.000000835**	0.000001045	0.000000837**
		(0.000000401)	(0.000000392)	(0.000000393)	(0.000000874)	(0.000000413)	(0.000000389)	(0.000000991)	(0.000000375)
tenurea22						−0.029939860*		−0.022747760	
						(0.017412390)		(0.020186320)	
tenurea2		0.081325330	−0.028551950	−0.030881410	0.002242516	0.389792000	−0.003247877	0.310455100	
		(0.093611400)	(0.092987120)	(0.093305660)	(0.096767400)	(0.260293900)	(0.092735860)	(0.281360500)	
employees2		−0.000003792	−0.000002456	−0.000002720	−0.000002120	−0.000001948	−0.000002823	−0.000002553	
		(0.000002555)	(0.000002536)	(0.000002602)	(0.000002551)	(0.000002541)	(0.000002516)	(0.000002652)	
boardsize2		−0.274095900**	−0.117476900	−0.128624100	−0.101296200	−0.070849480	1.354468000**	1.200594000*	1.304713000*
		(0.122701900)	(0.122758800)	(0.125211200)	(0.123482200)	(0.125102700)	(0.673585900)	(0.688582600)	(0.667821200)
Constant	4.016040000***	9.397846000***	8.154730000***	7.856595000***	7.452905000***	7.168359000***	−0.397748300	−0.284033700	−0.296713200
	(1.272799000)	(1.244830000)	(1.742735000)	(1.854813000)	(1.847159000)	(1.826221000)	(4.218325000)	(4.272637000)	(4.106861000)
Observations	207	207	207	207	207	207	207	207	207
R^2	0.229042100	0.090912990	0.313446000	0.314275800	0.318151600	0.324075800	0.331010100	0.337498300	0.326520200
Adjusted R^2	0.181354000	0.068298880	0.251692500	0.248621300	0.252868300	0.259359600	0.266957800	0.262295400	0.269806200
Residual Std. Error	3.138621000 (df = 194)	3.348337000 (df = 201)	3.000757000 (df = 189)	3.006909000 (df = 188)	2.998399000 (df = 188)	2.985345000 (df = 188)	2.969992000 (df = 188)	2.979422000 (df = 185)	2.964217000 (df = 190)
F Statistic	4.802919000*** (df = 12; 194)	4.020190000*** (df = 5; 201)	5.075759000*** (df = 17; 189)	4.786816000*** (df = 18; 188)	4.873395000*** (df = 18; 188)	5.007650000*** (df = 18; 188)	5.167815000*** (df = 18; 188)	4.487836000*** (df = 21; 185)	5.757304000*** (df = 16; 190)

