The Impact of Corporate Governance on Research and Development Voluntary Disclosure: UK Evidence

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DEDICATION

To My Mother and To the Memory of My Father.

To My Husband and My Daughter Salma.

Thank You for Your Love, Sacrifice, and Support.

DECLARATION

I hereby declare that this thesis has been composed by myself, and the material contained in it has not been previously submitted in any previous application for a degree. The product of this thesis is the author's own research. No quotation from it should be published without the author's prior written consent, and information derived from it should be acknowledged.

Howida Shehata Mohamed Ahmed

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ABSTRACT

The Impact of Corporate Governance on the Research and Development Voluntary Disclosure: UK Evidence

Research and development (R&D) activities are characterised by unique features and limited mandated accounting disclosure. Hence, R&D investment is one of the most confidential activities creating information asymmetry. Consequently, firms that are involved in R&D activities may try to introduce more voluntary disclosure in order to reduce the information asymmetry and enhance their transparency.

Corporate disclosure has been examined in a large number of prior studies over the years. Recently, small numbers of studies have considered research and development voluntary disclosure in annual reports.

The current study seeks to introduce helpful insights into the R&D disclosure practices in annual reports. Moreover, it examines the impact of corporate governance on R&D voluntary disclosure in the annual reports of the UK non-financial firms with intensive R&D investments.

The sample consists of 505 firm-year observations of the UK non-financial listed firms, which are considered among the high spenders on R&D activities in the UK according to the R&D scoreboards, as published by the Department of Business Innovations and Skills (BIS).

Using content analysis, the R&D disclosure score is measured by self-constructed disclosure index. The current study employs two techniques to examine the relationship between the R&D voluntary disclosure and the independent variables: Ordinary Least Square (OLS), and Censored Regression (Tobit).

In terms of the level of R&D disclosure in annual reports, the findings reveal that, in average the UK firms introduce about 30% of the examined R&D disclosure index items. Moreover, the deviations in R&D disclosure score according to the industry type are significant. The results also show that, overall R&D disclosure is positively associated with board size and audit committee quality.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF GLOSSARY AND ABBREVIATIONS

AE	Audit Committee Experts Number
AI	Audit Committee Independence
AICPA	American Institute of Certified Public Accountants
AIM	Alternative Investment Markets
AIMR	Association of Investment Management and Research
AM	Audit Committee Meetings
AS	Audit Committee Size
ASB	Accounting Standards Board
AUDQUAL	Audit Committee Quality
BI	Board Independence
BIS	Business Innovations and Skills
BM	Board Meetings
BS	Board Size
CFO	Chief Executive Officer
DUL	Role Duality
e. g.	Exempli Gratia (Latin: For Example)
et al.	Et alia (Latin: and other)
FAF	Financial Analysts Federation
FASB	Financial Accounting Standards Board
FDIS	Financial Disclosure
FRC	Financial Reporting Council
GAAP	Generally Accepted Accounting Principles
GDIS	General Disclosure
GROW	Firm's Growth
IAS	International Accounting Standards
IFRS	International Financial Reporting Standards
INDIS	Input Disclosure
KPI	Key Performance Indicators
LEV	Leverage
LIQUID	Liquidity
LSDV	Least Squares with Dummy Variables
MONR	Managerial Ownership
NFDIS	Non-financial Disclosure
OFR	Operating and Financial Review
OLS	Ordinary Least Square
ONRC	Ownership Concentration
OUTDIS	Output Disclosure
P.	Page
PROFIT	Profitability
R&D	Research and Development
RDDIS	Total Voluntary R&D Disclosure Score
ROA	Return on Assets
SIZE	Firm Size
UK	The United Kingdom
US/USA	The United States of America
VIF	The Variance Inflation Factor
β_1 to β_{13}	Coefficient of Slope Parameters
2SLS	Two-stage Least Square Regression
3SLS	Three-Stage Least Squares

LIST OF APPENDICES

CHAPTER ONE

INTRODUCTION

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INTRODUCTION

1.1. BACKGROUND

Research and development activities (R&D hereafter) are economic investments, which play an important role in improving products, create values that may benefit the company over many years and are a valuable source of the world economic growth (Zhao, 2002; Gelb, 2002). R&D activities are an essential part of intellectual capital, which is not recognized in financial statements, raises the call for enhancing the reporting model to meet the information needs of the market by introducing the fundamental information required for a firm's transparency (Beattie et al., 2004). Consequently, investigating corporate disclosure and enhancing firms' transparency regarding intellectual capital and specially R&D activities is a rich and productive research area.

A large and growing body of literature has investigated the corporate disclosure in annual reports (e.g. Chow & Wong-Boren, 1987; Cooke, 1989; Ahmed & Courtis, 1999; Mak,1991; Gray et al., 2001; Watson et al., 2002; Eng and Mak 2003; Huafang & Jianguo, 2007; Lim et al., 2007; Garcia-Meca and Sanchez-Ballesta 2010, Samaha et al., 2015), and many studies have examined the voluntary disclosure of intellectual capital in annual reports (e.g. Carbioni and Parbonetti, 2007; Li et al., 2008; Hidalgo et al., 2011; Li et al., 2012).

In general, the findings of these studies indicate that the variation in some firm characteristics could explain the differences in voluntary disclosure among firms. They also provide evidence that certain corporate governance attributes affect significantly the discretionary information introduced by firms. However, the

findings of these studies are not necessarily extending to R&D activities disclosure practices. Considering the type of information is an important element in the development hypotheses, so the findings from specific disclosure may not be suitable for generalisation (Merkly, 2014). Moreover, the disaggregation of intellectual capital reporting into distinct categories of information including R&D activities may introduce valuable supplementary insights into the disclosure practices of intellectual capital as a whole (La Rosa and Liberatore, 2014).

Notwithstanding the importance of R&D activities as a major driver of growth, investors have difficulty in effectively assessing the firm's R&D efforts (Lev & Zarowin, 1999; Lev, 1999). Two main reasons could explain this problem. The first reason is due to the unique and risky nature of R&D activities: these have been highlighted by many researchers (e.g. Chauvin and Hirschey, 1993; Aboody and Lev, 2000; Munari et al., 2010). The second reason is the insufficient information required by the accounting regulations: this has been emphasised by others (e.g. Lev and Zarowin, 1999 and Lev, 1999). A similar conclusion is put forward by Merkly (2014) who argues that the inadequate mandatory disclosure requirements of R&D activities, and its accounting measures do not reflect the performance of R&D activities.

Furthermore, Lev and Zarowin (1999) find a decline in the value relevance of earnings as a consequence of the increased R&D intensity, suggesting that the reporting of R&D activities does not effectively reveal the value and economic consequences of R&D investments. Lev (1999) argues that the financial statements of R&D intensive firms fail to introduce adequate information about the valuation of the performance as well as growth, and for the assessment of the risk. Amir and Lev

(1996) document that non-financial indicators of performance in the wireless telecommunication sector have a significant association with stock prices. They argue that the inadequate accounting treatment of intangibles causes firms with a significant level of intangibles to employ non-financial information to supplement their financial statement information.

Consequently, outside investors who are interested in evaluating the economic performance of firms and potential future benefits from innovation projects are forced to look beyond the financial statements (Healy and Palepu, 2001). So, firms with high levels of R&D expenditure and with insufficient disclosure according to GAAP will probably turn to other forms of disclosure (Gelb, 2002).

From the previous discussion, it can be concluded that, the information problem regarding R&D activities may create a demand for more information beyond the financial statements and encourage management to introduce this kind of valuable information. Therefore, firms may use other communicating tools to improve investors understanding of their R&D activities: these include, annual reports, press releases, announcements, conference calls and websites. Consequently, the complementarily between limited mandated disclosure and the voluntary disclosure of R&D activities may enhance the ability of assessing the R&D performance, risk, and value. For this reason, the information problems surrounding R&D activities raise the call for more research on the R&D voluntary disclosure (e.g. Cazavan-Jeny and Jeanjean, 2006; Nekhili et al., 2010; Abdelbadie and Elshandidy, 2013).

The present study focuses on the R&D voluntary disclosure provided in firms' annual reports rather than other narrative information tools. Annual reports are considered the most common tools of communication used by firms to reach

different internal and external stakeholders (Guthrie & Petty, 2000). Currently, there is insufficient evidence regarding the R&D disclosure in annual reports.

This chapter is structured as follows: section (2), outlines the research objectives, section (3) explains the motivations for conducting the current study, the research questions are presented in section (4), followed by the research hypotheses in section (5), section (6) summarises the research methodology, section (7) explains the contributions of the current study. Finally, section (8) introduces the description of the thesis's organisation.

1.2. AIMS AND OBJECTIVES

The main aim of the current study is to provide a deep insight into the R&D narrative disclosure practices in annual reports. It also seeks to investigate the drivers of the level of R&D disclosure, particularly in relation to the impact of corporate governance on R&D voluntary disclosure. To achieve these goals, the current study seeks to address three main objectives:

First, to explore the R&D voluntary disclosure practices in the UK non-financial firms' annual reports. This deep investigation leads to identifying the types of R&D-related information introduced discretionarily by firms in annual reports. **Second**, to assess the extent and trend of R&D-related information introduced discretionarily by UK firms in annual reports. **Third**, to investigate the determinants of R&D voluntary disclosure in annual reports by examining the role of corporate governance, which has not had the expected attention in prior studies, and by controlling for the most other R&D disclosure drivers that have been addressed by the literature.

1.3. THE RESEARCH QUESTIONS

In order to achieve the objectives of the current study, the following research questions have been addressed:

- What type of R&D information do the UK non-financial listed firms disclose in their annual reports?
- To what extent do the UK non-financial listed firms introduce discretionary information related to their R&D activities in their annual reports?
- How do R&D disclosure practices in the annual reports of the UK non-financial listed firms change over time?
- Does corporate governance have any influence on managers' incentives to disclose information regarding R&D activities in the annual reports of the UK non-financial listed firms?

1.4. THE RESEARCH MOTIVATIONS

This study is motivated by the importance of R&D activities for the future of companies and the world economy, and by three main factors:

First, there is a lack of studies, which have investigated the determinants of R&D voluntary disclosure in annual reports. Furthermore, the few studies that have examined the drivers of R&D voluntary disclosure in annual reports has considered only firm characteristics (e.g. Entwistle, 1999; Jones, 2007; Merkley, 2014; La Rosa and Liberator, 2014), with limited evidence regarding the corporate governance variables (e.g. Nor et al., 2010; Nekhili et al., 2012; Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015).

Second, the difference across countries regarding the voluntary disclosure practices of R&D is another motivation for introducing helpful insights into R&D disclosure practices in the annual reports of the UK firms. Furthermore, this study investigates the association between corporate governance and R&D narrative disclosure for a sample of R&D intensive firms in the UK, specifically, to the best of my knowledge, the studies that examine R&D voluntary disclosure in annual reports conducted in many countries such as Canada, US, Malaysia and France. However, the UK context is only examined by a recent working paper introduced by Abdelbadie and Elshandidy (2013).

Third, this study is considered to be a response to the call for more research to examine the R&D voluntary disclosure (e.g. Cazavan-Jeny and Jeanjean, 2006; Nekhili et al., 2010; Abdelbadie and Elshandidy, 2013).

1.5. THE RESEARCH HYPOTHESES

The first three questions are answered by applying a descriptive analysis of R&D disclosure practices in annual reports. To answer the fourth question, seven hypotheses related to corporate governance variables are developed depending on the theoretical ground and prior empirical studies. These hypotheses are as follows:

H1*: There is a positive relationship between the board size and the level of R&D voluntary disclosure in annual reports.*

H2*: There is a negative relationship between the role duality and the level of R&D voluntary disclosure in annual reports.*

H3*: There is a positive relationship between the board independence and the level of R&D voluntary disclosure in annual reports.*

***H4**: There is a positive relationship between the number of board meetings and the level of R&D voluntary disclosure in annual reports.*

***H5**: There is a negative relationship between the level of management ownership and the level of R&D voluntary disclosure in annual reports.*

***H6**: There is a negative relationship between the level of ownership concentration and the level of R&D voluntary disclosure in annual reports.*

***H7**: There is a positive relationship between the audit committee quality and the level of R&D voluntary disclosure in annual reports.*

1.6. THE RESEARCH METHODOLOGY

The current study investigates the R&D voluntary disclosure in annual reports for a sample of the R&D intensive UK firms over a three-year time period. The sample comprised 505 firm year observations across three years: 2007, 2008, and 2009 from nine industries.

The study employs manual content analysis to identify the R&D-related information introduced in the narrative section in the annual reports. A self constructed disclosure index is established to measure the level of R&D disclosure in annual reports.

The disclosure index employed in this study consists of 26 R&D information items, grouped into four categories (general, input, output, and financial information). Each item in the disclosure index is scored without weighting. Binary scoring is used, so the disclosure of an item in the annual report is coded (1), and the absence of an item in the annual report is coded (0).

To explore the R&D disclosure practices and to assess the R&D disclosure extent in the annual reports, a descriptive analysis is applied for the total R&D voluntary

disclosure, its categories (general, input, output, and financial information), and its types (financial and non-financial information) and for each item of R&D information presented in the annual reports. To evaluate the R&D disclosure trend, the level of R&D disclosure is tracked over the three-year period of the study, and a statistical test is employed to examine whether there is a significant change in the extent of R&D disclosure practices over the period of the study.

To examine the relationship between corporate governance and R&D voluntary disclosure in annual reports, two main models are specified. The first model examines the association between the levels of R&D disclosure and both corporate governance and firm characteristics. The second model examines the same relationship considering the year and industry effects. Two main methods are used: Ordinary Least Squares (OLS) regression and Tobit regression.

Figure 1.1 illustrates the relationship between research objectives, research questions, research techniques and research hypotheses:

The first objective of the current study is to explore the R&D voluntary disclosure practices in annual reports. This objective is achieved by answering the first research question of the current study which is what type of R&D information does the UK firms disclose in annual reports?. To find the answer for this question, the current study conducted a manual content analysis using a self constructed disclosure index to collect the R&D-related information from annual reports. Following this, a descriptive analysis is applied for the overall R&D disclosure, its categories, its types, and for each item of R&D-related information.

The second objective of the current study is to assess the extent and trend of R&D-related information introduced discretionarily by the UK firms in annual reports. To achieve this goal, two research questions have been identified:

- To what extent do the UK firms introduce discretionary information related to their R&D activities in annual reports? This question is answered by using the same technique that has been used to answer the first question of the current study.

- How do R&D disclosure practices in the annual reports of the UK firms change over time? To provide an answer to this question, the R&D voluntary disclosure score has been tracked over the three-year period of the study, and a statistical test has been applied to investigate whether there is a significant change in the extent of R&D disclosure practices over this time.

The third objective of the current study is to examine the impact of corporate governance on the level of R&D voluntary disclosure in the UK firms' annual reports. This objective is achieved by answering the fourth research question of the current study which is, does corporate governance have any influence on the managers' incentives to disclose information regarding R&D activities in the annual reports of the UK firms?

To find the answer of this question, the study reviews the relevant theoretical foundations that have been used to explain managers' incentives to introduce voluntary disclosure regarding R&D activities. It also reviews the prior studies that investigate the R&D disclosure in annual reports. Therefore, the study formulates seven hypotheses in order to examine the impact of seven corporate governance

variables on the R&D disclosure. To examine the research hypotheses, the seven proposed explanatory variables are grouped into three sets: board characteristics, ownership structure, and audit committee quality controlling for six firm characteristics. Finally, the hypotheses have been tested using OLS regression and Tobit regression.

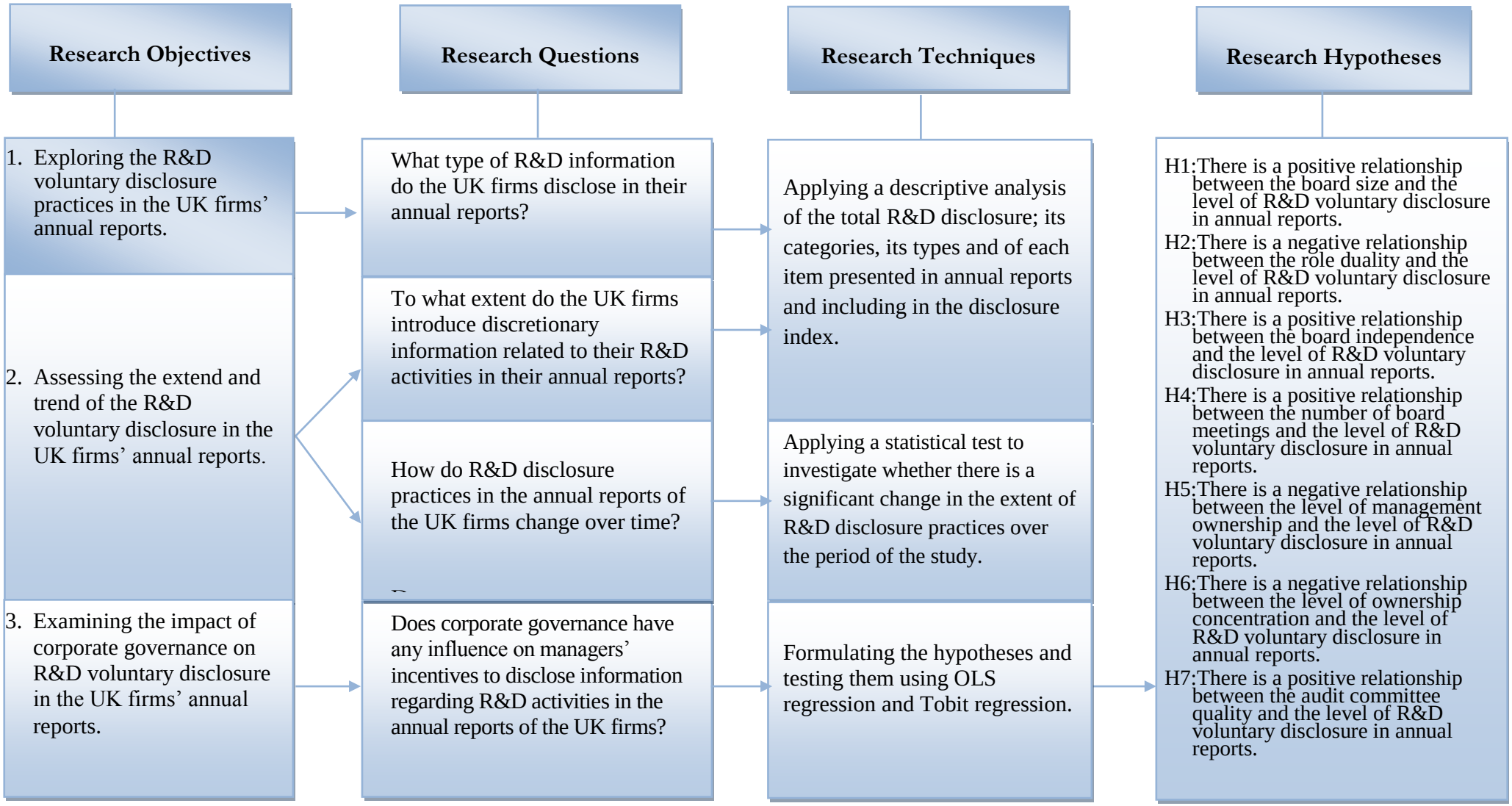

Figure 1.1
The Relationship between Research Objectives, Research Questions, Research Techniques and Research Hypotheses

1.7. THE RESEARCH CONTRIBUTIONS

The present study contributes to the prior literature in several ways:

First, the current study belongs to the stream of research on R&D activities, which investigates the R&D activities' economic, financial and accounting implications. A considerable amount of literature has addressed R&D expenditures, focused on their limited disclosure regulation, and evaluating their performance and productivity (e.g. Sougiannis, 1994; Lev and Sougiannis, 1996; Aboody and Lev, 1998; Zhao, 2002; Tsoligkas and Tsalavoutas, 2011). The findings from these studies emphasize the significant impact of R&D investments on a firm's productivity and growth. Another group of studies examines R&D voluntary disclosure outside the formal firms' annual reports (e.g. Chan et al., 1990; Woolridge & Snow, 1990; Hirshey et al., 2001; Dedman et al., 2008). This group of studies highlight the importance of R&D voluntary disclosure introduced by the firms outside the formal annual reports.

Although the previous literature points out that the R&D context is a rich research area, too little attention has been paid to the R&D narrative disclosure in annual reports. However, recently, researchers have shown an increased interest in the R&D narrative disclosure in annual reports (e.g. Nekhili et al., 2012; Abdelbadie and Elshandidy, 2013; La Rosa and Liberator, 2014; Nekhili et al., 2015).

The current study is one of a few studies, which sheds light on the importance of this area of research. It seeks to improve the understanding of R&D-related information introduced discretionarily into annual reports as an important tool to provide more information about R&D activities beyond the financial statement.

Second, the previous studies that addressed the R&D narrative disclosure in annual reports has been conducted in many countries other than the UK such as Canada (e.g. Entwistle, 1999; Zeghal et al., 2007), US (e.g. Jones, 2007; Merkley, 2014), Malaysia (e.g. Nor et al., 2010), France (e.g. Nekhili et al., 2012; Nekhili et al., 2015). Moreover, it is argued that the environmental factors could be the reason for the international differences in accounting and corporate disclosure from one country to other (e.g. Cooke and Wallace, 1999; Von Alberti-Alhtaybat et al., 2012). In addition, empirically, Ding et al., (2004) hypothesize and find significant differences in R&D voluntary disclosure practices between Canadian and French firms. Therefore, the results of the few previous studies that conducted in some countries cannot be generalised to other countries. Consequently, further work is required to introduce evidence on the UK regarding the R&D disclosure practices in the firms' annual reports.

To the best of my knowledge, the only study into the UK context that investigates the R&D disclosure in annual reports is a working paper conducted by Abdelbadie and Elshandidy (2013). They employ computerised content analysis to investigate the overall R&D disclosure and examine its determinants. They use the total number of the R&D-related sentences in annual report to measure the level of R&D disclosure. One of the limitations, which is mentioned in their study, is considering the level of overall R&D disclosure without incorporating the R&D-related topics such as R&D competition, strategies, patents, and findings.

However, the current study employs the manual content analysis, and uses a self constructed disclosure index to measure the R&D disclosure in annual reports of the UK firms. Furthermore, the current study identifies and analyses the types of R&D-

related information that is introduced discretionarily by the UK firms in annual reports. Finally, the current study examines the impact of corporate governance on R&D disclosure, and considers some other variables that have not been addressed by Abdelbadie and Elshandidy (2013), such as the effectiveness of the audit committee and the number of board meetings.

Third, the current study makes a contribution to the literature on corporate governance studies by exploring whether corporate governance attributes influence the level of R&D disclosure in annual reports. Many researchers consider the association between corporate governance and corporate disclosure (e.g. Eng and Mak, 2003; Huafang and Jianguo, 2007; Lim et al., 2007). Moreover, a large and growing body of literature investigated the impact of corporate governance on a number of specific types of information that have been introduced in firms' annual reports, including, environmental disclosure (e.g. Salama et al., 2012), intellectual capital disclosure (e.g. Cerbioni and Parbonetti, 2007; Li et al., 2008; Hidalgo et al., 2011; Li et al., 2012), forward looking information (e.g. Hussainey et al., 2003; Wang & Hussainey, 2013) and risk disclosure (e.g. Elshandidy et al., 2013; Elshandidy and Neri, 2015).

However, less attention has been devoted to the relationship between corporate governance and R&D disclosure in annual reports (e.g. Zeghal et al., 2007; Nor et al., 2010; Nekhili et al., 2012; Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015).

Although, some studies introduce helpful insights into the determinants of R&D disclosure, they only consider incomplete proxies for corporate governance mechanisms. Therefore, the systematic analysis of the corporate governance

attributes that might affect the managers' decisions to introduce more R&D-related information in the firm's annual reports is limited. In other words, the few studies that addressed the impact of corporate governance on R&D disclosure have focused on examining the characteristics of the board of directors and the firm's ownership structure without considering the role of the audit committee in influencing R&D disclosure.

The current study examines the influence of a comprehensive set of corporate governance variables, which are expected to affect R&D voluntary disclosure according to the theoretical foundation and prior empirical studies. To the best of my knowledge, the current study is the only study that addresses the impact of audit committee characteristics on R&D disclosure decisions, except Nekhili et al., (2015). They consider only the impact of audit committee independence on R&D disclosure in annual reports of French companies. Moreover, the current study considers the interaction effect between audit committee characteristics by employing the composite measure used by Zaman et al., (2011).

Fourth, notwithstanding the significant contributions of the previous studies that investigated the R&D narrative disclosure in annual reports, the findings must be interpreted within the context of the number of limitations. Some studies cover only one year (e.g. Entwistle, 1999; Jones, 2007) which may help in exploring R&D disclosure in annual reports, but does not help in assessing the trend of disclosure across time. Moreover, the majority of these studies are limited to small samples (e.g. Entwistle, 1999; Ding et al., 2004; Zeghal et al., 2007; Jones, 2007; Nor et al., 2010) which may affect the potential for generalising the findings. Furthermore, some of the prior studies emphasise R&D intensive industries (e.g. Jones, 2007; La Rosa and

Liberator, 2014), hence, the sample cannot claim to represent R&D disclosure practices of all firms from different industries.

The current study considers the limitations of the previous studies. It contributes to the disclosure literature and the R&D setting through exploring R&D voluntary disclosure in annual reports of a large sample of the UK firms (505 firm year observations), from different industries (nine industry sectors) and covering three years (2007-2009) to assess the extent and trend of R&D disclosure in annual reports.

Fifth, the current study uses a self constructed disclosure index to measure the level of R&D disclosure in annual reports. This index is primarily based upon the classification of R&D-related information that introduced by the pioneer study of Entwistle (1999), and reviews 100 annual reports of the UK firms to identify the R&D information that fit the UK context. To the best of my knowledge, there are very few studies that use a self constructed disclosure index to measure the level of R&D disclosure in annual reports (Jones, 2007; Nekhili et al., 2012; La Rosa and Liberator, 2014; Nekhili et al., 2015). Moreover, to the best of my knowledge, there is no previous index established in the UK context.

Sixth, the current study examines the impact of corporate governance on the overall R&D disclosure. Moreover, it investigates the association between corporate governance and each of R&D financial disclosure and R&D non-financial disclosure. To the best of my knowledge, Nor et al., (2010) is the only study that considers the disaggregation of R&D disclosure in annual reports into forward looking disclosure, quantitative disclosure, and financial disclosure in examining the association between R&D disclosure and corporate governance. They use the number of text

units to measure the level of R&D disclosure for 187 annual reports of firms listed in the Malaysian market.

Although, Nor et al., (2010) introduce a useful analysis of three types of R&D disclosure, which are forward looking, quantitative, and financial information, their study is limited by the small sample size. Another limitation, mentioned in their study, is the unique environment of Malaysia, so the findings cannot be generalized to other capital markets.

The current study contributes to this research area by using a self-constructed disclosure index to measure R&D voluntary disclosure in annual reports for a large sample size (505 firm year observations) of the UK firms. Furthermore, it examines the impact of corporate governance separately on financial and non-financial R&D disclosure.

Finally, drawing on a specific theory or a particular concept, the previous studies that investigated the R&D disclosure practices in annual reports have developed their hypotheses and have explained their findings. For example, some researchers have built their argument drawing on agency theory (e.g. Nor et al., 2010; Abdelbadie and Elshandidy, 2013), and other studies have employed both agency and signalling theories (e.g. Zegal et al., 2007; Nekhili et al., 2015). Moreover, some studies have used a theoretical foundation drawing on a number of concepts to formulate their hypotheses and interpret their results. These include, the cost-benefit analysis (Entwistle, 1999), proprietary costs and information asymmetry (Jones, 2007; Nekhili et al., 2012; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015). The current study employs an integrated theoretical framework based on

agency and signalling theories. It also considers cost-benefit analysis and more importantly proprietary costs and information asymmetry.

1.8. STRUCTURE OF THE THESIS

This section presents the structure of the current study and provides an overview of its contents. The thesis is organised into seven chapters as follows:

Chapter two discusses the main concepts related to the current study, identifying the nature and importance of R&D activities. Moreover, it highlights the growing trend toward enhancing a firm's narrative disclosure. It also discusses R&D disclosure in the UK, followed by a summary of the research framework of the narrative disclosure in annual reports. Finally, the chapter identifies the main aspects of corporate governance that include corporate governance definition and its impact on the disclosure policy.

Chapter three introduces a discussion of the integrated theoretical framework employed in the current study. The chapter starts with a summary of the potential costs and benefits of R&D disclosure, which may affect the managers' incentives to introduce R&D information. This is followed by a discussion of agency and signalling theories and how they can be employed to explain the R&D disclosure in annual reports. Finally, the theoretical framework of the current study is identified based on agency and signalling theories, with a consideration of the main aspects of costs and benefits analysis.

Chapter four reviews the main studies concerning the influence of corporate governance on corporate disclosure in annual reports, especially on the disclosure of intellectual capital. Furthermore, it introduces a brief discussion of the studies that

are concerned with R&D activities in general. Moreover, the chapter reviews in details, the studies that have investigated R&D voluntary disclosure in annual reports, which is the core of the current study. Therefore, the chapter identifies the gap in the literature and explains how the current study will contribute to the knowledge. Moreover, this chapter presents the different approaches employed in literature to analyse the narrative disclosure in annual reports. Finally, the hypotheses are formulated based on the theoretical framework presented in chapter three, and the literature review introduced in this chapter.

Chapter five outlines the methodology employed in the current study to answer the research questions and to examine the research hypotheses. It clarifies the research method and research design which includes choosing a UK context, the R&D disclosure in annual reports, the time horizon, the study population, the sample selection, the characteristics of the disclosure index, the construction of the disclosure index and the assessment of its reliability and validity. This is followed by the definition and measurement of the variables and the shaping of the model specification. Finally, the chapter summarizes the analytical procedures.

Chapter six introduces the analysis of data and presents its results. It starts with a descriptive analysis of the extent and trend of R&D disclosure. Four levels of analysis are presented: overall R&D disclosure, its categories, its types and R&D disclosure items. This is followed by the descriptive analysis of the dependent and independent variables. The regression diagnostics are summarised, and the results of OLS regression and Tobit regression are presented for each of overall R&D disclosure, financial R&D disclosure, and non-financial R&D disclosure. The

chapter ends with the sensitivity analysis for the full model and for both dependent and independent variables.

Finally, chapter seven presents a summary of the research objectives, research questions and methodology. It also introduces a brief report of the research findings. This is followed by the theoretical and practical implications of the current study. Finally, the chapter outlines the limitations of the study and suggests some ideas for future research.

CHAPTER TWO

A CONCEPTUAL FRAMEWORK

CHAPTER TWO
A CONCEPTUAL FRAMEWORK

2.1. INTRODUCTION

There has been growing concern that the traditional financial report cannot cope with the information needs of the new economy (AICPA, 1994). Consequently, to bridge the gap between information introduced in financial statements and the information needs of the users of financial statements, many commentators argue that more disclosure of non-financial, forward looking, and intangible assets information is needed (FASB, 2001, a). Therefore, improving the quality of corporate disclosure and enhancing firms' transparency is one of the most rich and attractive research areas.

In general, narrative disclosure in corporate annual reports is well documented in a considerable body of literature (e.g. Chow and Wong-Boren, 1987; Cooke, 1989; Ahmed & Courtis, 1999; Mak, 1991; Gray et al., 2001; Watson et al., 2002; Eng and Mak 2003; Huafang & Jianguo, 2007; Lim et al., 2007; Garcia-Meca and Sanchez-Ballesta, 2010). However, few studies have addressed the narrative disclosure of R&D activities in annual reports (e.g. Entwistle, 1999; Jones, 2007; Nekhili et al., 2012; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015).

The current study contributes to the corporate disclosure literature by introducing new evidence of the R&D narrative disclosure practices in annual reports. The previous chapter presents the main focus of this study, which is R&D voluntary disclosure practices in the UK firms. The current chapter aims to identify the main concepts and aspects related to the present study.

Section (2) starts with the definition of R&D activities, followed by highlighting its importance and finally, an explanation of the unique nature of R&D investments. Section (3) discusses issues related to R&D disclosure. These include: the definition of accounting disclosure in general, the importance of narrative disclosure, R&D disclosure and specifically, R&D disclosure in the UK. Section (4) reviews the framework for research on accounting narratives. Section (5) starts with the definition of corporate governance and followed by the role that has been played by corporate governance to enhance the firm's transparency. Finally, section (6) summarises the main issues discussed in the current chapter.

2.2. RESEARCH AND DEVELOPMENT ACTIVITIES

This section introduces the definition of R&D activities that is used in the current study and stated by the International Accounting Standards (IAS). It also emphasizes the importance of R&D activities for firms and for the general economy. Finally, the distinctive nature of R&D investments is highlighted.

2.2.1. Definition of Research and Development Activities

IAS 38 (Para: 8) defines the research activity as *"original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding"*, while the development activity is defined as *"the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems, or services before the start of the commercial production or use"* (IAS 38 Para. 8).

2.2.2. The Importance of Research and Development Activities

R&D activities play an important role in economic growth and a nation's welfare; they are a major contributor to technological change that leads to enhanced productivity and growth (Lev, 1999).

The literature has provided evidence on the importance of R&D investments. Sougiannis (1994) investigates the productivity of R&D investments and proves that investors place a high value on R&D investments, and the market value reflects this assessment in the future. He finds that approximately every one-dollar increase in R&D spending creates a five-dollar increase in the market value. In addition, Lev (1999) surveys a large group of empirical research and concluded that, most results clearly demonstrate that R&D activities significantly contribute to productivity and firm value as reflected in stock prices.

Moreover, an exploratory international study conducted by Ding et al., (2007) introduced further evidence on the positive contribution of R&D activities for the future performance of a firm, and points out that this contribution varies from one country to another.

2.2.3. The Nature of Research and Development Activities

R&D activities have a unique nature. The distinctive features of R&D activities have been identified by many researchers. Munari et al., (2010) indicate that R&D activities are a long-term investment which characterized by the high level of uncertainty. Chauvin and Hirschey (1993) show that R&D expenditure is considered as a type of intangible asset investment with expected positive influence on future cash flow. They argue that any information regarding R&D spending can help

investors to form their expectations about the amount and variability of future cash flow.

The main differences between R&D activities and other types of investments are summarized by Aboody and Lev (2000) as follows:

- Most R&D activities are unique to each developing firm, while most capital investments have similar features across firms within a certain industry. For this reason, it will be not appropriate to compare the R&D performance among firms.
- While most physical and financial assets can be assessed in the organised markets, the R&D activities do not have such an organised market where the asset's price can convey its value.
- R&D activities are traded differently from other types of investments, according to accounting reporting rules. While the fair value of most financial investments and the recognition of value impairment of physical assets are mandated by accounting rules, immediately expensed of R&D expenditure is the basic rule. The only exception is R&D expenditures capitalisation when the firm can meet specific conditions. Consequently, there is no reported value of R&D investments to communicate the productivity of R&D activities to investors.

2.3. RESEARCH AND DEVELOPMENT DISCLOSURE

This section briefly discusses the definition of accounting disclosure in general. Then, it highlights the increasing importance of the narrative disclosure as a result of the fundamental changes in a business environment that notably affect information

needs and a firm's transparency. Next is a more detailed discussion of R&D disclosure, and in particular, the R&D disclosure in the UK context.

2.3.1. Accounting Disclosure

Corporate disclosure can be defined as *"the communication of information by people inside the public firms towards people outside"* (Farvaque et al., 2011: 8).

The company can communicate its performance to all stakeholders by using different means. Firstly, through financial statements which are prepared according to the accounting standards and must follow specific rules and format. The second formal way to introduce more information to stakeholders is through the annual report which contains information about the firm's operations, performance and activities. Besides financial reporting as a main formal tool of corporate disclosure, there are many other channels available for firms to communicate with stakeholders, including conferences, press releases, websites and announcements.

Consequently, financial disclosures are simply defined by (Gibbins et al., 1990: 122) as:*"any deliberate release of financial information, whether numerical or qualitative, required or voluntary, or via formal or informal channels."*. For a more particular definition, Meek et al., (1995: 555) define voluntary disclosure in annual reports as *"disclosure in excess of requirements-present free choices on the part of company management to provide accounting and other information deemed relevant to the decision needs of users of their annual reports."*.

2.3.2. The Importance of Narrative Disclosures

Beattie et al., (2004) argue that the fundamental changes in the business environment, which has become gradually more involved in the value creation

process that depends on intangible assets not recognized in the financial statements, raise the call for enhancing the reporting model and meeting the information needs of the market by introducing the fundamental information required for firm transparency.

It can be noticed that, there is a growing trend towards enhancing corporate disclosure. Many academic researchers and accounting entities draw attention to the importance of narrative disclosure and emphasise the need to improve corporate reporting to bridge the gap between traditional financial reporting, and the information needs of the new economy. (e.g. Lev and Zarowin, 1999; AICPA, 1994; FASB, 2001, b; ASB, 2006; FRC, 2014).

The next paragraphs outline some of the important reports produced by significant accounting entities that emphasise the importance of narrative disclosures.

The American Institute of Certified Public Accountants (AICPA) formed the Jenkins Committee. The committee issues its report in 1994: *"Improving Business Reporting. A Customer Focus; Meeting the Information Needs of Investors and Creditors."*.

The committee conducted a comprehensive study to illustrate the information needs of professional investors, creditors and their advisors to identify the most useful types of information in evaluating firms and assessing their future prospects. It develops some recommendations to improve business reporting. Providing more forward-looking information and non-financial data is among these recommendations. In addition, the committee identifies some areas for further research that would provide helpful information to standard setters, regulators, and other parties interested in improving business reporting.

The current study belongs to one of these suggested areas; which is investigating the types of information that introduced discretionarily by firms.

The steering committee of the Financial Accounting Standards Board (FASB) issued its report in 2001 entitled "*Improving Business Reporting: Insights into Enhancing Voluntary Disclosure.".* This report aims to help firms to improve their business reporting by providing them with examples of extensive voluntary disclosure introduced by leading firms. These examples illustrate how companies can communicate effectively with investors. The report introduces the findings of a set of working groups that investigated voluntary disclosure practices in eight industries. The working groups consider firms' annual and quarterly reports, SEC reports, press releases, web sites and conference calls.

The steering committee's recommendations highlight the expected increasing importance of voluntary disclosures in the future as a result of the significant changes in the business environment. In addition, the committee encourages firms to introduce additional information about unrecognized intangible assets. It also indicates that this kind of information would be beneficial due to the importance of intangible assets to a firm's value. Moreover, the committee believes that forward-looking information would be helpful to current and potential investors. However, the adverse influence of this disclosure on the firm's competitive position should be considered.

The Accounting Standards Board (ASB) issued its report (2006) entitled *"Reporting Statement: Operating and Financial Review"* to identify the best practices in the preparation of the Operating and Financial Review (OFR). The report introduces a set of recommendations and implementation guidance. It specifies the key elements

of the disclosure framework that should be addressed in an OFR such as, information with forward-looking orientation that helps others in the assessment of the current and future performance of the firm. The report also recommends introducing financial and non-financial information to complement the financial statements. Indeed, the key performance indicators (KPIs) and the principal risks facing the firm are considered as a necessary kind of information to evaluate the objectives and strategies of the firm.

The reporting statement has been replaced by the report published by The Financial Reporting Council (FRC), (2014) entitled *"Guidance on the Strategic Report"*. It is non-mandatory guidance supporting the mandatory requirements of the strategic report that apply for periods ending on or after 30 September 2013. The guidance helps firms to tell their businesses' stories with a focus on the shareholders' needs and with achieving the best use of the regulatory framework that is drawn up in the companies Act 2006.

The importance of investigating R&D disclosure arises from the increasing focus on improving narrative disclosure in general and especially on intangibles and forward looking information.

2.3.3. The Importance of Research and Development Disclosure

Recently, intangible assets have received great attention. This study concentrates on R&D activities as an important part of intangible assets, which play an important role in the future of companies and in the world economy.

IAS 38 states that any spending on research activity must be recognized as an expense immediately, (IAS 38, Para. 54). An asset arising from development activity

shall be recognised if the firm can demonstrate the recognition criteria. Considering these criteria, the company should capitalise development expenditures when it intends to complete the asset and can demonstrate the technical feasibility of completing it and also its ability to either use it or sell it. In addition, the company should be able to show how the asset will generate future economic benefits, and illustrate the availability of resources to complete and use, or sell the asset. Finally, the company must demonstrate its ability to measure reliably the development expenditures (IAS 38, Para. 57). According to the requirements of IAS 38, most R&D expenditures will be expensed in financial statements.

Several studies have documented a decrease in the usefulness of the financial statements of firms. They argue that, the reason behind this decline could be the inadequate value of intangible assets introduced by firms in their financial statements (e.g. Amir and Lev, 1996; Lev and Zarowin, 1999; Canibano et al., 2000).

Amir and Lev (1996) examine the value relevance of financial and non-financial information in the wireless telecommunication industry. They find that non-financial information has value relevance, while financial information (earnings, book value, and cash flow) is not significantly associated with stock price. They argue that because of the insufficiency of accounting information, firms provide non-financial information to enhance their disclosure.

Lev and Zarowin (1999) document a systematic decrease in the association between market values and accounting information. They also find that the rise in R&D intensity is associated with a decrease in the value relevance of earnings. The authors conclude that the investment in R&D activities is a significant factor in the decline of the usefulness of financial reports. Moreover, this noticeable decline is due to the

non-reporting of intangible assets in the balance sheet. Given the drawbacks of the informative of accounting information, financial statements are becoming less revealing of the current financial position and future forecasts because they concentrate on the reliable estimates of the firm value but not necessarily the relevant ones (Canibano et al., 2000).

The limited systematic investigation of information relating to intangible assets, including R&D activities has raised the call for further research into R&D voluntary disclosure. Gelb (2002) empirically investigated the intangible assets and firm disclosure. He finds that firms with significant levels of R&D expenditure are more likely to enhance their voluntary disclosure above mandated accounting requirements as the primary tool to present their financial performance. He suggests that standard setters may wish to consider additional disclosures about intangible assets within the requirements of generally accepted accounting principles.

Cazavan-Jeny and Jeanjean, (2006) examine the association between stock prices and R&D reporting and suggest future research to study the voluntary disclosure of R&D activities as an alternative source of information other than R&D reporting.

The importance of R&D information is widely considered in an emerging body of research. Many researchers document a significant influence of R&D expenditures on the market value of firms (e.g. Chauvin and Hirschey, 1993; Sougiannis, 1994, Lev and Sougiannis, 1996), and confirm a value relevance of non-financial patent information as a long-term benefit derived from R&D activities (e.g. Hirschey et al., 2001). Accordingly, R&D information would be helpful to investors in their ongoing valuation of firms.

This study contributes to the debate on disclosure of R&D activities by exploring R&D disclosure in annual reports. Moreover, it investigates the determinants of R&D voluntary disclosure, especially the role of corporate governance as a potential driver of disclosure in annual reports, using a sample of the largest corporate spenders on R&D in the UK.

2.3.4. Research and Development Disclosure in the UK

Narrative disclosure in annual reports is considered as the key element in achieving the required enhancement of corporate reporting, and regulators are focusing their efforts on management discussion, operations and financial matters by issuing, extending and revising their guidelines for the narrative report (Beattie et al., 2004).

In the UK, the ASB issued *"Reporting Statement: Operating and Financial Review"* in 1993 to set out guidance for a narrative report on the OFR which was revised in 2006 (Deloitte, 2009). More recently, new enhancement of business review requirements has come into force for UK listed companies under the companies ACT 2006 (FRC, 2009).

The companies Act 2006 (Part 15, chap. 5, Section 417) requires listed companies to introduce a business review in their director's report. This should include a fair review of the company's business, a description of the principal risks, information about some issues: environmental matters, the company's employees, social and community issues and an analysis using KPIs.

However, a survey conducted by Deloitte (2009) to set out the common implementation problems for mandatory requirements, and the recommended content of the OFR reveal that there is a difficulty in interpreting some requirements, whilst

others are too generic. The results of the survey suggested that the ASB needs to issue another document and provide companies with a clear, comprehensive and logically ordered guide to narrative disclosures.

Moreover, The Companies Act 2006 (Part 15, chapter 5, Section 417:10) declares that *"Nothing in this section requires the disclosure of information about impending developments or matters in the course of negotiation if the disclosure would, in the opinion of the directors, are seriously prejudicial to the interests of the company."*.

This statement provides a level of protection for firms against certain negative effects of introducing this highly confidential information. It was pointed out in section two of this chapter, the R&D activities are long-term investments with a high level of uncertainty and distinctive features (Chauvin and Hirschey, 1993; Aboody and Lev, 2000; Munari et al., 2010). Accordingly, the managers have the right to withhold the R&D-related information when they believe that specific disclosures would be harmful to the company.

In addition, The Companies Act 2006 does not assure any particular disclosures related to specific issues. Therefore, the selection of issues to be discussed and KPIs to be introduced in the business review are at the discretion of the directors (Li et al., 2012). Consequently, current narrative disclosure practices of R&D activities are essentially voluntary.

2.4. NARRATIVE DISCLOSURE STUDIES:THE RESEARCH FRAMEWORK

The importance of narrative disclosure and the growing trend toward enhancing the firm's transparency have attracted many researchers to explore corporate disclosure and explain the existing practices. Moreover, they have tried to investigate the

consequences of information introduced by firms and draw some helpful recommendations in order to improve corporate reporting.

Beattie, (2014) introduces a framework for the observed research questions regarding accounting narratives. Her framework includes five questions as follows:

- What is reported?
- What explains the observed practice?
- How does the author explain observed practice?
- What are the consequences of observed practice?
- What should be reported? [1]

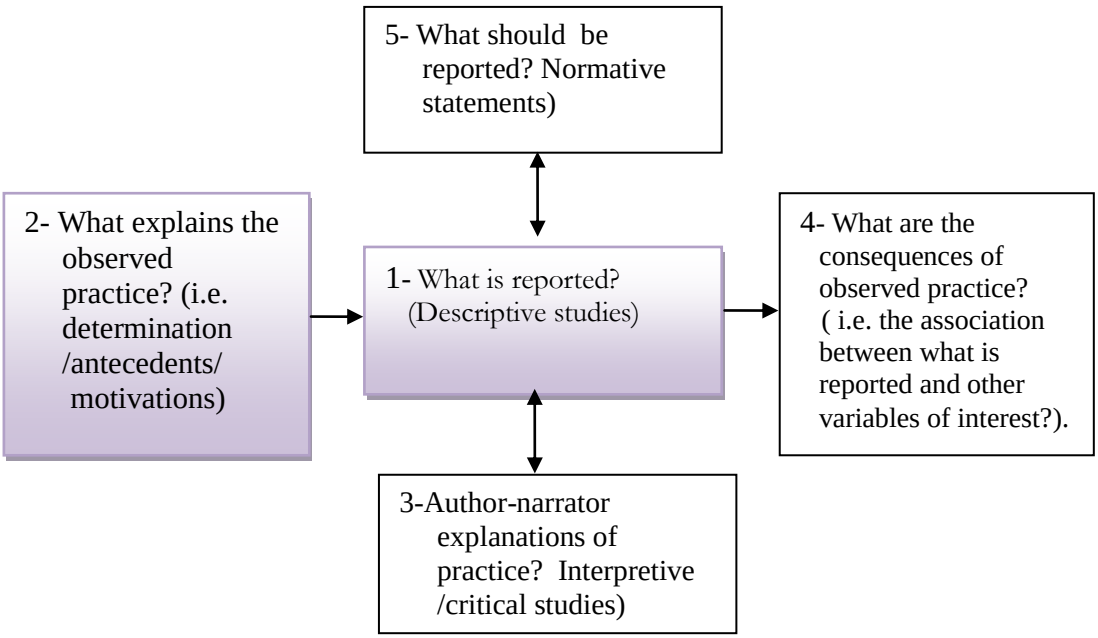

Figure 2.1
Research into Accounting Narratives
Source: adopted from Beattie, 2014.

[1] The interpretive narrative research, the consequences of narrative practice and normative statements are beyond the Current study.

Given the lack of studies that address R&D voluntary disclosure in annual reports, especially in the UK context, the present study investigates the first and second questions from the previous framework outlined by Beattie, (2014). The description of the actual R&D disclosure practice in annual reports and examining its determinants could be a logical starting point to introduce useful insights into the R&D disclosure process in annual reports.

Therefore, the current study seeks to explore R&D narrative disclosure practices introduced by the UK firms in their annual reports. Furthermore, the current study tries to explain the observed R&D disclosure practices by investigating the impact of a set of corporate governance variables on the level of R&D disclosure. At the same time, it considers some firm characteristics that could explain the R&D disclosure practices based on the theoretical foundation and prior empirical studies.

However, further research in this field is needed to complement the current study. Considering the consequences of R&D voluntary disclosure in annual reports could be an important research area. These would include the influence of R&D disclosure on market value and on information asymmetry. In addition, the management's explanations of the existence disclosures and the researcher's recommendations for the best practices of the R&D disclosure in annual reports are important issues for future research.

2.5. CORPORATE GOVERNANCE: OVERVIEW

This section starts with identifying the narrower and broader definitions of corporate governance, followed by a brief discussion of the association between corporate governance and disclosure policy. Finally, the development of corporate governance code in the UK is discussed.

2.5.1. Definition of Corporate Governance

The Cadbury Committee (Cadbury Report, 1992, Para. 2.5) defines corporate governance in one statement as *"the system by which companies are directed and controlled"*. In the simple corporate governance structure, the demand for corporate governance mechanisms is created by the separation between the capital managers and the capital providers (Gillan, 2006).

However, the firm is more than managers and capital suppliers. Accordingly, a more comprehensive corporate governance structure is considered by Gillan and Starks (1998: 4) who define corporate governance as *"the system of laws, rules and factors that control operations at a company"* and by Donnelly and Mulcahly (2008: 416) who defines corporate governance as *"a set of control mechanisms that is specially designed to monitor and ratify managerial decisions, and to ensure the efficient operation of a corporation on behalf of its stakeholders."*.

Consequently, the stakeholders of a firm such as shareholders, creditors, suppliers, consumers, employees, and the government can protect their interests in a firm by the existence of the effective corporate governance mechanisms. (John and Senbet, 1998:374) State that *"Corporate governance is a means by which various stakeholders exert control over a corporation by exercising certain rights as established in the existing legal and regulatory frameworks as well as corporate bylaws."*.

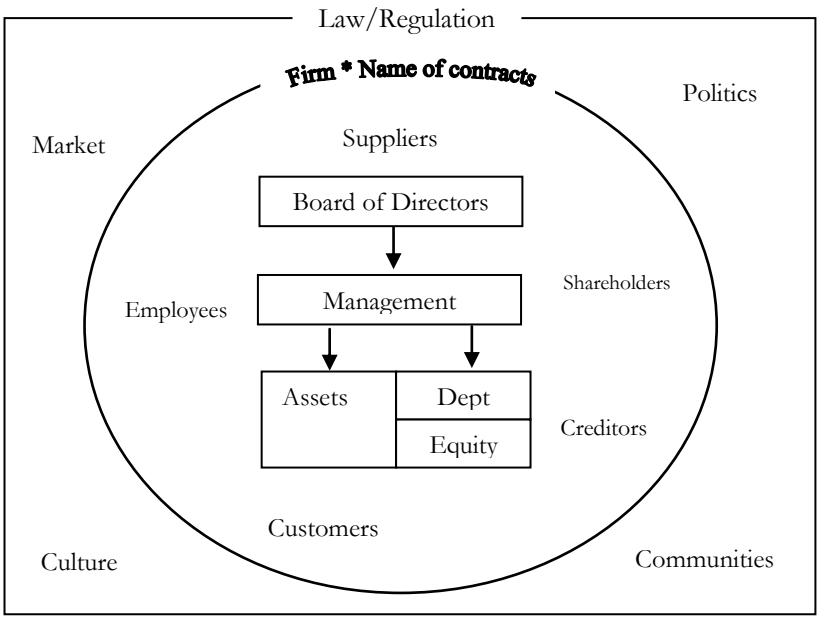

Figure 2.2
Corporate Governance beyond the Balance Sheet Model
Source: Gillan, 2006, 383.

2.5.2. Corporate Governance and Disclosure Policy

Effective corporate governance is supposed to improve monitoring quality by reducing the possibility that managers will increase their interest through withholding information; therefore, both voluntary disclosure and corporate governance are considered mechanisms of accountability (Cerbioni and Parbonetti, 2007; Hidalgo et al., 2011).

In addition, Hidalgo et al., (2011) indicate that the design of efficient corporate governance mechanisms that reduce information asymmetry and enhance firm's transparency is one of the most broadly discussed issues in both academic and business press settings. Therefore, a positive association between the quality of corporate governance structure and firm disclosure decisions is expected, given the monitoring role of corporate governance. (Karamanou and Vafeas, 2005, Cerbioni and Parbonetti, 2007; Brown et al., 2011).

Empirically, previous literature demonstrates the association between corporate governance and voluntary disclosure (e.g. Eng and Mak, 2003; Huafang and Jianguo, 2007; Lim et al., 2007; Garcia-Meca and Sanchez-Ballesta, 2010). However, there are a few studies address the influence of corporate governance on intellectual capital disclosures (e.g. Cerbioni and Parbonetti, 2007; Li et al., 2008; Hidalgo et al., 2011; Li et al., 2012).

Although the influence of corporate governance on R&D voluntary disclosure can be theoretically justified, the systematic analysis of this effect is limited and inconclusive. To date, the literature introduces very little evidence regarding the relationship between corporate governance and R&D disclosure in annual reports (Nor et al., 2010; Nekhili et al., 2012; Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015).

2.5.3. Corporate Governance in the UK

The growing attention to corporate governance in the UK started in the late 1980s and early 1990s, as a result of the concerns about the corporate financial systems following a series of corporate collapses and scandals (FRC, 2010). This led to the setting up of the corporate Governance Committee in 1991. The committee was chaired by Sir Adrian Cadbury, and in 1992 issued its report *"The Financial Aspects of Corporate Governance"*, now known as the Cadbury report.

The Cadbury committee's objective was to review those aspects of corporate governance relating to financial reporting and accountability. The committee's report was mainly concerned three issues: the structure and responsibilities of boards of directors, the role of auditors and the rights and responsibilities of shareholders. The main achievement of the committee was the code of best practices, which draws the

outlines for high standards of corporate governance. Although, the corporate governance code was not mandatory, all listed companies in the UK had to state whether they are complying with the code or if not, identify the reasons for non-compliance; this requirement is known as *"comply or explain"* (Cadbury, 1992). Cadbury has been followed by further moves to improve the corporate governance in the UK[2].

The Greenbury report (1995) specified the recommendations of director's remuneration. The Hampel committee (1998) reviewed the Cadbury and Greenbury reports and introduced its report that led to the publication of the combined code of corporate governance in 1998. In 2003, the UK government decided that the FRC should take the responsibility for maintaining and publishing the corporate governance code. The UK corporate governance code sets out the principles of good practice in relation to issues such as board leadership and effectiveness, remuneration, accountability and the relations with shareholders. The FRC has revised and updated the code regularly in 2006, 2008, 2010, and 2012 and most recently in September 2014.

Throughout all of these improvements, over two decades of dynamic developments of corporate governance code's principals and provisions, the *"comply or explain"* approach, which was first set out in the Cadbury report has been retained as a trademark of corporate governance in the UK and a foundation of its flexibility (FRC, 2014).

[2] The Greenbury Report, 1995;The Hampel Report, 1998;The combined Code, 1998; The Turnbull Report,1999; Directors' Remuneration Report Regulation, 2002; The Higgs Report, 2003; The Smith Report, 2003;The combined code, 2003; The combined code, 2006;The combined code, 2008; The UK corporate governance code, 2010; The UK corporate governance code, 2012; The UK corporate governance code, 2014. For more details, Coyle, B. (2009).

2.6. SUMMARY

The business environment has changed fundamentally. The increasing of competition, the rapid advance of technology, innovations and a value creation process that mainly relies on intellectual capital has led to significant changes in information needs. In response to these new information requirements that go behind the traditional financial statements, firms try to differentiate themselves by adapting effective corporate governance mechanisms. This leads to reduce agency costs and to introduce more voluntary disclosure in order to enhance the firm's transparency. R&D activities have a considerable influence on the future of firms and of the whole economy. They are also characterised by unique features and limited mandated accounting disclosure. Hence, R&D investment is one of the most confidential activities that create information asymmetry.

Enhancing voluntary disclosure of business information has been recommended by many researchers and professional accounting entities with an emphasis on those concerning intangible assets and forward-looking information. Consequently, it can be argued that, effective voluntary disclosure about intangible assets generally and particularly R&D activities, can provide more transparency and better understanding of the firm's activity.

The current chapter discusses the main concepts related to the present study. It mainly identifies the R&D activities, the accounting disclosure and the corporate governance. The chapter starts with the definition of R&D activities, followed by highlighting the importance of the R&D activities and explaining the unique nature of the R&D investments. Next, the importance of narrative disclosure and particularly, the importance of R&D disclosure are discussed.

This chapter, also presents briefly, the framework of narrative disclosure studies. The literature on accounting narratives considers many research interests; the present study addresses two related research issues. These are, firstly, the exploring of R&D disclosure practices in corporate annual reports and secondly, the determinants of the observed practices. After that, the chapter identifies the definition of corporate governance and its potential influence on disclosure policy. Finally, it summarises the development of corporate governance regulations in the UK.

CHAPTER THREE

THEORETICAL FRAMEWORK

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THEORETICAL FRAMEWORK

3.1. INTRODUCTION

In the context of accounting disclosure, many theories have been employed to explain disclosure practices. These theories include, agency theory, signalling theory, stakeholder theory, legitimacy theory, political cost theory, capital need theory and cost-benefits analysis [3].

However, surveying R&D disclosure literature indicates that agency and signalling theories are the central theories that are employed to clarify the managers' incentives to disclose or not disclose R&D information (e.g. Zeghal et al., 2007; Nor et al., 2010, Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015). Moreover, the costs and benefits of introducing voluntary R&D-related information in annual reports is considered in addressing R&D disclosure decisions (e.g. Entwistle, 1999; Jones, 2007; Nekhili et al., 2012; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015).

The theoretical framework employed in the current study is built on the combination of the theories and concepts that have been considered in prior studies to explain R&D voluntary disclosure practices in firms' annual reports. This framework includes agency theory, signalling theory and the benefits and costs of R&D disclosure.

Based on agency theory and signalling theory, the argument of the current study can be put forward as follows: R&D activities have been comprehensively described by

3 Details on disclosure theories are given in Von Alberti-Alhtaybat et al., 2012; Omran and El-Galfy, 2014.

Aboody and Lev (2000) as risky, long-term investments with limited mandated disclosure and much confidential related information. These characteristics create an information asymmetry problem (Aboody and Lev, 2000; Merkley, 2014).

In addition, the separation between managers and capital suppliers leads to the agency problem (Jensen and Meckling, 1976). Consequently, it can be argued that, firms with an effective corporate governance may have the incentive to enhance their R&D disclosure. Hence, they can reduce information asymmetry and agency costs by signalling their ability in managing R&D activities and their firm's transparency. However, this notion cannot be accepted without considering the disclosure-related costs, which may be a significant obstacle to any comprehensive R&D disclosure. The proprietary cost is an essential difficulty for discretionary R&D disclosure decisions (Jones, 2007; Merkly, 2014)

The current chapter aims to provide a discussion of the integrated theoretical framework adopted by the current study. Section (2) focuses on the cost-benefit analysis of the R&D voluntary disclosure. Section (3) summarises the main aspects of agency theory and how it can be employed to explain the R&D voluntary disclosure. Section (4) summarises the main aspects of signalling theory and how it can be employed to explain the R&D voluntary disclosure. Section (5) introduces the integrated theoretical framework that has been employed in the current study. Section (6) summaries the main issues discussed in the current chapter.

3.2. THE TRADE-OFF BETWEEN COSTS AND BENEFITS OF R&D DISCLOSURE

Within the disclosure literature, many researchers address a number of disclosure's benefits. The main possible disclosure advantages, according to theoretical foundation and empirical evidence is: (1) reducing information asymmetry (e.g.

Verrecchia, 2001; Jones, 2007; Beyer et al., 2010 Farvaque et al. 2011; Von Alberti-Alhtaybat, 2012; Merkley, 2014), (2) enhancing the firm's value (e.g. Chan et al., 1990; Woolridge and Snow, 1990; Hirshey et al., 2001; Dedman et al., 2008; Li et al., 2008), (3) reducing the cost of capital (e.g. Botosan 1997; Sengupta, 1998), (4) increasing the firm's liquidity (e.g. Diamond and Verrecchia, 1991; Healy et al., 1999), and (5) reducing the agency costs (e.g. Huang and Zhang, 2012; Beattie and Smith, 2012).

Although there are considerable benefits to increasing transparency through more informative disclosure, firms do not reveal all their private information because the disclosure is not without cost. The disclosure costs may be weighed in the managers' decisions regarding introducing voluntary information. Entwistle (1999) concluded from his field study that managers consider many benefits gained from introducing appropriately information about their R&D activities, such as enhancing the firm's credibility and ensuring realistic expectations. He also points out that managers tend to employ cost/benefit analysis before deciding to introduce R&D-related information discretionarily.

Accordingly, disclosure is considered as a rational trade-off between costs and benefits. Hence, managers need to make difficult decisions to determine the amount and the type of voluntary disclosure that maximise the disclosure benefits combined with affordable costs (Entwistle, 1999; Healy and Palepu, 2001; Prencipe, 2004; Garcia-Meca and Sanchez-Ballesta, 2010).

However, it is impractical to measure with accuracy many of the costs and benefits of enhancing disclosure; these would include the cost of disclosing harmful

competitive information, or the benefit of introducing a specific useful piece of information (AICPA, 1994).

Figure 3.1 illustrates the trade-off between the benefits and costs of disclosure. It shows three main types of benefits that could promote managers to introduce voluntary R&D disclosure. These benefits are information asymmetry reduction, agency costs reduction, and balancing the limited mandated R&D disclosure requirements.

The figure also demonstrates three main types of disclosure costs that could be obstacles to introduce more R&D disclosure. These costs are the cost of collecting information, litigation costs, and proprietary costs. To make a decision regarding the R&D disclosure that introduced discretionarily by firms, the managers need to evaluate both costs and benefits of the R&D disclosure, and decide the level and the kind of information that will be appropriate.