Note: *p<0.1; **p<0.05; ***p<0.01

Appendix C

R Code

```
setwd("C:/Users/sbsfb/Desktop/OneDrive - Sheffield Hallam University/USB/
    Recovered/FIROZ/PhD/MaD/Draft/Final")
#to tell R wherer the packages are located
#if package is not found after installation
.libPaths("C:/Users/sbsfb/Desktop/OneDrive - Sheffield Hallam University/USB/
    Recovered/FIROZ/PhD/MaD/Draft/R")

#################check linear models as the model names are same

df <- read.csv("tmtdatav2.csv", header= TRUE)

names(df)
company<-df[,4]
bb1y<-df[,25]*100000 #reduce number of decimal places
bb5y<-df[,26]*100000 #reduce number of decimal places
altmanz<-df[,27]+2 #remove negative z-score
salaryt<-df[,9]
bonust<-df[,7]-df[,9]+1#removed 0 by adding 1
tenuret<-df[,12]+df[,13]+df[,14]
employees<-df[,18]
mcap<-df[,19]
boardsize<-df[,20]
performance<-(df[,30]+df[,31])/2+70#removed negatives by adding 70
gearing<-df[,29]+1
sector<-df[,6]
salarya<-salaryt/2
bonusa<-bonust/2
tenurea<-tenuret/3
id<-df[,1]
```

```
t<-df[,2]

install.packages("stargazer")
library(stargazer)

var<-cbind.data.frame(t,sector,bb1y,bb5y,altmanz, salaryt ,bonust, tenuret ,
    employees,mcap,boardsize,performance,gearing, salarya ,bonusa,tenurea)
stargazer(var, type = "html", title ="Descriptive statistics ", digits =1, out="
    descriptive with missing.htm")
stargazer(df, type = "html", title ="Descriptive statistics ", digits =1, out="
    descriptive with missing all.htm")

##################################Descriptives
    ############################################

stargazer(subset(df, sector=="Consumer Discretionary"), title ="Consumer
    Discretionary",type="html",out="Sec1.htm")
stargazer(subset(df, sector=="Consumer Staples"), title ="Consumer Staples",type=
    "html",out="Sec2.htm")
stargazer(subset(df, sector=="Energy"), title ="Energy",type="html",out="Sec3.htm
    ")
stargazer(subset(df, sector=="Health Care"), title ="Health Care",type="html",out
    ="Sec4.htm")
stargazer(subset(df, sector==" Industrials "), title =" Industrials ",type="html",out
    ="Sec5.htm")
stargazer(subset(df, sector=="Information Technology"), title ="Information
    Technology",type="html",out="Sec6.htm")
stargazer(subset(df, sector=="Materials"), title ="Materials",type="html",out="
    Sec7.htm")
```

```
stargazer (subset(df, sector=="Real Estate"), title ="Real Estate",type="html",out
    ="Sec8.htm")
stargazer (subset(df, sector=="Telecommunication Services"), title ="
    Telecommunication Services",type="html",out="Sec9.htm")
stargazer (subset(df, sector==" Utilities "), title =" Utilities ",type="html",out="
    Sec10.htm")

stargazer (subset(var, sector=="Consumer Discretionary"), title ="Consumer
    Discretionary",type="html",out="Sec11.htm")
stargazer (subset(var, sector=="Consumer Staples"), title ="Consumer Staples",type
    ="html",out="Sec12.htm")
stargazer (subset(var, sector=="Energy"), title ="Energy",type="html",out="Sec13.
    htm")
stargazer (subset(var, sector=="Health Care"), title ="Health Care",type="html",out
    ="Sec14.htm")
stargazer (subset(var, sector==" Industrials "), title =" Industrials ",type="html",out
    ="Sec15.htm")
stargazer (subset(var, sector=="Information Technology"), title ="Information
    Technology",type="html",out="Sec16.htm")
stargazer (subset(var, sector=="Materials"), title ="Materials",type="html",out="
    Sec17.htm")
stargazer (subset(var, sector=="Real Estate"), title ="Real Estate",type="html",out
    ="Sec18.htm")
stargazer (subset(var, sector=="Telecommunication Services"), title ="
    Telecommunication Services",type="html",out="Sec19.htm")
stargazer (subset(var, sector==" Utilities "), title =" Utilities ",type="html",out="
    Sec20.htm")

stargazer (subset(df,t=="12/31/2013"), title ="2013",type="html",out="t1.htm")
stargazer (subset(df,t=="12/31/2014"), title ="2014",type="html",out="t2.htm")
```

```
stargazer (subset(df,t=="12/31/2015"), title ="2015",type="html",out="t3.htm")
stargazer (subset(df,t=="12/31/2016"), title ="2016",type="html",out="t4.htm")

stargazer (subset(var,t=="12/31/2013"), title ="2013",type="html",out="t11.htm")
stargazer (subset(var,t=="12/31/2014"), title ="2014",type="html",out="t12.htm")
stargazer (subset(var,t=="12/31/2015"), title ="2015",type="html",out="t13.htm")
stargazer (subset(var,t=="12/31/2016"), title ="2016",type="html",out="t14.htm")

stargazer (subset(var2, sector=="Consumer Discretionary"), title ="Consumer
    Discretionary",type="html",out="Sec21.htm")
stargazer (subset(var2, sector=="Consumer Staples"), title ="Consumer Staples",type
    ="html",out="Sec22.htm")
stargazer (subset(var2, sector=="Energy"), title ="Energy",type="html",out="Sec23.
    htm")
stargazer (subset(var2, sector=="Health Care"), title ="Health Care",type="html",
    out="Sec24.htm")
stargazer (subset(var2, sector==" Industrials "), title =" Industrials ",type="html",
    out="Sec25.htm")
stargazer (subset(var2, sector=="Information Technology"), title ="Information
    Technology",type="html",out="Sec26.htm")
stargazer (subset(var2, sector=="Materials"), title ="Materials",type="html",out="
    Sec27.htm")
stargazer (subset(var2, sector=="Real Estate"), title ="Real Estate",type="html",
    out="Sec28.htm")
stargazer (subset(var2, sector=="Telecommunication Services"), title ="
    Telecommunication Services",type="html",out="Sec29.htm")
stargazer (subset(var2, sector==" Utilities "), title =" Utilities ",type="html",out="
    Sec30.htm")

stargazer (subset(var2,t=="12/31/2013"), title ="2013",type="html",out="t21.htm")
```

```
stargazer (subset(var2,t=="12/31/2014"), title ="2014",type="html",out="t22.htm")
stargazer (subset(var2,t=="12/31/2015"), title ="2015",type="html",out="t23.htm")
stargazer (subset(var2,t=="12/31/2016"), title ="2016",type="html",out="t24.htm")

stargazer (subset(bb1y,==" Utilities "), title =" Utilities ",type="html",out="Sec30.
    htm")

##########################Multiple linear regression
    #############################

company<-factor(company)

#average variables for salary, bonus and tenure (used instead of total as same
     significance )
aacon.lm<-lm(bb1y~mcap+performance+gearing+sector)
aa.lm<-lm(bb1y~salarya+bonusa+tenurea+employees+boardsize)
ba.lm<-lm(bb1y~salarya+bonusa+tenurea+employees+boardsize+mcap+performance+
    gearing+sector)
summary(aacon.lm)
summary(aa.lm)
summary(ba.lm)
stargazer (aacon.lm,aa.lm,ba.lm,type = "html", title ="Linear Regression with
    missing data", digits =9, out="Reg1.htm")

cacon.lm<-lm(bb5y~mcap+performance+gearing+sector)
ca.lm<-lm(bb5y~salarya+bonusa+tenurea+employees+boardsize)
da.lm<-lm(bb5y~salarya+bonusa+tenurea+employees+boardsize+mcap+performance+
    gearing+sector)
summary(cacon.lm)
summary(ca.lm)
```

```
summary(da.lm)
stargazer(cacon.lm,ca.lm,da.lm, type = "html", title ="Linear Regression with
    missing data", digits =9, out="Reg2.htm")

eacon.lm<-lm(altmanz~mcap+performance+gearing+sector)
ea.lm<-lm(altmanz~salarya+bonusa+tenurea+employees+boardsize)
fa.lm<-lm(altmanz~salarya+bonusa+tenurea+employees+boardsize+mcap+
    performance+gearing+sector)
summary(eacon.lm)
summary(ea.lm)
summary(fa.lm)
stargazer(eacon.lm, ea.lm,fa.lm, type = "html", title ="Linear Regression with
    missing data", digits =9, out="Reg3.htm")

#remove missing data

y1<-1*is.na(employees)+1*is.na(mcap)+1*is.na(boardsize)+1*is.na(performance)+1
    *is.na(gearing)+1*is.na(altmanz)
company2<-company[y1<1]
bb1y2<-bb1y[y1<1]
bb5y2<-bb5y[y1<1]
altmanz2<-altmanz[y1<1]
salaryt2<-salaryt[y1<1]
bonust2<-bonust[y1<1]
tenuret2<-tenuret[y1<1]
employees2<-employees[y1<1]
mcap2<-mcap[y1<1]
boardsize2<-boardsize[y1<1]
performance2<-performance[y1<1]
gearing2<-gearing[y1<1]
```

```
sector2<-sector[y1<1]
salarya2<-salarya[y1<1]
bonusa2<-bonusa[y1<1]
tenurea2<-tenurea[y1<1]
id2<-id[y1<1]
t2<-t[y1<1]

#quadratic term
salarya22<-salarya2^2
bonusa22<-bonusa2^2
tenurea22<-tenurea2^2
boardsize22<-boardsize2^2
#quadratic term for boardsize is a good variable to introduce

var2<-cbind.data.frame(bb1y2,bb5y2,altmanz2,salaryt2,bonust2, tenuret2 ,
    employees2,mcap2,boardsize2,performance2,gearing2, salarya2 ,bonusa2,tenurea2
    )
stargazer(var2, type = "html", title =" Descriptive statistics ", digits =1, out="
    descriptive with missing2.htm")

correlation.matrix1<-cor(var2)
stargazer(correlation.matrix1, type="html",out="cor2.htm")


dfmissing<-cbind.data.frame(company2,bb1y2,bb5y2,altmanz2,salarya2,bonusa2,
    tenurea2,employees2,mcap2,boardsize2,performance2,gearing2, sector2 ,id2, t2,
    salarya22 ,bonusa22,tenurea22)

#id2 and comapny2 are same
```

```
#adding quadratic term for salary has no significant effect however bonus and
    tenure has a significnat effect

#introducing a quadratic term for total salary for the linear models has a
    significant effect to the BB1y
#however no significant effect on BB5y and Altman Z−score. The model with the
    quadratic salary for BB1y
#has both salary and salary ^2 as significant predictors .

#average variables for salary , bonus and tenure (used instead of total as same
    significance )
a1acon.lm<−lm(bb1y2~mcap2+performance2+gearing2+sector2)
a1a.lm<−lm(bb1y2~salarya2+bonusa2+tenurea2+employees2+boardsize2)
b1a.lm<−lm(bb1y2~salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2+
    performance2+gearing2+sector2)
b1aqs.lm<−lm(bb1y2~salarya22+salarya2+bonusa2+tenurea2+employees2+boardsize2
    +mcap2+performance2+gearing2+sector2)
b1aqb.lm<−lm(bb1y2~salarya2+bonusa22+bonusa2+tenurea2+employees2+boardsize2
    +mcap2+performance2+gearing2+sector2)
b1aqt.lm<−lm(bb1y2~salarya2+bonusa2+tenurea22+tenurea2+employees2+
    boardsize2+mcap2+performance2+gearing2+sector2)
b1aqbs.lm<−lm(bb1y2~salarya2+bonusa2+tenurea2+employees2+boardsize2+
    boardsize22+mcap2+performance2+gearing2+sector2)
b1afull .lm<−lm(bb1y2~salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2
    +performance2+gearing2+sector2+salarya22+bonusa22+tenurea22+boardsize22)
b1afinal .lm<−lm(bb1y2~salarya22+salarya2+bonusa2+employees2+boardsize2+
    mcap2+performance2+gearing2+sector2+boardsize22)
summary(a1acon.lm)
summary(a1a.lm)
```

```
summary(b1a.lm)
summary(b1aqs.lm)
summary(b1aqb.lm)
summary(b1aqt.lm)
summary(b1aqbs.lm)
anova(b1a.lm,b1aq.lm)
stargazer (a1acon.lm,a1a.lm,b1a.lm, type = "html", title ="Linear Regression
    without missing data", digits =9, out="Reg4.htm")
stargazer (a1acon.lm,a1a.lm,b1a.lm, b1aqs.lm,b1aqb.lm,b1aqt.lm,b1aqbs.lm, b1afull
    .lm, b1afinal .lm, type = "html", title ="Linear Regression without missing
    data", digits =9, out="Reg4v1.htm")

#introducing quadratic terms for bonus and tenure has no significant
    contribution to the model however
#introducing salary significantly improves the model # seems like a good model

c1acon.lm<−lm(bb5y2~mcap2+performance2+gearing2+sector2)
c1a.lm<−lm(bb5y2~salarya2+bonusa2+tenurea2+employees2+boardsize2)
d1a.lm<−lm(bb5y2~salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2+
    performance2+gearing2+sector2)
d1qs.lm<−lm(bb5y2~salarya22+salarya2+bonusa2+tenurea2+employees2+boardsize2+
    mcap2+performance2+gearing2+sector2)
d1qb.lm<−lm(bb5y2~salarya2+bonusa22+bonusa2+tenurea2+employees2+boardsize2+
    mcap2+performance2+gearing2+sector2)
d1qt.lm<−lm(bb5y2~salarya2+bonusa2+tenurea22+tenurea2+employees2+boardsize2+
    mcap2+performance2+gearing2+sector2)
d1qbs.lm<−lm(bb5y2~salarya2+bonusa2+tenurea2+employees2+boardsize2+
    boardsize22+mcap2+performance2+gearing2+sector2)
d1afull .lm<−lm(bb5y2~salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2
    +performance2+gearing2+sector2+salarya22+bonusa22+tenurea22+boardsize22)
```

```
d1afinal .lm<−lm(bb5y2~tenurea2 + employees2 + boardsize2 + mcap2 +
    performance2 + gearing2 + sector2 + boardsize22)
summary(c1acon.lm)
summary(c1a.lm)
summary(d1a.lm)
summary(d1qs.lm)
summary(d1qb.lm)
summary(d1qt.lm)
anova(d1a.lm,d1q.lm)
stargazer (c1acon.lm,c1a.lm,d1a.lm, type = "html", title ="Linear Regression
    without missing data", digits =9, out="Reg5.htm")
stargazer (c1acon.lm,c1a.lm,d1a.lm, d1qs.lm, d1qb.lm, d1qt.lm,d1qbs.lm, d1afull .
    lm, d1afinal .lm, type = "html", title ="Linear Regression without missing
    data", digits =9, out="Reg5v1.htm")

#introducing quadratic terms for salary , tenure and bonus has no significant
    contribution to the model however



e1acon.lm<−lm(altmanz2~mcap2+performance2+gearing2+sector2)
e1a.lm<−lm(altmanz2~salarya2+bonusa2+tenurea2+employees2+boardsize2)
f1a.lm<−lm(altmanz2~salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2+
    performance2+gearing2+sector2)
f1qs.lm<−lm(altmanz2~salarya22+salarya2+bonusa2+tenurea2+employees2+
    boardsize2+mcap2+performance2+gearing2+sector2)
f1qb.lm<−lm(altmanz2~salarya2+bonusa22+bonusa2+tenurea2+employees2+
    boardsize2+mcap2+performance2+gearing2+sector2)
f1qt.lm<−lm(altmanz2~salarya2+bonusa2+tenurea22+tenurea2+employees2+
    boardsize2+mcap2+performance2+gearing2+sector2)
```

```
f1qbs.lm<-lm(altmanz2~salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2
    +performance2+gearing2+sector2+boardsize22)
f1afull.lm<-lm(altmanz2~salarya2+bonusa2+tenurea2+employees2+boardsize2+
    mcap2+performance2+gearing2+sector2+salarya22+bonusa22+tenurea22+
    boardsize22)
f1afinal.lm<-lm(altmanz2~salarya2+bonusa2+boardsize2+mcap2+performance2+
    gearing2+sector2+boardsize22)
summary(e1acon.lm)
summary(e1a.lm)
summary(f1a.lm)
summary(f1qs.lm)
summary(f1qb.lm)
summary(f1qt.lm)
anova(f1a.lm,f1q.lm)
stargazer(e1acon.lm,e1a.lm,f1a.lm, type = "html", title ="Linear Regression
    without missing data", digits =9, out="Reg6.htm")
stargazer(e1acon.lm,e1a.lm,f1a.lm, f1qs.lm, f1qb.lm, f1qt.lm,f1qbs.lm, f1afull.
    lm, f1afinal.lm, type = "html", title ="Linear Regression without missing
    data", digits =9, out="Reg6v1.htm")

#introducing a quadratic term for bonus and tenure has a significant impact on
    the model but salary has no significant
#impact

#introducing a quadratic term for average salary for the linear models has no
    significant effect to the BB1y and BB5y models however
#the effect on Altman Z-score is significant. The model with the quadratic
    salary for altman z-score has both salary and salary^2 as significant
# predictors.
```

```
#
    ##########################################################################

#Regression assumptions (andy field )

##############assumption of normality with charts ##############
library(ggplot2)

hist(bb1y2)
qplot(sample=bb1y2,stat="qq")
# positively skewed more companies less likely to fail
hist(bb5y2)
qplot(sample=bb5y2,stat="qq")
# slight positive skew more companies less likely to fail
hist(altmanz2)
qplot(sample=altmanz2,stat="qq")
# slight positive skew however more companies les likely to fail
hist(mcap2)
qplot(sample=mcap2,stat="qq")
# positive skew with more smaller companies
hist(performance2)
qplot(sample=performance2,stat="qq")
#normal curve however some extreme observations
hist(gearing2)
qplot(sample=gearing2,stat="qq")
# positive skew with more companies with lower gearing
hist( salarya2 )
qplot(sample=salarya2, stat="qq")
#normal distribution
hist(bonusa2)
```

```
qplot(sample=bonusa2,stat="qq")
#normalish distribution with few extremely high bonus
hist(tenurea2)
qplot(sample=tenurea2,stat="qq")
#normalish distribution
hist(employees2)
qplot(sample=employees2,stat="qq")
#extreme figures with a positive skew
hist(boardsize2)
qplot(sample=boardsize2,stat="qq")
#normalish distribution
hist(salarya22)
qplot(sample=salarya22,stat="qq")
#normalish distribution
hist(bonusa22)
qplot(sample=bonusa22,stat="qq")
# positive skew with many at lower end and a few at higher end
hist(tenurea22)
qplot(sample=tenurea22,stat="qq")
# positive skew with many at lower end and a few at higher end

##############assumption of normality with numbers##############
install.packages("psych")
library(psych)
round(describe(cbind(bb1y2,bb5y2,altmanz2,mcap2,performance2,gearing2, salarya2,
    bonusa2,tenurea2,employees2,boardsize2, salarya22,bonusa22,tenurea22)),
    digits =1)
```

```
describe<-round(describe(cbind(bb1y2,bb5y2,altmanz2,mcap2,performance2,
    gearing2,salarya2,bonusa2,tenurea2,employees2,boardsize2, salarya22,bonusa22,
    tenurea22)), digits =1)
write.table(describe, file ="describe.txt",sep=",",quote=FALSE,row.names=F)

install.packages("pastecs")
library(pastecs)
round(stat.desc(cbind(bb1y2,bb5y2,altmanz2,mcap2,performance2,gearing2, salarya2
    ,bonusa2,tenurea2,employees2,boardsize2, salarya22,bonusa22,tenurea22), basic
    =FALSE,norm=TRUE),digits=1)

stat.desc<-round(stat.desc(cbind(bb1y2,bb5y2,altmanz2,mcap2,performance2,
    gearing2, salarya2,bonusa2,tenurea2,employees2,boardsize2, salarya22,bonusa22,
    tenurea22), basic=FALSE,norm=TRUE),digits=1)
write.table(stat.desc, file ="stat.desc.txt",sep=",",quote=FALSE,row.names=F)

#skew and kurtosis should be zero in normal distribution . positive skew
    indicate a pile up of score
#to the left negative skew indicate a pile up to the right
# positive kurtosis indicate a pointy curve and negative kurtosis indicates a
    flat curve
#values closer to zero indicate normality

#describe - shows performance and average salary with a normal curve however
    only average salary shows a normal point
#The other variables are all positively skewed with a pointed curve

#in a sample of more than 200 is is important to look at the shape of the
    distribution and to look at the value of skew and kurtosis
# rather than calculate their significance
```

```
# descriptive statistics by year
by(data=bb1y2, INDICES = t2, FUN=describe)
by(data=bb1y2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
# positive skew

by(data=bb5y2, INDICES = t2, FUN=describe)
by(data=bb5y2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
# positive skew

by(data=altmanz2, INDICES = t2, FUN=describe)
by(data=altmanz2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
# positive skew

#The above three show that breaking down the observation into number of years
    shows a big reduction in skewness and kurtosis
#reducing the positive skew and extreme peak

by(data=salarya2, INDICES = t2, FUN=describe)
by(data=salarya2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
#normalish curve and peak

by(data=bonusa2, INDICES = t2, FUN=describe)
by(data=bonusa2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
#normal curve and peak for one year and positive skew and peaked for three
    years

by(data=tenurea2, INDICES = t2, FUN=describe)
by(data=tenurea2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
# positive skew and peaked slightly
```

```
by(data=employees2, INDICES = t2, FUN=describe)
by(data=employees2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
# positive  skew and peaked  slightly

by(data=boardsize2, INDICES = t2, FUN=describe)
by(data=boardsize2, INDICES = t2, FUN=stat.desc,basic=FALSE,norm=TRUE)
# positive  skew and peaked  slightly

#not sure what the relevance of this is
y1<-subset(t2, t2=="1")
y2<-subset(t2, t2=="2")
y3<-subset(t2, t2=="3")
y4<-subset(t2, t2=="4")

#shaprio  test
shapiro.test(bb1y2)
shapiro.test(bb5y2)
shapiro.test(altmanz2)
shapiro.test(mcap2)
shapiro.test(performance2)
shapiro.test(gearing2)
shapiro.test(salarya2)
shapiro.test(bonusa2)
shapiro.test(tenurea2)
shapiro.test(employees2)
shapiro.test(boardsize2)
#as per this test all not normal however large datasets will easily have a
    significant
#shapiro.wilk test
```

```
#However, according to the central limit theorem as the sample size becomes
    greater
#the sampling distribution  has a normal distribution with a mean closer to the
     poppulation mean
# therefore we can assume that as the sample size is 207 wihtout missing
# observations ( greater than 30 for central limit theorem) the sampling
     distribution
#has a normal distribution with a mean approximately similar to the poppulation
     mean

##############testing for homogeneity of variance##############
install.packages("car")
library(car)
#Levene's test

leveneTest(bb1y2,t2)
leveneTest(bb1y2,id2)
leveneTest(bb1y2,sector2)
#sector2 is not significant leveneTest scores therefore the variances are not
     significantly different
#and the assumption of homogeneity of variance is tenable however id2 and t2 is
      significantly
# different and the assumption of homogeneity of variance has been violated

leveneTest(bb5y2,t2)
leveneTest(bb5y2,id2)
leveneTest(bb5y2,sector2)
#t2 is not significant leveneTest scores therefore the variances are not
     significantly different
```

```
#and the assumption of homogeneity of variance is tenable however id2 and
    sector is significantly
# different and the assumption of homogeneity of variance has been violated

leveneTest(altmanz2,t2)
leveneTest(altmanz2,id2)
leveneTest(altmanz2, sector2)
#t2, id2 and sector2 are not significant leveneTest scores therefore the
    variances are not significantly different
#and the assumption of homogeneity of variance is tenable

leveneTest( salarya2 , t2)
leveneTest( salarya2 ,id2)
leveneTest( salarya2 , sector2)
#id2 and t2 is not significant leveneTest scores therefore the variances are
    not significantly different
#and the assumption of homogeneity of variance is tenable however sector2 is
    significantly
# different and the assumption of homogeneity of variance has been violated

leveneTest(bonusa2,t2)
leveneTest(bonusa2,id2)
leveneTest(bonusa2, sector2)
#id2 and t2 is not significant leveneTest scores therefore the variances are
    not significantly different
#and the assumption of homogeneity of variance is tenable however sector2 is
    significantly
# different and the assumption of homogeneity of variance has been violated
```

```
leveneTest(tenurea2, t2)
leveneTest(tenurea2, id2)
leveneTest(tenurea2, sector2)
#t2 is not significant leveneTest scores therefore the variances are not
    significantly different
#and the assumption of homogeneity of variance is tenable however id2 and
    sector2 is significantly
# different and the assumption of homogeneity of variance has been violated

leveneTest(boardsize2, t2)
leveneTest(boardsize2, id2)
leveneTest(boardsize2, sector2)
#t2, id2 and sector2 is not significant leveneTest scores therefore the
    variances are not significantly different
#and the assumption of homogeneity of variance is tenable

leveneTest(employees2,t2)
leveneTest(employees2,id2)
leveneTest(employees2,sector2)
#id2 and t2 is not significant leveneTest scores therefore the variances are
    not significantly different
#and the assumption of homogeneity of variance is tenable however sector2 is
    significantly
# different and the assumption of homogeneity of variance has been violated

#In large samples Levene's Test can be significant even when group variances
    are not very different
# therefore it should be interpreted in conjunction with the variance ratio
```

```
##############################Transformation of data
##############################

lnbb1y2<-log(bb1y2)
hist (lnbb1y2)
qplot (sample=lnbb1y2)
lnbb5y2<-log(bb5y2)
hist (lnbb5y2)
qplot (sample=lnbb5y2)
lnaltmanz2<-log(altmanz2)
hist (lnaltmanz2)
qplot (sample=lnaltmanz2)
lnsalarya2 <-log(salarya2)
hist ( lnsalarya2 )
qplot (sample=lnsalarya2)
lnbonusa2<-log(bonusa2)# not normal
hist (lnbonusa2)
qplot (sample=lnbonus2)
sqbonusa2<-sqrt(bonusa2)# better  than  above
hist (sqbonusa2)
qplot (sample=sqbonusa2)
lntenurea2 <-log(tenurea2)
hist ( lntenurea2 )
qplot (sample=lntenurea2)
lnboardsize2 <-log(boardsize2)
hist ( lnboardsize2 )
qplot (sample=lnboardsize2)
lnemployees2<-log(employees2)
hist (lnemployees2)
```

```
qplot(sample=lnemployees2)
lnmcap2<-log(mcap2)
hist(lnmcap2)
qplot(sample=lnmcap2)
lnperformance2<-log(performance2)# not normal
hist(lnperformance2)
qplot(sample=lnperformance2)
sqperformance2<-sqrt(performance2)# better than above
hist(sqperformance2)
qplot(sample=sqperformance2)
lngearing2<-log(gearing2)
hist(lngearing2)
qplot(sample=lngearing2)

###########The above is not useful in modelling############
#Glass,Peckham and Sanders (1972), 'the payoff of normalizing transformations
    in terms of more valid probability statements
#is low, and they are seldom considered to be worth the effort '(p241) - page
    193 (andy field - jane superbrain 5.1)
#Wilcox(2005) found that with heavy tailed distributions requir larger samples(
    more than previous 40) to invoke
# central limit theorem
#by transforming the data you change the hypothesis being tested
#The consequence of applying the wrong transformation could be worse than the
    consequence of analysing untransformed scores

#use robust methods or bootstrap
#bootstrap (Efron and Tibshirani, 1993) - It estimates the properties of the
    sampling distribution from the sample data
```

```
#The sample data is treated as a poppulation from which smaller samples are
    taken – for a gentle introduction
#Wright, London and Field (2011)

##############################Correlation
    #######################################################


cordf<−data.frame(bb1y2,bb5y2,altmanz2,salarya2,bonusa2,tenurea2 , boardsize2 ,
    employees2,mcap2,performance2,gearing2, salarya22 ,bonusa22,tenurea22)
 install .packages("Hmisc")
library (Hmisc)
 install .packages("ggm")
library (ggm)
 install .packages("polycor")
library (polycor)
 install .packages("ppcor")
library (ppcor)

c1<−cor(cordf,method="pearson")
round(c1,2)
write. table (c1, file ="c1pearson. txt " ,sep="," ,quote=FALSE,row.names=F)
c2<−cor(cordf,method="spearman")
round(c2,2)
write. table (c2, file ="c1spearman.txt" ,sep="," ,quote=FALSE,row.names=F)
c3<−cor(cordf,method="kendall")
round(c3,2)
write. table (c3, file ="c1kendall . txt " ,sep="," ,quote=FALSE,row.names=F)
```

```
#the sign of the effect size between variables for parametric(pearson) and non
    -parametric(kendall-spearman) is the same for all relationship but the
    following
#bonus-altmanz;gearing-salary;boardsize-tenure;mcap-gearing;boardsize-
    performance; boardisize-gearing
#Howell(1997:293) Kendall's statstic is actually a better estimate than
    spearman

#p-value
cor.test(bb1y2,bb5y2,method="pearson")
cor.test(bb1y2,bb5y2,method="spearman")
cor.test(bb1y2,bb5y2,method="kendall")


# partial correlation - correlation between two variables in which the effects
    of other variables (on both variables) are held constant
pcor()
pcor.test(bb1y2,bb5y2,altmanz2)
#example of controlling variables
#pcor.test(bb1y2,bonusa2,cordf[,c("bb5y2","altmanz2","salarya2")])

#part/semi-partial correlation - correlation between two variables in which the
    effects of other variables (on only one variable) is held constant
spcor.test(bb1y2,bb5y2,altmanz2)
#example of controlling variabls
#spcor.test(bb1y2,bonusa2,cordf[,c("bb5y2","altmanz2","salarya2")])

# Correlation coefficients are effect sizes, so these can be interpreted without
    needing p-values
#because p-values are related to sample size
```

```
#
    ################################################################################

#bodo winter  tutorial  1 and other  sources  for  regression  assumption  testing  or
    regression  diagnostics
#
    ################################################################################

# testing  assumptions

#*** linearity ***

#bodowinter
plot( fitted (a1acon.lm), residuals (a1acon.lm))# linearity  assumption holds
plot( fitted (a1a.lm), residuals (a1a.lm))# linearity  assumption holds
plot( fitted (b1a.lm), residuals (b1a.lm))# linearity  assumption holds
plot( fitted (b1aqs.lm), residuals (b1aqs.lm))# linearity  assumption holds
plot( fitted (b1aqb.lm), residuals (b1aqb.lm))# linearity  assumption holds
plot( fitted (b1aqt.lm), residuals (b1aqt.lm))# linearity  assumption holds

plot( fitted (c1acon.lm), residuals (c1acon.lm))# linearity  assumption holds
plot( fitted (c1a.lm), residuals (c1a.lm))# linearity  assumption holds
plot( fitted (d1a.lm), residuals (d1a.lm))# linearity  assumption holds
plot( fitted (d1qs.lm), residuals (d1qs.lm))# linearity  assumption holds
plot( fitted (d1qb.lm), residuals (d1qb.lm))# linearity  assumption holds
plot( fitted (d1qt.lm), residuals (d1qt.lm))# linearity  assumption holds

plot( fitted (e1acon.lm), residuals (e1acon.lm))# linearity  assumption holds
plot( fitted (e1a.lm), residuals (e1a.lm))# linearity  assumption holds
```

```
plot( fitted (fa.lm), residuals (f1a.lm))# linearity  assumption holds
plot( fitted (f1qs.lm), residuals (f1qs.lm))# linearity  assumption holds
plot( fitted (f1qb.lm), residuals (f1qb.lm))# linearity  assumption holds
plot( fitted (f1qt.lm), residuals (f1qt.lm))# linearity  assumption holds


#https://biologyforfun.wordpress.com/2014/04/16/checking-glm-model-
   assumptions-in-r/
#do two at a time i.e. par and plot  function
par(mfrow=c(2,2))
plot(a1acon.lm)
par(mfrow=c(2,2))
plot(a1a.lm)
par(mfrow=c(2,2))
plot(b1a.lm)
par(mfrow=c(2,2))
plot(b1aqs.lm)
par(mfrow=c(2,2))
plot(b1aqb.lm)
par(mfrow=c(2,2))
plot(b1aqt.lm)

par(mfrow=c(2,2))
plot(c1acon.lm)
par(mfrow=c(2,2))
plot(c1a.lm)
par(mfrow=c(2,2))
plot(d1a.lm)
par(mfrow=c(2,2))
plot(d1qs.lm)
```

```
par(mfrow=c(2,2))
plot(d1qb.lm)
par(mfrow=c(2,2))
plot(d1qt.lm)

par(mfrow=c(2,2))
plot(e1acon.lm)
par(mfrow=c(2,2))
plot(e1a.lm)
par(mfrow=c(2,2))
plot(f1a.lm)
par(mfrow=c(2,2))
plot(f1qs.lm)
par(mfrow=c(2,2))
plot(f1qb.lm)
par(mfrow=c(2,2))
plot(f1qt.lm)

#http://www.statmethods.net/stats/rdiagnostics.html
library(car)
crPlots(a1acon.lm)
crPlots(a1a.lm)
crPlots(b1a.lm)
crPlots(b1aqs.lm)
crPlots(b1aqb.lm)
crPlots(b1aqt.lm)
crPlots(c1acon.lm)
crPlots(c1a.lm)
crPlots(d1a.lm)
crPlots(d1qs.lm)
```

```
crPlots(d1qb.lm)
crPlots(d1qt.lm)
crPlots(e1acon.lm)
crPlots(e1a.lm)
crPlots(f1a.lm)
crPlots(f1qs.lm)
crPlots(f1qb.lm)
crPlots(f1qt.lm)
#sector being skipped in ceresplots
ceresPlots(a1acon.lm)
ceresPlots(a1a.lm)
ceresPlots(b1a.lm)
ceresPlots(b1aqs.lm)
ceresPlots(b1aqb.lm)
ceresPlots(b1aqt.lm)
ceresPlots(c1acon.lm)
ceresPlots(c1a.lm)
ceresPlots(d1a.lm)
ceresPlots(d1qs.lm)
ceresPlots(d1qb.lm)
ceresPlots(d1qt.lm)
ceresPlots(e1acon.lm)
ceresPlots(e1a.lm)
ceresPlots(f1a.lm)
ceresPlots(f1qs.lm)
ceresPlots(f1qb.lm)
ceresPlots(f1qt.lm)

#if linearity assumption borken then:
#might have missed an important fixed effect
```

```
#perform nonlinear transformation e.g. by taking the log transform
#non linear transformation of fixed effects e.g. add iv and ivsquared
#if seeing stripes then probably dealing with categorical data, use logistics
    regression

#***absence of collinearity ***
 install.packages("Hmisc")
 install.packages("ggplot2")
 install.packages("munsell")
library(Hmisc)
library(ggplot2)
library(munsell)
library(car)
cor.my.df<-cbind(salarya2,bonusa2,tenurea2,boardsize2,employees2)
rcorr(cor.my.df) # not working

#http://www.statmethods.net/stats/rdiagnostics.html
# >2 problem?
vif1<-vif(a1acon.lm)
write.table(vif1, file="vif1.txt",sep=",",quote=FALSE,row.names=T)
vif2<-sqrt(vif(a1acon.lm))>2
write.table(vif2, file="vif2.txt",sep=",",quote=FALSE,row.names=T)

vif3<-vif(a1a.lm)
vif4<-sqrt(vif(a1a.lm))>2

vif5<-vif(b1a.lm)
vif6<-sqrt(vif(b1a.lm))>2

vif7<-vif(b1aqs.lm)
```

```
vif8<-sqrt(vif(b1aqs.lm))>2

vif9<-vif(b1aqb.lm)
vif10<-sqrt(vif(b1aqb.lm))>2

vif11<-vif(b1aqt.lm)
vif12<-sqrt(vif(b1aqt.lm))>2

vif13<-vif(c1acon.lm)
vif14<-sqrt(vif(c1acon.lm))>2

vif15<-vif(c1a.lm)
vif16<-sqrt(vif(c1a.lm))>2

vif17<-vif(d1a.lm)
vif18<-sqrt(vif(d1a.lm))>2

vif19<-vif(d1qs.lm)
vif20<-sqrt(vif(d1qs.lm))>2

vif21<-vif(d1qb.lm)
vif22<-sqrt(vif(d1qb.lm))>2

vif23<-vif(d1qt.lm)
vif24<-sqrt(vif(d1qt.lm))>2

vif25<-vif(e1acon.lm)
vif26<-sqrt(vif(e1acon.lm))>2

vif27<-vif(e1a.lm)
```

```r
vif28<-sqrt(vif(e1a.lm))>2

vif29<-vif(f1a.lm)
vif30<-sqrt(vif(f1a.lm))>2

vif31<-vif(f1qs.lm)
vif32<-sqrt(vif(f1qs.lm))>2

vif33<-vif(f1qb.lm)
vif34<-sqrt(vif(f1qb.lm))>2

vif35<-vif(f1qt.lm)
vif36<-sqrt(vif(f1qt.lm))>2

write.table(vif3, file ="vif3.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif4, file ="vif4.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif5, file ="vif5.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif6, file ="vif6.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif7, file ="vif7.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif8, file ="vif8.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif9, file ="vif9.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif10, file ="vif10.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif11, file ="vif11.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif12, file ="vif12.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif13, file ="vif13.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif14, file ="vif14.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif15, file ="vif15.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif16, file ="vif16.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif17, file ="vif17.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif18, file ="vif18.txt",sep=",",quote=FALSE,row.names=T)
```

```
write.table(vif19, file ="vif19.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif20, file ="vif20.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif21, file ="vif21.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif22, file ="vif22.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif23, file ="vif23.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif24, file ="vif24.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif25, file ="vif25.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif26, file ="vif26.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif27, file ="vif27.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif28, file ="vif28.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif29, file ="vif29.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif30, file ="vif30.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif31, file ="vif31.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif32, file ="vif32.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif33, file ="vif33.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif34, file ="vif34.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif35, file ="vif35.txt",sep=",",quote=FALSE,row.names=T)
write.table(vif36, file ="vif36.txt",sep=",",quote=FALSE,row.names=T)


#if fixed effects are correlated:
#could focus on few fixed effects that you know are not correlated
#which one is the most meaningful and drop the others
#dimension reduction techniques such as Principal Component Analysis

#***homoskedasticity or "absence of hetroskedasticity"***

#use plot from linearity as it lays the graph in 4 different boxes same plots

#http://www.statmethods.net/stats/rdiagnostics.html
```

```
#Breusch-Pagan test; it was independently suggested by Cook and Weisberg (1983)
ncvTest(a1acon.lm)
ncvTest(a1a.lm)
ncvTest(b1a.lm)
ncvTest(b1aqs.lm)
ncvTest(b1aqb.lm)
ncvTest(b1aqt.lm)
ncvTest(c1acon.lm)
ncvTest(c1a.lm)
ncvTest(d1a.lm)
ncvTest(d1qs.lm)
ncvTest(d1qb.lm)
ncvTest(d1qt.lm)
ncvTest(e1acon.lm)
ncvTest(e1a.lm)
ncvTest(f1a.lm)
ncvTest(f1qs.lm)
ncvTest(f1qb.lm)
ncvTest(f1qt.lm)

spreadLevelPlot(a1acon.lm)
spreadLevelPlot(a1a.lm)
spreadLevelPlot(b1a.lm)
spreadLevelPlot(b1aqs.lm)
spreadLevelPlot(b1aqb.lm)
spreadLevelPlot(b1aqt.lm)
spreadLevelPlot(c1acon.lm)
spreadLevelPlot(c1a.lm)
spreadLevelPlot(d1a.lm)
spreadLevelPlot(d1qs.lm)
```

```
spreadLevelPlot(d1qb.lm)
spreadLevelPlot(d1qt.lm)
spreadLevelPlot(e1acon.lm)
spreadLevelPlot(e1a.lm)
spreadLevelPlot(f1a.lm)
spreadLevelPlot(f1qs.lm)
spreadLevelPlot(f1qb.lm)
spreadLevelPlot(f1qt.lm)

#if plot is hetroskedastic or not homoskedastic:
#log-transform could help here
#weighted least squares?

#***normality of residuals ***
# least important assumption

hist(residuals(a1acon.lm))
hist(residuals(a1a.lm))
hist(residuals(b1a.lm))
hist(residuals(b1aqs.lm))
hist(residuals(b1aqb.lm))
hist(residuals(b1aqt.lm))
hist(residuals(c1acon.lm))
hist(residuals(c1a.lm))
hist(residuals(d1a.lm))
hist(residuals(d1qs.lm))
hist(residuals(d1qb.lm))
hist(residuals(d1qt.lm))
hist(residuals(e1acon.lm))
hist(residuals(e1a.lm))
```

```
hist(residuals(f1a.lm))
hist(residuals(f1qs.lm))
hist(residuals(f1qb.lm))
hist(residuals(f1qt.lm))

#all showing normalish residuals

qqnorm(residuals(a1acon.lm))
qqnorm(residuals(a1a.lm))
qqnorm(residuals(b1a.lm))
qqnorm(residuals(b1aqs.lm))
qqnorm(residuals(b1aqb.lm))
qqnorm(residuals(b1aqt.lm))
qqnorm(residuals(c1acon.lm))
qqnorm(residuals(c1a.lm))
qqnorm(residuals(d1a.lm))
qqnorm(residuals(d1qs.lm))
qqnorm(residuals(d1qb.lm))
qqnorm(residuals(d1qt.lm))
qqnorm(residuals(e1acon.lm))
qqnorm(residuals(e1a.lm))
qqnorm(residuals(f1a.lm))
qqnorm(residuals(f1qs.lm))
qqnorm(residuals(f1qb.lm))
qqnorm(residuals(f1qt.lm))


#***absence of influential data points***
#defbetaPlots is not in the bodowinter tutorial
```