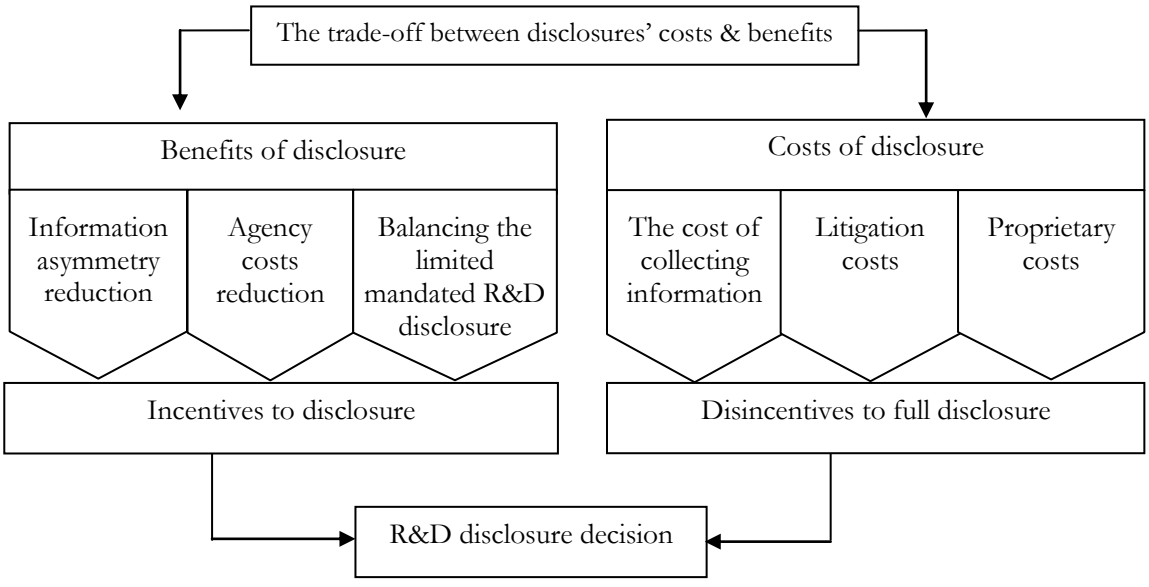


Figure 3.1
The Trade-off between Benefits and Costs of R&D Disclosure

The following paragraphs summarise the main potential benefits and costs of R&D disclosure, which may affect positively or negatively the management's incentives to introduce discretionary information about their R&D activities.

3.2.1. Disclosure Benefits

The main objective of traditional financial reporting is to introduce sufficient information to meet accounting standards. However, many firms exceed the mandatory disclosure requirements and provide more information within their corporate annual reports. The reason for such behaviour is the expected benefits that may be achieved by firms from voluntary disclosure (Dedman et al., 2008). The main benefits of disclosing R&D-related information can be classified into three groups: (1) information asymmetry reduction, which may enhance the firm value, reduces cost of capital, and improves liquidity, (2) agency cost reduction, and (3) balancing the limited mandated R&D disclosure requirements.

3.2.1.1. Information Asymmetry Reduction

The information asymmetry existence explained by Stiglitz (2002: 469) as *"different people know different things."*. Connelly et al., (2011) believes that not all information is freely available and there is confidential information that is only accessible to a subset of the public: therefore, information asymmetry arises between people who hold this information and others who could improve their decisions if they hold it too.

Verrecchia, (2001) emphasises the importance of information asymmetry reduction and argues that it could be a potential foundation upon which to build a comprehensive disclosure theory. Verrecchia (2001:97) states, *"I recommended information asymmetry reduction as a vehicle to integrate the efficiency of the*

disclosure choice, the incentives to disclose and the endogeneity of the capital market process as it involves the interactions among individual and diverse investors.". Farvaque et al., (2011:11) support this point of view and state:

> *"Enhancing the information received by investors in the financial market allows them to improve the quality of their expectations. The more transparent a firm is, the more actors in the market get information that is specific to the share. Variations of the price of the share, thus depend less on the general market trend, and more on reasons related to the firms. Thus, the systematic risk decreases, and the cost of capital is lower."*.

The information asymmetry between the firm and the capital market and between informed and uninformed investors can be reduced by increasing voluntary disclosure and firm's transparency (Beyer et al., 2010; Von Alberti-Alhtaybat, 2012). For that reason, managers could use voluntary disclosure as a mechanism to reduce the information asymmetries between themselves and outsiders (Verrecchia, 1990, Jones, 2007). Consistent with this argument, Merkley, (2014) confirms a negative relationship between R&D narrative disclosure and information asymmetry, suggesting that R&D disclosure can be used as an effective tool to decrease information asymmetry.

To sum up, it seems that the effective disclosure could reduce information asymmetry. Hence, this reduction could have positive effects on firm value and share liquidity. Moreover, it may decrease the cost of capital.

The following paragraphs discuss the interaction between information asymmetry reduction and each of: firm value, cost of capital, and liquidity, in addition to their association with R&D voluntary disclosure.

3.2.1.1.1. Value Creation

It is argued that, managers have the incentives to introduce information concerning intellectual capital in order to enhance the firm's value: this is achieved by helping investors to build a better assessment of the firm's financial position, when they make their decisions (Li et al., 2008). In a survey conducted by Petty et al., (2008) and directed to a group of financial professionals in Hong Kong, most respondents would like firms to introduce more information on their intellectual capital activities. They believe that more transparency would be rewarded with an increase in the firm's stock price. This conclusion has been supported by the empirical researches that address the influence of R&D voluntary disclosure on the market value (e.g. Chan et al., 1990; Woolridge & Snow, 1990; Dedman et al., 2008; Hirshey et al., 2001). Regarding R&D voluntary disclosure in annual reports, the findings of the empirical research are mixed. While Nekhili et al., (2012) find a positive association between firm value and R&D disclosure, the result of Nekhili et al., (2015) does not support this relationship.

This indicates that disclosing more information concerning R&D activities may have value-relevance for investors. Therefore, managers may have incentives to be more transparent and introduce such private information about R&D activities to reduce information asymmetry and gain market rewards for better disclosure.

3.2.1.1.2. Cost of Capital

Verrecchia, (2001) explains the relation between information asymmetry and the cost of capital, and argues that information asymmetry represents a component of the cost of capital. This comes out because the varying degrees of information among investors make firm equity more costly as a result of the problem of adverse

selection. Hence the firms introduce a discount as a tool to moderate this problem. A similar argument is made by Healy and Palepu, (2001) who suggests that the information asymmetry problem in capital markets increases the cost of capital and provides managers with motivation to reduce it by increasing voluntary disclosure.

Literature provides some evidence consistent with this argument. Botosan (1997) examines the relationship between voluntary disclosures in annual reports and the firm's cost of equity capital, and finds a negative association between disclosure level and cost of equity capital for firms with a low analyst following.

Sengupta (1998) extended the examination of the consequences of voluntary disclosure by investigating the association between disclosure quality and the cost of debt capital. She finds that firms with a higher disclosure score enjoy a lower interest cost. Recently, Mangena et al., (2014) have confirmed the negative association between the cost of equity capital and the level of intellectual capital disclosure. These findings provide evidence of the importance of corporate disclosure as an effective tool used by managers to reduce the cost of capital.

In the R&D context, although La Rose and Liberator (2014) hypothesised that firms with higher levels of R&D disclosure can benefit from a lower cost of equity; their empirical evidence does not support their hypothesis. The nature of R&D information that raises the fear of investors and makes them ask for higher rates of return is considered by the researchers as a potential explanation of the unexpected positive relationship between the R&D disclosure and the cost of equity.

3.2.1.1.3. Liquidity

Many researchers highlighted the influence of voluntary disclosure on capital market liquidity and on the liquidity of the firm's securities. Elliot & Jacobson (1994) argue that disclosure enhances the liquidity of the capital market by reducing information asymmetry and uncertainty between buyers and sellers. It is also suggested that, reducing information asymmetry through greater disclosure will enhance the liquidity of the firm's securities and attract more investment (Diamond and Verrecchia, 1991).

Empirically, Healy et al., (1999) find that firms with increased improvements in disclosure quality are accompanied by an increase in liquidity of the firms' stock. Regarding R&D disclosure, Boone and Raman (2001) find that R&D-intensive firms have less market liquidity. Consequently, they argue that, the reason behind this result may be the limited mandated information about R&D activities, and suggest introducing more R&D disclosures to reduce information asymmetry and enhance market liquidity.

3.2.1.2. Agency Costs Reduction

The agency problem occurs because the development and enforcement of the contract between the principals and agent are not without cost (Fama and Jensen, 1983). The agency costs are defined by Jensen and Meckling (1976) as the sum of : (1) monitoring costs, incurred by principals to limit the unfavourable activities of the agent; (2) bonding costs, incurred by the agent to guarantee that the agent does not act in ways that go against the interests of principals; (3) residual loss (with the optimal monitoring activities by the principals and the optimal bonding activities by the agent) is any reduction in the principals' welfare resulting from the difference

between the actual agent's choices, and those decisions which would maximize the principals' welfare.

The control role of disclosure policy is highlighted by many researchers. For example, Huang and Zhang (2012) argue that higher disclosure levels increase the external monitoring function and enhance the discipline forced by the market; this in turn limits the managers' ability to achieve private benefits against the interest of outside shareholders. Consequently, the shareholders' monitoring can be facilitated by voluntary disclosure; this leads to the subsequent reduction of agency costs (Beattie and Smith, 2012).

3.2.1.3. Balancing the Limited Mandated R&D Disclosure Requirements

It is argued that, firms with relatively fewer informative mandated disclosure requirements have stronger incentives to introduce more discretionary information (Tasker, 1998; Dedman et al., 2008). Moreover, a survey conducted by Graham et al., (2005) to explore the economic implications of corporate reporting, finds that nearly three-quarters of the interviewed CFOs think that voluntary disclosure is an important tool to fill the gaps in the effectiveness of mandatory reporting.

The valuation of R&D investments under the current accounting standards, and the limited mandated disclosure regarding R&D activities is unable to introduce sufficient information for effective assessment of the consequences of R&D investments (Lev and Zarowin, 1999; Lev, 1999). In the line with this argument, Merkley, (2014) argues that the unique characteristics of R&D activities, and the limited R&D disclosure mandated by accounting standards give rise to information problem. Therefore, he concluded that managers may have an incentive to introduce

more R&D disclosure to help investors in evaluating the firm's R&D investments, which improve the firm's transparency.

Many empirical studies support this point of view. Gelb (2002) finds that firms with higher levels of R&D expenditure are more likely to enhance their voluntary disclosure as a tool to demonstrate their financial performance. Jones (2007) also finds that managers disclose substantial information voluntarily about their R&D activities in annual reports and conference calls. Moreover, she proves that firms with a lower book-to-market value ratio disclose more R&D-related information, suggesting that firms with fewer informative financial statements tend to disclose more information about their R&D activities.

Consequently, it can be concluded that managers may consider the voluntary disclosure of R&D activities as a way to balance the poor mandated requirements.

3.2.2.Disclosure Costs

Managers do not select the full disclosure option because there are costs involved in this choice, which may work as forces against it. The costs of R&D disclosure can be mainly classified into three types: first, the cost of collecting information, second: the litigation costs, and third the cost of losing the competitive position if competitors can benefit from proprietary information.

3.2.2.1 The Cost of Collecting and Presenting Information

As stated by Elliott and Jacobson (1994: 83) *"disclosure costs include the cost of gathering, processing, auditing (if the information is audited) and disseminating the information."*. The costs of preparing the R&D information may have a significant

impact on the amount and kind of R&D disclosure, since producing this information needs scientific expertise in addition to financial knowledge.

3.2.2.2 Litigation Costs

Firms may face litigation claims when they introduce insufficient, or misleading disclosures (Elliott and Jacobson, 1994). Accordingly, it can be argued that the litigation costs may be one of the reasons for withholding information by managers. On the other hand, Skinner, (1994) argues that managers may disclose voluntary information, especially bad news such as negative earnings to avoid legal action from stockholders. A survey conducted by Graham et al., 2005 provides moderately supportive result regarding the negative effect of litigation on the managers' incentive to introduce forward looking information.

3.2.2.3 Proprietary Costs

The proprietary costs are considered as one of the most important obstacles to the introduction of full disclosure by managers. These costs are derived from introducing private information, which may be used by competitors in a way that affect the firm negatively (Prencipe, 2004).

The proprietary cost as an important consideration on discretionary disclosure decisions was modelled by Verrecchia (1983) who provides evidence that when the proprietary costs exist, and information is not provided to the market; the traders cannot make sure whether the managers retained this information because it signals bad news, or because it was just not good enough to warrant the related proprietary costs. He finds that the reaction of the market of retaining greater proprietary costs of information is less negative than when the proprietary costs are limited.

Elliott and Jacobson, (1994) argue that the level of competitive disadvantage from informative disclosure can be determined by considering four factors: the timing of disclosure, the type of information, the level of details and the disclosure's audience.

Actually, it is difficult to be certain about the effect of disclosing particular confidential information on competitiveness (FASB, 2001, b). For example, disclosing information about new and planned products could guide competitors to develop the same product or to improve an existing one to win the race to the market (Elliott and Jacobson, 1994). On the other hand, disclosing product development plans may give the product a head start and reveal the firm's progress to outsiders (FASB, 2001, b). However, when stealing a firm's ideas by competitors is relatively difficult, the expected harm of disclosing private information will be low (Jones, 2007).

Therefore, the managers must evaluate the potential disadvantage from the use of confidential information to decide which specific disclosure would be unsafe to reveal to competitors and, which would not (FASB, 2001, b).

Consequently, the level of disclosure and the kind of information introduced by the firm discretionarily depends on the trade-off between the negative effect of revealing proprietary information, and the disclosure benefits achieved from introducing such private information.

Some empirical evidence on the impact of the proprietary costs on the level of disclosure is documented. Depoers (2000) documents that firms with low proprietary costs (measured by gross fixed assets on gross total assets) disclose significantly more information than firms with fewer fixed assets. Moreover, Prencipe (2004)

confirms that proprietary costs tend to limit the management's incentive to introduce voluntary segment information. The major challenge in understanding the influence of proprietary costs on the disclosure decision is the measuring and quantifying of it (Beyer et al., 2010).

In the R&D context, the assessment of proprietary costs is likely to be more sensitive because of the highly confidential nature of R&D activities (Zhao, 2002). Jones (2007) confirms a negative relationship between abnormal stock returns in the previous year and the level of R&D disclosure, suggesting that managers may prefer not to introduce detailed information about firm's R&D activities when the proprietary costs of this information are high.

3.3. AGENCY THEORY

This section discusses the main concepts of the agency theory and the rationale behind using it to explain managers' incentives to disclose R&D information discretionarily.

3. 3.1. Background to Agency Theory Development

Agency theory is considered a broadened of the risk sharing problem that occurs when collaborating parties do not have the same attitude toward risk; the theory was developed in literature during the 1960s and early 1970s, by including the agency problem that arises when cooperating parties have been conflicting goals and interests (Eisenhardt, 1989).

The conflict of interests between cooperating parties are well documented in literature. For example, the relationship between ownership and control of a firm (Jensen and Meckling, 1976), between bondholders and stockholders (Smith and

Warner, 1979), and the separation of decision management, residual risk bearing and decision control (Fama and Jenesn, 1983).

Jensen and Meckling (1976:5) define the agency relationship as *"a contract under which one or more persons (the principle(s)) engage another person (the agent) to perform some service on their behalf, which involves delegating some decision making authority to the agent."*.

On other words, agency theory is concerned with the agency relationship in which one party (the principal) delegates some duties to the other party (the agent). The separation between the principal and the agent could create a conflict between their interests. This conflict creates agency costs that managers have an incentive to reduce.

Agency theory is commonly employed in accounting research to explain the managers' incentives for voluntary disclosure (e.g. Lim et al., 2007; Cerbioni and Parbonetti, 2007; Li et al., 208; Von Alberti-Alhtaybat et al., 2012).

According to agency theory, the ownership of a firm (principals) delegates the task of managing the firm to the agent (managers). The agency relationship that results from the separation between the stockholders, and management may create some kind of interest conflict between the agent and the principals. This conflict leads to the agency problem when managers tend to make decisions that achieve their interests, although these decisions could be harmful to the interests of principals. Consequently, principals will need to monitor whether their agent performs according to the contractual agreements, and to control its behaviour by bridging the

information asymmetry. Therefore, the performance of managers will be tracked and evaluated[4].

Disclosure can be considered as one of the common devices to alleviate agency problems (Healy and Palepu, 2001). Furthermore, it is used by management to enhance the firm's transparency and reduce the agency costs (Morris, 1987; Von Alberti-Alhtaybat et al., 2012). Figure 3.2 illustrates the main idea of the agency theory.

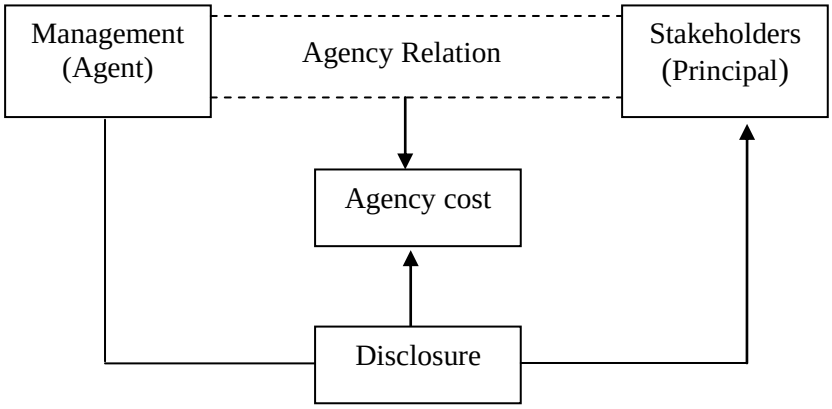


Figure 3.2
Agency Theory (Principal-Agent Relationship)

3. 3.2. Agency Theory and R&D Disclosure

Munari et al., (2010) argue that the management decisions of R&D investments are mainly indicative of the disagreement between principals' and agents' interests; this happens because R&D investments have unique characteristics as a type of long-term investments with a high level of uncertainty.

Moreover, it is argued that for firms engaged in risky innovation, the monitoring by principals will be more difficult because there is a lack of informative signals about the performance of the agent until the outcome of innovation is noticed as financial data (Holthausen, et al., 1995).

[4] Agency theory see, Jensen and Mecking, 1976; Eisenhardt, 1989; Healy and Palepu, 2001; Shapiro, 2005; Cotter et al., 2011 ; Omran and El-Galfy, 2014.

From the previous discussion, it can be concluded that, managers may have incentives to introduce more information concerning the R&D activities to reduce the agency problems.

3.4. SIGNALLING THEORY

This section discusses the main concepts and relations that underpin signalling theory and the rationale behind using it to explain managers' incentives to disclose R&D information discretionary**.**

3.4.1. Background to Signalling Theory Development

Signalling theory was developed in the labour market by Spence (1973) who used education as a signal of the workers' skills, and suggested that the potential employers do not have enough information about the workers, so, the workers try to signal their ability by gaining education (Verrecchia, 1983; Connelly et al., 2011).

Although the signalling theory was developed to explain the information asymmetry in the labour market, it has been applied to explain the information being introduced voluntarily by managers (e.g. Singh and Mitchell Van der Zahn, 2008; Elshandidy et al., 2013). In the case of applying signalling theory to explain corporate reporting, Campbell et al., (2001) points out that the existence of information asymmetry problem will motivate the firms to signal their quality to the market when they believe that they are better than other firms. Therefore, they can attract investment and enhance the firm's reputation.

Although firms with good news have been understandable motivations to signal their quality to others, firms with bad news also have incentives to reveal this news. Managers choose to disclose bad news to avoid the reputational costs that may be

incurred if they do not expose these bad news in a timely manner (Skinner, 1994). Figure 3.3 illustrate the main idea of the signalling theory.

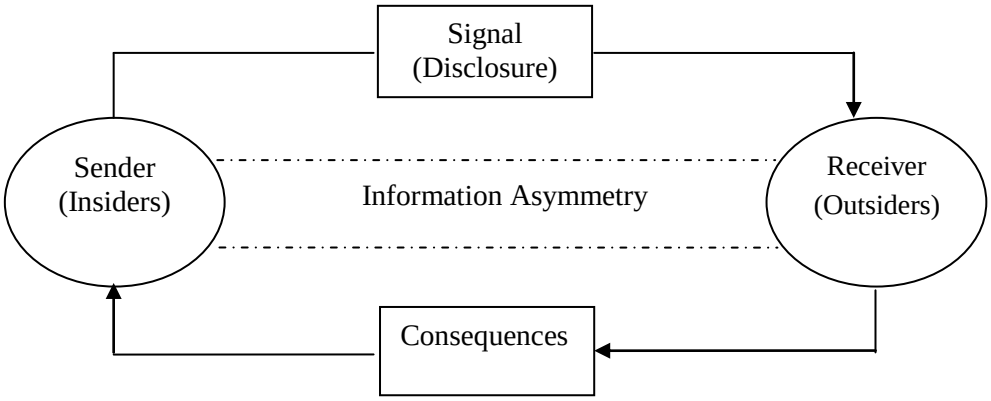


Figure 3.3
Signalling Theory

According to signalling theory, the senders are insiders (managers) who hold private information about the company, and the receivers are outsiders (stakeholders) who already have some information about the company, but would like to have this confidential information. They think that this information may help them to make better decisions. Hence, information asymmetry between managers and stakeholders arises and this problem may have a negative influence on the firm's transparency.

Consequently, managers would have incentives to enhance transparency and prove their ability in managing the different activities of the firm. Voluntary disclosure is one of the most common means used by managers to signal the quality of the firm and its management. Stakeholders who receive these signals and interpret them as expected by managers may reward the managers with favourable consequences, such as an increase in the firm's market value or a reduction in the cost of capital[5].

[5] Signalling theory, See Connelly et al., 2011; Cotter et al., 2011 ; Omran and El-Galfy, 2014.

3.4.2. Signalling Theory and R&D Voluntary Disclosure

As stated by Omran & El-galfy (2014:261) *"Signalling theory is useful for describing behaviour when two parties (individuals or organizations) have access to different information."*.

Therefore, signalling theory is useful for explaining the management attitude when the insiders' information about the firm is superior to the outsiders; this information gap between managers and stakeholders creates the information asymmetry problem which is a crucial condition of signalling theory (Omran and El-galfy, 2014).

Aboody and Lev (2000) suggest that all kinds of firm's investments are associated with information asymmetries. This is because the managers can track the value of each investment and its productivity continually, while outsiders can only have highly aggregated information at specific points of time. On the other hand, they argue that the information asymmetry created by R&D activities is larger than that created by any other types of tangible and financial investments as a result of the unique features of R&D investments that make it difficult for outsiders to assess its value and productivity. Consequently, Aboody and Lev (2000) conclude that R&D activities can be identified as a major contributor to information asymmetry.

Empirically, many researchers introduce evidence consistent with the existence of considerable information asymmetry associated with R&D investments. For example, Tasker (1998) reports that R&D-intensive firms carry out more conference calls than firms with low R&D activities. In addition, Barth et al., (2001) find that the number of analysts following a firm as a proxy of analyst coverage is significantly greater for firms with larger R&D spending. These finding reflect the relatively importance of R&D activities related information and the significant demand for

such information. Moreover, Aboody and Lev (2000) provide evidence that the insider gains in R&D-intensive firms are significantly larger than insider gains in firms with no R&D activities. This suggests that R&D activities are associated with a significant level of information asymmetry.

Trueman (1986) argues that managers use the voluntary disclosure of earning's forecasts to signal their ability to predict the future. A survey conducted by Graham et al., (2005) to explore the executives' attitude toward the drivers of voluntary disclosure concluded that, the management talent signalling is a statistically significant motivation for voluntary disclosure. Furthermore, CFOs use voluntary disclosure as a tool to enhance a reputation for transparent reporting.

The previous discussion emphasizes that managers of the firms with a high level of R&D activities may have an incentive to signal the positive prospects to the market, by using voluntary disclosure as a device to reduce information asymmetry concerning the performance of R&D projects (Zeghal et al., 2007).

In the line with the previous argument, Jones (2007) points out that managers of firms with promising R&D projects may tend to provide more detailed information about their R&D activities to differentiate themselves from firms with fewer expectation's success from their R&D projects. Percy (2000) confirms that the R&D intensity, as a proxy of information asymmetry, has a considerable influence on R&D voluntary disclosure by introducing evidence that high research-intensive firms introduce more voluntary disclosure about their R&D activities than low research-intensive firms.

Consequently, managers who know more than others about their abilities, experience and sincerity, could signal their quality and capability in managing the firm's R&D investments and also their credibility through voluntary disclosure. Therefore, they distinguish themselves from other managers whose performance may be considered less effective.

3.5. THE INTEGRATED THEORETICAL FRAMEWORK

Morris, (1987) demonstrates that agency and signalling theories are not equivalent because they do not share the same necessary conditions. He argues that they are actually consistent theories and proved his argument by comparing the essential conditions of the two theories. He concludes that there is a considerable overlap between agency and signalling theories such as the relational behaviour of all market participants. Moreover, the monitoring costs, and the separation of capital suppliers and managerial control as necessary conditions of agency theory imply information asymmetry (the necessary condition of the signalling theory). In addition, agency theory does not identify the concept of *"quality"*, but its meaning can be applied in the market context and may be defined in terms of variables such as the expected firm's value and its risk. This is because the signal is a general phenomenon and can be valid in any market with information asymmetry.

Finally (Morris, 1987: 52) states *"Given the consistency of signalling and agency theories, it is conceivably possible to combine them to yield predictions about accounting choices not obtainable from either theory along."*.

Morris, (1987) argues that, given the consistency of the agency and signalling theories, the predictions of accounting choices can be improved by combining the predictions from each theory. Furthermore, this combination of the two theories

could also contain new concepts not included in either agency or signalling theories. Empirically, many researchers employed agency theory and signalling theory together to explain voluntary disclosure practices (e.g. Elzahar and Hussainy, 2012; Elshandidy et al., 2013).

In terms of R&D context, reviewing the literature regarding R&D voluntary disclosure in annual reports indicates that, some researchers have formulated their hypotheses and explaining their findings drawing on agency theory (e.g. Nor et al., 2010; Abdelbadie and Elshandidy, 2013), and other studies have employed both agency and signalling theories (e.g. Zeghal et al., 2007; Nekhili et al., 2015). Alternatively, some studies have used a theoretical foundation drawing on cost-benefit analysis (e.g. Entwistle, 1999), or concentrating on proprietary costs and information asymmetry (e.g. Jones, 2007; Nekhili et al., 2012; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015).

The theoretical framework employed in the current study incorporates the main theories and concepts used in prior studies to explain the R&D voluntary disclosure practices in annual reports. It is also used to consider the factors which may influence the management decision to introduce discretionary information regarding the firm's R&D activities. Therefore, the current study employs an integrated theoretical framework based on agency and signalling theories, considering the cost-benefit analysis, and placing further attention on proprietary costs and information asymmetry.

Figure 3.4 illustrates the integrated theoretical framework employed in the current study. The figure shows that, the agency relationship between managers and stockholders (the core of the agency theory) creates agency costs. In addition, the

information gap between managers and stockholders (the core of the signalling theory) produces information asymmetry problems. Mitigating the agency costs and reducing the information asymmetry could encourage managers to introduce more R&D voluntary disclosure. On the other hand, the negative effect of revealing proprietary information could be a significant obstacle to any comprehensive R&D disclosure. Consequently, the managers need to make a rational disclosure decision based on the expected effects of the previous factors.

The corporate governance as a control tool to monitor the managerial decisions, and the firm characteristics as important determinants of disclosure, that well documented in literature, could also have a significant influence on the level of R&D disclosure.

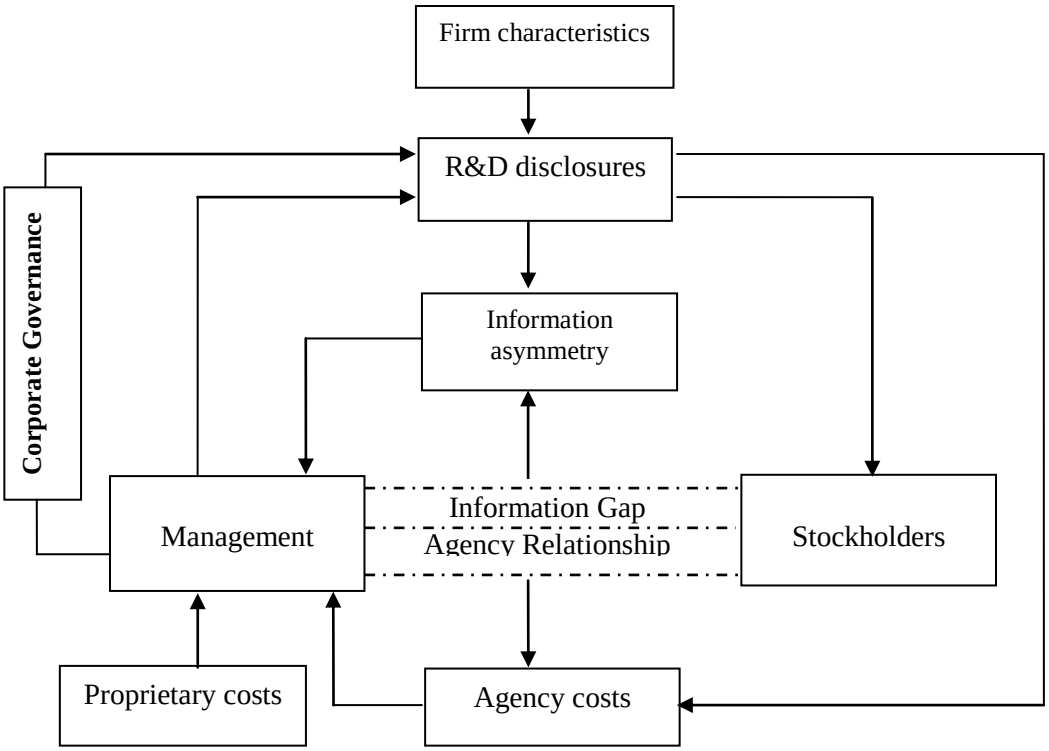


Figure 3.4
The Integrated Theoretical Framework

3.6. SUMMARY

Managers could be willing to introduce more voluntary disclosure about their R&D activities to gain some expected benefits such as reducing information asymmetry and decreasing the agency costs. However, they need to consider whether disclosures about their private R&D information would cause competitive disadvantage.

Given the significant needs to monitor risky, confidential and unrecognised R&D activities, the agency costs and information asymmetry may be considered as important issues in studying R&D voluntary disclosure. Consequently, the managers' incentives to disclose or not disclose information about R&D activities can be realized by employing agency and signalling theories and by considering the cost-benefit analysis of the disclosure decision.

The current chapter discusses the main potential disclosure benefits that are expected to increase the managers' incentives to introduce more information about their R&D activities. These benefits are: (1) reducing information asymmetry, (2) reducing agency costs, and (3) balancing the limited mandated disclosure requirements. The chapter also discusses the main possible disclosure costs that may reduce the managers' incentives to disclose voluntary R&D information. These costs are: (1) collecting and processing information costs, (2) litigation costs, and (3) proprietary costs.