dfbeta (a1acon.**lm**)

dfbeta (a1a.**lm**)

dfbeta (b1a.**lm**)

dfbeta (b1aqs.**lm**)

dfbeta (b1aqb.**lm**)

dfbeta (b1aqt.**lm**)

dfbeta (c1acon.**lm**)

dfbeta (c1a.**lm**)

dfbeta (d1a.**lm**)

dfbeta (d1qs.**lm**)

dfbeta (d1qb.**lm**)

dfbeta (d1qt.**lm**)

dfbeta (e1acon.**lm**)

dfbeta (e1a.**lm**)

dfbeta (f1a.**lm**)

dfbeta (f1qs.**lm**)

dfbeta (f1qb.**lm**)

dfbeta (f1qt .**lm**)

dfbetaPlots (a1acon.**lm**)

dfbetaPlots (a1a.**lm**)

dfbetaPlots (b1a.**lm**)

dfbetaPlots (b1aqs.**lm**)

dfbetaPlots (b1aqb.**lm**)

dfbetaPlots (b1aqt.**lm**)

dfbetaPlots (c1acon.**lm**)

dfbetaPlots (c1a.**lm**)

dfbetaPlots (d1a.**lm**)

dfbetaPlots (d1qs.**lm**)

dfbetaPlots (d1qb.**lm**)

```r
dfbetaPlots (d1qt.lm)
dfbetaPlots (e1acon.lm)
dfbetaPlots (e1a.lm)
dfbetaPlots (f1a.lm)
dfbetaPlots (f1qs.lm)
dfbetaPlots (f1qb.lm)
dfbetaPlots (f1qt.lm)

#https://cran.r-project.org/web/packages/olsrr/vignettes/intro.html

install.packages("glue")
library(glue)
install.packages("olsrr")
library(olsrr)

#remove sector as the graphs is not relevant with it

ols_dfbetas_panel(a1acon.lm)
ols_dfbetas_panel(a1a.lm)
ols_dfbetas_panel(b1a.lm)
ols_dfbetas_panel(b1aqs.lm)
ols_dfbetas_panel(b1aqb.lm)
ols_dfbetas_panel(b1aqt.lm)
ols_dfbetas_panel(c1acon.lm)
ols_dfbetas_panel(c1a.lm)
ols_dfbetas_panel(d1a.lm)
ols_dfbetas_panel(d1qs.lm)
ols_dfbetas_panel(d1qb.lm)
ols_dfbetas_panel(d1qt.lm)
ols_dfbetas_panel(e1acon.lm)
```

```
ols_dfbetas_panel(e1a.lm)
ols_dfbetas_panel(f1a.lm)
ols_dfbetas_panel(f1qs.lm)
ols_dfbetas_panel(f1qb.lm)
ols_dfbetas_panel(f1qt.lm)

#check if dfbeta higher than slope
#run analysis without influential datapoints
#dat2=my.df[-61,][-148,][-150,](this is how to delete specific data points)
#running regression again without influential points as per Cook's D value
    improves the regression models or increases significance of particular
    variables or agrees with regression with influential points

#http://www.statmethods.net/stats/rdiagnostics.html
#Cook's D value >4/(n-k-1)

cutoff1<-4/((nrow(df)-length(a1acon.lm$coefficients)-2))
cutoff2<-4/((nrow(df)-length(a1a.lm$coefficients)-2))
cutoff3<-4/((nrow(df)-length(b1a.lm$coefficients)-2))
cutoff4<-4/((nrow(df)-length(b1aqs.lm$coefficients)-2))
cutoff5<-4/((nrow(df)-length(b1aqb.lm$coefficients)-2))
cutoff6<-4/((nrow(df)-length(b1aqt.lm$coefficients)-2))
cutoff7<-4/((nrow(df)-length(c1acon.lm$coefficients)-2))
cutoff8<-4/((nrow(df)-length(c1a.lm$coefficients)-2))
cutoff9<-4/((nrow(df)-length(d1a.lm$coefficients)-2))
cutoff10<-4/((nrow(df)-length(d1qs.lm$coefficients)-2))
cutoff11<-4/((nrow(df)-length(d1qb.lm$coefficients)-2))
cutoff12<-4/((nrow(df)-length(d1qt.lm$coefficients)-2))
cutoff13<-4/((nrow(df)-length(e1acon.lm$coefficients)-2))
cutoff14<-4/((nrow(df)-length(e1a.lm$coefficients)-2))
```

```
cutoff15<-4/((nrow(df)-length(f1a.lm$coefficients)-2))
cutoff16<-4/((nrow(df)-length(f1qs.lm$coefficients)-2))
cutoff17<-4/((nrow(df)-length(f1qb.lm$coefficients)-2))
cutoff18<-4/((nrow(df)-length(f1qt.lm$coefficients)-2))


plot(a1acon.lm, which=4, cook.levels=cutoff1)
plot(a1a.lm, which=4, cook.levels=cutoff2)
plot(b1a.lm, which=4, cook.levels=cutoff3)
plot(b1aqs.lm, which=4, cook.levels=cutoff4)
plot(b1aqb.lm, which=4, cook.levels=cutoff5)
plot(b1aqt.lm, which=4, cook.levels=cutoff6)
plot(c1acon.lm, which=4, cook.levels=cutoff7)
plot(c1a.lm, which=4, cook.levels=cutoff8)
plot(d1a.lm, which=4, cook.levels=cutoff9)
plot(d1qs.lm, which=4, cook.levels=cutoff10)
plot(d1qb.lm, which=4, cook.levels=cutoff11)
plot(d1qt.lm, which=4, cook.levels=cutoff12)
plot(e1acon.lm, which=4, cook.levels=cutoff13)
plot(e1a.lm, which=4, cook.levels=cutoff14)
plot(f1a.lm, which=4, cook.levels=cutoff15)
plot(f1qs.lm, which=4, cook.levels=cutoff16)
plot(f1qb.lm, which=4, cook.levels=cutoff17)
plot(f1qt.lm, which=4, cook.levels=cutoff18)

#run analysis without influential datapoints as highlighted in plots above

#influence plot
influencePlot(a1acon.lm,id.method="identify", main="Influence Plot", sub="
    Circle size is proportial to Cook's Distance" )
```

```
influencePlot (a1a.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (b1a.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (b1aqs.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (b1aqb.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (b1aqt.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (c1acon.lm,id.method="identify", main="Influence Plot", sub="
   Circle size is proportial to Cook's Distance" )
influencePlot (c1a.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (d1a.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (d1qs.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (d1qb.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (d1qt.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (e1acon.lm,id.method="identify", main="Influence Plot", sub="
   Circle size is proportial to Cook's Distance" )
influencePlot (e1a.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (f1a.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (f1qs.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
```

```
influencePlot (f1qb.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )
influencePlot (f1qt.lm,id.method="identify", main="Influence Plot", sub="Circle
    size is proportial to Cook's Distance" )



# outliers
#http://www.statmethods.net/stats/rdiagnostics.html
#Bonferonni p-value for most extreme observations
outlierTest (a1acon.lm)
outlierTest (a1a.lm)
outlierTest (b1a.lm)
outlierTest (b1aqs.lm)
outlierTest (b1aqb.lm)
outlierTest (b1aqt.lm)
outlierTest (c1acon.lm)
outlierTest (c1a.lm)
outlierTest (d1a.lm)
outlierTest (d1qs.lm)
outlierTest (d1qb.lm)
outlierTest (d1qt.lm)
outlierTest (e1acon.lm)
outlierTest (e1a.lm)
outlierTest (f1a.lm)
outlierTest (f1qs.lm)
outlierTest (f1qb.lm)
outlierTest (f1qt.lm)

#run analysis without influential datapoints
```

```
#QQ plot for  studentized  residuals
qqPlot(a1acon.lm,main="QQ Plot")
qqPlot(a1a.lm,main="QQ Plot")
qqPlot(b1a.lm,main="QQ Plot")
qqPlot(b1aqs.lm,main="QQ Plot")
qqPlot(b1aqb.lm,main="QQ Plot")
qqPlot(b1aqt.lm,main="QQ Plot")
qqPlot(c1acon.lm,main="QQ Plot")
qqPlot(c1a.lm,main="QQ Plot")
qqPlot(d1a.lm,main="QQ Plot")
qqPlot(d1qs.lm,main="QQ Plot")
qqPlot(d1qb.lm,main="QQ Plot")
qqPlot(d1qt.lm,main="QQ Plot")
qqPlot(e1acon.lm,main="QQ Plot")
qqPlot(e1a.lm,main="QQ Plot")
qqPlot(f1a.lm,main="QQ Plot")
qqPlot(f1qs.lm,main="QQ Plot")
qqPlot(f1qb.lm,main="QQ Plot")
qqPlot(f1qt.lm,main="QQ Plot")

#leverage  plots
 leveragePlots (a1acon.lm)
 leveragePlots (a1a.lm)
 leveragePlots (b1a.lm)
 leveragePlots (b1aqs.lm)
 leveragePlots (b1aqb.lm)
 leveragePlots (b1aqt.lm)
 leveragePlots (c1acon.lm)
 leveragePlots (c1a.lm)
```

```
leveragePlots (d1a.lm)
leveragePlots (d1qs.lm)
leveragePlots (d1qb.lm)
leveragePlots (d1qt.lm)
leveragePlots (e1acon.lm)
leveragePlots (e1a.lm)
leveragePlots (f1a.lm)
leveragePlots (f1qs.lm)
leveragePlots (f1qb.lm)
leveragePlots (f1qt.lm)

#***independence***
#most important assumption
#if violated then resolve this using mixed models
#durbinWatsonTest is not required as there is clear lack of independece but
    test agrees with this
durbinWatsonTest(a1acon.lm)
durbinWatsonTest(a1a.lm)
durbinWatsonTest(b1a.lm)
durbinWatsonTest(b1aqs.lm)
durbinWatsonTest(b1aqb.lm)
durbinWatsonTest(b1aqt.lm)
durbinWatsonTest(c1acon.lm)
durbinWatsonTest(c1a.lm)
durbinWatsonTest(d1a.lm)
durbinWatsonTest(d1qs.lm)
durbinWatsonTest(d1qb.lm)
durbinWatsonTest(d1qt.lm)
durbinWatsonTest(e1acon.lm)
durbinWatsonTest(e1a.lm)
```

```
durbinWatsonTest(f1a.lm)
durbinWatsonTest(f1qs.lm)
durbinWatsonTest(f1qb.lm)
durbinWatsonTest(f1qt.lm)

#gvlma performs a global validation of linear assumptions as well separate
    evaluation of skewness, kurtosis, and heteroskedasticity
install.packages("gvlma")
library(gvlma)

gvmodel1<-gvlma(a1acon.lm)
summary(gvmodel1)
gvmodel2<-gvlma(a1a.lm)
summary(gvmodel2)
gvmodel3<-gvlma(b1a.lm)
summary(gvmodel3)
gvmodel4<-gvlma(c1acon.lm)
summary(gvmodel4)
gvmodel5<-gvlma(c1a.lm)
summary(gvmodel5)
gvmodel6<-gvlma(d1a.lm)
summary(gvmodel6)
gvmodel7<-gvlma(e1acon.lm)
summary(gvmodel7)
gvmodel8<-gvlma(e1a.lm)
summary(gvmodel8)
gvmodel9<-gvlma(f1a.lm)
summary(gvmodel9)
```

```
########################Multilevel modelling (Andy Field)
    ###########################################
library(nlme)
install.packages("xtable")
library(xtable)
#check to see if multi level modelling is required as does the intercept vary
    across contexts (time/year)
bb1yinterceptonly <-gls(bb1y2~1,method="ML")
summary(bb1yinterceptonly)
bb1yrandominterceptonly<-lme(bb1y2~1,random=~1|id2,method="ML")
summary(bb1yrandominterceptonly)
anova1<-anova(bb1yinterceptonly,bb1yrandominterceptonly)
xanova1<-xtable(anova1)
print.xtable(xanova1, type="html", file="xanova1.htm")
#AIC, BIC lower for random model and loglik higher significant result

bb5yinterceptonly <-gls(bb5y2~1,method="ML")
summary(bb5yinterceptonly)
bb5yrandominterceptonly<-lme(bb5y2~1,random=~1|id2,method="ML")
summary(bb5yrandominterceptonly)
anova2<-anova(bb5yinterceptonly,bb5yrandominterceptonly)
xanova2<-xtable(anova2)
print.xtable(xanova2, type="html", file="xanova2.htm")
#AIC, BIC lower for random model and loglik higher significant result

altmanzinterceptonly <-gls(altmanz2~1,method="ML")
summary(altmanzinterceptonly)
altmanzrandominterceptonly<-lme(altmanz2~1,random=~1|id2,method="ML")
summary(altmanzrandominterceptonly)
anova3<-anova(altmanzinterceptonly,altmanzrandominterceptonly)
```

```
xanova3<-xtable(anova3)
print.xtable(xanova3, type="html", file="xanova3.htm")
#AIC, BIC lower for random model and loglik same non-significant result

#Based on above there is significant variance in intercepts between years for
    the BB1y and BB5y dependent variables
#whereas the variance in intercepts between years for the altmanz score as
    dependent variable is non-significant
#This provides confirmation to proceed with multilevel modelling for BB1y and
    BB5y and revert to linear modeling for
#altmanz score - using sector as the context between which intercepts vary we
    find that the model is significantly better
#only for the altmanz score and non-significant for BB1y and BB5y

#adding fixed effects

bb1yrandominterceptcontrol<-lme(bb1y2~mcap2+performance2+gearing2+sector2,
    random=~1|id2,method="ML")
summary(bb1yrandominterceptcontrol)
bb1yrandominterceptpredict<-lme(bb1y2~salarya2+bonusa2+tenurea2+employees2+
    boardsize2,random=~1|id2,method="ML")
summary(bb1yrandominterceptpredict)
bb1yrandominterceptfull<-lme(bb1y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2,random=~1|id2,method="ML
    ")
summary(bb1yrandominterceptfull)
bb1yrandominterceptfull2<-lme(bb1y2~salarya22 + salarya2 + bonusa2 +
    employees2 + boardsize2 + mcap2 + performance2 + gearing2 + sector2 +
    boardsize22,random=~1|id2,method="ML")
summary(bb1yrandominterceptfull2)
```

```
anova4<-anova(bb1yrandominterceptonly,bb1yrandominterceptcontrol,
    bb1yrandominterceptfull2 )
xanova4<-xtable(anova4)
print . xtable (xanova4, type="html", file ="xanova4.htm")


#The results show that adding just the controls as fixed effects significantly
    improves the model as there is an increase
#in the logLik. Furthermore when the predictor variables are added to the
    control model the full model is significant better
#than the control model as evidenced by an increase in the logLik
stargazer ( bb1yrandominterceptcontrol , bb1yrandominterceptpredict ,
    bb1yrandominterceptfull )

bb5yrandominterceptcontrol <-lme(bb5y2~mcap2+performance2+gearing2+sector2,
    random=~1|id2,method="ML")
summary(bb5yrandominterceptcontrol)
bb5yrandominterceptpredict <-lme(bb5y2~salarya2+bonusa2+tenurea2+employees2+
    boardsize2,random=~1|id2,method="ML")
summary(bb5yrandominterceptpredict)
bb5yrandominterceptfull <-lme(bb5y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2,random=~1|id2,method="ML
    ")
summary(bb5yrandominterceptfull)
bb5yrandominterceptfull2 <-lme(bb5y2~tenurea2 + employees2 + boardsize2 + mcap2
    + performance2 + gearing2 + sector2 + boardsize22 ,random=~1|id2,method="
    ML")
summary(bb5yrandominterceptfull2)
anova5<-anova(bb5yrandominterceptonly,bb5yrandominterceptcontrol,
    bb5yrandominterceptfull2 )
```

```
xanova5<−xtable(anova5)
print . xtable (xanova5, type="html", file ="xanova5.htm")