Next, the key concepts and relations of both agency and signalling theories were identified to highlight the consistency between them. This is followed by a justification of using the agency and signalling theories as a theoretical base to explain the R&D voluntary disclosure. Finally, the integrated theoretical framework is drawn based on the combination between agency and signalling theories, and with consideration of the costs and benefits of R&D disclosure.

CHAPTER FOUR

LITERATURE REVIEW
AND HYPOTHESES DEVELOPMENT

CHAPTER FOUR
LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

4.1. INTRODUCTION

Corporate disclosure is considered an important research area that has attracted many researchers in accounting since 1970s (Huafang and Jianguo, 2007). A considerable amount of literature has been primary concerned with the impact of certain corporate characteristics on corporate disclosure in annual reports (e.g. Chow and Wong-Boren, 1987; Cooke, 1989; Ahmed and Courtis, 1999; Mak, 1991; Gray et al., 2001; Khlif and Souissi, 2010). More recent a large and growing body of literature has investigated the association between corporate governance and corporate disclosure in annual reports (e.g. Eng and Mak, 2003; Huafang and Jianguo, 2007; Lim et al., 2007; Garcia-Meca and Sanchez-Ballesta, 2010; Samaha et al., 2015).

However, little attention has been paid to R&D narrative disclosure in annual reports. Recently, researchers have shown an increased interest in this area of research (e.g. Nekhili et al., 2012; Abdelbadie and Elshandidy, 2013; La Rosa and Liberator, 2014; Nekhili et al., 2015). The current study is one of a few studies that seeks to improve the understanding of R&D disclosure introduced discretionarily in firms' annual reports.

The main objective of the current study is to explore R&D voluntary disclosure in annual reports, and to investigate the influence of corporate governance on R&D voluntary disclosure in annual reports of the UK firms.

With a very limited number of studies investigating R&D voluntary disclosure in annual reports, the aim of this chapter is to review some existing studies that

addressed the impact of corporate governance on disclosure as a whole, and specifically on intellectual capital disclosure. This is because R&D activities are a specific component of intellectual capital. Therefore, this review can help in identifying the determinants which may explain the variations in R&D voluntary disclosure among firms. Moreover, the chapter briefly highlights the main studies that addressed the R&D activities in general. It also reviews in detail the studies that investigated R&D voluntary disclosure in annual reports, which is the core of the current study. Consequently, the gap in the literature can be identified, and the role of the current study to fill this gap can be determined. Figure 4.1 shows the structure of corporate disclosure in annual reports and R&D context studies.

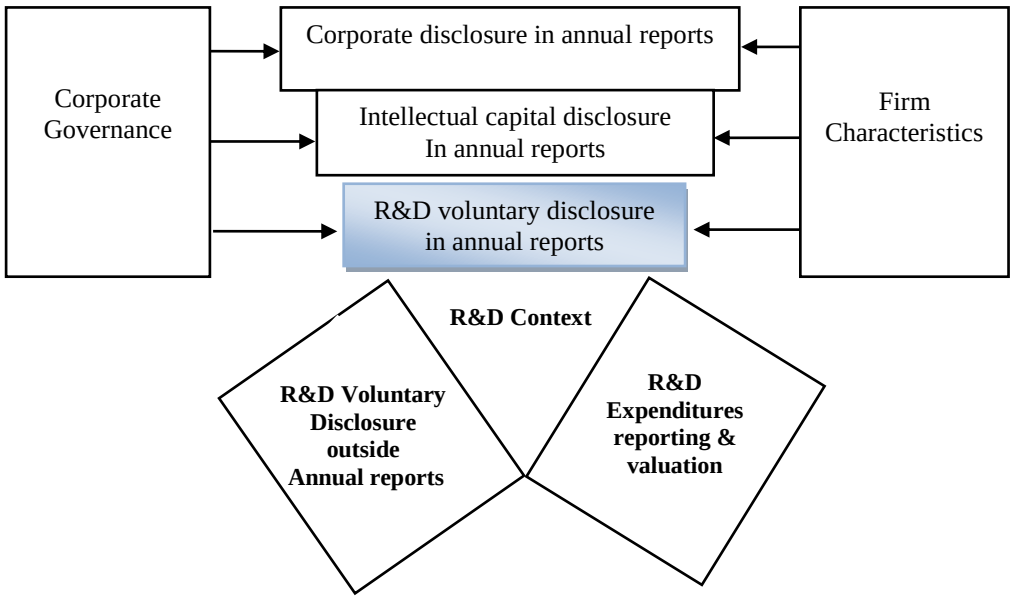


Figure 4.1
The Structure of Corporate Disclosure in Annual Reports and R&D Context Studies

The following three streams of studies are relevant to the current study:

- Prior studies examining the relationship between corporate governance and corporate disclosure.
- Prior studies examining the relationship between corporate governance and intellectual capital disclosure.
- Prior studies examining the research and development disclosure.

The structure of the present chapter is as follows. Section (2) reviews the literature regarding corporate disclosure in annual reports; this includes two main research issues: the association between corporate governance and overall corporate disclosure, and the association between corporate governance and intellectual capital disclosure. Section (3) surveys briefly the researchers' efforts in many aspects related to R&D activities. This is followed by a review of the few studies investigating R&D voluntary disclosure in annual reports. Section (4) highlights the gaps in the existing literature, and explains how the present study will fill this gap, and section (5) reviews the main approaches used to measure the disclosure in annual reports. Section (6) explains hypotheses development, finally, section (7) presents a summary of the main issues discussed in this chapter.

4.2. LITERATURE ON CORPORATE DISCLOSURE STUDIES

Corporate disclosure in annual reports has been examined in a large number of prior studies over the years. Most earlier studies mainly investigated the extent of disclosure and the influence of some firm characteristics on the observed disclosure practices, which may explain the variations in the level of disclosure (e.g. Chow and Wong-Boren, 1987; Cooke, 1989; Ahmed and Courtis, 1999; Mak, 1991; Gray et al., 2001; Watson et al., 2002).

More recently, an increasing number of empirical studies have examined the association between corporate disclosure in annual reports and corporate governance (e.g. Eng and Mak, 2003; Huafang and Jianguo, 2007; Lim et al., 2007; Garcia-Meca and Sanchez-Ballesta, 2010; Samaha et al., 2015). For the purpose of the current study, prior studies examining the corporate disclosure can be classified into two groups. First, the studies assessing the impact of corporate governance on the overall

corporate disclosure. Second, the studies assessing the impact of corporate governance on intellectual capital disclosure, since R&D activities are one of the main components of intellectual capital. The following paragraphs introduce some of the important studies that examined the association between corporate governance and firstly, corporate disclosure and secondly, intellectual capital disclosure.

4.2.1. Prior Studies Assessing the Relationship Between Corporate Disclosure and Corporate Governance

The next paragraphs present some of the important studies that assess the relationship between corporate disclosure in annual reports and corporate governance.

Eng and Mak (2003) investigate the association between corporate governance and voluntary disclosure for a sample of 158 firms listed on the Stock Exchange of Singapore (SES) at the end of 1995. They examine the influence of ownership structure and board composition on a firm's disclosure policy. Ownership structure is measured by managerial ownership, blockholder ownership and government ownership. Board composition is measured by the proportion of outside directors. The study uses the agency theory to formulate its hypotheses. It uses a disclosure index to measure the voluntary disclosure of strategic, non-financial and financial information.

The effect of some firm characteristics on voluntary disclosure is considered. These characteristics included firm size, debt, growth opportunities, profitability, audit firm size, number of analysts following the firm, stock price performance and industry type. Ordinary least squares (OLS) regression is employed to examine the research hypotheses.

The results indicate that lower managerial ownership and higher government ownership are associated positively with voluntary disclosure. However, there is no association between blockholder ownership and disclosure. Regarding the board composition, the findings reveal that an increase of independent directors reduces voluntary disclosure. Finally, firm size and lower debt are positively associated with disclosing more information.

Huafang and Jianguo (2007), investigate the effect of ownership structure and board composition on voluntary disclosure practices of listed companies in China. Five types of ownership structure are examined: blockholder ownership, managerial ownership, state ownership, legal person ownership and foreign shares ownership. In addition, the study considers two variables related to board composition, which are independent directors and CEO duality. The study assumed the expected relationships between voluntary disclosure and explanatory variables based on agency theory. The control variables are firm size, leverage, intangible assets ratio and auditor reputation.

The sample, of 559 firm observations, come from financial and non-financial companies listed on the Shanghai Stock Exchange (SSE) in 2002. The unweighted disclosure index is developed based primarily on Botosan (1997) and modified to adapt with the disclosure environment in China.

The linear multiple regression analysis is employed to test the research hypotheses. The findings indicate that both blockholder ownership and foreign ownership have a positive impact on voluntary disclosure. The other three types of ownership structure have no influence on voluntary disclosure. In terms of board composition, there is a

positive association between voluntary disclosure and the proportion of independent directors, conversely, disclosure is negatively associated with CEO duality.

Based on agency theory, Lim et al., (2007) address the impact of board composition on voluntary disclosure in annual reports. Using a sample of 181 Australian listed companies in 2001, a two-stage least square regression (2SLS) model is employed to examine the association between board composition and voluntary disclosure. A self constructed disclosure index based on the index used by Meek et al., (1995) and modified for the Australian disclosure environment is used to measure the total disclosure in annual reports and its subsets. The developed index contains 67 items to consider the total voluntary disclosure in annual reports and its different types such as forward looking, strategic, historical, financial and non-financial information.

The study controls for the voluntary disclosure determinants which have been documented in the previous studies, including firm size, leverage, return on assets, type of auditing, industry and market to book value ratio. The findings provide empirical evidence of the positive relationship between board composition and total voluntary disclosure in annual reports. Moreover, the results indicate that independent board introduces more strategic and forward looking information. However, the board composition has no impact on financial and non-financial voluntary disclosure.

Garcia-Meca and Sanchez-Ballesta (2010) conducted a meta-analysis to explore the influence of board independence and ownership concentration on voluntary disclosure. Using a sample of 27 empirical studies from all over the world, they aim to achieve a quantitative generalization for the different results obtained in this research field.

The results reveal that there is a positive association between the board independence and voluntary disclosure, and this positive relationship occurs in those countries that protect investor rights. Thus, the reason behind the mixed results in different countries, when applying the similar measures for corporate governance variables, may be the differences between the legal and institutional environments of countries. The findings also document a negative association between ownership concentration and voluntary disclosure.

A recent meta-analysis conducted by Samaha et al., (2015) complements the study of Garcia-Meca and Sanchez-Ballesta (2010). It investigates the influence of board and Audit committee characteristics on voluntary disclosure. Using 64 empirical studies between 1997 and 2013 that examine the total disclosure score, intellectual capital disclosure, and social and environmental disclosure.

The results show that there is a positive association between voluntary disclosure and board size, board composition, and audit committee. However, the results indicate that role duality has a negative impact on voluntary disclosure. Moreover, the findings reveal that the country location moderates the association between voluntary disclosure and each of board size, board composition, and role duality. Additionally, investor protection, the type of disclosure and the measure of disclosure affect the association between role duality and voluntary disclosure.

Table 4.1
Empirical Studies on the Impact of Corporate Governance on Corporate Disclosure

Author date & Country	Research Issue	Sample size and Time of Observation,	Variables			Findings
			Dependent	Independent	Control	
Eng and Mak (2003) Singapore	Corporate governance & voluntary disclosure.	158 1995	Disclosure score.	Managerial ownership; blockholder ownership; government ownership; proportion of outside directors.	Firm size; debt; growth opportunities; profitability; audit firm size; number of analysts following the firm; stock price performance and industry type.	The results reveal that the lower managerial ownership and significant government ownership are associated positively with voluntary disclosure. The increase of independent directors reduces voluntary disclosure.
Huafang and Jianguo (2007) China	The effect of ownership structure & board composition on voluntary disclosure practice.	559 2002	Disclosure score.	Blockholder ownership; managerial ownership; state ownership; legal person ownership; foreign shares; ownership; independent directors; and CEO duality.	Firm size; leverage; intangible assets ratio; and auditor reputation.	The findings reveal that both blockholder ownership and foreign ownership have a positive impact on voluntary disclosure. There is a positive association between voluntary disclosure and the proportion of independent directors, conversely, the disclosure negatively associated with CEO duality.
Lim et al., (2007) Australia	The association between board composition and voluntary disclosure.	181 2001	Disclosure score.	Board composition.	Firm size; leverage; return on assets; type of auditor; industry and market to book value ratio.	The findings provide an empirical evidence of the positive relation between board composition and total voluntary disclosure in annual reports. Moreover, the results indicated that the independent board introduces more strategic and forward looking information.

Table 4.1 (Continued)

Author date & Country	Research Issue	Sample size and time of observation,	Variables			Findings
			Dependent	Independent	Control	
Garcia-Meca and Sanchez-Ballesta (2010) Meta Analysis	The influence of board independence and ownership concentration on voluntary disclosure.	27 empirical studies.	Voluntary disclosure	Board independence; ownership concentration.		The results reveal that there is a positive association between the board independence and voluntary disclosure. The findings also document a negative association between ownership concentration and voluntary disclosure.
Samaha et al., 2015 Meta Analysis	The influence of board and Audit committee characteristics on voluntary disclosure.	64 empirical studies	Voluntary disclosure	board and audit committee characteristics.		The results reveal that there is a positive association between voluntary disclosure and each of board size, board composition, and audit committee. However, the results indicate that the role duality has a negative impact on voluntary disclosure.

Based on the above review of studies investigating corporate disclosure in annual reports, it can be concluded that generally, corporate governance has an influence on corporate disclosure in annual reports. However, the results are mixed and there is no agreement regarding the nature and significance of this influence for each corporate governance mechanism.

Although the findings of these studies do not necessarily extend to R&D disclosure practices, they are still a useful guide for the hypotheses development and also when considering the suitable research methods.

4.2.2. Prior Studies Assessing the Relationship Between Intellectual Capital Disclosure and Corporate Governance

The aim of the current study is to identify the impact of the corporate governance on R&D voluntary disclosure. R&D activity is a specific component of intellectual capital. Consequently, the studies that investigated the disclosure of intellectual capital can provide a helpful indicator for the elements which may affect R&D voluntary disclosure. Accordingly, the next paragraphs present some of the important studies that assess the relationship between intellectual capital disclosure in annual reports and corporate governance.

Cerbioni and Parbonetti (2007), explore the impact of corporate governance on intellectual capital disclosure and base their argument on agency theory. The study covers four characteristics of the board of directors: board size, CEO duality, board composition and board structure. It controls for firm size, leverage, profitability, ownership structure, growth opportunities, listing status and legal enforcement. The study uses a sample of listed European biotechnology companies for the years 2002, 2003 and 2004. The sample includes 54 companies belong to ten different countries.

Using the content analysis of 145 annual reports, eight different scores of intellectual capital disclosure are calculated. The first one includes the total amount of information disclosed. Three disclosure scores are calculated for the content of information disclosed, which are: internal, external and human capital information. Two scores are calculated for the orientation outlook which are forward-looking and historical information. Two scores are calculated for the economic sign which are : positive and negative information. The findings reveal that board size, board structure and CEO duality have a negative effect on the extent of disclosure. However, there is a positive association between the proportion of independent directors and disclosure of intellectual capital information.

Li et al., (2008), investigate the association between intellectual capital disclosure and corporate governance structure in the UK firms, controlling for company age, profitability and firm size. The researchers justify the expected relationships between the dependent variable and the independent variables using agency theory.

The study examines five corporate governance variables, which are board composition, role duality, share concentration, audit committee size and frequency of audit committee meetings. Content analysis is carried out for 100 UK firms'annual reports from high intellectual capital sectors, listed on the London Stock Exchange (LSE) for the financial year-ends between March 2004 and February 2005. Three different metrics are used to measure the dependent variable. These metrics are disclosure index, word count and word count as a percentage of total word count of the annual reports. Based on multiple regression models, the empirical results indicate that all variables together are associated with intellectual capital disclosure with the exception of role duality. While board composition, audit committee size

and frequency of audit committee meetings have a positive impact on intellectual capital disclosure, share concentration was found to be negatively associated with intellectual capital disclosure.

Hidalgo et al., (2011) examine the influence of corporate governance on intellectual capital disclosure. They cover eight corporate governance characteristics, which include board size, board independence, audit committee independence, the role duality, insider ownership, family ownership, ownership concentration, institutional shareholding. The study controls for firm size, leverage, profitability and industry type. Agency theory is used to establish the proposed influence of corporate governance on intellectual capital disclosure.

The dependent variable is measured by a self-constructed disclosure index, including 58 items classified into three groups: structural capital, human capital and relational capital. The sample consists of 300 annual reports of 100 companies listed on the Mexican Stock Exchange (MSE) over a three-year period 2005-2007.

Linear regression analysis is employed to test the expected relationships. The results show that board size has a positive and significant effect on intellectual capital disclosure. However, institutional ownership structure has a negative influence on intellectual capital information introduced by listed Mexican companies. The study could not find any significant association between the other corporate governance variables and intellectual capital disclosure. Regarding control variables, the results indicate that larger firms introduce more intellectual capital information in their annual reports. However, profitability and leverage have no significant influence on intellectual capital disclosure.

Li et al., (2012), examine the association between audit committee characteristics and intellectual capital disclosure based on agency theory. The audit committee characteristics, which have been examined, are audit committee size, frequency of audit committee meetings, audit committee independence, audit committee directors' shareholding and audit committee financial expertise. The study controls for a number of other variables, two control variables related to corporate governance: board independence, ownership concentration, and three control variables related to corporate characteristics: listing age, profitability and firm size. A sample of 100 companies is selected from intellectual capital intensive sectors in the UK. The selected companies were listed on (LSE) on 30 December 2005.

The study applies the disclosure index developed by Li et al., (2008) which included 61 items. Based on multiple regression analysis, the results show that audit committee size and frequency of audit committee meetings have a positive effect on intellectual capital disclosure. However, there is a negative association between intellectual capital disclosure and audit committee directors' shareholding. Audit committee independence and audit committee financial expertise do not have any significant influence on intellectual capital disclosure.

With respect to control variables, the study reveals that there is a positive association between intellectual capital disclosure and each of board independence firm size and profitability. In contrast, there is a negative association between intellectual capital disclosure and both ownership concentration and listing status. An interesting observation is that the association between explanatory variables and intellectual capital disclosure varies with the three components of it (structural capital, relational capital and human capital), concluding that the determinants of different components of intellectual capital disclosure are different.

Table 4.2
Empirical Studies on the Impact of Corporate Governance on Intellectual Capital Disclosure

Author date & Country	Research Issue	Sample size & time of observations	Variables			Findings
			Dependent	Independent	Control	
Cerbioni and Parbonetti (2007) European	The impact of corporate governance on intellectual capital disclosure.	145 2002-2004	Disclosure score.	Board size; CEO duality; board composition; board structure.	Firm size; leverage; profitability; ownership structure; growth opportunities; listing status and legal enforcement.	The findings show that board size, board structure and CEO duality have a negative effect on the extent of disclosure. However, there is a positive association between the proportion of independent directors and disclosure of intellectual capital information.
Li et al., (2008) UK	The influence of corporate governance on intellectual capital disclosure in annual reports.	100 2004	Disclosure index, word count and word count as a percentage of total word count of the annual reports	Board composition; role duality; share concentration; audit committee size and frequency of audit committee meeting.	Company age; profitability and firm size.	The empirical results reveal that all variables together are associated with intellectual capital disclosure except of role duality.
Hidalgo et al., (2011) Mexican	The impact of corporate governance on intellectual capital disclosure.	300 2005-2007	Disclosure score.	Board size; boardindependence; audit committee independence; the role duality; insider; ownership; Family ownership ; ownership concentration and institutional shareholding.	Firm size; leverage; profitability and industry type.	The results reveal that the board size has a positive and significant effect on the intellectual capital disclosure. However, institutional ownership structure has a negative influence on the intellectual capital information introduced by listing Mexican companies.
Li et al., (2012) UK	The effect of audit committee characteristics on intellectual capital disclosure.	100 2005	Disclosure score.	Audit committee size; frequency of audit committee meetings; audit committee independence; audit committee directors' shareholding and audit committee financial expertise.	Board independence; ownership concentration; listing age; profitability and firm size.	The results reveal that the audit committee size and frequency of meetings have a positive effect on intellectual capital disclosure. However, there was a negative association between intellectual capital disclosure and audit committee directors' shareholding.

The previous review of the voluntary disclosure of intellectual capital studies shows that generally, firms introduce discretionary information in their annual reports regarding intellectual capital, and the variation in the amount of this information could be related to some corporate governance mechanisms.

La Rosa and Liberatore (2014) argue that the desegregation of intellectual capital reporting into distinct categories of information such as R&D activities may introduce valuable supplementary insights into the disclosure practices of intellectual capital as a whole. This point of view is supported by the findings of Li et al., (2012) who find that the determinants of different components of intellectual capital disclosure are different.

Consequently, the aim of this study is to examine, in the UK context, the impact of corporate governance on R&D voluntary disclosure in annual reports, as a distinct type of intellectual capital information.

4.3. LITERATURES ON RESEARCH AND DEVELOPMENT DISCLOSURE STUDIES

There are many channels firms may use to introduce information about their R&D activities. These channels can be classified into three types: R&D information in mandatory financial reporting, R&D Voluntary disclosure outside of the firms' formal annual reports and R&D voluntary disclosure in annual reports. Figure 4.2 illustrates the channels that may be used by firms to provide information regarding their R&D activities.

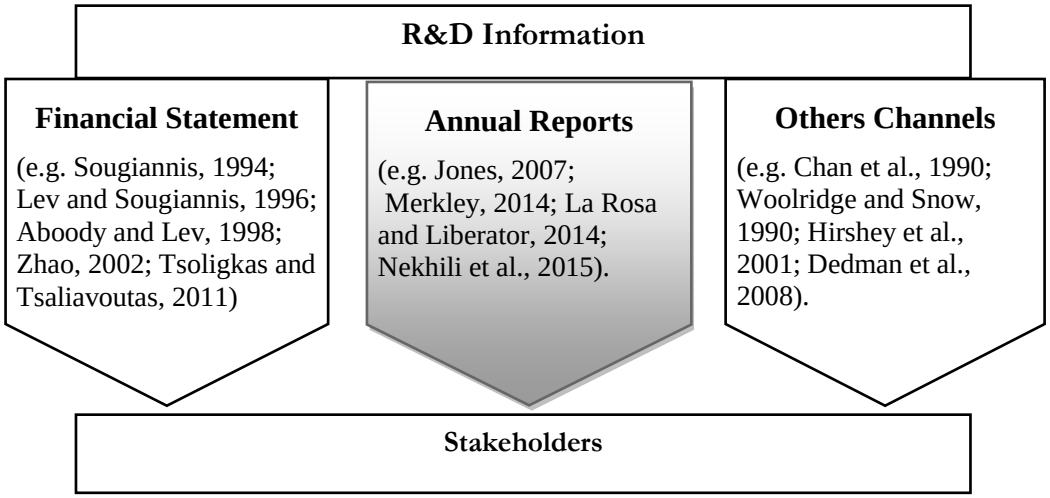


Figure 4.2
The Structure of the Studies in R&D Context

In the context of R&D activities, a large body of literature examined R&D expenditures concentrating on its performance, valuation and limited disclosure regulations. (e.g. Sougiannis, 1994; Lev and Sougiannis, 1996; Aboody and Lev, 1998; Zhao, 2002; Tsoligkas and Tsalavoutas, 2011). Another group of studies examine R&D voluntary disclosure outside the formal firms' annual reports (e.g. Chan et al., 1990; Woolridge & Snow, 1990; Hirshey et al., 2001; Dedman et al., 2008).

Recently, a growing number of studies have started to consider the importance of R&D narrative disclosure in annual reports (e.g. Abdelbadie and Elshandidy, 2013; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015). Although, these studies introduce a helpful understanding of the R&D disclosure environment, the findings of these studies are generally limited to small samples, selected industries, short time period or overlook many variables, which may affect R&D disclosure practices.

The literature related to R&D activities can be categorised into three groups of studies: (1) R&D expenditures: reporting, productivity and valuation, (2) R&D voluntary disclosure outside of the firms' formal annual reports, and (3) R&D voluntary disclosure in annual reports.

The following parts of this chapter introduce a brief discussion of the first and second categories. This is followed by a detailed discussion of the third category, because the focus of the present study is R&D voluntary disclosure in annual reports.

4.3.1. R&D Expenditures: Reporting, Productivity and Valuation

In recent years, innovations and value creation processes in a highly competitive environment rely on intangible assets not reflected in financial statements (Healy and Palepu, 2001; Beattie, 2004). Innovations are the reward of R&D activities, so information required to communicate R&D efforts and to effectively assess innovations has been considered by many studies. There was a great debate regarding R&D reporting as a traditional tool to provide the essential information about firm's activities.

Many researchers have attempted to employ the incremental association studies to examine the value relevance of R&D expenditures (e.g. Lev and Sougiannis, 1996; Aboody and Lev, 1998; Zhao 2002; Tsoligkas and Tsalavoutas 2011). This approach tests whether a specific financial component or disclosure is helpful in explaining the market value[6]. The main assumption of the incremental value relevance studies is that the accounting number has value relevance if its estimated regression coefficient is significantly different from zero (Holthausen and Watts, 2001). The main challenge of conducting the incremental association studies of R&D activities is the

[6] For more details: Holthausen & Watts, 2001; Barth, et al., 2001.

lack of data. This problem is due to the accounting treatment which charges R&D expenditures to the income statement and permits capitalisation when the company succeeds in meeting some criteria.

To deal with this difficulty, some researchers estimated the amounts of capitalised R&D, including Lev and Sougiannis (1996) who used the relation between the value of tangible and intangible assets and earnings to estimate the R&D capital, and adjusted the reported earnings and book values of the sample for capitalised R&D. The results indicate that R&D capitalization has a positive relation with stock return and market value.

Other researchers used the real data; for instance, Aboody and Lev (1998) investigate the value relevance of capitalisation of software development costs, which is the only exception in the US to the expensing rule of all R&D costs. Using data from 163 software companies during 1987-1995, they find a significant association between the annual capitalised development costs and stock returns. They also find that the software asset reported on the balance sheet is associated with stock prices.

Along with the US studies, some empirical evidence from other countries is documented. An international comparison conducted by Zhao (2002) examines the value relevance of R&D reporting in France, Germany, the UK and the US under different R&D accounting standards for a ten-year period from 1990 to 1999. The study concludes that the allocation between capitalisation and expense increases the value relevance of R&D reporting.

The previous studies may be criticised because they depend on adjusted data or a small sample. Tsoligkas and Tsalavoutas (2011) uses data from 2005 to 2007 to

investigate the value relevance of R&D expenditures after the mandatory adoption of IFRS in 2005 in the UK. The study concluded that the capitalised portion has value relevant, while the expenses are negatively associated with the market value.

Oswald (2008) argues that managers desire the accounting method for R&D expenditure, which provides the best communication of their private information regarding R&D expenditures.

From the previous brief discussion, it can be concluded that generally, R&D expenditures have a substantial impact on share prices and market value. Consequently, investors consider the investment in R&D activities and find that the amount of R&D expenditures, and the accounting treatment of these expenditures have an impact on share valuation.

Another group of studies investigate the consequences of R&D investment and consider the impact of R&D expenditure on firm's productivity and growth (e.g. Chauvin and Hirschey, 1993; Sougiannis, 1994; Lev, 1999; Ding et al., 2007). Chauvin and Hirschey (1993) find a significant positive influence of advertising and R&D expenditures on a firm's market value and conclude that the spending on advertising and R&D activities is a kind of investment in intangible assets, which can be expected to affect positively future cash flow. Sougiannis (1994) examines the long-run effect of R&D investment and documented the substantial contribution of R&D investment to earnings, suggesting that the capital market rewards the companies for this investment with an increase in market value.

After conducting a survey of the major empirical findings regarding productivity of R&D investment, Lev (1999) concluded that R&D investments contribute

significantly to the productivity, and stock prices reflect this contribution. Ding et al., (2007) conducted an international study to compare the rate of return on R&D investment for six developed countries. The study presents additional evidence on the positive contribution of R&D investment to the future performance of companies. This contribution differs from one country to another with the rates of return varying from 17.6 percent based on a Swiss sample to 35.6 percent for the Japanese sample.

4.3.2. R&D Voluntary Disclosure Outside of the Firms'Formal Annual Reports

The accounting mandated information about R&D activities is inadequate to evaluate R&D efforts and their consequences (Lev, 1999; La Rosa and Liberator, 2014). To meet the information needs of all parties interested in corporate transparency, the managers may discretionarily introduce information about their R&D activities.

A large stream of literature examines whether the firms with significant R&D activities choose to supplement the financial statement with more flexible voluntary R&D information through different devices, including announcements, press releases, conference calls, and websites.

Some of these studies employ the information content approach which uses event studies to examine the impact of R&D information on firm value (e.g. Chan et al., 1990; Woolridge and Snow, 1990; Dedman et al., 2008).

Chan et al., (1990) examine the response of share prices to 95 announcements of increases in spending on R&D. They find a significant positive response for a two-day announcement period, and concluded that investors in the US equity market value strategic investments and look beyond short-term earnings. Woolridge and Snow (1990) investigate the US market response to four strategic investment

decisions, including R&D projects. They use 52 announcements of new R&D projects. The findings indicate a strong relationship between the announcements of strategic investment decisions and market value.

Similar studies conducted in the US, for instance, those of Kelm et al., (1995) and Sundaram et al., (1996) find new evidence for a market valuation of R&D information. However, there is little empirical evidence other than from the US market.

Using a sample of 22 firms from UK biotechnology and pharmaceutical sectors, Dedman et al., (2008) examine the impact of voluntary disclosure on share prices. They examine the abnormal share price returns around 151 drug development announcements. The findings support the importance of non-financial voluntary disclosure for the market valuation of high R&D firms in biotechnology and pharmaceutical sectors.

Concerning the role of non-financial information in improving the understanding of firm's performance and valuation, Hirshey et al., (2001) find that the patent information adds to the value relevance of R&D expenditure information. They suggest that the corresponding relation between financial information and non-financial information regarding R&D activities may help investors to assess the value created by firm's R&D efforts in the high-tech sector.

The previous studies highlight the importance of R&D voluntary disclosure introduced by firms outside the formal annual reports. Moreover, the findings of these studies suggest that R&D voluntary disclosure can supplement traditional

financial reporting to help investors assess R&D activities by improving their understanding of essential issues related to these activities.

4.3.3. R&D Voluntary Disclosure in Annual Reports

Although a considerable number of studies provided insights into R&D information introduced in financial statements or voluntarily disclosed via many sources other than annual reports, our understanding of the narrative disclosure of R&D activities in annual reports is still limited and based on the findings of a few studies. The reason for this limited empirical evidence may be the difficulty of capturing R&D narrative information in annual reports and the unavailability of this type of information in large commercial databases (Merkly, 2014).

Although, there are many other communication channels such as press releases and corporate websites, the disclosure in corporate annual reports is widely investigated in prior research. The importance of annual reports as a formal communication channel is well justified in literature (Lang and Lundholm, 1993; Botosan, 1997; Guthrie, 2004). Campbell and Abdul Rahman (2010:57) states *"As a document produced regularly, editorially controlled by the company and intended for a shareholder leadership, the annual report has a crucial role in the conveyance of material information to a range of stakeholders including shareholders."*.

The main focus of the present study is investigating R&D-related information introduced voluntarily by firms in their annual reports. Hence, the next paragraphs present a detailed discussion of the studies that addressed R&D voluntary disclosure in firms'annual reports. These studies can be classified into two groups. The first group includes the prior studies assessing the association between the R&D voluntary disclosure in firms'annual reports and firm characteristics. The second

group includes the prior studies assessing the association between the R&D voluntary disclosure in firms'annual reports and corporate governance.

4.3.3.1. Prior Studies Assessing the Relationship between Research and Development Disclosure and Firm Characteristics

Entwistle (1999) conducted a pioneering study into the research and development disclosure environment in Canada. He performs a series of interviews with 15 analysts and 21 executives from intensive technology firms, and he carries out content analysis for firm's annual reports.

His field interviews illustrate six main groups of information, which are disclosed by firms and used by analysts: inputs, outputs, future expenditures, financing, accounting and strategy information. The responses of interviewers also reveal that the decision to introduce R&D-related information is dependent on cost/benefit analysis. In addition, the content analysis of the annual reports of 113 Toronto Stock Exchange-listed firms provides a description of the extent of R&D disclosure. It also identifies the most common types of R&D information and their location in annual reports.

The sample consists of four industry groups: hardware, software, biotech and traditional. The traditional group includes less technologically intensive firms such as household goods and electrical products. The findings of content analysis reveal that the greatest amount of R&D disclosure is provided by biotech firms, followed by software and hardware while the traditional sector introduces the smallest number of sentences related to R&D activities. In addition, the majority of information describes the actual and potential outputs from R&D activities.

Finally, the study examines the association between R&D disclosure, measured by the number of sentences of R&D-related information in annual report, and six explanatory variables: R&D spending, accounting policy, listing status, industry type, capital structure and firm size. The results of the multiple regression analysis reveal that R&D expenditures and listing status explain the disclosure of R&D information, while industry type provides a partial explanation of it. The regression result of the whole sample, including traditional firms indicated a significant influence on the industry type on R&D disclosure. However, after excluding the 36 traditional firms, the results provide no evidence of the industry effect. The author argues that the traditional firms (not technology-intensive) introduce far less R&D information than any of the other groups (technology-intensive).

However, firm size, capital structure and firm's accounting policy did not have any significant association with the level of R&D disclosure.

Notwithstanding the importance of Entwistle (1999) as a pioneering explanatory study that highlights R&D disclosure practices in annual reports and examines their determinants, the findings are subject to at least two limitations. First, the study depends on a small sample (113 observations). Second, the study examines the impact of firm characteristics on R&D disclosure and ignores the role of corporate governance as a potential driver of the observed R&D disclosure practices.

Following Entwistle (1999), some subsequent papers investigate issues related to R&D voluntary disclosure in annual reports. Based on the environmental determinism theory, a comparison study conducted by Ding et al., (2004) explored the differences between R&D disclosure practices in France and Canada. The annual reports of a sample of 186 high-tech firms are analysed. The sample consists of 76

French companies listed on the Paris Stock Exchange and 110 Canadian companies listed on the Toronto Stock Exchange. The study found that Canadian firms introduce significantly more R&D disclosure than French companies. Moreover, the findings reveal a positive correlation between R&D intensity and R&D disclosure among Canadian firms.

These findings suggest that Canadian firms in high-tech segments with intensive R&D activities intend to introduce more information regarding R&D activities beyond the traditional financial reporting. In contrast, the French firms desire confidentiality more than introducing information about their R&D activities. Finally, according to the findings, while French firms provide more traditional financial information, Canadian firms use more non financial information to communicate their R&D efforts.

Although, the study emphasizes the impact of differences in the environment on R&D disclosure practices by comparing the R&D information provided discretionarily by firms in France and Canada, it does not introduce any empirical evidence on the determinants of R&D voluntary disclosure.

A very similar study to Entwistel (1999) performed in Canada as well, was conducted by Zeghal et al., (2007) to improve understanding of R&D disclosure practices. Both agency and signalling theories were used to justify R&D voluntary disclosure. The researchers investigate the relationship between the level of R&D voluntary disclosure and three groups of variables that were expected to affect R&D voluntary disclosure. First, firm characteristics (firm size, leverage, and listing status). Second, R&D-related variables (R&D intensity, R&D accounting policy, R&D partnership agreement). Third, governance-related variables (board

independence, and the separation of the CEO and board chair roles). Industry type is included as a control variable. They use a sample of annual reports of 150 Canadian companies, which are composed of all listed firms on the Toronto Stock Exchange (TSX) in February 2005 that reported R&D information in their annual reports. The final sample included 82 firms in 2004 and 68 firms in 2003.

Using content analysis, the extent of R&D voluntary disclosure is measured by the number of sentences that include R&D-related information in the annual report. The study finds that firm size, R&D intensity and R&D partnership agreement have a significant positive impact on R&D disclosure. However, the results reveal that leverage, listing status and R&D accounting policy have no significant impact on the level of R&D disclosure. With regard to corporate governance-related variables, the findings indicate that the separation of the CEO and board chair function positively impacts on information disclosed on R&D activities. Conversely, the board independence has no significant effect in explaining R&D disclosure. Moreover, firms in the biotechnological sector provide more information on their R&D activities relative to the other sectors.

Although Zeghal et al., (2007) extend Entwistle (1999) with a little bearing of corporate governance mechanisms, they only consider the board independence and the separation of the board chair and the CEO function and overlooked other corporate governance mechanisms such as board size, and audit committee characteristics. In addition, the findings are limited by the small sample and by covering only one year.

Jones (2007) investigates three related research areas. First, she explores R&D related voluntary disclosure for a sample of 119 US firms over a one-year time

period. The study aims to examine whether managers of R&D-intensive firms introduce some information about their R&D activities and if so, what kind of information does they introduce. Second, she examines three main drivers, which are expected to influence R&D-related disclosures: information asymmetry, proprietary costs and firm characteristics (firm size, R&D intensity, financial statement informativeness, the need of external financing, and analysts following). Finally, the study investigates the association between R&D-related information and analysts' forecasts.

The study depends on hand collecting data on R&D-related information in four R&D intensive industries: chemicals & pharmaceuticals, machinery & computer hardware, electronics and scientific instruments. It examines voluntary disclosure from the annual reports, as well as from sources other than annual reports, including disclosure introduced directly to financial analysts in the form of conference calls or other presentations made by a firm's management.

Jones (2007) relies primarily on Entwistle, (1999) to construct the R&D disclosure index which comprises all information related to R&D activities and includes three types of information that capture the different stages of R&D activities: R&D spending, R&D projects in progress and in the development stage.

She assigns a disclosure score to each firm in the sample and gives the descriptive information one point and numerical information two points. The findings reveal that companies disclose substantial information about the three stages of R&D activities, although R&D-related disclosures are potentially costly to make. As general, the majority of companies disclose descriptive information only. However, managers provide numerical and descriptive information about the developmental stage.

In addition, the study finds a negative association between the level of R&D disclosure and abnormal returns, suggesting that the proprietary costs influence negatively on R&D disclosure provided by the firms. Moreover, firms with a lower book-to-market value ratio disclose more R&D-related information, suggesting that firms with less informative financial statements tend to disclose more information about their R&D activities. In contrast, there is a positive, but not significant relationship between R&D intensity and R&D-related information.

The study could not find a relationship between information asymmetry measured by the standard deviation of daily market-adjusted stock returns in the previous year and the level of R&D disclosure. Finally, the study reveals that the disclosure about both R&D projects in progress, and R&D development stage are negatively associated with earnings forecast error, while a higher level of disclosure about development stage is associated with less error in sales forecasts.

Although Jones (2007) investigates many important issues related to R&D disclosure, the study has a number of limitations. Firstly, it uses a small sample (119 observations). Secondly, it covers a single point of time (only one year) which does not help in assessing the trend of R&D disclosure. Thirdly, the study has a bias towards R&D intensive industries. Finally, it ignores the role of corporate governance.

A recent study conducted by Merkly (2014) examined whether managers adjust R&D narrative information according to changes in earnings performance. To address the influence of earnings performance on R&D narrative disclosure provided by firms in annual reports, Merkly (2014) considered three related research areas. First, examining the relationship between R&D disclosure and earnings performance

and considering the role of information demand and proprietary costs on this relationship. Second, investigating the impact of R&D narrative disclosure on analyst forecasts and information asymmetry. Finally, measuring R&D disclosure detail, tone and readability.

The final sample includes 22445 firm-year observations for fiscal years from 1996 to 2007 with R&D investment and financial data available on the compustat fundamental annual table and pricing data from the Centre for Research in Security Prices (CRSP). Using computerized content analysis, narrative R&D disclosure is measured as the total number of R&D-related sentences.

Regarding the relationship between earnings performance and R&D narrative disclosure, multivariate regression is employed controlling for many disclosure determinants examined in prior studies. The results show that current earnings performance is negatively associated with R&D narrative disclosure, and this relationship is stronger for firms that invest more resources in their R&D activities. Moreover, the study finds that firms with higher leverage and positive net stock issuance introduce more R&D disclosure.

Moreover, the study investigates the influence of information demand and proprietary cost aspects of the estimated negative relationship between earning performance and R&D narrative disclosure. Some empirical proxies for information demand, including the number of analysts, institutional ownership and number of earnings forecasts are used. Other proxies for proprietary costs, including book to market value, ease to entry by competitors and industry competition are employed. The results in general support the role of information demand and proprietary costs

in the negative relationship between R&D narrative disclosure and earnings performance.

In general, the results are consistent with economic theories that suggest that disclosure can be used as an effective tool to decrease information asymmetry. The findings confirm a negative relationship between R&D narrative disclosure and information asymmetry. Moreover, the study provides evidence that R&D narrative disclosure is positively related to earnings forecast accuracy, suggesting that R&D disclosure improves the information required for corporate transparency.

Three main characteristics of R&D narrative disclosure are examined: disclosure detail, tone, and readability. The study uses the forward-looking statements, the amount of numerical content and repetition to measure the detail of R&D disclosure. It finds that the increase of forward-looking statements and repetition is related to the decline in earnings performance. However, the amount of numerical content does not have any significant impact on earnings. Regarding R&D disclosure tone and readability, the findings reveal that the tone relates positively to earnings performance. In contrast, there is no evidence that readability of R&D disclosure affect earnings performance.

Merkly (2014) extends the prior literature in R&D disclosure in annual reports. He considers some limitations in the previous studies by examining a larger sample (22445 observations), for a long time period (from 1996 to 2007) from different industries. He also contributes to prior literature by considering the characteristics of narrative R&D disclosure such as tone and readability. However, Merkly (2014) does not consider the impact of corporate governance on R&D voluntary disclosure.

Another recent study conducted by La Rosa and Liberator (2014) explores whether the regulatory regime of R&D narrative disclosure affects the cost of equity capital. To measure the extent of firm's R&D narrative disclosure, the study uses the construction of a disclosure index obtained from the content analysis of 77 biopharmaceutical and chemical listed companies' management reports from eight Western European Countries across the period 2005-2009.

The rationale behind choosing eight Western European countries is to consider the effect of the different regulatory regimes of R&D narrative disclosure. Hence, some countries have a mandatory regulation of R&D activities such as Germany and Denmark, and others have voluntary recommendations such as France and UK. The 2005-2009 period is selected after the mandatory implementation of International Financial Reporting Standards (IFRS), so the European listed companies employ the same accounting treatment of R&D expenditures.

The final disclosure index composed of 58 items across nine subcategories and employed in 309 annual reports. To consider the differences between countries across years; the study uses LSDV regression (Least Squares with Dummy Variables).

The first main model examines the influence of the regulatory regime on the quantity of total disclosure of R&D activity introduced by the firm. It controls for some variables, including firm size, R&D expenses, leverage, return on equity, market to book value ratio, industry and effective legal insinuation. The impact of the regulatory regime on the disclosure level of each of the ninth sub-categories of the index is also examined.

The findings of the first model show a significant influence of the regulatory regime on the level of R&D disclosure with the exception of the strategic aspects of R&D, which is not related to the level of regulation. Moreover, the results reveal a positive influence of the firm size and the effective legal insinuation on the total amount of R&D disclosure for the main model and also for some others models of sub-categories. However, market to book value ratio is inversely related to R&D information provided by the sample.

The second main model examines the influence of the level of R&D disclosure as a consequence of the regulatory regime on the cost of equity capital. The findings are contrary to the study's hypothesis and could not confirm a significant relationship between the amount of R&D disclosure and the cost of capital. Generally, La Rosa and Liberator (2014) provide a further evidence regarding the impact of the regulatory regime on R&D disclosure in a number of Western European countries.

However, regarding the understanding of R&D disclosure trends, the study cannot claim to represent R&D disclosure practices of all firms from different countries due to the small number of observations for each country (e.g. 49 observations for UK firms). In addition, the results are limited to specific industry sectors (biopharmaceutical and chemical firms) and overlook the role of corporate governance.

4.3.3.2. Prior Studies Assessing the Relationship between Research and Development Disclosure and Corporate Governance

Nor et al., (2010) examine the association between R&D voluntary disclosure and corporate governance. The study investigates 187 annual reports for a sample of listed companies on the Malaysian market (MESDAQ) in the years 2005 and 2006.

Three groups of corporate governance variables were examined: ownership structure, board structure, and audit firm size. The study controls for leverage, profitability, firm size, current ratio and the proportion of R&D capitalized to total assets. The hypotheses of the study are formulated drawing on agency theory.

The dependent variable is measured as the number of text unit of R&D information introduced in the annual report. The study uses Tobit regression to examine the relationship between corporate governance and each of total R&D disclosure, R&D forward looking information, R&D quantitative information and R&D financial information.

The results show a positive association between government ownership and R&D disclosure. However, the other four types of ownership structure: family, foreign, management and institutional ownership, do not affect R&D reporting.

Nor et al., (2010) perform a more detailed study and address three dimensions of R&D disclosure: historical and forward looking, financial and non-financial, quantitative and non-quantitative. They also consider the effect of ownership structure and board composition on R&D voluntary disclosure. However, they overlook the other corporate governance mechanisms such as audit committee characteristics. In addition, the small sample is a limitation for this study.

Nekhili et al., (2012) examine the influence of ownership structure on R&D disclosure. They investigate five variables related to ownership structure: ownership concentration, institutional ownership, family ownership, managerial ownership, and director's ownership. They control for R&D intensity, R&D capitalization, firm performance, sales growth, leverage and firm size. The study uses a sample of 84

French listed companies in the SBF 250 index over the 2000-2004 periods: a total of 420 firm-year observations are examined.

An unweighted R&D disclosure index composed of 32 items is constructed. The study uses content analysis to measure the level of R&D disclosure in annual reports. The R&D disclosure score is calculated by dividing the total score for each company over the potential maximum score. The results show that, family and French institutional ownerships negatively influence R&D disclosure. On the other hand, foreign institutional ownership is positively associated with R&D information. However, the study could not find any relationship between management or director's ownership and the level of R&D disclosure.

Regarding the control variables, the results reveal that both R&D intensity and firm size have a positive effect on R&D disclosure. However, firm performance and sales growth affect R&D disclosure negatively.

While Nekhili et al., (2012) consider the effect of ownership structure on R&D voluntary disclosure, they overlook the other corporate governance mechanisms such as board and audit committee characteristics.

A recent working paper introduced by Abdelbadie and Elshandidy, (2013) investigates the determinants of voluntary disclosure of R&D activities in the UK context using a computerised content analysis. It examines the impact of firm characteristics, board features, and ownership structure on R&D voluntary disclosure of 95 non-financial firms in the FTSE 350 index. Considering the mandatory adoption of the IFRS in EU countries, the study covers the period from 2005 to 2009.

It uses the total number of R&D-related sentences in annual report to measure the level of R&D disclosure.

The regression results show that R&D voluntary disclosure is positively associated with poor earnings performance and large board size. Moreover, firms with more R&D activities and more volatile earnings introduce more information related to their R&D activities. However, the results did not confirm a significant influence of the board composition, the ownership structure, and the dividend policy on the managerial incentives to introduce voluntary disclosure about their R&D activities.

Abdelbadie and Elshandidy, (2013) introduce the first evidence regarding R&D disclosure in annual reports in the UK context. The study has several limitations. One of the limitations, which is mentioned in the study, is investigating the level of overall R&D disclosure without incorporating the R&D-related topics such as R&D competition, strategies, patents, and findings. The study overlooks the effectiveness of the audit committee as a potential driver of R&D disclosure in annual reports.

A more recent study conducted by Nekhili et al., (2015) to complement Nekhili et al., (2012) investigates the impact of R&D narrative disclosure on the market value of equity and considers several corporate governance mechanisms. The study depends on agency and signalling theories and cost-benefit analysis to justify the expected relationships between variables.

Using Three-Stage Least Squares (3SLS) estimation, the study examines the association between R&D narrative disclosure and the market value of equity. A simultaneous equation model is built to consider the direct effect of corporate governance mechanisms on firm market value and their indirect effect through their

influence on R&D narrative disclosure. The sample comprised 98 French listed firms over the period 2000-2004. Therefore, a total of 490 observations are examined. The R&D disclosure index that constructed by Nekhili et al., (2012) is adopted to calculate the R&D voluntary disclosure score.

The results indicate that, the audit committee independence and the equity-based compensation are the most important corporate governance mechanisms that positively affect R&D voluntary disclosure. Moreover, both R&D intensity and R&D capitalization have a positive influence on it.

Unexpectedly, the results did not reveal any significant impact of R&D voluntary disclosure on firm's value. Furthermore, the association between R&D voluntary disclosure and each of board size, board independence, and role duality is insignificant. However, the family ownership has a negative impact, while the institutional ownership has a positive impact on R&D voluntary disclosure. Surprisingly, the results reveal a negative relationship between R&D voluntary disclosure and firm size.

Nekhili et al., (2015) contribute to R&D literature by investigating the influence of a set of corporate governance variables on the level of R&D disclosure in annual reports. The study only considers the independence of the audit committee and overlooks the other audit committee characteristics recommended by the FRC, (2012). These are audit committee size, frequency of audit committee meetings and the existence of audit committee financial expertise. Moreover, the study examines the overall R&D disclosure without employing a detailed analysis on the type of R&D information introduced discretionarily by firms in annual reports.

Table 4.3
Empirical Studies on the Impact of Firm Characteristics and Corporate Governance on Research and Development Disclosure

Author date & country	Research Issue	Theoretical Base	Sample size, Time of observation	Variables			Findings
				Dependent	Independent	Control	
Entwistle (1999) Canada	Exploring the R&D disclosure environment.	Cost-benefit analyses	113 1994	Number of sentences.	R&D spending; accounting policy; listing status;industry type; Capital structure and firm size.		The results reveal that the R&D expenditures and listing status explain the disclosure of R&D information, while industry type provides a partial explanation of it.
Ding et al., (2004) Canada - France	The differences in research and development reporting practices between France and Canada.	Environmental determinism	76 French listed companies 110 Canadian listed companies.	Number of sentences.	R&D intensity		The study finds that Canadian firms introduce significantly R&D voluntary disclosure more than French companies.
Zeghal et al., (2007) Canada	The determinants of research and development voluntary disclosure.	Agency theory and signalling theories.	150 2003-2004	Number of sentences.	Firm size; leverage; listing status; R&D intensity; R&D accounting policy; R&D partnership agreement; board independence; CEO and board chair roles.	Industry	The study shows that firm size, R&D intensity and R&D partnership agreement have a significant positive impact on R&D disclosure, and the separation of the CEO and board chair function positively impacts the information disclosed on R&D activities.

Table 4.3 (Continued)

Author date & country	Research Issue	Theoretical Base	Sample size,Time of observation	Variables			Findings
				Dependent	Independent	Control	
Jones (2007) US	Voluntary disclosure in R&D, Intensive industries.	Proprietary costs. Information asymmetry.	119 firms 1997	R&D disclosure score.	Information asymmetry; proprietary costs; firm size; R&D intensity; financial statement informativeness; the need of external financing; and analysts following.		The R&D disclosure score is negatively associated with proprietary costs and the informative of the financial statements.
Merkley (2014) US	R&D narrative disclosure and earnings performance.	Information asymmetry, Proprietary costs	22445 Observations 1996-2007	Number of sentences	Earnings performance	Firm size; firm age; number of analysts following the firm; Institutional ownership, number of management forecasts issued during the year; book to market value; R&D intensity, book to market value; capital intensity; information uncertainly; leverage and stock return performance.	The results show that current earnings performance is negatively associated with the quantity of narrative R&D disclosure, and this relationship is stronger for firms that invest more resources in its R&D activities and facing a higher degree of competition.

Table 4.3 (Continued)

Author date & country	Research Issue	Theoretical Base	Sample size, Time of observation	Variables			Findings
				Dependent	Independent	Control	
La Rosa and Liberator (2014) eight Western European Countries	The impact of regulatory regime on R&D disclosure & cost of capital.	Proprietary costs.	77 firms 2005-2009 (309 observations)	R&D disclosure score.	Regulatory regime.	Firm size; R&D expenses; leverage; return on equity; market to book value ratio; industry; effective legal insinuation.	The findings show a significant influence of the regulatory regime on the level of R&D disclosure.
Nor et al., (2010) Malaysia	The association between corporate governance & R&D reporting.	Agency theory.	187 firm year observation 2005-2006	The number of text unit.	Family government; foreign management and institutional; ownership; independent directors; audit firm size.	Leverage; profitability; firm size; current ratio and the proportion of R&D capitalized to total assets.	The results reveal a positive association between government ownership & quantitative R&D disclosure. In addition, independent directors and big audit firm influence R&D voluntary disclosure.
Nekhili et al., (2012) France	The influence of ownership structure on R&D disclosure.	Proprietary cost. Information asymmetry.	84 firms 2000-2004 420 firm year observations.	R&D disclosure score.	Ownership concentration; institutional ownership; family ownership; managerial ownership; & director's ownership	R&D intensity; R&D capitalization; firm performance; sales growth; leverage & firm size.	The results show that, family & French institutional investor's ownership is negatively influencing the R&D disclosure. While, foreign institutional investor's ownership is positively associated with R&D information.

Table 4.3 (Continued)

Author date & country	Research Issue	Theoretical Base	Sample size, Time of observation	Variables			Findings
				Dependent	Independent	Control	
Abdelbadie and Elshandidy (2013) UK	The determinants of voluntary disclosures on R&D expenditures.	Agency theory. Cost and benefits analysis.	95 firms 2005-2009	Number of R&D-related sentences in annual reports	Profitability; board characteristics, ownership structure; firm size; investment mix, Financing mix; volatility of the market return (standard deviation); dividend policy.		The results show that R&D voluntary disclosure is positively associated with poor earnings performance & large board size. Indeed, firms with more R&D activities and more volatile earnings introduce more information related to their R&D activities.
Nekhili et al., (2015) France	The impact of narrative R&D disclosure and corporate governance on the market value.	Agency and signaling theories. Cost and benefits analysis.	98 companies 2000-2004 490 firm year observations	R&D disclosure score.	Board size; board independence; CEO duality; equity based management compensation; audit committee independence.	R&D intensity; R&D accounting; ownership structure, audit quality; leverage; return on assets, firm size; industry.	The audit committee independence and the equity, based compensation are the most important corporate governance mechanisms that positively affect the R&D voluntary disclosure. Both R&D intensity and R&D capitalization have a positive influence on R&D voluntary disclosure. The association between R&D voluntary disclosure and each of board size, board independence, and role duality is insignificant.

4.4. LITERATURE GAP AND THE CURRENT STUDY

While corporate disclosure in annual reports has been examined in a large number of prior studies, and the importance of R&D information is well documented in the literature, very few studies have been concerned with the voluntary disclosure in annual reports with respect to R&D activities.

These pioneer studies, that investigated R&D disclosure in annual reports, highlight the importance of R&D narrative disclosure, and introduce insights into the type and extent of R&D information in annual reports. Consequently, the understanding of the R&D disclosure environment has been improved. Moreover, some of these studies examine the determinants of R&D information introduced discretionarily in annual reports.

Notwithstanding the helpful contributions of these studies, the findings must be interpreted in the context of a number of limitations. First, some studies cover only one year (e.g. Entwistle, 1999; Jones, 2007) which may help in exploring R&D disclosure in annual reports, but does not help in assessing the trend of disclosure across time. Other studies investigate observations from two years without assessing the trend (e.g. Zeghal et al., 2007; Nor et al., 2010). However, a longitudinal study that can track the R&D disclosure practices over the years may be helpful in improving the understanding of extent and trend of R&D disclosure practices. Consequently, the current study extends the prior work by employing the analysis of a longitudinal basis for three years, aiming to monitor the changes in R&D disclosure practices.

Second, the majority of studies that examine R&D voluntary disclosure in annual reports are limited to small samples (e.g. Entwistle, 1999; Ding et al., 2004; Zeghal

et al., 2007; Jones, 2007; Nor et al., 2010) which may affect the generalising of their findings. The current study considers this limitation by examining a large sample which consists of (505) observations.

Third, some studies have a bias towards R&D intensive industries (e.g. Jones, 2007; La Rosa and Liberator, 2014). Consequently, the sample cannot claim to represent R&D disclosure practices of all firms from different industries. The current study considers this limitation by examining a sample from nine industries. The industry sectors investigated in the current study are: utilities, basic materials, consumer goods, consumer services, healthcare, industrials, oil & gas, technology and telecommunications.

Fourth, the previous studies that specifically examine R&D voluntary disclosure in annual reports are employed in different countries (Canada, France, US, eight Western European Countries, Malaysia). Regarding the UK setting, to the best of my knowledge, there is no evidence on the extent, trend and determinants of R&D voluntary disclosure in annual reports except a working paper conducted by Abdelbadie and Elshandidy (2013). This employs computerised content analysis to investigate only the overall voluntary disclosure of R&D expenditures without analysis of any R&D-related topics such as competition, funding or patents.

The current study considers this limitation by examining the R&D disclosure practices in the UK context using manual content analysis, and exploring the total R&D voluntary disclosure: its categories (general, input, output, and financial information), its types (financial and non-financial information) and each item of R&D information presented in the annual reports.

Finally, Although, some studies introduce helpful insights into the determinants of R&D disclosure, they only consider incomplete proxies for corporate governance attributes. (e.g. Zeghal et al., 2007; Nor et al., 2010; Nekhili et al., 2012; Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015).

The expectation that corporate governance could affect R&D disclosure derives from the monitoring role of corporate governance, which could suggest a positive relation between the quality of corporate governance and firm's transparency (Brown et al., 2011).

The few studies that addressed the impact of corporate governance on R&D disclosure in annual reports focused on examining the characteristics of the board of directors and ownership structure without considering the role of the audit committee. To the best of my knowledge, the only study that addresses the impact of audit committee characteristics on R&D disclosure decision, is Nekhili et al., (2015). This considers only the impact of audit committee independence on R&D disclosure in the annual reports of French companies.

The current study considers this limitation by examining the influence of a comprehensive set of corporate governance variables, which are expected to affect R&D voluntary disclosure in annual reports according to the study's theoretical foundation and prior empirical studies.

Based on the above discussion, the current study contributes to disclosure literature and R&D setting through exploring R&D voluntary disclosure in annual reports of UK non-financial listed firms. To bridge the gap in the literature, the current study will extend the previous studies by introducing a number of contributions:

Firstly, the present study is the first to undertake a disclosure study of R&D activities in annual reports of UK firms using a self-constructed disclosure index. Moreover, it considers the total R&D voluntary disclosure, its categories (general, input, output, and financial information), its types (financial and non-financial information) and each item of R&D information presented in the annual reports.

Secondly, the present study uses a large sample (505 observations) from different industries (nine industry sectors) and covers three years (2007-2009) to assess the extent and trend of R&D disclosure in annual reports.

Finally, the study investigates the determinants of R&D disclosure in annual reports by examining the impact of a comprehensive set of corporate governance variables. It also considers a group of firm characteristics that could affect the R&D disclosure practices.

4.5. THE MEASUREMENT OF DISCLOSURE

The main objective of the current study is to explore and analyse R&D narrative disclosure introduced discretionarily by UK firms in their annual reports and to examine its determinants.

To achieve this goal, the different existing approaches employed in the literature to analyse narrative disclosure in annual reports should be considered. Hence every approach should be evaluated to choose the appropriate method which achieves the aim of the current study.

Beattie et al., (2004) documented five approaches to analyse the narratives in annual reports that can be classified into three groups: (1) subjective analyst rankings, (2) the two principal ways to measure the disclosure which have been employed by

accounting researchers for a long time: Self-Constructed Disclosure Indices and Thematic content analysis, and (3) the renewed trend that includes readability studies and Linguistic analysis. Although, the main objective of the first and second groups is to measure narrative disclosure, the third group pays more attention to its characteristics. Figure 4.3 summarises the main approaches that have been used by researchers to analyse the narratives in annual reports.

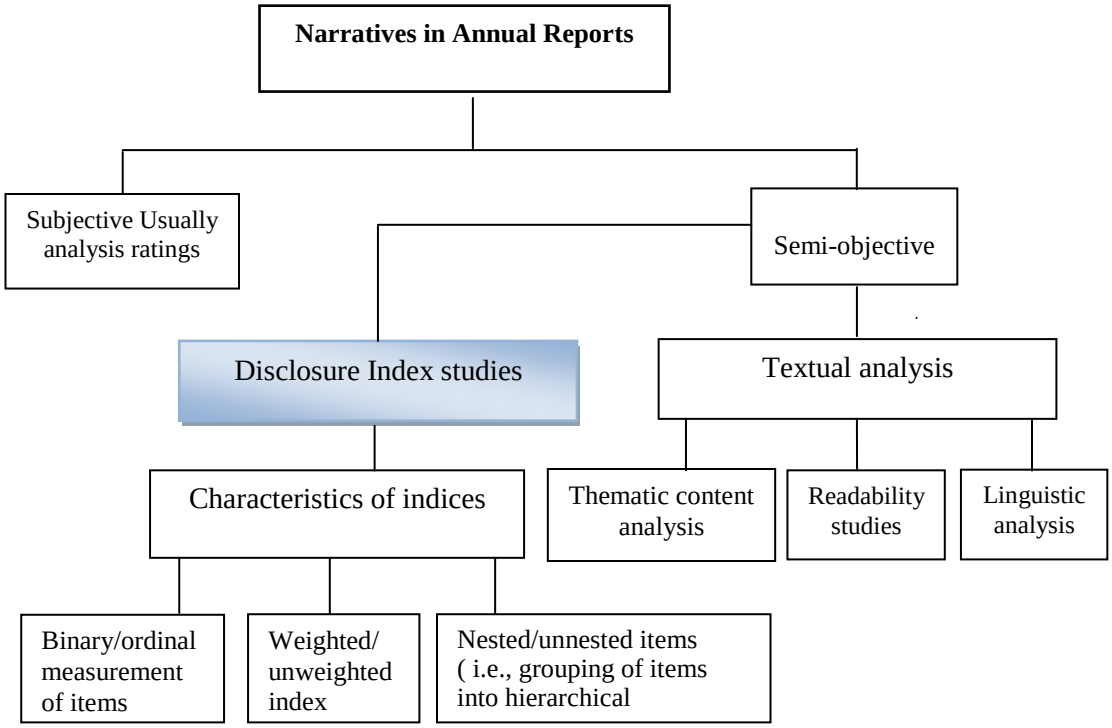


Figure 4.3
Approaches used to Analyse the Narratives in Annual Reports.
Source: adapted Beattie et al., 2004.

The next paragraphs presents a brief discussion of the approaches used to analyse narrative disclosure.