#The results show that adding just the controls as fixed effects significantly
    improves the model as there is an increase
#in the logLik. Furthermore when the predictor variables are added to the
    control model the full model is significant better
#than the control model as evidenced by an increase in the logLik
 stargazer ( bb5yrandominterceptcontrol , bb5yrandominterceptpredict ,
    bb5yrandominterceptfull )


 altmanzrandominterceptcontrol <−lme(altmanz2~mcap2+performance2+gearing2+
    sector2,random=~1|id2,method="ML")
summary(altmanzrandominterceptcontrol)
 altmanzrandominterceptpredict <−lme(altmanz2~salarya2+bonusa2+tenurea2+
    employees2+boardsize2,random=~1|id2,method="ML")
summary(altmanzrandominterceptpredict)
 altmanzrandominterceptfull <−lme(altmanz2~mcap2+performance2+gearing2+sector2
    +salarya2+bonusa2+tenurea2+employees2+boardsize2,random=~1|id2,method="
    ML")
summary(altmanzrandominterceptfull)
 altmanzrandominterceptfull2 <−lme(altmanz2~salarya2 + bonusa2 + boardsize2 +
    mcap2 + performance2 + gearing2 + sector2 + boardsize22 ,random=~1|id2,
    method="ML")
summary(altmanzrandominterceptfull2)
anova6<−anova(altmanzrandominterceptonly,altmanzrandominterceptcontrol ,
    altmanzrandominterceptfull2 )
xanova6<−xtable(anova6)
print . xtable (xanova6, type="html", file ="xanova6.htm")
```

```
#The results show that adding just the controls as fixed effects significantly
    improves the model as there is an increase
#in the logLik. Furthermore when the predictor variables are added to the
    control model the full model is significant better
#than the control model as evidenced by an increase in the logLik
stargazer ( altmanzrandominterceptcontrol , altmanzrandominterceptpredict ,
    altmanzrandominterceptfull )

##############################add random slope for indivdual companies

bb1yaddrandomslope<-lme(bb1y2~salarya22 + salarya2 + bonusa2 + employees2 +
    boardsize2 + mcap2 + performance2 + gearing2 + sector2 + boardsize22,
    random=~salarya2|id2,method="ML")
summary(bb1yaddrandomslope)
anova7<-anova(bb1yrandominterceptfull2,bb1yaddrandomslope)
xanova7<-xtable(anova7)
print.xtable(xanova7, type="html", file ="xanova7.htm")


bb5yaddrandomslope<-lme(bb5y2~tenurea2 + employees2 + boardsize2 + mcap2 +
    performance2 + gearing2 + sector2 + boardsize22,random=~id2|t2,method="ML"
    )
summary(bb5yaddrandomslope)
anova8<-anova(bb5yrandominterceptfull2,bb5yaddrandomslope)
xanova8<-xtable(anova8)
print.xtable(xanova8, type="html", file ="xanova8.htm")
```

```
altmanzaddrandomslope<-lme(altmanz2~salarya2 + bonusa2 + boardsize2 + mcap2 +
    performance2 + gearing2 + sector2 + boardsize22,random=~id2|t2,method="ML
    ")
summary(altmanzaddrandomslope)
anova9<-anova(altmanzrandominterceptfull2,altmanzaddrandomslope)
xanova9<-xtable(anova9)
print.xtable(xanova9, type="html", file ="xanova9.htm")

#adding a random slope for individual companies does not provide a significant
    improvement to the model without a random slope

############################adding random slope for sector

#bb1yaddrandomslopesector<-lme(bb1y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2,random=~sector2|t2,method
    ="ML")
#summary(bb1yaddrandomslopesector)
#anova8<-anova(bb1yrandominterceptfull,bb1yaddrandomslopesector)
#xtable(anova8)

#bb5yaddrandomslopesector<-lme(bb5y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2,random=~sector2|t2,method
    ="ML")
#summary(bb5yaddrandomslopesector)
#anova9<-anova(bb5yrandominterceptfull,bb5yaddrandomslopesector)
#xtable(anova9)

#adding a random slope for different sectors does not provide a significant
    improvement to the model without a random slope
```

```
###########################adding a quadratic term for  salary

# bb5yrandominterceptfull2 <−lme(bb5y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2+salarya22,random=~1|t2,
    method="ML")
#summary(bb5yrandominterceptfull2)

#anova( bb5yrandominterceptfull ,  bb5yrandominterceptfull2 )

#including a quadratic term for salary has no significant effect on the
    bb1yrandomintercept full model however it is a significant predictor
#for the bb5yrandomintercept model and improves the model significantly

#adding a random slope for individual companies to the quadratic model has no
     significant effect to the model


###################introducing interaction terms – do this
    #################################
# introducing an interaction between market capitalisation and number of
    employees
#bb1yinteractmcapemployees<−lme(bb1y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2:employees2,random=
    ~1|t2,method="ML")
#summary(bb1yinteractmcapemployees)
#anova( bb1yrandominterceptfull ,bb1yinteractmcapemployees)
#bb5yinteractmcapemployees<−lme(bb5y2~mcap2+performance2+gearing2+sector2+
    salarya2+bonusa2+tenurea2+employees2+boardsize2+mcap2:employees2,random=
    ~1|t2,method="ML")
#summary(bb5yinteractmcapemployees)
```

```
#anova( bb5yrandominterceptfull , bb5yinteractmcapemployees)
#BB1y shows a significant improvement to model by introducing the interaction term however this is not true for the BB5y model

################################growth model—not sure if to include ####################################

################################bb1y ################################################
# growthintercept <−gls(bb1y2~1, method="ML")
#allow intercept to vary across contexts i.e. comapnies
#growthrandomintercept<−lme(bb1y2~1,random=~1|id2,method="ML",control=list(opt="optim"))
#adding in time as fixed effect
#growthtimeri<−lme(bb1y2~t2,random=~1|id2,method="ML",control=list(opt="optim"))
#introducing random slope
#growthtimers<−lme(bb1y2~t2,random=~t2|id2,method="ML",control=list(opt="optim"))

#covariance structure
#corAR1()− used when time points are equally spaced
#corCAR1() − time points are not equally spaced
#corARMA() − allows the correlation structure to involve a moving average of error variance

#growtharmodel<−lme(bb1y2~t2,random=~t2|id2,method="ML",control=list(opt="optim"), correlation =corAR1(0,form=~t2|id2))
#anova( growthintercept , growthrandomintercept , growthtimeri , growthtimers , growtharmodel)
```

```
# all the models show a significant improvement at each step however the
    autoregressive model does not show a significant
#improvement to the model before it however it is a significant improvement to
    the random intercept only model

#adding higher-order polynomials
#growthtimequadratic<-lme(bb1y2~t2+I(t2^2),random=~t2|id2,method="ML",control
    =list(opt="optim"), correlation =corAR1(0,form=~t2|id2))
#growthtimecubic<-lme(bb1y2~t2+I(t2^2)+I(t2^3),random=~t2|id2,method="ML",
    control=list(opt="optim"), correlation =corAR1(0,form=~t2|id2))
#anova( growthintercept , growthrandomintercept , growthtimeri , growthtimers ,
    growtharmodel, growthtimequadratic , growthtimecubic)
#summary(growthtimecubic)
#the results show adding higher-order polynomials does not significantly
    improve the model

#################################bb5y
    ################################################
# growthintercept5 <-gls(bb5y2~1, method="ML")
#allow intercept to vary across contexts i.e. comapnies
#growthrandomintercept5<-lme(bb5y2~1,random=~1|id2,method="ML",control=list(
    opt="optim"))
#adding in time as fixed effect
#growthtimeri5<-lme(bb5y2~t2,random=~1|id2,method="ML",control=list(opt="optim
    "))
# introducing random slope
#growthtimers5<-lme(bb5y2~t2,random=~t2|id2,method="ML",control=list(opt="
    optim"))

#covariance structure
```

```
#corAR1()– used when time points are equally spaced
#corCAR1() – time points are not equally spaced
#corARMA() – allows the correlation structure to involve a moving average of
    error variance

#growtharmodel5<–lme(bb5y2~t2,random=~t2|id2,method="ML",control=list(opt="
    optim"), correlation =corAR1(0,form=~t2|id2))
#anova( growthintercept5 ,growthrandomintercept5 , growthtimeri5 , growthtimers5 ,
    growtharmodel5)
# all the models show a significant improvement at each step

#adding higher–order polynomials
#growthtimequadratic5<–lme(bb5y2~t2+I(t2^2),random=~t2|id2,method="ML",
    control=list(opt="optim"), correlation =corAR1(0,form=~t2|id2))
#growthtimecubic5<–lme(bb5y2~t2+I(t2^2)+I(t2^3),random=~t2|id2,method="ML",
    control=list(opt="optim"), correlation =corAR1(0,form=~t2|id2))
#anova( growthintercept5 ,growthrandomintercept5 , growthtimeri5 , growthtimers5 ,
    growtharmodel5,growthtimequadratic5 ,growthtimecubic5)
#summary(growthtimecubic)
#the results show adding higher–order polynomials does not significantly
    improve the model

####################Reporting multilevel models################
#The relationship between surgery and quality of life showes a significant
    variance in intercepts across participants , SD=5.48
#(95% CI:3.31, 9.07), X^2(1) = 107.65, p<.0001. In addition , the slopes varied
    across participants , SD= 5.42 (3.13,9.37) ,
# X^2 (2) = 38.87, p<.0001, adn the slopes and intercepts were negatively and
    significantly correlated , cor=–.95(–.99,–.60).
#################################################################
```

```
##################For the model itself##########################
#Report the results in the text with b-values, ts, and degrees of freedom for the
    fixed effects, and then report parameters for
#the random effects in the text as well. Produce a table of parameters as you
   would for regression.
#Quality of life before surgery significantly predicted quality of life after
   surgery, b=0.31, t(262) = 5.75, p<.001,
#surgery did not significantly predict quality of life, b=-3.19,t(262)=-1.46,p
   =.15, but the reason for surgery,
#b=-3.52,t(262)=-3.08,p<.01, and the interaction of the reason for surgery and
   surgery, b=4.22, t(262)=2.48, p<.05, both did
# significantly predict quality of life. This interaction was broken down by
   conducting seperate multilevel models on the
#'physical reason' and 'attractiveness reason'. The models specified wer the
   same as the main model but excluded
#the main effect and interaction term involving the reason for surgery. These
   analyses showed that for those operated on only
#to cahnge their appearence, surgery almost significantly predicted quality of
   life, b=-4.31, t(87)=-1.89,p=.06: quality of life
#was lower after surgery compared to the control group. However, for those who
   had surgery to solve a physical problem, surgery
#did not significantly predict quality of life, b=1.20, t(166)=0.57, p=.57. The
   interaction effect, therfore, reflets the difference
#in slopes for surgery as a predictor of quality of lifein those who had
   surgery for physical problems (slight positive slope)
#and those who had surgery purely for vanity (a negative slope). ***include
   table***
###################################################################
```

```
#bodowinter tutorial 2
install .packages("lme4")
library("lme4")

#error message some predictor variables are on very different scales: consider
  rescaling (check this!)
my.df=data.frame(bb1y2,bb5y2,altmanz2,salarya2,bonusa2,tenurea2,employees2,
  mcap2,boardsize2,performance2,gearing2, sector2, id2, t2, salarya22, boardsize22
  )
scalevars <-c("bb1y2","bb5y2","altmanz2","salarya2","bonusa2","tenurea2","mcap2
  ","boardsize2","employees2","performance2","gearing2", "salarya22", "
  boardsize22")
my.dfs<-my.df
my.dfs[scalevars]<-lapply(my.dfs[scalevars], scale)
#averages show 0 for above variables

#random interecepts for company and time
bb1y.company.null=lmer(bb1y2~(1|id2), data=my.dfs[scalevars], REML=FALSE)
summary(bb1y.company.null)
stargazer(bb1y.company.null,type = "html", title ="BB1y null model company
  random intercept", digits =9, out="bb1ycompanynull.htm")
bb1y.time.null=lmer(bb1y2~(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(bb1y.time.null)
stargazer(bb1y.time.null,type = "html", title ="BB1y null model time random
  intercept ", digits =9, out="bb1ytimenull.htm")
bb1y.null=lmer(bb1y2~(1|id2)+(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(bb1y.null)
stargazer(bb1y.null,type = "html", title ="BB1y null model company and time
  random intercept ", digits =9, out="bb1ycompanytimenull.htm")
```

```
bb1y.company.null2=lmer(bb1y2~performance2+gearing2+sector2+(1|id2), data=my.
    dfs[ scalevars ], REML=FALSE)