- ***Subjective Rankings***

Subjective rankings provide an overall score of corporate disclosure quality. In the US, the Association of Investment Management and Research (AIMR), formerly the Financial Analysts Federation (FAF) introduced a composite measure of the

disclosure quality dependent on the analysts' evaluation of three sources of information: annual published information, other published information such as press releases and quarterly reports, and investor relations. These measures are prepared by a specific analysts subcommittee for each industry. Each group of analysts prepares a list for each industry containing the most important information requirements and allocates a score for each company[7]. Many studies employed AIMR ranking (e.g. Lang and Lundholm, 1993; Healy et al., 1999; Gelb and Zarowin, 2002). The UK does not have a similar ranking.

- ***Self-Constructed Disclosure Indices***

Healy and Palepu (2001:2) argue that*"One of the limitations of the studies on voluntary disclosure is the difficulty in measuring the extent of voluntary disclosure."*. Considering the difficulty of assessing disclosure quality, disclosure index studies assume that the amount of disclosure on certain topics is considered a proxy for the quality of disclosure (Beattie et al., 2004). The disclosure index has been widely used to analyse the narrative disclosure in annual reports (e.g. Botosan, 1997; Meek et al., 1995; and Hossain et al., 1995; Nekhili et al., 2015).

Core (2001) argues that the disclosure rating introduced by Botosan (1997), Lang and Lundholm (2001), may involve some small problems of judgment error. However, the actual problem with this method is that it is so labour-intensive, hence; it is appropriate only for small samples.

- ***Thematic Content Analysis***

A key assumption underlying content analysis is that volume equates with the importance of the information being disclosed (Unerman, 2000). Hence, the choice

[7] For more details: Lang and Lundholm, 1993; Healy and palepu, 2001; Beattie et al., 2004.

of the unit of measurement is a critical decision in any content analysis study. Generally, in thematic content analysis studies, the researchers measure the quantity of information at the level of word, sentence, paragraph, page and text. Each unit of measurement has its own advantages and disadvantages.

Regarding the level of the word, Campbell et al., (2010) argue that the word will be appropriate as a unit of analysis when the meaning is conveyed at that level and where the writer weighted every word for meaning before using, as it would be in a legal document. However, the coding of individual words without a sentence for context is clearly meaningless (Milne and Adler, 1999). Moreover; the same word may be a part of a more distinct kind of disclosure. For example: the word *"development"* could be related to R&D activities *"research and development expenditures"*, and could be related to any other type of information*: "market development, leadership development, development of strategy".*

Milne and Adler (1999) believe that the sentence is more reliable than any other unit of analysis to provide the foundation for both coding and measuring disclosure. On the other hand, using sentence count may have some implementation problems when one sentence conveys two types of information. For example *"around 12,000 people in our R&D organisation and 17 principal R&D centres in eight countries"* (Astra Zeneca annual report, 2008, p.8). This sentence holds two types of information : *"Around 12,000 people in our R&D organization"* reporting information about Management and People and*"17 principal R&D centres in eight countries"* reporting information about the infrastructure of R&D activities.

In addition, the counting of words, sentences, or paragraphs will only capture narrative disclosure, and are not able to effectively reveal non narrative forms of disclosure (McMurtrie, 2005).

Beattie and Thomson (2007) suggest the text unit as an alternative unit of analysis and measurement and to relax the concerns of using the sentence. They recommend splitting sentences into single pieces of information. They declare that this coding measure is not claimed to be the best and do not introduce a solution to all the issues involved. The main problem of the text unit according to Beattie and Thomson (2007) is the complexity of using it compared to the use of sentences; this complexity may decrease reliability.

- ***Readability and Linguistic studies*** [8].

Loughran and McDonald (2014:1649) define readability as *"the ability of individual investors and analysis to assimilate valuation-relevant information from a financial disclosure"*. Beattie, (2014:116) states that *"Linguistic sentiment analysis generally involves the creation of wordlists to capture positive and negative opinions. The tone is measured as the ratio of positive to negative words."*. Beattie et al., (2014) argue that this trend is encouraged by the increasing availability of digital texts and advanced computerised software.

To sum up, in the absence of a subjective disclosure rating in the UK, there are two alternative approaches to investigate R&D narrative disclosure in annual reports using manual content analysis:

[8] The review of the readability studies and linguistic analysis is beyond the scope of this study. For more details: Dreyer, 1984; Stevens et al., 1992; Sydserff and Weetman, 1998; and Beattie et al., 2004.

The first approach quantifies the extent of disclosure by the frequency of a specific unit such as words, sentences, text, or page proportion. Although this approach is commonly used in previous studies that have investigated R&D disclosure in annual reports (e.g. Entwistle, 1999; Zeghal et al., 2007; Merkley, 2014), some concerns can be identified. Firstly, the higher frequency of specific information does not necessarily reveal the importance of it. Secondly, the counting of words, sentences, or texts does not help in capturing other non-narrative disclosures such as tables and graphs.

The second approach is the use of disclosure index, which has been employed in many studies that concerned R&D disclosure in annual reports (e.g. Jones, 2007; La Rosa and Liberator, 2014; Nekhili et al., 2012; Nekhili et al., 2015). Although Marston and Shrives (1991) acknowledge that the construction of a disclosure index involves subjective judgment, they conclude that the value of the results depending on the disclosure score cannot be considered uncritically and the aim of researchers should be to minimise the subjectivity of the disclosure index. Therefore, the current study employs a self-constructed disclosure index.

4.6. DEVELOPMENT OF HYPOTHESES

Reviewing the disclosure literature and prior research on the R&D context reveals that, R&D investments are important activities that affect significantly the productivity, performance and market value of firms. Moreover, R&D-related information has value relevance. Hence, R&D disclosure is necessary for communicating the management's efforts.

R&D voluntary disclosure may be driven by many factors. In addition to the firm characteristics that have been examined extensively in the disclosure literature; the

current study examines a set of corporate governance variables that could influence the level of R&D voluntary disclosure in annual reports.

4.6.1.Corporate Governance Variables

Brown et al., (2011) argue that the positive influence of corporate governance quality on disclosure is expected according to the regulators' presumption. They also point out that the empirical evidence provides mixed results, suggesting rich research opportunities to investigate the impact of corporate governance on corporate disclosure on a cross country basis.

The current study contributes to the limited existing literature regarding R&D voluntary disclosure in annual reports. It investigates the influence of three groups of corporate governance variables on the level of R&D disclosure in annual reports for a sample of the UK firms. These groups are: the board characteristics, Ownership Structure, and Audit Committee characteristics.

4.6.1.1. The Board Characteristics

Conheady et al., (2014:13) state *"an effective board of directors is central to agency theory's prescription to protecting owners' interests, the minimization of agency costs and ensuring that principal-agent interests are aligned."*. Hence, the board of directors is considered a main tool to exercise control on top management by shareholders (John and Senbet, 1998). Moreover, the main responsibility of the board of directors, as identified by the UK Corporate Governance Code (2014), is to present a fair, balanced and understandable evaluation of the company's position and prospects. Accordingly, board effectiveness is a key element in mitigating the agency costs, and enhancing the firm's transparency. Consequently, board characteristics

could influence the R&D disclosure decisions. The current study examines four board characteristics these are: board size, role duality, board independence and frequency of board meetings.

- ***Board Size***

The size of the board represents the total number of directors on the board. The influence of board size on the board effectiveness has been a subject to debate. Hidalgo et al., (2011) summarize this debate by concluding that, the large number of members on the board increase the range of expertise and the board's monitoring capacity. However, this benefit may be compensated by the incremental costs of decision making time that are associated with large groups.

According to agency theory, the board effectiveness in implementing its monitoring role is determined by its size, independence, and composition (John and Senbet, 1998).

As recommended by the UK Corporate Governance Code (2014), having sufficient diversity on the board is very important to achieve an effective engagement with key stakeholders and to fulfil the firm's strategy. Moreover, the guidance of board effectiveness issued by (FRC, 2011: 2) states that *"Diversity in board composition is an important driver of a board's effectiveness, creating a breadth of perspective among, and breaking down a tendency towards 'group think'."*.

Empirically, the evidence is mixed. While, the positive influence of large board size on intellectual capital disclosure is supported by the findings of Hidalgo et al., (2011), Cerbioni and Parbonetti (2007) find a negative relationship between board size and intellectual capital disclosure.

Regarding R&D disclosure, the empirical evidence on the relationship between board size and R&D disclosure is very limited. Although, Nekhili et al., (2015) were unable to confirm a significant impact of board size on R&D narrative disclosure, the existence of a significant and positive association between board size and R&D disclosure in annual reports is documented by Abdelbadi and Elshandidy (2013).

The positive association between R&D disclosure and board size is expected because R&D activities have a distinctive nature. Hence they may need the judgement of a director with a scientific background to provide a clear understanding of some R&D-related information. This kind of skill is more likely to be available in large boards that have a greater diversity of expertise. This leads to the first hypothesis in the current study.

H1*: There is a positive relationship between the board size and the level of R&D voluntary disclosure in annual reports.*

- ***Role Duality***

Role duality exists when the (CEO) is also the chairman of the board. According to agency theory, the separation of decision management and decision control functions will reduce the agency costs and improve firm's performance (Fama and Jensen, 1983). This separation will be effective when the chairman of the board does not hold the CEO position (Brown et al., 2011).

Consequently, separating the roles of chairman of the board and CEO helps the board to improve its performance and implement its control function more effectively (Donnelly and Mulcahy, 2008; Conheady et al., 2014). Moreover, the UK Corporate

Governance Code 2014 recommends that, the roles of the chairman of the board and (CEO) should not be performed by the same person.

Although the majority of studies that address the association between role duality and R&D voluntary disclosure in annual reports were not able to confirm a significant association between the two variables (Nor et al., 2010; Abdelbadi& Elshandidy, 2013; Nekhili et al., 2015), Zeghal et al., (2007) find a negative association between role duality and R&D voluntary disclosure in annual reports in the Canada context.

Based on the above discussion, separating the roles of chairman of the board and CEO makes the board of directors more likely to carry out its control function more effectively, and ensure the firm's transparency. Consequently, role duality is expected to be associated negatively with the level of R&D disclosure in annual reports. This leads to the second hypothesis in the current study:

H2*: There is a negative relationship between the role duality and the level of R&D voluntary disclosure in annual reports.*

- ***Board Independence***

Board independence is measured as the percentage of the number of independent non-executive directors to the total number of directors on the board.

According to agency theory, Lim et al., (2007) argue that the employment of independent non-executive directors works as a mechanism to monitor management's performance and decrease information asymmetry between managers and owners. In addition, the outside directors have an incentive to perform as decision experts to

develop their reputation and increase their own value in the human capital market (Fama & Jensen, 1983).

R&D activities are a specific type of investment, which differs from most of the company's other activities. They are long-term investments characterised by uncertainly and long run return (Munari et al., 2010). Therefore, R&D activities can be identified as a major contributor of information asymmetry (Aboody and Lev, 2000)

Consequently, drawing on agency theory, the independent directors may increase the R&D voluntary disclosure by monitoring the management's performance and encouraging managers to introduce more R&D-related information in order to reduce information asymmetry. Moreover, they have a motivation to perform as experts in order to enhance their reputation in the human capital market.

The existing literature provides empirical evidence supporting the role of independent directors in introducing more voluntary disclosure in general (Lim et al., 2007; Donnelly and Mulcahy, 2008 Gisbert and Navallas, 2013), and intellectual capital disclosure, in particular (e.g. Cerbioni and Parbonetti, 2007; Huafang and Jianguo, 2007)

In terms of the R&D context, the empirical evidence on the relationship between board independence and R&D disclosure is limited. In addition, the few studies, that have addressed this relationship, could not find a significant association between board independence and R&D disclosure in annual reports (e.g. Zegal et al., 2007; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015). Although, these few studies were unable to introduce evidence on this relationship, a positive influence of board independence on the level of R&D disclosure is expected. This proposed relationship

follows the argument that support the effective monitoring role of the independent non executive directors. Hence, the following hypothesis is formulated.

H3*: There is a positive relationship between the board independence and the level of R&D voluntary disclosure in annual reports.*

- ***Frequency of Board Meetings***

According to agency theory, the board of directors has the power to monitor the decisions which are made by top level management, and this role exercised by the board of directors is one of the main bases of the decision control system of firms (Fama and Jensen, 1983).

The number of board meetings held during the year could be an indicator of the board effectiveness in implementing this monitoring role. As stated by Zaman et al., (2011:173)*"the number of board meetings can indicate the level of diligence exercised by the board of directors."*. This view is supported by The UK Corporate Governance Code (2014:7)*"The board of directors should meet sufficiently regularly to discharge its duties effectively."*.

Consequently, the frequency of board meetings is more likely to increase the board effectiveness, and improve its monitoring role, in turn, enhancing the firm's transparency. Based on this argument, boards that meet more frequency are more likely to introduce more R&D voluntary disclosure.

There is a very limited investigation of the association between frequency of board meetings and the level of disclosure. Kent and Stewart, (2008) find a positive relationship between the quantity of disclosure and the frequency of board meetings. Empirically, to the best of my knowledge, the relationship between the number of

board meetings and R&D disclosure in annual reports has not been examined. From the previous discussion, it could be argued that, boards that held more meetings are more likely to be more effective and provide enhanced R&D disclosure. Hence, the following hypothesis is formulated:

H4*: There is a positive relationship between the number of board meetings and the level of R&D disclosure in annual reports.*

4.6.1.2. Ownership Structure

Eng and Mak, (2003:326) states that*"The structure of ownership determines the level of monitoring and thereby the level of disclosure."*.

Following (Eng and Mak, 2003) the ownership structure can be assessed by the percentage of ordinary shares held by managers and by blockholders. Therefore, ownership structure examined in the present study includes managerial ownership and ownership concentration.

- ***Managerial ownership***

Managerial ownership is measured as a percentage of shares held by management. Jensen and Meckling (1976) argue that the increase of managerial ownership will decrease the need for monitoring and controlling the behaviour of an agent by the principal. Consequently, according to agency theory, firms with higher management ownership may have less incentive to introduce more disclosure (Eng and Mak, 2003; Rouf and Alharun, 2011). Management ownership supports the interests of the agent and shareholders, thus reducing the need for monitoring by shareholders and thereby the need for more disclosure (Samaha et al., 2012).

Empirical evidence in Eng and Mak (2003) show that firms are less likely to provide voluntary disclosure when managerial ownership increases. However, regarding R&D disclosure in annual reports, most studies could not detect any significant association between managerial ownership and R&D disclosure (e.g. Nor et al., 2010; Nekhili et al., 2012; Nekhili et al, 2015).

Based on agency theory the negative association between managerial ownership and the level of R&D disclosure is expected. Therefore, the fifth hypothesis is formulated as follows:

H5*: There is a negative relationship between the level of management ownership and the level of R&D disclosure in annual reports.*

- ***Ownership Concentration (Blockholder Ownership)***

Blockholder ownership is the percentage of ordinary shares held by substantial shareholders. This percentage identified as 5% or more (e.g. Eng and Mak, 2003; Huafang & Jianguo, 2007), or as 3% or more of the firm's share capital (e.g. Li et al., 2012).

Fama and Jensen (1983) theorized that diffusion in ownership raises the agency problems. Hence, it is expected that managers will disclose more information to mitigate the agency costs resulting from the ownership dispersion. (Huafang and Jianguo, 2007; Garcia-Meca and Ballesta, 2010). Moreover, the diffusion in ownership will increase the monitoring by outside shareholders and thereby the level of disclosure (Eng and Mak, 2003).

Li et al., (2012) suggest that enhanced intellectual capital disclosure is less likely in firms with higher levels of blockholder ownership. They indicate that the availability

of the information in the private meetings that are attended by substantial shareholders may decrease their motivation to prompt firms to enhance public disclosure of this information.

The evidence from empirical studies reveals a significant negative association between ownership concentration and corporate disclosure (e.g. Garcia-Meca and Sanchez-Ballesta, 2010). However, other empirical results indicate a positive relationship between corporate disclosure and ownership concentration (e.g. Huafang and Jianguo, 2007). To the best of my knowledge, no empirical evidence of the relationship between ownership concentration and R&D disclosure in annual reports has been confirmed (e.g. Nekhili et al., 2012; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015)

Based on the above discussion, ownership concentration is associated with less agency conflicts, so the managers may have less incentive to introduce more voluntary disclosure. Consequently, the ownership concentration is expected to decrease the probability of introducing more R&D voluntary disclosure in annual reports. Hence, the following hypothesis is formulated:

H6*: There is a negative relationship between the level of ownership concentration and the level of R&D disclosure in annual reports.*

4.6.1.3. Audit Committee Characteristics

The guidance on audit committees issued by FRC in September (2012) identifies the role of the audit committee regarding narrative reporting as:

> *"Where requested by the board, the audit committee should review the content of the annual report and accounts and advise the board on whether, taken as a*

whole, it is fair, balanced and understandable and provides the information necessary for shareholders to assess the company's performance, business model and strategy.". (FRC, 2012: 7)

Li et al., (2012) argue that the audit committee would affect the intellectual capital disclosure by reducing the information asymmetry. This is because the main responsibility of the audit committee as a sub-committee of the board of directors is monitoring the reporting processes of financial and non financial information including intellectual capital information.

From the agency theory perspective, this monitoring role of the audit committee can be considered as a tool to mitigate the agency costs (Ho and Wong, 2001). Consequently, the effectiveness of the audit committee may have a positive influence on R&D disclosure decisions. Following Zaman et al., (2011), the audit committee effectiveness can be assessed by four dimensions that are audit committee size, audit committee independence, frequency of audit committee meetings and the existence of an audit committee financial expertise.

- ***Audit Committee Size***

The size of an audit committee is the total number of audit committee members. The audit committee size will vary according to the need and culture of the company, hence; the cornerstone of the committee's efficiency is meeting the board's expectations and carrying out its delegated responsibilities (KPMG, 2009). Bedard et al., (2004) argue that the key element is to establish a committee large enough to achieve effective monitoring, but not so large to negatively affect the decision-making process. FRC recommended a minimum audit committee membership of three, or two in the case of smaller companies (FRC, 2009).

- ***Audit Committee Independence***

The audit committee should be independent of the firm's management in order to undertake its duties (Bedard et al., 2004). Audit committee independence is measured as the proportion of independent non-executive directors on the audit committee.

FRC recommends that the audit committee should be established with at least three (or two in the case of smaller companies) members, who are independent non-executive directors (FRC, 2009).

Consequently, the composition of the audit committee, which included a majority of independent directors, can improve the quality of financial disclosure to ensure the accurate evaluation of management performance (Cerbioni & Parbonetti, 2007).

- ***Frequency of Audit Committee Meetings***

Frequency of audit committee meetings is measured by the number of audit committee meetings held during the year. The frequency of audit committee meetings and their duration should vary depending on the range and complexity of the committee's responsibilities, and it is recommended that the audit committee may need to meet at least eight times a year to conduct its activities effectively (KPMG, 2009). According to the guidance on the audit committee published by FRC, there should be at least three meetings of audit committee during the year; however, most audit committee chairmen will wish to call more frequent meetings (FRC, 2009).

Raghunandan and Rama (2007) argue that the frequency of audit committee meetings is considered the only publicly available quantitative indicator about the diligence of audit committees.

- ***Audit Committee Financial Expertise***

In order to carry out their tasks and achieve an effective reviewing of both financial and narrative reporting and also an efficient monitoring of internal controls and risk management systems, the members of the audit committee should have relevant financial experience. Best practice required that at least one member of the audit committee should have recent and relevant financial experience (FRC, 2009). On the other hand, Li et al., (2012) do not empirically support the association between intellectual capital disclosure and existence of financial expertise on the audit committee. They argue that the rationale behind this result may be that the financial experience is more related to financial issues than to intellectual capital information. This is because understanding some intellectual capital information such as research and development activities may require another knowledge.

- ***Audit Committee Quality***

According to the guidance of audit committees published by the FRC (Guidance on Audit Committees) in September 2012 to revise the Smith Report (2003), the audit committee should be established with at least three independent non-executive directors; one of them at least should have recent and relevant financial experience. It is recommended by the FRC that there should be no fewer than three meetings during the year. Zaman et al., (2011) suggest that the audit committee effectiveness can be measured according to the composite measure of four dimensions: audit committee size, audit committee independence, audit committee financial expertise, frequency of audit committee meetings. Following Zaman et al., (2011) audit committee effectiveness is a dichotomous variable equal to (1) when an audit committee is comprised of at least three members, all of them independent non-

executive directors, at least one member of the audit committee has financial expertise, and audit committee members meet at least three times a year, and equal to (0) if otherwise.

Given the role of the audit committee in monitoring the reporting processes of financial and non financial information the following hypothesis is formulated:

H7*: There is a positive relationship between the audit committee quality and the level of R&D disclosure in annual reports.*

4.6.2. Control Variables

The control variables of the current study are the corporate characteristics that have been examined by a large number of studies and considered to be important determinants of corporate disclosure. These are: firm size, R&D investments, liquidity, leverage, profitability and growth rate.

- ***Firm Size***

Firm size has been used in literature as an important control variable on studying the association between corporate disclosure and corporate governance. According to signaling theory, large companies are more likely to catch the attention of financial analysts to gain the information needed in making rational advices (Hussainey and Al-Najjar, 2011). So, signaling theory would suggest a positive association between corporate disclosure and firm size.

One explanation of the association between firm size and disclosure is the decrease of the fixed cost component of disclosure for large companies (Lang and Lundholm 1993). Large companies have a more developed internal reporting system; hence, the

disclosure costs are smaller for large companies (Chavent et al., 2006). Another possible explanation could be that small firms may be unwilling to introduce more information because this disclosure might put them at a competitive disadvantage (Cooke, 1989). Furthermore, Raffournier (1995) suggests that larger companies will disclose more to reduce political costs.

The influence of firm size on disclosure has been examined in most prior studies, which investigated the determinants of voluntary disclosure. Results have often provided evidence that firm size is positively associated with disclosure levels (e.g. McNally et al., 1982; Chow and Wong-Boren 1987; Cooke 1989, Hossain et al., 1995; Raffournier, 1995; Depoers, 2000; Watson et al., 2002). However, other studies find an insignificant relationship between voluntary disclosure and firm size (e.g. Mak, 1991; Entwistle, 1999; Jones, 2007). Moreover, Nor et al., (2010) and Nekhili et al., (2015) document a negative association between firm size and R&D voluntary disclosure. According to the previous discussion and the results of the majority of prior studies, a positive relationship between firm size and R&D disclosure in annual reports is expected.

- ***R&D Investment***

Many researchers argue that R&D activities are associated with the existence of considerable information asymmetry (Tasker, 1998; Aboody and Lev, 2000; Barth et al., 2001). Therefore, some researchers use R&D intensity as a proxy for information asymmetry (e.g. Aboody and Lev, 2000; Percy, 2000). Hence, the information asymmetry hypothesis will expect a positive association between R&D investments and the level of disclosure (Gu and Li, 2003).

Moreover, Munari et al., (2010) indicate that the management decisions of R&D investments are mainly indicative of the disagreement between principals' and agents' interests. In addition, providing more information regarding R&D activities has value-relevance influencing the firm's market value (Chan et al., 1990; Woolridge and Snow, 1990; Dedman et al., 2008; Hirshey et al., 2001). Therefore, signalling and agency theories would suggest that, the managers of the firms with high level of R&D investments may have a stronger incentive to signal their transparency, reduce the information asymmetry, moderate the conflict between principals' and agents' interests and finally, gain the market rewards for better disclosure. This can be achieved by introducing more information about their R&D activities. Accordingly, signalling and agency theories would predict a positive relationship between the disclosure and R&D investments.

Empirically most studies that address R&D disclosure document a significant positive relationship between R&D disclosure and each of, R&D expenditures to total sales (Zeghal et al., 2007; Nekhili et al., 2012; Nekhili et al., 2015), and R&D expenses as a percentage of total current operating expenses (Entwistle, 1999; Abdelbadi and Elshandidy, 2013; Merkley, 2014). However, other studies could not find a significant association between R&D disclosure, and each of R&D capitalised over the total assets (Nor et al., 2010), amount of R&D expenses (La Rosa and Liberatore, 2014), R&D expenditures to total sales (Jones, 2007).

- ***Leverage***

Leverage describes the financial structure of the firm, and measures its financial risk. Drawing on agency theory two different arguments have been used to explain the expected relationship between leverage and the level of disclosure.

The first point of view suggests that a positive relationship is expected between voluntary disclosure and leverage because firms with high leverage are more likely to incur higher monitoring cost (Huafang and Jianguo, 2007). Therefore, managers would use the disclosure as a tool to reduce the monitoring costs for creditors (Raffournier, 1995; Depoers, 2000; Chavent et al., 2006). On the contrary, the other point of view argues that increasing leverage is more likely to reduce equity agency costs by involving more debt financing, thus, reducing total equity financing (Crutchley and Hansen, 1989). Jensen, (1986) argued that debt creation can be an effective substitute for dividend in reducing the agency costs of the firms with free cash flow, that is available for spending at the discretion of managers, and pointed out the importance of considering the debt agency costs.

Although leverage is widely examined in prior disclosure studies, conflicting results have been reported regarding the influence of leverage on corporate disclosure.

Many studies have confirmed a significant positive relationship between disclosure level and leverage (e.g. Hossain et al., 1995; Ahmed and Courtis, 1999; Merkley, 2014). On the contrary, Eng and Mak (2003) found a negative relationship between debt and disclosure. However, other studies found no significant effect due to leverage on disclosure (e.g. Chow and Wong-Boren, 1987; Entwistle, 1999; Cerbioni and Parbonetti, 2007; Huafang and Jianguo, 2007; Depoers, 2000; Nekhili, 2012).

- ***Profitability***

Many theories have been employed to explain the effect of a firm's performance on its disclosure decisions. Signalling theory would suggest that the firm would provide information about its high profitability to investors (Watson et al., 2002). Moreover, Li et al., (2008) suggest that profitability may be considered as the gain from

continuous investments in intellectual capital, so managers may introduce more information to signal the significance of their investment decisions.

Agency theory can also be used to support this relationship, Singhvi et al., (1971) argue that managers tend to disclose more information when they achieve a high rate of return in order to support their position.

Empirically, there have been conflicting results in prior literature relating to the impact of profitability on disclosure. While Ahmed and Courtis (1999) find no significant association between corporate profitability and disclosure level, Raffournier (1995) and Watson et al., (2002) find a positive association between voluntary disclosure and profitability. Recently, Merkley (2014) has reported a negative relationship between earnings performance and narrative R&D disclosure.

- ***Liquidity***

liquidity is an indicator of the firm's ability to cover its current obligations. Wallace and Naser (1995) suggest that firms with a high liquidity ratio are more likely to introduce more disclosure to demonstrate their ability to meet their short term obligations. From signalling theory perspective, managers of highly-liquid firms will introduce more disclosure to signal their ability in managing liquidity compared to other managers in companies with low liquidity ratios (Elzahar and Hussainey, 2012).

Regarding the R&D context, managers may have the incentive to disclose more information about R&D activities in highly-liquid firms to signal their strong position and their ability to face their current obligations.

Empirical evidence on the relationship between corporate disclosure and liquidity is quite limited. While Elshandidy et al., (2013) confirm a positive association between

the liquidity and voluntary risk disclosure, Mangena and Pike (2005) are unable to confirm any significant relationship between liquidity and the level of disclosure in interim reports; Elzahar and Hussainey, (2012) also find an insignificant association between liquidity and corporate risk disclosure in the UK interim reports. However, Wallace et al., (1994) provide evidence that firms with lower liquidity ratios provided more disclosure in their annual reports. Regarding R&D disclosure, Nor et al., (2010) are not able to confirm any significant influence of liquidity on the level of R&D voluntary disclosure in annual reports.

- ***Firm's Growth Rate***

Firms with a higher growth rate may have higher information asymmetry between managers and shareholders, so they would have more incentives to disclose voluntary information in order to reduce this information gap (Gul and Leung, 2004). However, the growth rate is used by Prencip (2004) as a proxy for proprietary costs. Prencip (2004) argues that the competitive costs of introducing voluntary segment information could be higher for growing companies, so, the negative association between a firm's growth rate and voluntary disclosure is expected.

Empirical evidence on the relationship between corporate disclosure and growth rate is also inconclusive. La Rosa and Liberattore (2014) confirm a negative association between the firm's growth, measured by market to book ratio, and the level of R&D voluntary disclosure. While, Eng and Mak (2003) find no significant association between the growth opportunities and voluntary disclosure; McNally et al., (1982) as well, are not able to confirm any significant association between corporate voluntary disclosure and firm's growth measured by growth in total assets.

4.7. SUMMARY

This chapter reviews some of the important studies that examined the association between corporate governance and each of corporate disclosure and intellectual capital disclosure. In general, the findings indicate that corporate governance has an influence on corporate disclosure and on intellectual capital disclosure in annual reports. However, the results are mixed and there is no agreement regarding the nature and significance of this influence for each corporate governance attribute.

More specifically, the chapter reviews the studies, which have investigated R&D activities. Generally, the findings reveal that R&D investments are important activities that affect significantly the productivity, performance and market value of the firms, and highlight the importance of R&D voluntary disclosure introduced by firms outside the formal annual reports.

Although, there are many studies which investigate voluntary disclosure in annual reports, few specifically examine the R&D disclosure in annual reports. The findings of the few studies concerning R&D disclosure in annual reports are limited to a short time period, small samples, specific industries. They also overlook the role of some corporate governance attributes as a possible explanation of variations in the level of R&D disclosure among firms. Consequently, the current study contributes to literature by considering these limitations. It examines the influence of a comprehensive set of corporate governance on R&D voluntary disclosure in annual reports, for a large sample of the UK firms, from different industries, and over a three-year period. It uses a self-constructed disclosure index that considers the total R&D voluntary disclosure, its categories (general, input, output, and financial

information), its types (financial and non-financial information) and each item of R&D information presented in the annual reports.

The second part of this chapter summarises and evaluates the main approaches that have been used by researchers to analyse the narratives in annual reports. Finally, the research hypotheses are formulated based on the integrated theoretical framework presented in chapter three, and the literature review presented in the first part of the current chapter.

CHAPTER FIVE

RESEARCH METHODOLOGY

Chapter Five
Research Methodology

5.1. INTRODUCTION

The current study investigates R&D voluntary disclosure practices in annual reports of the UK firms. The theoretical discussion in chapter three outlines the proposed theoretical framework for the current study. In addition, the review of prior literature in chapter four **highlights** the lack of studies that have investigated R&D voluntary disclosure in annual reports, especially, the influence of corporate governance attributes on R&D-related information introduced discretionarily by firms.

Based on the previous chapters, the main objective of the current study is to measure the extent and trend of R&D voluntary disclosure in the UK firms' annual reports. The study also seeks to examine the impact of corporate governance on R&D disclosure provided discretionarily in annual reports, with controlling for the firm characteristics that could influence the R&D disclosure practices.

The current chapter outlines the methodology employed to carry out the empirical part of this study. This chapter consists of eight sections. Section (2) discusses the research approach, type and technique. Section (3) discusses the research method selected for the current study. Section (4) summaries the research design, including, the UK context, the time horizon, the population of the study, the sample selection, the characteristics of the disclosure index, the construction of the R&D disclosure checklist and finally the assessment of its reliability and validity. Section (5) presents the definitions and measurements of dependent and independent variables, followed by, model specification in section (6). Section (7) summaries the analytical

procedures employed in the study. Finally, section (8) introduces the main issues discussed in the current chapter.

5.2. RESEARCH APPROACH, TYPE AND TECHNIQUE

There are two main research approaches: the inductive and the deductive. The main difference between the two approaches is that in the inductive approach, researchers move from data to theory, while they move from theory to data in the deductive approach (Saunders et al., 2007). In other words, The inductive research starts with collecting data about a particular topic. Then, the researcher looks for the pattern of data and analyses it, finally; from the results, it may be possible to construct generalizations relationships and even theories (Gray, 2009). On other hands, the deductive approach starts with developing hypotheses, drawing on the existing theories, and empirically testing them. Hence, the hypotheses are supported or not based on the results of analysing (Gray, 2009). Figure 5.1 outlines the steps involved with both inductive and deductive approaches.

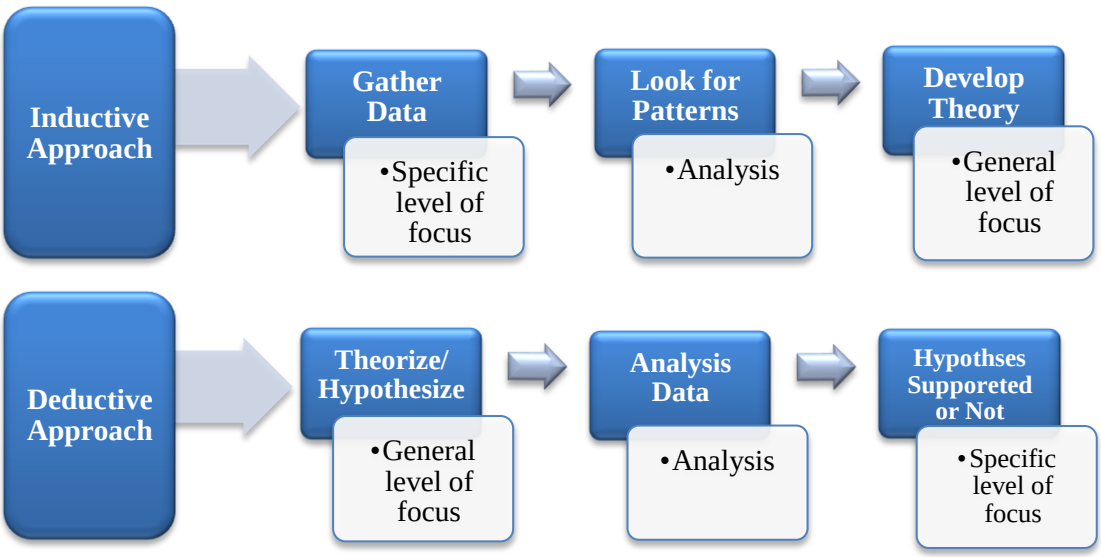


Figure 5.1
Inductive and Deductive Approaches
Source: adopted from Blackstone (2012:43)

The current study aims to investigate the R&D voluntary disclosure in annual reports and examine the relationship between the level of R&D disclosure and corporate governance. Therefore, the deductive approach is considered to be more suitable to achieve the aim of the current study.

The research can be classified by its purpose to three types of studies: exploratory, descriptive and causal studies. Exploratory research is conducted when not enough is known about a particular phenomenon (Gray, 2009) Therefore, it is usually a first step, followed by additional research to provide more conclusive evidence (Zikmund et al., 2009). Descriptive research is conducted to identify a particular phenomenon by drawing a picture of it (Gray, 2009). In other words, it seeks to describe characteristics of objects, people, groups, organisations, or environment (Zikmund et al., 2009). Explanatory (causal) research aims to explain the descriptive information (Gray,209). Therefore, Zikmunnd et al., (2009 :57) states that *"The different types of research discussed here are often building blocks- exploratory research builds the foundation for descriptive research, which usually establishes the basis for causal research.*".

The current study aims to complement the pioneering exploratory study which conducted by Entwistle (1999) to clarify the R&D disclosure environment. Therefore, the current study seeks to describe the R&D disclosure practices in annual reports and examine the impact of corporate governance on the level of R&D disclosure. Accordingly, the first part of the current study is considered to be a descriptive research, while the second part is considered to be an explanatory study.

Data collection techniques can be classified into quantitative and qualitative. Quantitative technique is based on the measurement of quantity or amount, while the

qualitative technique is concerned with a qualitative phenomenon (Kothari, 2004). Zikmund et al., (2009) tabulated the differences between the two techniques as shown in table 5.1.

Table 5.1
Comparing Quantitative and Qualitative Research

Research Aspect	Quantitative Research	Qualitative Research
Common purpose	Test hypotheses or specific research questions.	Discover ideas, used in exploratory research with general research objects
Approach	Measure and test.	Observe and interpret
Data collection approach	Structured response, categories provided.	Unstructured, free-form
Researcher independence	Researcher uninvolved observer, results are objective.	Researcher is intimately involved, results are subjective.
Samples	Large samples .	Small samples.
Most often used	Descriptive and causal research designs.	Exploratory research designs.

Source: adopted from Zikmund et al., (2009: 136)

From the table, it can be noticed that quantitative technique is more suitable to descriptive and causal research. In addition, Greener (2008) argues that quantitative technique is likely to be associated with a deductive approach. Accordingly, in line with the objectives of the current study, it adopted the deductive approach and employed descriptive and explanatory research. Therefore, it is believed that quantitative technique is the appropriate choice to employ the current study.

5.3. RESEARCH METHOD

The objective of the current study is to explore R&D voluntary disclosure practices in annual reports. Moreover, the study seeks to measure the extent of R&D voluntary disclosure, and investigate its trend over the period of study. Furthermore, the current study aims to identify the determinants of R&D voluntary disclosure in the UK context, especially the potential role of corporate governance.

As discussed in chapter four, two alternative approaches could be used to investigate the narrative disclosure in annual reports in order to achieve the purpose of the current study: **The first approach** quantifies the extent of disclosure by the frequency of a specific unit such as words, sentences, text, or page proportion. Although, this approach can help in capturing particular units such as words, sentences, or text, it does not help in capturing other non-narrative disclosures such as tables and graphs. **The second approach** is the use of a disclosure index. Although Marston and Shrives (1991) acknowledge that the construction of disclosure index involves subjective judgment, they conclude that the value of the results depending on the disclosure score cannot be considered uncritically, and the aim of researchers should be how to minimise the subjectivity of the disclosure index.

Therefore, the current study conducts content analysis as a research method and employs a self-constructed disclosure index to capture the R&D-related information in annual reports.

5.3.1. The Content Analysis

Krippendorf (2004:18) defines content analysis as *"a research technique for making replicable and valid inferences from texts (or other meaningful mater) to the contexts of their use"*. Morris (1994:903) states that *"content analysis is a research technique used to objectively and systematically make inferences about the intentions, attitudes, and values of individual by identifying specified characteristics in textual messages."*.

Weber (1990:12) summarises the core idea of content analysis as *"the central idea in content analysis is that the many words of the text are classified into much fewer*

content categories, each category may consist of one, several or many words.". Since the main objective of the current study is to explore the R&D disclosure practices in annual reports of the UK firms to make conclusions and introduce helpful insights about these practices, content analysis is the appropriate technique for conducting the current study.

5.3.2. Manual and Computerised Content Analysis

Several studies have used content analysis as a research method to capture different types of information in annual reports. The content analysis can be manually based on human-coding or computerised founded on computer-aided .

The two methods have been used in prior literature. The manual method is employed by many researchers (e.g. Eng & Mak, 2003; Zeghal et al., 2007; La Rosa & Liberator, 2014), and the computerized method is used by other studies (e.g Hussainey et al., 2003; Elshandidy et al., 2013; Merkley, 2014).

Although the computer-aided content analysis saves time and effort and allows examination of a large sample, the researchers acknowledged some concerns about the robustness of computerized content analysis. The electronic search is not a sufficient method in investigating the intellectual capital disclosure in annual reports (Beattie and Thomson, 2007). Hussainey (2004:53) states that *"Traditional content analysis via manual reading is generally more effective than the computerised analysis in identifying certain themes in the texts."*. Therefore, the manual content analysis was chosen to conduct the current study.

5.4. RESEARCH DESIGN

The next paragraphs discuss the main features of the research design that have been chosen by the current study, and the rationale behind these selections.

5.4.1. The UK Context

The choice of UK context based on three reasons: **first**, to the best of my knowledge, there is no empirical evidence from the UK context regarding R&D narrative disclosure in annual reports except a working paper introduced by Abdelbadie and Elshandidy (2013) that use computerised content analysis to investigate only the overall voluntary disclosure of R&D expenditures; there was no analysis of any R&D-related topics such as competition, tax credit, funding or patents.

This gap is considered a motivation to improve the understanding of how the UK firms communicate R&D information in their annual reports. Consequently, the current study uses manual content analysis to explore R&D disclosure practices in annual reports of the UK firms, and uses a self constructed disclosure index to measure the level of R&D disclosure. In addition, the study identifies and analyses the type of R&D-related information in annual reports. Finally, it examines the impact of corporate governance on R&D disclosure, and considers some other variables that have not been addressed by Abdelbadie and Elshandidy (2013), such as the effectiveness of the audit committee and the number of board meetings.

Second, there is a very recent study conducted by La Rosa and Liberatore (2014) to examine the impact of the regulatory regime of R&D narrative disclosure on the cost of capital. This study compares the regulatory regime of R&D narrative disclosure in eight western European countries (Belgium, Sweden, Germany, Denmark, Norway,

France, Switzerland and the United Kingdom). The study separates the countries with mandatory R&D disclosure requirements from the countries with a degree of flexibility concerning R&D disclosure requirements; the UK has only recommended R&D disclosure. Hence, the choice of UK context is appropriate for the current study which aims to examine the voluntary disclosure of R&D activities.

Third, the UK context provides a suitable setting to examine the relationship between R&D voluntary disclosure in annual reports and corporate governance. As stated by Lie et al., (2012: 99) *"the' comply or explain' approach of corporate governance adopted in the UK implies that, there is a likelihood of greater variation in both corporate governance structure and disclosure among firms."*. In addition, Shirves and Brennan (2015: 1) States *"The essence of the UK Corporate Governance Code is flexibility, with companies able to choose whether or not to fully comply."*.

These variations in corporate governance structure introduce a good opportunity to examine the impact of corporate governance on the level of R&D disclosure.

5.4.2. The R&D Disclosure in Annual Reports

The current study focuses on the disclosure in the annual report as a statutory document with a formalised structure. These features help in comparing R&D voluntary disclosure practices over years and assessing its trend as well as investigating a large number of observations.

The present study focuses on R&D voluntary disclosure provided in firms' annual reports rather than other narrative information tools due to several reasons:

First, the disclosure introduced by firms in annual reports is an area of interest to many researchers (e.g. Botosan, 1997; Eng and Mak, 2003; Huafang & Jianguo, 2007; Bruggen et al., 2009).

Second, the annual report is considered as a very useful source of information and managers commonly use it as a mechanism to signal what is important to all stakeholders (Guthrie et al., 2004).

Third, annual reports are considered the most common tools of communication used by firms to locate themselves with different internal and external stakeholders. (Guthrie and petty, 2000).

Moreover, Botosan (1997:330) states that:*"Although annual report is only one means of corporate reporting, it should serve as a good proxy for the level of voluntary disclosure provided by a firm across all disclosure avenues."*. Her argument based on the study of Lang and Lundholm (1993) who document a positive correlation between the disclosure score of annual reports and the disclosure score of other media.

5.4.3. The Study Population

The sample population in the current study is the top UK companies ranked by their R&D investments. This choice follows the same criteria used by Jones (2007) who ranks the firms by R&D intensity and includes only those firms in the top two quintiles to make sure that R&D investments are considered as an important part of the firm's activities.

The current study followed Tsoligkas and Tsalavoutas (2011), and it is based on the R&D Scoreboards that are published by the Department of Business Innovations and Skills (BIS). There are three reasons for choosing this source:

First, many previous studies document a positive relationship between the quantity of R&D voluntary disclosure and the amount of R&D expenditures (e.g. Entwistle, 1999; Jones, 2007; Merkly, 2014). Therefore, the companies that spend more on their R&D activities will be expected to introduce more information about their R&D efforts. This affords a suitable environment to explore the voluntary disclosure of R&D activities.

Second, the use of the BIS Scoreboards reduces the selection bias because they include only firms with material R&D investments. Therefore, the differences between firms with no substantial R&D investments (so, with no R&D disclosure) and firms with R&D investments, but who prefer to withhold the information about their R&D activities can be considered.

Third, a practical reason for using the BIS scoreboards is the availability of the data related to the amount of R&D investments. The R&D expenditures are considered an important explanatory variable in examining the determinants of R&D voluntary disclosure, which has been documented in the majority of previous studies (e.g. Entwistle, 1999; Zeghal et al., 2007; Jones, 2007; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili, 2015). The BIS scoreboards provide data about R&D investments as reported in the firms' annual reports. Moreover, the Scoreboards define R&D investments as the investments on R&D activities, which are funded by the firms themselves considering any additions to intangible assets and eliminating

any amortisation [9]. Consequently, this calculation takes into account both expensed and capitalized R&D expenses.

5.4.4. The Time Horizon

The majority of studies that investigate R&D disclosure in annual reports employ cross sectional analysis and focus on one year (e.g. Entwistle, 1999; Jones, 2007), or observations from two years without assessing the trend (e.g. Zeghal et al., 2007; Nor et al., 2010); the current study is considered to be a longitudinal study using panel data for three years. This choice helps to examine the trend of R&D disclosure practices over the years of the study.

The annual reports of the top UK firms titled as the biggest spenders in R&D activities in the years 2007, 2008, and 2009 were chosen. The rationale behind choosing the year 2007 is the growing trend toward enhancing corporate disclosure in the UK, which reached its peak in 2006, when the ASB issued the report that introduced a set of recommendations and implementation guidance to identify the best practices in the preparation of the OFR.

The rationale behind choosing the year 2009 was the cessation of publishing The R&D Scoreboards after the scoreboard which was published in 2010; this contained the required data of top 1000 UK firms ranked by their R&D investment as reported in their annual reports for the year 2009. So, the 2010 R&D Scoreboard was the 20th and final scoreboard published by the BIS and sponsored by the UK government.

[9] The 2010 R&D Scoreboard, Company Data.

5.4.5. The Sample Selection

Following Tsoligkas and Tsalavoutas (2011), the current study depends on the 2008, 2009, 2010 R&D Scoreboards as published by the BIS, which provide details of the top 1000 UK companies ranked by their R&D investment, (top 850 companies for 2008). To ensure that all firms were subject to the same accounting rules and disclosure requirements, the sample selection process undertakes the next steps:

First, the target population is the firms mentioned in the 2008, 2009 and 2010 R&D scoreboard, that present the biggest UK spenders in R&D activities in years 2007, 2008, and 2009. The initial number of observations displayed in the R&D scoreboards for all the three years is 2850.

Second, the financial sector is excluded because it has specific regulations, which differ from other sectors. Hence the annual reports of financial companies may not be comparable to those of other companies.

Third, the mining sector is also excluded because the International Accounting Standard IAS 38 (Intangible Assets) excludes expenditure on the development of non-regenerative resources from its scope (IAS 38, Para.2).

Finally, unlisted firms and those firms that are listed in the Alternative Investment Markets (AIM) are excluded, because listed firms are subject to different statutory requirements that may affect their disclosure decisions and corporate governance structure.

Therefore, the main sample includes 612 firm-year observations. Some other firms are excluded from the sample due to the absence of published annual reports or because there were no associated corporate governance data in their annual reports,

or corporate characteristics data in Data Stream. Therefore, the final sample is 505 observations.

Table 5.2 panel A shows the sample selection process, panel B provides a breakdown of the sample by year and panel C presents the composition of sample by industry.

Table 5.2
Summary of Sample Selection & Distribution of Observations by Year and by Industries

Panel A: Sample Selection process

Years	2007	2008	2009	Total
Total Observations from the Scoreboard	850	1000	1000	2850
Financial firms	(15)	(15)	(16)	(46)
Mining	(4)	(4)	(5)	(13)
Unlisted firms	(487)	(626)	(648)	(1761)
Listed firms in AIM	(137)	(152)	(129)	(418)
Sample	207	203	202	612
Firms with incomplete data	(50)	(30)	(27)	(107)
Final Sample	157	173	175	505

Panel B: Distribution of Observations by Year

Year	Freq.	Percent	Cum.
2007	157	31.09	31.09
2008	173	34.26	65.35
2009	175	34.65	100.00
Total	505	100.00	

Panel C: Distribution of Observations by Industry

Industry	Freq.	Percent	Cum.
Oil & Gas	13	2.57	2.57
Basic Materials	21	4.16	6.73
Industrials	175	34.65	41.39
Consumer Goods	63	12.48	53.86
Health Care	69	13.66	67.52
Consumer Services	46	9.11	76.63
Telecommunications	11	2.18	78.81
Utilities	19	3.76	82.57
Technology	88	17.43	100.00
Total	505	100.00	

5.4.6. The Characteristics of Disclosure Index

Both weighted and unweighted indexes have been employed by the literature to measure the level of disclosure. While the weighted disclosure index assigns a weight to each item to consider the variations in the importance of each type of information (e.g. Botoson, 1997; Jones, 2007), the unweighted index awards each item the same score (e.g. Cooke, 1989; Raffournier, 1995, Oliveira et al., 2006).

The main assumption of using the unweighted index is that each item of disclosure is considered equally important (Cooke, 1989). Since, the current study does not focus on a specific user group, therefore, the unweighted index will be the appropriate choice.

The current study uses binary measurement, so each of the (26 items) included in the R&D disclosure index scores (1) if disclosed and (0) otherwise. This decision is made to avoid the subjective ordinary scale which measures items according to a specific content of information such as forward-looking information and backward-looking information.

The disclosure index employed in this study grouped the disclosure items into four categories: general, input, output and financial information. This classification helps in investigating each group of information, and expands the analysis of R&D disclosure by considering the differences among these groups.

Figure 5.2 summarises the selected methodological approach employed in the current study.

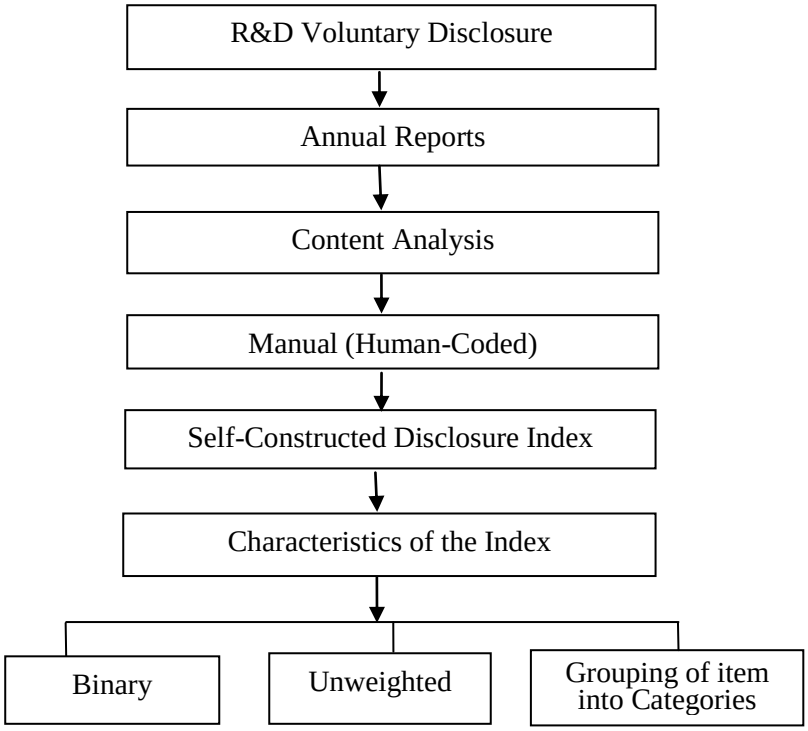


Figure 5.2
Selected Methodological Approach

5.4.7. Construction the R&D Disclosure Checklist

The construction of the R&D disclosure index was in five stages: **Firstly**, list of R&D information items was identified based on Entwistle (1999). **Secondly**, reviewing 100 annual reports of the UK firms which are included in the main sample of the current study and chosen randomly to identify the maximum possible items of R&D information. **Thirdly**, modifying the list of R&D information introduced by Entwistle (1999) to fit with the UK context. **Next**, the initial checklist was reviewed by two UK academics, the comments were discussed and considered. **Finally**, the R&D disclosure index is constructed and composed of (26 items). It contains four main groups: general, input, output and financial disclosure. Figure 5.3 illustrates the steps that are followed to construct the R&D disclosure index.

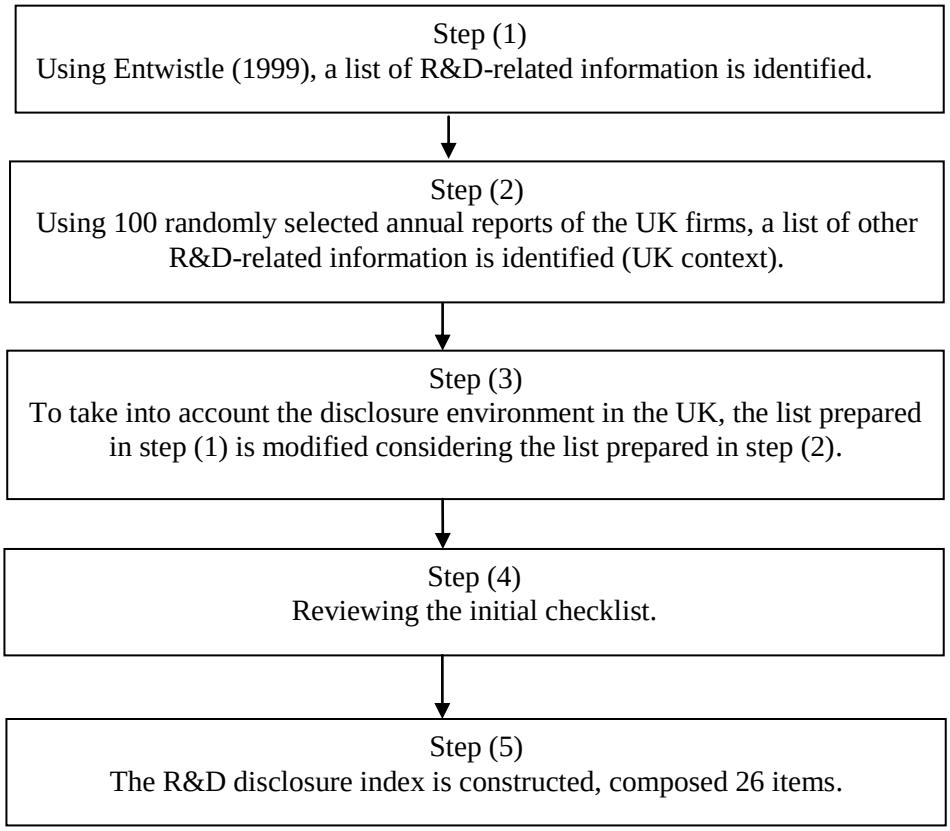


Figure 5.3
The Construction of R&D Disclosure Index

The following sections describe the steps that are performed to construct the R&D disclosure index.

- ***Step (1): Identifying R&D Related Information According to Entwistle (1999)***

Entwistle (1999) prepared an R&D disclosure checklist on the base of a series of field interviews with 15 of Canada's top technology analysts, and with 21 executives from Canada's technology-intensive firms to explore the different aspects regarding R&D disclosure. Furthermore, he confirms his list by conducting a content analysis of annual reports of 113 Toronto Stock Exchange (TSE) listed firms. Hence, he supports his findings from the field study by exploring the firm's management practices on R&D-related information in annual reports.

Entwistle (1999) classifies R&D disclosure into six main categories: inputs, outputs, future expenditure, financing, accounting and strategy. He divided his main categories into 19 subcategories containing both quantitative and qualitative information.

Table 5.3 presents the classification of R&D information according to Entwistle (1999).

Table 5.3
Types of R&D Information according to Entwistle (1999)

Main	Subcategories (information item)
1. Inputs	– Product description. – People involved in performing R&D activities. – Physical R&D Infrastructure.
2. Outputs	– Actual Achievements (Product development) – Actual Achievements (Beyond Product development: e.g., revenue, market share) – Potential Achievements. – Timing Issues.
3. Future Expenditures	– Estimated spending. – Focus on future R&D spending.
4. Financing	– Source of R&D financing (past and current year). – Source of R&D financing (future).
5. Accounting/Financial	– Comparisons-Prior Years – Comparisons-Competitors – Comparisons-Budget – R&D spending Ratios – R&D as Explanatory of changes in other financial items. – Explaining R&D spending Changes. – Accounting Policies.
6. Strategy	– R&D information with a strategic tone.

- ***Step (2): Exploring R&D Voluntary Disclosure in Annual Reports UK context***

A randomly selected 100 annual reports of the UK firms from different industries included in the main sample of the current study is investigated as follows:

- Reading the narrative section in the annual report.
- Marking any sentence, text, graph, and table provides any information related to R&D activities.
- Identifying the type of information for each sentence, graph, and table.
- Making a list for any new R&D information in annual reports that not found in the checklist of Entwistle (1999).

For example, the following sentence could be categorised as providing information in relation to Future R&D expenditures. *"In 2010, R&D costs as a percentage of turnover are expected to remain at around 14%"* (Source: GSK Annual Report, 2009: 33).

For example, the table 5.4 could be categorised as providing information in relation to five types of R&D disclosure: Present R&D expenditures, Comparison of R&D expenditures to those of prior year, R&D Ratios, Funding and R&D accounting policy discussion outside the financial statements.

Table 5.4
Analysis of R&D costs (Meggitt plc, Annual Report 2009)

Analysis of R&D Costs	2009 Group £'m.	2008 Group £'m.
Total R&D expenditure	85.278.8	78.8
% of revenue	7%	7%
Customer funded R&D	(19.2)	(19.4)
Capitalised	(35.1)	(23.7)
Amortisation	6.5	3.5
Charge to income statement	37.4	39.2

Source: Meggitt plc, Annual Report, 2009, p. 14

For example, the figure 5.4 could be categorised as providing information in relation to three types of R&D disclosure. Present R&D expenditures, Comparison of R&D expenditures to those of the prior year, Comparison of R&D expenditures to those of prior years.

Figure 5.4
Research & Development Expenditure
Source: Halma plc, annual report 2008, p.3.

- ***Step (3): Modifying the Checklist of Entwistle (1999) with the R&D Information Identified from the UK Firm's Annual Reports***

A comparison between the checklist of Entwistle (1999) in the Canadian context and the list of R&D information prepared based on the randomly selected annual reports in the UK context is employed. Then, the checklist of Entwistle (1999) is updated following the pilot study of the annual reports of the UK firms to ensure that the final checklist includes all types of R&D information that are relevant to the UK environment and able to capture R&D disclosure practices in annual reports.

Finally, this process leads to adding seven more items of R&D-related information to the checklist introduced by Entwistle (1999): R&D as a main activity, R&D & competition & market, R&D and risk, Tax credit relating to R&D activities, R&D and future opportunities, other parties involved in R&D and firm's patent.

- ***Step (4): Reviewing the Initial Checklist***

After constructing the initial checklist, two UK academics have been asked to review it and refine the R&D disclosure items in order to improve the validity of the research instruments. All suggestions are discussed and considered to ensure the ability of the final checklist to capture all the R&D-related information in annual reports.

- ***Step (5): Constructing the Final Checklist***

A final R&D disclosure checklist is constructed. It classifies R&D-related information into four main categories: general, input, output and financial information, and 26 subcategories, including both financial and non-financial items.

General disclosure includes matters related to R&D activities in general that cover firm objectives and vision about R&D activities, risks, competition, the effect of

R&D spending on other financial items and explanation of that spending, future opportunities and tax credit.

The input disclosure includes information about the resources used in R&D activities such as infrastructure, people and management, funds and financial resources and collaboration with other parties involved in R&D activities.

The output information regarding the result of R&D activities includes past achievement from R&D activities that have already been recognised in the past, the achievement completed during the present year, a specific success expected in the future and finally R&D efforts which are in progress.

The fourth category, financial disclosure, includes the financial information about the number of R&D expenditures in past, present and future. In addition, the numeric comparison of R&D expenditures between years or the comparison between the actual R&D expenditures and the target or expected expenditures. It also includes any ratio regarding R&D expenditures such as R&D expenses to revenue ratio. Table 5.5 presents the final R&D disclosure checklist.

Table 5.5
R&D Disclosure Checklist

Information Item	
General Disclosure	
1	Statement of strategy or objectives or vision about R&D
2	R&D is a main activity
3	The focus of R&D activities
4	R&D and competition and market
5	R&D and Risk
6	The effect of R&D spending on other financial items
7	Explaining R&D spending changes
8	R&D accounting policy discussion outside the financial statements
9	R&D and future opportunities
10	Tax credit
Input	
11	Management and People
12	Other parties involved in R&D (R&D collaboration)
13	Infrastructure
14	Funding
Output: (in progress and achievement: new product or beyond product)	
15	Past achievement from R&D activities
16	R&D progress
17	This year achievement
18	Potential achievement
19	Patents
Financial Disclosure	
20	Past R&D expenditures
21	Present R&D expenditures
22	Future R&D expenditures
23	R&D Ratios
24	Comparison of R&D expenditures to those of prior year
25	Comparison of R&D expenditures to those of prior years
26	Comparison of R&D expenditures to those of target or to expectations
Total Score	

5.4.8. Assessment of Reliability and Validity of Disclosure Index

Reliability and validity are considered the principal criteria used to evaluate the content analysis.

5.4.8.1 Assessment of Reliability

Neuendorf, (2002:112) defines reliability as*"the extent to which a measuring procedure yields the same results on repeated trials.*". Three types of reliability are identified by Krippendorf (2004:25): (1) stability the degree to which a coding process produces the same results over time, (2) reproducibility: the degree to which a coding process can be duplicated by using different researchers and still produce the same results, and (3) Accuracy: the degree to which a coding process corresponds to a standard.

The most common measure used to assess reliability is reproducibility because stability is the weakest measure and standard performance seldom exists (Beattie et al., 2004).

Assessing the reliability of the coding process and resolving the disagreements among the coders are essential procedures in conducting the content analysis (Weber, 1990). To ensure the coding process' reliability, the coding should be carried out by two or more coders. For example, Entwistle (1999) ensures the acceptable level of coding reliability through coding eight randomly selected annual reports (the overall sample is 113 annual reports) independently by the author and other coder. The overall agreement rate between the two coders is 73%. This level is considered by the author as an acceptable level of inter-coder reliability. Moreover, Zeghal et al., (2007) ensures the coding reliability by coding five annual reports (the overall

sample is 150 annual reports) by all the three authors, and the results have been compared to resolve disagreements among coders.

Following previous R&D content analysis literature (Entwistle, 1999 and Zeghal et al., 2007), a pilot study was conducted on twenty annual reports drawn randomly from the sample to measure the R&D voluntary disclosure score. The researcher and other PhD student coded twenty randomly selected annual reports, and the results were compared to ensure an acceptable level of inter coder reliability; areas of disagreement were discussed and clarified. The overall agreement rate between the two coders was 92%, which can be considered a high degree of agreement between the two coders compared with Entwistel, (1999). Consequently, the result of the pilot study indicates a high degree of reliability in the content analysis procedures.