summary(bb1y.company.null2)
stargazer (bb1y.company.null2,type = "html", title ="BB1y control model company
    random intercept", digits =9, out="bb1ycompanynull2.htm")
bb1y.time. null2=lmer(bb1y2~performance2+gearing2+sector2+(1|t2), data=my.dfs[
    scalevars ], REML=FALSE)
summary(bb1y.time.null2)
stargazer (bb1y.time. null2 ,type = "html", title ="BB1y control model time random
    intercept ", digits =9, out="bb1ytimenull2.htm")
bb1y.null2=lmer(bb1y2~performance2+gearing2+sector2+(1|id2)+(1|t2), data=my.
    dfs[ scalevars ], REML=FALSE)
summary(bb1y.null2)
stargazer (bb1y.null2 ,type = "html", title ="BB1y control model company and time
    random intercept ", digits =9, out="bb1ycompanytimenull2.htm")

bb5y.company.null=lmer(bb5y2~(1|id2), data=my.dfs[ scalevars ], REML=FALSE)
summary(bb5y.company.null)
stargazer (bb5y.company.null,type = "html", title ="BB5y null model company
    random intercept", digits =9, out="bb5ycompanynull.htm")
bb5y.time. null=lmer(bb5y2~(1|t2), data=my.dfs[ scalevars ], REML=FALSE)
summary(bb5y.time.null)
stargazer (bb5y.time. null ,type = "html", title ="BB5y null model time random
    intercept ", digits =9, out="bb5ytimenull.htm")
bb5y.null=lmer(bb5y2~(1|id2)+(1|t2), data=my.dfs[ scalevars ], REML=FALSE)
summary(bb5y.null)
stargazer (bb5y.null ,type = "html", title ="BB5y null model company and time
    random intercept ", digits =9, out="bb5ycompanytimenull.htm")
```

```
bb5y.company.null2=lmer(bb5y2~performance2+gearing2+sector2+(1|id2), data=my.
    dfs[ scalevars ], REML=FALSE)
summary(bb5y.company.null2)
 stargazer (bb5y.company.null2,type = "html", title ="BB5y control model company
    random intercept", digits =9, out="bb5ycompanynull2.htm")
bb5y.time. null2=lmer(bb5y2~performance2+gearing2+sector2+(1|t2), data=my.dfs[
    scalevars ], REML=FALSE)
summary(bb5y.time.null2)
 stargazer (bb5y.time. null2 ,type = "html", title ="BB5y control model time random
    intercept ", digits =9, out="bb5ytimenull2.htm")
bb5y. null2=lmer(bb5y2~performance2+gearing2+sector2+(1|id2)+(1|t2), data=my.
    dfs[ scalevars ], REML=FALSE)
summary(bb5y.null2)
 stargazer (bb5y. null2 ,type = "html", title ="BB5y control model company and time
    random intercept ", digits =9, out="bb5ycompanytimenull2.htm")


altmanz.company.null=lmer(altmanz2~(1|id2), data=my.dfs[ scalevars ], REML=
    FALSE)
summary(altmanz.company.null)
 stargazer (altmanz.company.null,type = "html", title ="AltmanZ null model
    company random intercept", digits =9, out="altmanzcompanynull.htm")
altmanz.time. null=lmer(altmanz2~(1|t2), data=my.dfs[ scalevars ], REML=FALSE)
summary(altmanz.time.null)
 stargazer (altmanz.time. null ,type = "html", title ="AltmanZ null model time
    random intercept ", digits =9, out="altmanztimenull .htm")
altmanz. null=lmer(altmanz2~(1|id2)+(1|t2), data=my.dfs[ scalevars ], REML=
    FALSE)
summary(altmanz.null)
 stargazer (altmanz. null ,type = "html", title ="AltmanZ null model company and
    time random intercept ", digits =9, out="altmanzcompanytimenull.htm")
```

```
altmanz.company.null2=lmer(altmanz2~performance2+gearing2+sector2+(1|id2),
    data=my.dfs[ scalevars ], REML=FALSE)
summary(altmanz.company.null2)
stargazer (altmanz.company.null2,type = "html", title ="AltmanZ control model
    company random intercept", digits =9, out="altmanzcompanynull2.htm")
altmanz.time.null2=lmer(altmanz2~performance2+gearing2+sector2+(1|t2), data=
    my.dfs[ scalevars ], REML=FALSE)
summary(altmanz.time.null2)
stargazer (altmanz.time.null2 ,type = "html", title ="AltmanZ control model time
    random intercept ", digits =9, out="altmanztimenull2 .htm")
altmanz.null2=lmer(altmanz2~performance2+gearing2+sector2+(1|id2)+(1|t2), data
    =my.dfs[ scalevars ], REML=FALSE)
summary(altmanz.null2)
stargazer (altmanz.null2 ,type = "html", title ="AltmanZ control model company
    and time random intercept ", digits =9, out="altmanzcompanytimenull2.htm")


xanova10<-anova(bb1y.company.null,bb1y.company.null2)
write.table(xanova10, file ="xanova10.txt",sep=",",quote=FALSE,row.names=T)
xanova11<-anova(bb5y.company.null,bb5y.company.null2)
write.table(xanova11, file ="xanova11.txt",sep=",",quote=FALSE,row.names=T)
xanova12<-anova(altmanz.company.null,altmanz.company.null2)
write.table(xanova12, file ="xanova12.txt",sep=",",quote=FALSE,row.names=T)

xanova13<-anova(bb1y.time.null,bb1y.time.null2)
write.table(xanova13, file ="xanova13.txt",sep=",",quote=FALSE,row.names=T)
xanova14<-anova(bb5y.time.null,bb5y.time.null2)
write.table(xanova14, file ="xanova14.txt",sep=",",quote=FALSE,row.names=T)
xanova15<-anova(altmanz.time.null,altmanz.time.null2)
```

```
write.table(xanova15, file ="xanova15.txt",sep=",",quote=FALSE,row.names=T)


xanova16<-anova(bb1y.null,bb1y.null2)
write.table(xanova16, file ="xanova16.txt",sep=",",quote=FALSE,row.names=T)
xanova17<-anova(bb5y.null,bb5y.null2)
write.table(xanova17, file ="xanova17.txt",sep=",",quote=FALSE,row.names=T)
xanova18<-anova(altmanz.null,altmanz.null2)
write.table(xanova18, file ="xanova18.txt",sep=",",quote=FALSE,row.names=T)


# full model with company intercept
bb1y.company.model=lmer(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+(1|id2), data=my.dfs[scalevars], REML=FALSE)
summary(bb1y.company.model)
 stargazer (bb1y.company.model,type = "html",  title ="BB1Y Predict variables
    model company random intercept",  digits =9, out="bb1ypredictcompany.htm")


bb1y.company.model2=lmer(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|id2), data=my.dfs[scalevars],
    REML=FALSE)
summary(bb1y.company.model2)
 stargazer (bb1y.company.model2,type = "html",  title ="BB1Y Full model company
    random intercept",  digits =9, out="bb1yfullcompany.htm")


bb5y.company.model=lmer(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+(1|id2), data=my.dfs[scalevars], REML=FALSE)
summary(bb5y.company.model)
 stargazer (bb5y.company.model,type = "html",  title ="BB5Y Predict variables
    model company random intercept",  digits =9, out="bb5ypredictcompany.htm")
```

```
bb5y.company.model2=lmer(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|id2), data=my.dfs[scalevars],
    REML=FALSE)
summary(bb5y.company.model2)
 stargazer (bb5y.company.model2,type = "html",  title ="BB5Y Full model company
    random intercept",  digits =9, out="bb5yfullcompany.htm")

altmanz.company.model=lmer(altmanz2~salarya2+bonusa2+tenurea2+mcap2+
    boardsize2+employees2+(1|id2), data=my.dfs[scalevars], REML=FALSE)
summary(altmanz.company.model)
 stargazer (altmanz.company.model,type = "html",  title ="AltmanZ Predict  variables
     model company random intercept",  digits =9, out="altmanzpredictcompany.htm
    ")

altmanz.company.model2=lmer(altmanz2~salarya2+bonusa2+tenurea2+mcap2+
    boardsize2+employees2+performance2+gearing2+sector2+(1|id2), data=my.dfs[
    scalevars], REML=FALSE)
summary(altmanz.company.model2)
 stargazer (altmanz.company.model2,type = "html",  title ="AltmanZ Full model
    company random intercept",  digits =9, out="altmanzfullcompany.htm")

xanova19<-anova(bb1y.company.model, bb1y.company.model2)
write.table(xanova19, file ="xanova19.txt",sep=",",quote=FALSE,row.names=T)
xanova20<-anova(bb5y.company.model,bb5y.company.model2)
write.table(xanova20, file ="xanova20.txt",sep=",",quote=FALSE,row.names=T)
xanova21<-anova(altmanz.company.model,altmanz.company.model2)
write.table(xanova21, file ="xanova21.txt",sep=",",quote=FALSE,row.names=T)

# full  model with  time  intercept
```

```
bb1y.time.model=lmer(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(bb1y.time.model)
 stargazer (bb1y.time.model,type = "html",  title ="BB1Y Predict variables model
    time random intercept ",  digits =9, out="bb1ypredicttime.htm")

bb1y.time.model2=lmer(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|t2), data=my.dfs[scalevars],
    REML=FALSE)
summary(bb1y.time.model2)
 stargazer (bb1y.time.model2,type = "html",  title ="BB1Y Full model time random
    intercept ",  digits =9, out="bb1yfulltime.htm")

bb5y.time.model=lmer(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(bb5y.time.model)
 stargazer (bb5y.time.model,type = "html",  title ="BB5Y Predict variables model
    time random intercept ",  digits =9, out="bb5ypredicttime.htm")

bb5y.time.model2=lmer(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|t2), data=my.dfs[scalevars],
    REML=FALSE)
summary(bb5y.time.model2)
 stargazer (bb5y.time.model2,type = "html",  title ="BB5Y Full model time random
    intercept ",  digits =9, out="bb5yfulltime.htm")

altmanz.time.model=lmer(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(altmanz.time.model)
```

```
stargazer (altmanz.time.model,type = "html", title ="AltmanZ Predict variables
    model time random intercept ", digits =9, out=" altmanzpredicttime .htm")

altmanz.time.model2=lmer(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|t2), data=my.dfs[scalevars],
    REML=FALSE)
summary(altmanz.time.model2)
stargazer (altmanz.time.model2,type = "html", title ="AltmanZ Full model time
    random intercept ", digits =9, out=" altmanzfulltime .htm")

xanova22<−anova(bb1y.time.model, bb1y.time.model2)
write.table(xanova22, file ="xanova22.txt",sep=",",quote=FALSE,row.names=T)
xanova23<−anova(bb5y.time.model,bb5y.time.model2)
write.table(xanova23, file ="xanova23.txt",sep=",",quote=FALSE,row.names=T)
xanova24<−anova(altmanz.time.model,altmanz.time.model2)
write.table(xanova24, file ="xanova24.txt",sep=",",quote=FALSE,row.names=T)

# full model with both intercept
bb1y.model=lmer(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +(1|id2)+(1|t2), data=my.dfs[scalevars ], REML=FALSE)
summary(bb1y.model)
stargazer (bb1y.model,type = "html", title ="BB1Y Predict variables model
    company and time random intercept ", digits =9, out="bb1ypredictcompanytime.
    htm")

bb1y.model2=lmer(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|id2)+(1|t2), data=my.dfs[
    scalevars ], REML=FALSE)
summary(bb1y.model2)
```

```
stargazer (bb1y.model2,type = "html", title ="BB1Y Full model company and time
    random intercept", digits =9, out="bb1yfullcompanytime.htm")

bb5y.model=lmer(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +(1|id2)+(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(bb5y.model)
stargazer (bb5y.model,type = "html", title ="BB5Y Predict variables model
    company and time random intercept", digits =9, out="bb5ypredictcompanytime.
    htm")

bb5y.model2=lmer(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|id2)+(1|t2), data=my.dfs[
    scalevars], REML=FALSE)
summary(bb1y.model2)
stargazer (bb5y.model2,type = "html", title ="BB5Y Full model company and time
    random intercept", digits =9, out="bb5yfullcompanytime.htm")

altmanz.model=lmer(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+(1|id2)+(1|t2), data=my.dfs[scalevars], REML=FALSE)
summary(altmanz.model)
stargazer (altmanz.model,type = "html", title ="AltmanZ Predict variables model
    company and time random intercept", digits =9, out="
    altmanzpredictcompanytime.htm")

altmanz.model2=lmer(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+performance2+gearing2+sector2+(1|id2)+(1|t2), data=my.dfs[
    scalevars], REML=FALSE)
summary(altmanz.model2)
stargazer (altmanz.model2,type = "html", title ="AltmanZ Full model company and
    time random intercept", digits =9, out="altmanzfullcompanytime.htm")
```

```
xanova25<-anova(bb1y.model, bb1y.model2)
write.table(xanova25, file ="xanova25.txt",sep=",",quote=FALSE,row.names=T)
xanova26<-anova(bb5y.model,bb5y.model2)
write.table(xanova26, file ="xanova26.txt",sep=",",quote=FALSE,row.names=T)
xanova27<-anova(altmanz.model,altmanz.model2)
write.table(xanova27, file ="xanova27.txt",sep=",",quote=FALSE,row.names=T)

#***http://ase.tufts.edu/gsc/gradresources/guidetomixedmodelsinr/mixed%20
    model%20guide.html
#***to get p-values in lme models use Anova function in car package
#Analysis of Deviance table (type II wald chisquare tests)
library(car)
Anova(bb1y.company.model)
Anova(bb1y.time.model)
Anova(bb1y.model)

install.packages("xtable")
library(xtable)
xtable(Anova(bb1y.company.model))
xtable(Anova(bb1y.time.model))
xtable(Anova(bb1y.model))

Anova(bb5y.company.model)
Anova(bb5y.time.model)
Anova(bb5y.model)

xtable(Anova(bb5y.company.model))
xtable(Anova(bb5y.time.model))
xtable(Anova(bb5y.model))
```

Anova(altmanz.company.**model**)

Anova(altmanz.**time**.**model**)

Anova(altmanz.**model**)

xtable (Anova(altmanz.company.**model**))

xtable (Anova(altmanz.**time**.**model**))

xtable (Anova(altmanz.**model**))

Anova(bb1y.company.model2)

Anova(bb1y.**time**.model2)

Anova(bb1y.model2)

xtable (Anova(bb1y.company.model2))

xtable (Anova(bb1y.**time**.model2))

xtable (Anova(bb1y.model2))

Anova(bb5y.company.model2)

Anova(bb5y.**time**.model2)

Anova(bb5y.model2)

xtable (Anova(bb5y.company.model2))

xtable (Anova(bb5y.**time**.model2))

xtable (Anova(bb5y.model2))

Anova(altmanz.company.model2)

Anova(altmanz.**time**.model2)

Anova(altmanz.model2)

xtable (Anova(altmanz.company.model2))

```
xtable (Anova(altmanz.time.model2))
xtable (Anova(altmanz.model2))

# significance   testing
#need a  better  understanding  of  model  selection  through  AIC, BIC and  loglik
anova(bb1y.company.null,bb1y.company.model)#sig model improvement with
    predictors
anova(bb1y.company.null,bb1y.time.model)#no sig  model improvement
anova(bb1y.company.null,bb1y.model)#sig model improvement with  predictors
anova(bb1y.time.null , bb1y.company.model)#sig model improvement with  predictors
anova(bb1y.time.null , bb1y.time.model)#sig  model improvement with  predictors
anova(bb1y.time.null , bb1y.model)#sig  model improvement with  predictors
anova(bb1y.null , bb1y.company.model)#no sig model improvement
anova(bb1y.null , bb1y.time.model)#no sig  model improvement
anova(bb1y.null , bb1y.model)#sig  model improvement with  predictors
anova(bb1y.time.model,bb1y.company.model)#model sig improvement with company
    as intercept
anova(bb1y.time.model,bb1y.model)#model sig improvement with both   intercept
anova(bb1y.model,bb1y.company.model)#model with both intercept   better   than
    model with  company  intercept

coef(bb1y.model)

anova(bb1y.company.null2,bb1y.company.model2)#full model with  company  intercept
    sig   better   than   control   with  company
anova(bb1y.company.null2,bb1y.time.model2)#full  model with  time   intercept   sig
    better   than   control   with   company
anova(bb1y.company.null2,bb1y.model2)#full  model with  both   intercept   sig   better
    than   control   with  company
```

```
anova(bb1y.time.null2,bb1y.company.model2)#full model with company intercept
    sig better than control with time
anova(bb1y.time.null2,bb1y.time.model2)#full model with time intercept sig
    better than control with time
anova(bb1y.time.null2,bb1y.model2)#full model with both intercept sig better
    than control with time
anova(bb1y.null2,bb1y.company.model2)#no sig improvement in model
anova(bb1y.null2,bb1y.time.model2)#no sig improvement in model
anova(bb1y.null2,bb1y.model2)#full model with both intercept sig better than
    control with both intercept
anova(bb1y.time.model2,bb1y.company.model2)#full model with company intercept
    better than full model with time
anova(bb1y.time.model2,bb1y.model2)# full model with both intercept better than
    full model with time intercept
anova(bb1y.model2,bb1y.company.model2)#full model with both intercept better
    than company

coef(bb1y.model2)


anova(bb5y.company.null,bb5y.company.model)
anova(bb5y.company.null,bb5y.time.model)
anova(bb5y.company.null,bb5y.model)
anova(bb5y.time.null,bb5y.company.model)
anova(bb5y.time.null,bb5y.time.model)
anova(bb5y.time.null,bb5y.model)
anova(bb5y.null,bb5y.company.model)
anova(bb5y.null,bb5y.time.model)
anova(bb5y.null,bb5y.model)
anova(bb5y.time.model,bb5y.company.model)
anova(bb5y.time.model,bb5y.model)
```

anova(bb5y.**model**,bb5y.company.**model**)

coef(bb5y.**model**)

anova(bb5y.company.null2,bb5y.company.model2)

anova(bb5y.company.null2,bb5y.**time**.model2)

anova(bb5y.company.null2,bb5y.model2)

anova(bb5y.**time**.null2 , bb5y.company.model2)

anova(bb5y.**time**.null2 , bb5y.**time**.model2)

anova(bb5y.**time**.null2 , bb5y.model2)

anova(bb5y.null2 , bb5y.company.model2)

anova(bb5y.null2 , bb5y.**time**.model2)

anova(bb5y.null2 , bb5y.model2)

anova(bb5y.**time**.model2,bb5y.company.model2)

anova(bb5y.**time**.model2,bb5y.model2)

anova(bb5y.model2,bb5y.company.model2)

coef(bb5y.model2)

anova(altmanz.company.**null**,altmanz . company.**model**)

anova(altmanz.company.**null**,altmanz . **time**.**model**)

anova(altmanz.company.**null**,altmanz . **model**)

anova(altmanz.**time**. **null** , altmanz . company.**model**)

anova(altmanz.**time**. **null** , altmanz . **time**.**model**)

anova(altmanz.**time**. **null** , altmanz . **model**)

anova(altmanz.**null** , altmanz . company.**model**)

anova(altmanz.**null** , altmanz . **time**.**model**)

anova(altmanz.**null** , altmanz . **model**)

anova(altmanz.**time**.**model**,altmanz.company.**model**)

anova(altmanz.**time**.**model**,altmanz.**model**)

```
anova(altmanz.model,altmanz.company.model)

coef(altmanz.model)

anova(altmanz.company.null2,altmanz.company.model2)
anova(altmanz.company.null2,altmanz.time.model2)
anova(altmanz.company.null2,altmanz.model2)
anova(altmanz.time.null2,altmanz.company.model2)
anova(altmanz.time.null2,altmanz.time.model2)
anova(altmanz.time.null2,altmanz.model2)
anova(altmanz.null2,altmanz.company.model2)
anova(altmanz.null2,altmanz.time.model2)
anova(altmanz.null2,altmanz.model2)
anova(altmanz.time.model2,altmanz.company.model2)
anova(altmanz.time.model2,altmanz.model2)
anova(altmanz.model2,altmanz.company.model2)

coef(altmanz.model2)

# interesting tutorial https://www.zoology.ubc.ca/~schluter/R/fit-model/

################################princeton#############################

#https://www.princeton.edu/~otorres/Panel101R.pdf
#panel methods
library(foreign)

coplot(bb1y2~t2|id2, type="l",data=my.df)
coplot(bb1y2~t2|id2, type="b",data=my.df)
coplot(bb5y2~t2|id2, type="l",data=my.df)
```

```
coplot(bb5y2~t2|id2, type="b",data=my.df)
coplot(altmanz2~t2|id2, type="l",data=my.df)
coplot(altmanz2~t2|id2, type="b",data=my.df)

install.packages("gplots")
library(gplots)
plotmeans(bb1y2~id2, main="Heterogeineity across companies", data=my.df)
plotmeans(bb1y2~t2, main="Heterogeineity across years", data=my.df)
plotmeans(bb5y2~id2, main="Heterogeineity across companies", data=my.df)
plotmeans(bb5y2~t2, main="Heterogeineity across years", data=my.df)
plotmeans(altmanz2~id2, main="Heterogeineity across companies", data=my.df)
plotmeans(altmanz2~t2, main="Heterogeineity across years", data=my.df)

ols1<-lm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2, data=
    my.df)
summary(ols1)
ols2<-lm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2, data=
    my.df)
summary(ols2)
ols3<-lm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df)
summary(ols3)
ols4<-lm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+mcap2
    +performance2+gearing2+sector2, data=my.df)
summary(ols4)
ols5<-lm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+mcap2
    +performance2+gearing2+sector2, data=my.df)
summary(ols5)
ols6<-lm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df)
```

```
summary(ols6)

fixed.dum1<-lm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +factor(company2)-1,data=my.df)
summary(fixed.dum1)
fixed.dum2<-lm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +factor(company2)-1,data=my.df)
summary(fixed.dum2)
fixed.dum3<-lm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+factor(company2)-1,data=my.df)
summary(fixed.dum3)
fixed.dum4<-lm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +mcap2+performance2+gearing2+sector2+factor(company2)-1,data=my.df)
summary(fixed.dum4)
fixed.dum5<-lm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +mcap2+performance2+gearing2+sector2+factor(company2)-1,data=my.df)
summary(fixed.dum5)
fixed.dum6<-lm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2+factor(company2)-1,data=
    my.df)
summary(fixed.dum6)

install.packages("plm")
library(plm)

fixed1<- plm (bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2","t2"), model = "within")
summary(fixed1)
fixed2<- plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2","t2"), model = "within")
```

```
summary(fixed2)
fixed3 <- plm (altmanz2 ~  salarya2 +bonusa2+tenurea2+mcap2+boardsize2+
    employees2, data=my.df, index=c("id2","t2"),  model = "within")
summary(fixed3)
fixed4 <- plm (bb1y2 ~ salarya2 +bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2","t2"), model
    = "within")
summary(fixed4)
fixed5 <- plm (bb5y2 ~ salarya2 +bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2","t2"), model
    = "within")
summary(fixed5)
fixed6 <- plm (altmanz2 ~  salarya2 +bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2",
    "t2"), model = "within")
summary(fixed6)

fixef ( fixed1 )
fixef ( fixed2 )
fixef ( fixed3 )
fixef ( fixed4 )
fixef ( fixed5 )
fixef ( fixed6 )

#null  ols  better  than  fixed
pFtest ( fixed1 ,  ols1 )
pFtest ( fixed2 ,  ols2 )
pFtest ( fixed3 ,  ols3 )
pFtest ( fixed1 ,  ols4 )
pFtest ( fixed2 ,  ols5 )
```

```
pFtest ( fixed3 ,   ols6 )


random1<− plm (bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    , data=my.df, index=c("id2","t2"), model = "random")
summary(random1)
random2<− plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    , data=my.df, index=c("id2","t2"), model = "random")
summary(random2)
random3<− plm (altmanz2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2, data=my.df, index=c("id2","t2"),  model = "random")
summary(random3)
random4<− plm (bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2","t2"), model
     = "random")
summary(random4)
random5<− plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    +mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2","t2"), model
     = "random")
summary(random5)
random6<− plm (altmanz2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2",
    "t2"), model = "random")
summary(random6)


phtest ( fixed1 ,random1)#fixed  better
phtest ( fixed2 ,random2)#fixed  better
phtest ( fixed3 ,random3)#random better
phtest ( fixed4 ,random4)#fixed  better
phtest ( fixed5 ,random5)#fixed  better
phtest ( fixed6 ,random6)#random better
```

```
# testing for time fixed effects
fixed.time1<-plm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+factor(t2),data=my.df, index=c("id2","t2"),model="within")
summary(fixed.time1)
fixed.time2<-plm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+factor(t2),data=my.df, index=c("id2","t2"),model="within")
summary(fixed.time2)
fixed.time3<-plm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+factor(t2),data=my.df, index=c("id2","t2"),model="within")
summary(fixed.time3)
fixed.time4<-plm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2+factor(t2),data=my.df,
    index=c("id2","t2"),model="within")
summary(fixed.time4)
fixed.time5<-plm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2+factor(t2),data=my.df,
    index=c("id2","t2"),model="within")
summary(fixed.time5)
fixed.time6<-plm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2+factor(t2),data=my.df,
    index=c("id2","t2"),model="within")
summary(fixed.time6)

#null is that no time-fixed effects needed
pFtest(fixed.time1, fixed1)
pFtest(fixed.time2, fixed2)
pFtest(fixed.time3, fixed3)
pFtest(fixed.time4, fixed4)
pFtest(fixed.time5, fixed5)
```

```
pFtest(fixed.time6, fixed6)
#use time fixed effects


plmtest(fixed1,c("time"),type=("bp"))
plmtest(fixed2,c("time"),type=("bp"))
plmtest(fixed3,c("time"),type=("bp"))#use fixed effects
plmtest(fixed4,c("time"),type=("bp"))
plmtest(fixed5,c("time"),type=("bp"))
plmtest(fixed6,c("time"),type=("bp"))#use fixed effects



pool1 <- plm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2", "t2"), model="pooling")
summary(pool1)
pool2 <- plm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2", "t2"), model="pooling")
summary(pool2)
pool3 <- plm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2", "t2"), model="pooling")
summary(pool3)
pool4 <- plm(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2", "t2"), model
    ="pooling")
summary(pool4)
pool5 <- plm(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2", "t2"), model
    ="pooling")
summary(pool5)
```

```
pool6 <- plm(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2", "t2"), model
    ="pooling")
summary(pool6)

#null is no panel effect and OLS is better
plmtest(pool1, type=c("bp"))
plmtest(pool2, type=c("bp"))
plmtest(pool3, type=c("bp"))
plmtest(pool4, type=c("bp"))
plmtest(pool5, type=c("bp"))
plmtest(pool6, type=c("bp"))

fixed1<- plm (bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2","t2"), model = "within")
fixed2<- plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2","t2"), model = "within")
fixed3<- plm (altmanz2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2, data=my.df, index=c("id2","t2"), model = "within")
fixed4<- plm (bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2","t2"), model
    = "within")
fixed5<- plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2+
    mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2","t2"), model
    = "within")
fixed6<- plm (altmanz2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2+mcap2+performance2+gearing2+sector2, data=my.df, index=c("id2",
    "t2"), model = "within")

#test of independence is that residuals across entities are not correlated
```

```
#if cross-sectional dependence exists http://fmwww.bc.edu/repec/bocode/x/xtscc
    _paper.pdf
pcdtest(fixed1, test = c("lm"))
pcdtest(fixed1, test = c("cd"))
pcdtest(fixed2, test = c("lm"))
pcdtest(fixed2, test = c("cd"))
pcdtest(fixed3, test = c("lm"))
pcdtest(fixed3, test = c("cd"))
pcdtest(fixed4, test = c("lm"))
pcdtest(fixed4, test = c("cd"))
pcdtest(fixed5, test = c("lm"))
pcdtest(fixed5, test = c("cd"))
pcdtest(fixed6, test = c("lm"))
pcdtest(fixed6, test = c("cd"))

#applies to macro panel with long time series not a problem in micro panels
    with very few years
pbgtest(fixed1)
pbgtest(fixed2)
pbgtest(fixed3)
pbgtest(fixed4)
pbgtest(fixed5)
pbgtest(fixed6)

#null is that the series has a unit root(i.e.non-stational).
#if unit root is present you can take the first difference of the variable
panel.my.df<-plm.data(my.df,index=c("id2","t2"))
install.packages("tseries")
library(tseries)
adf.test(panel.my.df$bb1y2, k=2)
```

```
adf.test(panel.my.df$bb5y2, k=2)
adf.test(panel.my.df$altmanz2, k=2)

#null is homoskedasticity
library(lmtest)
bptest(bb1y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2 + factor(
    id2), data = my.df, studentize =F)
bptest(bb5y2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2 + factor(
    id2), data = my.df, studentize =F)
bptest(altmanz2~salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2 +
    factor(id2), data = my.df, studentize =F)

# heteroskedasticity use robust covariance matrix

# controlling for heteroskedasticity :random effects
random1<- plm(bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    , data=my.df, index=c("id2","t2"), model = "random")
coeftest(random1)
coeftest(random1,vcovHC)
coeftest(random1,vcovHC(random1,type="HC3"))
t(sapply(c("HC0","HC1","HC2","HC3","HC4"), function(x) sqrt(diag(vcovHC(
    random1,type=x)))))

# controlling for heteroskedasticity : fixed effects
fixed1<- plm(bb1y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2","t2"), model = "within")
coeftest(fixed1)
coeftest(fixed1,vcovHC)
coeftest(fixed1,vcovHC(fixed1,method="arellano"))
coeftest(fixed1,vcov(fixed1,type="HC3"))
```

```
t(sapply(c("HC0", "HC1", "HC2", "HC3", "HC4"), function(x) sqrt(diag(vcovHC(
    fixed1, type = x)))))

# controlling for heteroskedasticity :random effects
random1<- plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2
    , data=my.df, index=c("id2","t2"), model = "random")
coeftest (random1)
coeftest (random1,vcovHC)
coeftest (random1,vcovHC(random1,type="HC3"))
t(sapply(c("HC0","HC1","HC2","HC3","HC4"), function (x) sqrt (diag(vcovHC(
    random1,type=x)))))

# controlling for heteroskedasticity : fixed effects
fixed1<- plm (bb5y2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+employees2,
    data=my.df, index=c("id2","t2"), model = "within")
coeftest ( fixed1 )
coeftest ( fixed1 ,vcovHC)
coeftest ( fixed1 ,vcovHC(fixed1,method="arellano"))
coeftest ( fixed1 ,vcov( fixed1 ,type="HC3"))
t(sapply(c("HC0", "HC1", "HC2", "HC3", "HC4"), function(x) sqrt(diag(vcovHC(
    fixed1, type = x)))))

# controlling for heteroskedasticity :random effects
random1<- plm (altmanz2 ~ salarya2+bonusa2+tenurea2+mcap2+boardsize2+
    employees2, data=my.df, index=c("id2","t2"), model = "random")
coeftest (random1)
coeftest (random1,vcovHC)
coeftest (random1,vcovHC(random1,type="HC3"))
t(sapply(c("HC0","HC1","HC2","HC3","HC4"), function (x) sqrt (diag(vcovHC(
    random1,type=x)))))
```

```
# controlling for heteroskedasticity : fixed effects
fixed1 <- plm (altmanz2 ~ salarya2 +bonusa2+tenurea2+mcap2+boardsize2+
    employees2, data=my.df, index=c("id2","t2"), model = "within")
coeftest ( fixed1 )
coeftest ( fixed1 ,vcovHC)
coeftest ( fixed1 ,vcovHC(fixed1,method="arellano"))
coeftest ( fixed1 ,vcov( fixed1 ,type="HC3"))
t(sapply(c("HC0", "HC1", "HC2", "HC3", "HC4"), function(x) sqrt(diag(vcovHC(
    fixed1, type = x)))))

install .packages(" stargazer ")
library ( stargazer )


citation ()
citation ("lme4")
citation ("nlme")
citation ("plm")
citation (" leaps ")
citation ("gvlma")
citation ("car")
citation ("quantmod")
citation (" xts ")
citation ("TTR")
citation (" foreign ")
citation ("Hmisc")
citation ("ggplot2")
citation ("munsell")
citation ("FactoMineR")
```

```
citation (" scatterplot3d ")
citation ("psych")
citation ("nFactors")
citation ("sem")
citation (" matrixcalc ")
citation ("glue")
citation (" olsrr ")
citation (" stargazer ")
```