Inter coder reliability is different from internal consistency reliability, which indicates how well a set of items fits together (Neuendorf, 2002). One of the indicators that is usually used to assess the internal consistency is Cronbach's alpha coefficient. Cronbach's alpha coefficient takes on a minimum value of zero and maximum value of one. Pallent (2005) claims that, ideally the Cronbach's alpha coefficient should be higher than 70%. Table 5.6 shows the Cronbach's alpha coefficients for overall R&D disclosure and its categories.

Table 5.6
Internal Consistency, Reliability Test

Items	Chronbach's Alpha
GDIS	0.8314
INDIS	0.8733
OUTDIS	0.8555
FDIS	0.8796
RDDIS	0.7958
Total Scale	0.8796

From the table, it can be noticed that, the Cronbach's alpha coefficients is above than 0.70, so the research instrument can be considered reliable.

5.4.8.2 Assessment of Validity

Neuendorf (2002:112) defines the validity as *"the extent to which the measuring procedure represented the intended, and only the intended concept."*.

Following Li et al., (2008) the initial draft of the R&D disclosure index is reviewed by two UK academics to refine it in order to ensure that the research instrument captured the intended information.

Beattie et al., (2004:214) argue that most researchers focus on construct validity and define it as *"the extent to which the measure is correlated with other measures of the same construct."*.

Pair wise Correlation and Spearman correlation tests are performed to assess the construct validity of the disclosure index. Tables 5.7 & 5.8 present the Pair wise and Spearman correlation coefficients between all the categories of R&D disclosure: general disclosure (GDIS), input disclosure (INDIS), output disclosure (OUTDIS), financial disclosure (FDIS) and non-financial disclosure (NFDIS).

In addition, the tables show the correlation coefficients between the total R&D disclosure (RDDIS) and its categories. The tables illustrate that all the categories of R&D disclosure are highly correlated with total R&D disclosure, and they are also correlated with each other, indicating that the index consistently captures R&D disclosure across different types of information in annual reports.

Table 5.7
Pair wise Correlation Matrix for Dependent Variables

Variables	RDDIS	GDIS	INDIS	OUTDIS	FDIS	NFDIS
RDDIS	1					
GDIS	0.9055***	1				
	0.0000					
INDIS	0.7099***	0.5298***	1			
	0.0000	0.0000				
OUTDIS	0.8348***	0.6760***	0.5379***	1		
	0.0000	0.0000	0.0000			
FDIS	0.7149***	0.5435***	0.3583***	0.4172***	1	
	0.0000	0.0000	0.0000	0.0000		
NFDIS	0.9731***	0.9153***	0.7400***	0.8715***	0.5346***	1
	0.0000	0.0000	0.0000	0.0000	0.0000	

*** indicates p <. 01

Table 5.8
Spearman Correlation Matrix for Dependent Variables

Variables	RDDIS	GDIS	INDIS	OUTDIS	FDIS	NFDIS
RDDIS	1					
GDIS	0.9043***	1				
	0.0000					
INDIS	0.6936***	0.5252***	1			
	0.0000	0.0000				
OUTDIS	0.8393***	0.6760***	0.5362***	1		
	0.0000	0.0000	0.0000			
FDIS	0.7119***	0.5441***	0.3594***	0.4241***	1	
	0.0000	0.0000	0.0000	0.0000		
NFDIS	0.9723***	0.9147***	0.7220***	0.8758***	0.5341***	1
	0.0000	0.0000	0.0000	0.0000	0.0000	

*** indicates p <. 01

Where: RDDIS total voluntary R&D disclosure score, GDIS general information, INDIS, input information, OUTDIS output information, FDIS financial information, NFDIS nonfinancial information.

5.5. DEFINITION AND MEASUREMENT OF VARIABLES

The next paragraphs introduce the measurement of dependent and independent variables.

5.5.1. The Dependent Variable

R&D disclosure is measured by using a self-constructed R&D disclosure index. If a required item is disclosed, it is scored as one and zero otherwise. The disclosure score for each company is calculated as the ratio of the total items disclosed to the

maximum possible score for a company. Below is a summary of the measurement of the disclosure score:

Using the final checklist, the overall R&D disclosure score for each observation is calculated following the next steps:

Step 1, the narrative sections of annual reports were manually investigated. For the purposes of the current study, the "narrative section" of the annual report is defined as, all the pages in the annual report excluding the audited financial statements.

Step 2, identifying any sentence, text, graph and table containing any R&D-related information.

Step 3, using a copy of the checklist for each observation, and employing a binary method, every R&D disclosure item received a value equal to 1 if present, and 0 if absent.

Step 4, for calculating the aggregate score for every annual report, the current study follows the un-weighted approach, assuming that all R&D disclosure items are equally important.

Finally, the R&D disclosure score is calculated as a ratio of the total items disclosed in an annual report to the maximum possible score for a company.

The same procedure has been followed to compute the R&D voluntary disclosure score for each of R&D financial disclosure, and R&D non-financial disclosure.

5.5.2. The independent variables

Table 5.9 provides a summary of the definitions and measurements of the independent variables. It also illustrates the data source of each variable.

Table 5.9
Definitions and Measures of Independent Variables

Variable	Definition	Measurement	Data Source	Data Stream Code
Independent Variables				
BS	Board size	Number of directors on the board	Annual report	
DUL	Role Duality	Dummy variable equal to (1) if CEO is also chairman, (0) otherwise.	Annual report	
BI	Board Independence	The number of independent directors on the board divided by the total number of directors on the board. (%)	Annual report	
BM	Board Meetings	Number of board meetings held within the financial year of the annual report.	Annual report	
MONR	Managerial ownership	The percentage of shares held by executive directors (%)	Annual report	
ONRC	Ownership Concentration	Percentage of ordinary shares held by substantial shareholders, owning (5 %) or more of the firm's share capital. (%)	Annual report	
AUDQUAL	Audit Committee Quality	Dummy variable equal (1) if the audit committee is established at least three independent non-executive directors and one of them at least has recent and relevant financial experience, and there were no fewer than three meetings held during the year, (0) if otherwise.	Annual report	
Control Variables				
SIZE	Firm size	Total assets	Data Stream	WC02999
RD	R&D Investment	The total investments in R&D activities.	BIS	
LEV	Leverage	The percentage of total debt to total assets.	Data Stream	WC08236
PROFIT	Profitability	Return on assets.	Data Stream	WC08326
LIQUID	Liquidity	Current Ratio	Data Stream	WC08106
GROW	Firm's Growth	Total assets growth (1 year annual growth)	Data Stream	WC08621

5.6. MODEL SPECIFICATION

The current study regresses seven explanatory variables representing corporate governance mechanisms and ownership structure, and six control variables on the R&D voluntary disclosure score.

Two main models are developed to investigate the relationship between the dependent variable and the independent variables as follows:

- ***The General Regression Model***

$$RDDIS = \beta_0 + \beta_1 BS + \beta_2 DUL + \beta_3 BI + \beta_4 BM + \beta_5 MONR + \beta_6 ONRC + \beta_7 AQUAL + \beta_8 SIZE + \beta_9 RD + \beta_{10} LEV + \beta_{11} PROFIT + \beta_{12} LQUID + \beta_{13} GROW + \varepsilon$$

Where:

RDDIS = R&D disclosure score;

BS = Board size;

DUL = Role duality;

BI = Board independence;

BM = Board meetings;

MONR = Managerial ownership;

ONRC = Ownership concentration;

AQUAL = Audit committee quality;

SIZE = Firm size;

RD = R&D investment;

LEV = Leverage;

PROFIT = Profitability;

LIQUID = Liquidity;

GROW = Firm's growth;

β_0 = Intercept;

β_1 To β_{13} = Coefficient of slope parameters;

ε = Error term.

- ***The Regression Model with Dummy Variables***

Bruggen et al., (2009) argue that intellectual capital is more important in some industries than in others, hence, the value-relevance of intellectual capital information may differ between industries. This point of view is supported by Entwistle (1999), since his content analysis suggests that R&D disclosure varies by industry.

Gu & Li (2003) investigate the management incentive to introduce voluntary disclosure concerning their innovation activities via their media news releases, and control for the effect of the proprietary costs by using industry dummies. This view is supported by Oliveira et al., (2006) who argue that the proprietary costs can explain the variation of voluntary disclosure among industries: because the distinctive characteristics of each industry affect the level of voluntary disclosure introduced by firms belonging to the same industry.

In order to consider the differences between industries across years, dummy variables were created: two dummy variables to control for year-fixed effect, and eight dummy variables to control for industry-fixed effect. Therefore, the following model is developed.

$$RDDIS = \beta_0 + \beta_1 BS + \beta_2 DUL + \beta_3 BI + \beta_4 BM + \beta_5 MONR + \beta_6 ONRC + \beta_7 AQUAL + \beta_8 SIZE + \beta_9 RD + \beta_{10} LEV + \beta_{11} PROFIT + \beta_{12} LQUID + \beta_{13} GROW + \eta_t + \mu_{ind} + \varepsilon$$

Where all variables have the same definitions as in the general regression model, in addition to η_t and μ_{ind} that can be defined as follows:

η_t = control for year-fixed effect, by including two dummy variables: Dy 2007, Dy 2008 (2009 is assumed as the base year).

μ_{ind} = control for industry-fixed effect, by including eight dummy variables: IND basic materials, IND Consumer Goods, IND Consumer Services, IND Health Care, IND Industrials, IND Oil & Gas, IND Technology, IND Telecommunications (Utilities is assumed as the base industry).

Figure 5.5 illustrates the structure relationships between variables.

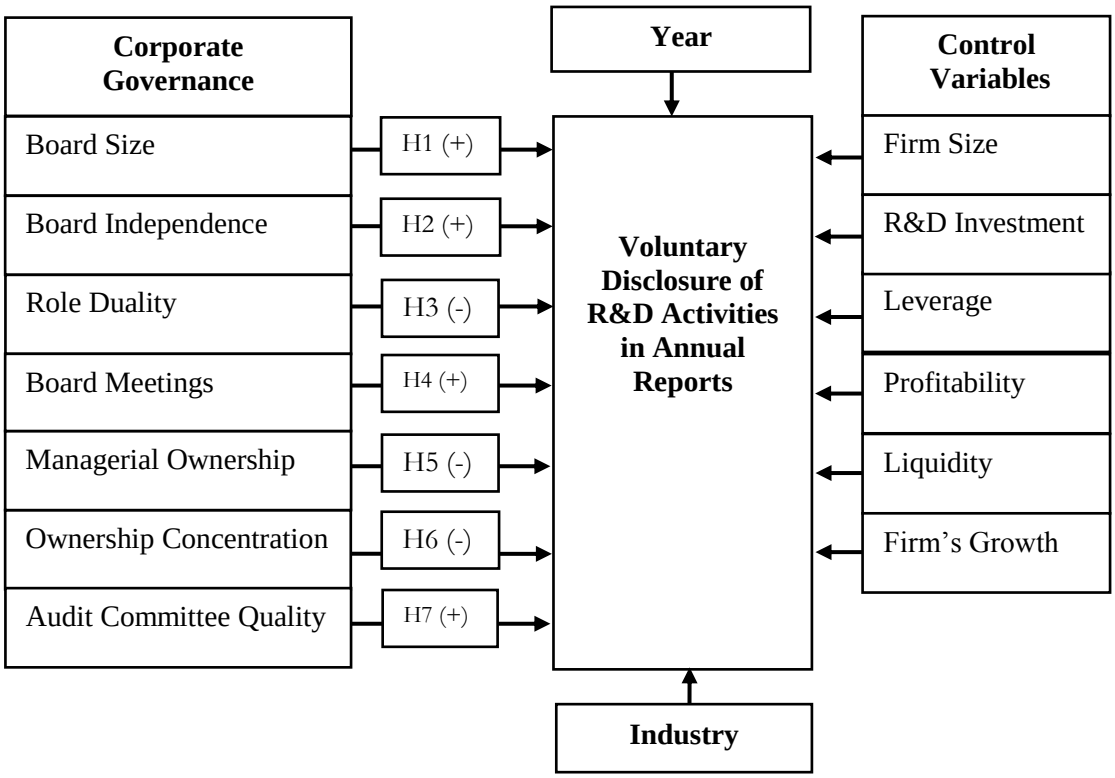


Figure 5.5
Structure Relationships Among Variables

5.7. ANALYTICAL PROCEDURES

This section discusses the statistical methods that are employed to achieve the research goals and examine the research hypotheses.

To explore R&D-related information, and measure the level of R&D voluntary disclosure in annual reports, the descriptive analysis is employed for the total R&D disclosure, its categories, its types and for each item presented in the annual reports and including in the disclosure index.

To investigate whether there is a significant change in the extent of R&D disclosure practices over the period of the study, the level of R&D disclosure is tracked over the three- year period of the study, and the Kruskal-Wallis test is conducted to assess the significance of the changes.

Regarding the influence of corporate governance and firm characteristics on the level of R&D voluntary disclosure in annual reports, the OLS regression and Tobit regression are conducted. Before employing the tests, the descriptive analysis for dependent and independent variables is employed to assess the pattern of the distribution, and find the most suitable transformation for each variable.

The normality, homoscedasticity, and multicollinearity are tested, before running the multiple regression analysis. To check the normality, both graphical methods (Kernel density plot with the normal density, P-P plot, Q-Q plot) and numerically methods (Skewness/Kurtosis, Shapiro-wilk tests) are used. To check the homoscedasticity two tests are applied: The Breusch-pagan/Cook-Weisberg test and the White's test. The possible existence of multicollinearity is tested through computing the variance inflation factor (VIF), and also depending on Pair-wise Correlation Matrix.

The OLS regression and Tobit regression are conducted using STATA software to examine the association between the explanatory variables and each of the overall R&D voluntary disclosure, R&D financial disclosure, and R&D non-financial disclosure.

Further analysis is conducted for the full model, the dependent variable, and for the independent variables. Regarding the full model, both OLS regression and Tobit regression are carried out with robust standard errors to ensure the goodness of the model, and with clustering the standard error at the firm level to account for the changes across individual firms. In terms of the dependent variable, a sensitivity analysis is conducted to check the sensitivity of measuring the dependent variable by using the weighted disclosure score, and by using three ranked categories of the level of R&D voluntary disclosure. Regarding the independent variables, a sensitivity analysis is conducted to examine the impact of each of audit committee characteristics on R&D voluntary disclosure separately, rather than the composite measure used in the main analysis. Moreover, the main analysis is repeated considering the cross listing to control for the non-UK regulatory influence.

5.8. SUMMARY

This chapter presents the methodology employed in the current study. The current study conducts content analysis as a research method and employs a self-constructed disclosure index to capture the R&D-related information in annual reports.

The research design illustrates the rationale behind the preferences related to the current study such as, the UK context, the annual reports, the time horizon, the population of the

study, the sample selection, the characteristics of the disclosure index, construction the R&D disclosure checklist and the assessment of its reliability and validity.

The chapter presents the definitions and measurements of dependent and independent variables, and illustrates the data source regarding each variable, followed by the model specification. Finally, the analytical procedures were summarised including, descriptive analysis, regression methods and further analysis.

CHAPTER SIX

ANALYSIS AND RESULTS

CHAPTER SIX
ANALYSIS AND RESULTS

6.1. INTRODUCTION

The main target of the current study is to provide deep insights into R&D narrative disclosure practices in annual reports of the UK firms, and to investigate the influence of corporate governance on R&D disclosure decisions. To achieve this goal, a self constructed disclosure index was formed. As discussed in chapter five, it classifies R&D-related information into four main categories: general, input, output and financial information, and 26 subcategories, including both financial and non-financial items. The current chapter can be classified into two main parts:

The first part seeks to answer the first, the second and the third research questions of the current study which are:

- What type of R&D information do the UK non-financial listed firms disclose in their annual reports?
- To what extent do the UK non-financial listed firms introduce discretionary information about their R&D activities in their annual reports?
- How do R&D disclosure practices in annual reports of the UK non-financial listed firms change over time?

The second part aims to empirically examine the relationship between corporate governance and R&D voluntary disclosure in annual reports, controlling for other variables that may affect the extent of R&D voluntary disclosure. This is based on the theoretical foundation which is explained in chapter three, and prior empirical studies, which are presented in chapter four.

The current chapter is organised as follows: section (2) presents the exploration of R&D voluntary disclosure and its categories by industry and across the three-year period. Section (3) reports the descriptive analysis of the dependent and independent variables included in the current study. Section (4) presents the results of examining the normality, homoscedasticity and multicollinearity for the regression models. Section (5) presents the statistical results of multivariate analysis that was undertaken to test the research hypotheses, by using two methods: Ordinary Least Squares (OLS), and Tobit regression. Section (6) presents the sensitivity tests that were performed to check the robustness of the main analysis.

6.2. THE EXTENT AND TREND OF R&D VOLUNTARY DISCLOSURE

The current study conducts a manual content analysis, using a self constructed disclosure index containing 26 items classified into four categories. This index has been used to analyse 505 annual reports of the UK firms for the years 2007, 2008, and 2009.

The extent and trend of R&D voluntary disclosure have been measured using four levels of analysis: overall R&D disclosure, R&D disclosure categories, R&D disclosure types and R&D disclosure items.

6.2.1. Exploring the Overall R&D Voluntary Disclosure Practices

The overall level of R&D voluntary disclosure was explored for 505 annual reports using the constructed disclosure index. The following paragraphs discuss the extent of total R&D voluntary disclosure for each year and for the three years all together. In addition, the total R&D disclosure is analysed by industry.

6.2.1.1. The Extent and Trend of Total R&D Voluntary Disclosure

The averages of disclosure scores represent the extent of R&D voluntary disclosure and the averages of disclosure scores over the three years demonstrate the trend of the R&D voluntary disclosure practices in annual reports.

Table 6.1
The Extent and Trend of Total R&D Voluntary Disclosure

Years	No.	Mean	Median	Std. Dev.	Min	Max
2007	157	28.46	26.92	19.10	0	80.77
2008	173	29.45	30.77	19.01	0	80.77
2009	175	31.42	30.77	20.50	0	80.77
Pooled	505	29.83	30.77	19.57	0	80.77

Table 6.1 presents descriptive statistics of the total R&D disclosure measured for 505 firm-year observations for the years 2007, 2008, and 2009. The analysis has been employed for each year of the study and pooled for all the three years. According to the table, on average the UK firms introduce just fewer than 30% of the examined R&D disclosure index items. This result is consistent with prior studies: Nekhili et al., (2012) who provides evidence from France and La Rosa and Liberatore (2014) who examine eight western European countries. The mean of R&D disclosure score according to these studies is 22.64% and 28.5% respectively.

The table also shows that, the maximum disclosure score is 80.77%, and the minimum disclosure score is zero for the pooled sample and as well for each year, indicating that at least one firm each year does not introduce any information related to its R&D activities.

The table also demonstrates that the average score of R&D disclosure increases across time from 28.46% in 2007 to 29.45 % in 2008 and to 31.42% in 2009.

Following Li et al., (2012), the Kruskal-Wallis test was conducted, and the result suggests that there are no significant differences in R&D disclosure scores among the three years of the study. The Chi-square result is 2.079 (P= 0.3537).

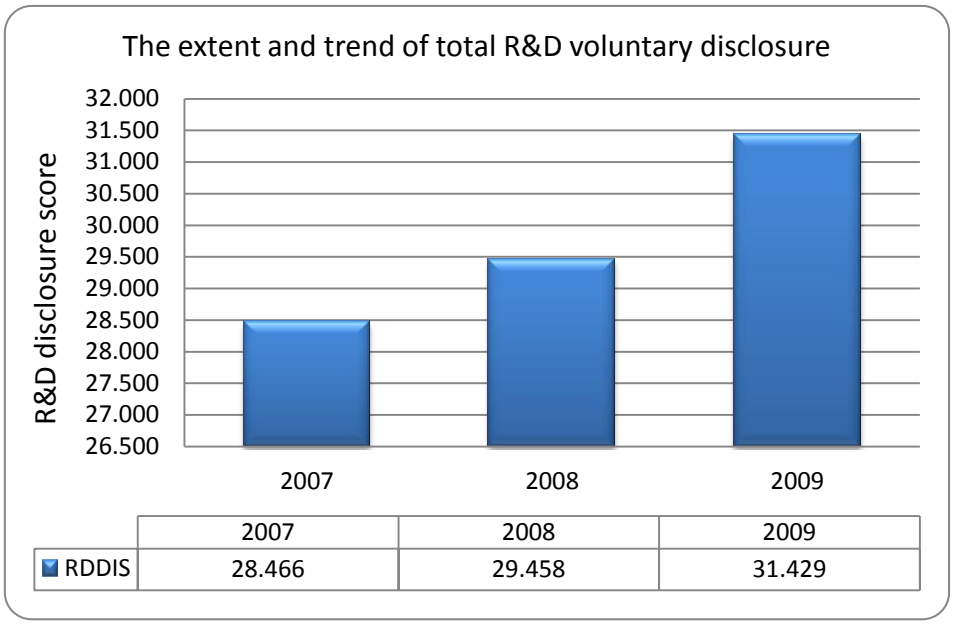


Figure 6.1
Total R&D Disclosure Score by Years

Figure 6.1 shows the extent of R&D voluntary disclosure over the three years of the current study, and illustrates a slightly increasing level of R&D-related information introduced voluntarily by the UK firms.

Although, the differences in R&D disclosure scores among the three years of the study are insignificant, the marginal increase in the extent of R&D disclosure might reflect a gradually response to the professional accounting entities. That draw attention to the importance of narrative disclosure and emphasise the need to improve the corporate reporting.

6.2.1.2. The Analysing of R&D Disclosure by Industry

The R&D disclosure practices of the UK firms were analysed for each of the nine industries that comprised the sample of the study. Table 6.2 presents the descriptive statistics of R&D disclosure score for each industry.

Table 6.2
Descriptive Statistics of R&D Disclosure by Industry

Industry	Mean	Median	Std. Dev.	Min	Max
Oil & Gas	19.23	15.38	18.91	0.00	53.85
Basic Materials	28.75	34.62	18.19	3.85	57.69
Industrials	29.03	26.92	18.39	0.00	73.08
Consumer Goods	26.98	26.92	16.43	0.00	69.23
Health Care	50.50	50.00	13.53	26.92	80.77
Consumer Services	6.94	5.77	8.57	0.00	30.77
Telecommunications	23.08	23.08	12.40	7.69	42.31
Utilities	19.03	15.38	13.10	0.00	46.15
Technology	34.22	32.69	17.30	0.00	80.77
Total	29.83	30.77	19.57	0.00	80.77

It can be seen from the table that, on average, the health care sector provides the greatest R&D disclosure scoring 50.50% followed by the firms in the technology sector, with an R&D disclosure score of about 34%. This result is consistent with prior studies: Entwistel, (1999) and Merkley, (2014). They find that the highest R&D disclosure score is introduced by pharmaceutical and technology sectors. It also in the line with the findings of the Steering Committee Report (FASB, 2001b) which reveals that firms in the pharmaceutical sector introduce considerable disclosures about their R&D activities. The committee argues that the managers realize the importance of R&D information as one of the key performance measurements in this sector, which help investors assess the firm's plans and strategies.

However, the Consumer Services sector produces the lowest average R&D disclosure score at 6.94%. In addition, the average of R&D disclosure in other

industries ranges from about 19% (Oil & Gas, Utilities) to less than 30% (Telecommunications, Consumer Goods, Basic Materials, and Industrials).

Following Li et al., (2012), the Kruskal-Wallis test was conducted, suggesting that there are significant differences in R&D disclosure scores among the industrial sectors. The Chi-square result is 156.680 (p.= 0.0001).

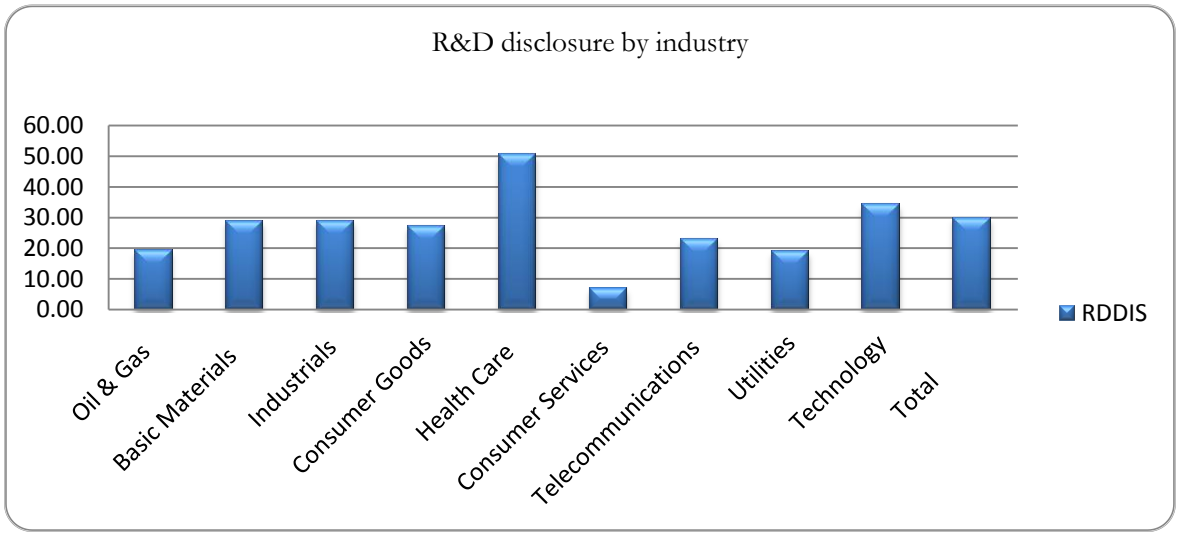


Figure 6.2
Total R&D Disclosure Score by Industry

Figure 6.2 illustrates the differences in the level of total R&D disclosure by industry. The figure shows that the R&D disclosure score varied between industries, and ranged from slightly more than 50% (the health care sector) to less than 10% (the Consumer Services sector).

6.2.1.3. Frequency of Total R&D Disclosure Score

To introduce more insights into R&D disclosure practices the frequencies of total R&D disclosure score were analysed.

Table 6.3
Frequency of Total R&D Disclosure Score

Total R&D Disclosure Score	Freq.	Percent %	Cum. %
0	50	9.90	9.90
1 - 9.99	37	7.33	17.23
10 -19.99	96	19.01	36.24
20 – 29.99	67	13.27	49.50
30 – 39.99	102	20.20	69.70
40 – 49.99	51	10.10	79.80
50 – 59.99	70	13.86	93.66
60 – 69.99	21	4.16	97.82
70 – 79.99	8	1.58	99.41
> 80	3	0.59	100.00
Total	505	100.00	

Table 6.3 presents the frequencies of the total R&D voluntary disclosure score. The table shows that, while 9.90% of the examined annual reports do not introduce any information related to R&D activities, only three annual reports 0.59% provide more than 80% of the disclosure index items. Moreover, nearly half of the examined observations introduce less than 30% of the maximum possible score.

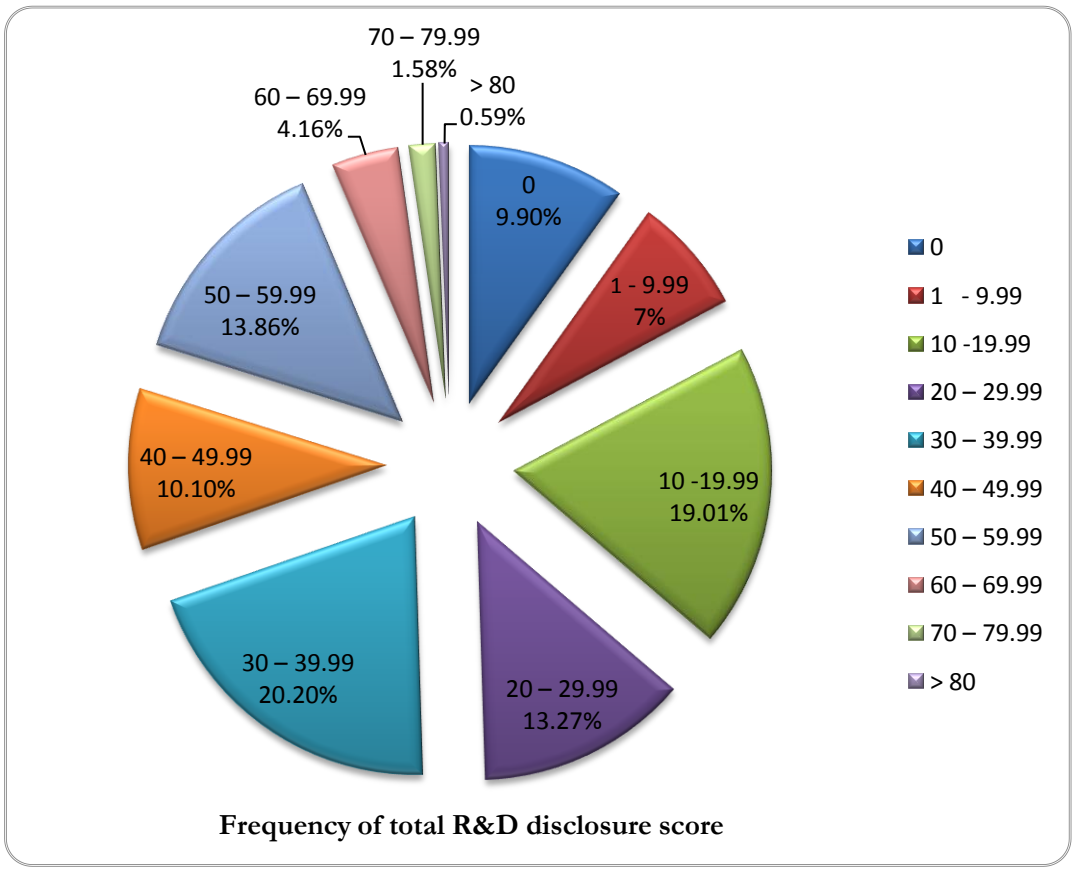


Figure 6.3
Frequency of Total R&D Disclosure Score

Figure 6.3 illustrates the frequency of total R&D disclosure score. The pie chart has been broken up into ten different parts. Each part depicts a specific level of overall disclosure. It can be clearly seen that the largest proportion (about 20% of the examined observations) introduced an R&D disclosure score ranged from 30% to 30.99%.

However, a tiny minority of the investigated annual reports 0.59% introduces over 80% of the examined disclosure index. In addition, 4.16% and 1.58% of the sample provide an R&D disclosure score ranged from 60% to 60.99% and from 70% to 70.99% respectively. That suggests, the majority of the sample reveals less than 60% of the R&D information identified in the disclosure index.

6.2.2. Exploring the R&D Voluntary Disclosure Categories

The current study classified the R&D-related information introduced by the UK non-financial firms into four categories: general Disclosure (GDIS), Input (INDIS), Output (OUTDIS), and Financial Disclosure (FDIS).

The following paragraphs discuss the extent of R&D voluntary disclosure for each category, and its trend over the three years of the current study. In addition, the R&D disclosure for each category is analysed by industry.

6.2.2.1. The Extent and Trend of R&D Voluntary Disclosure for Each Category

The extent of R&D disclosure for each category can be measured by its average disclosure score. In addition, the trend of the disclosure score can be observed over the three years of the study.

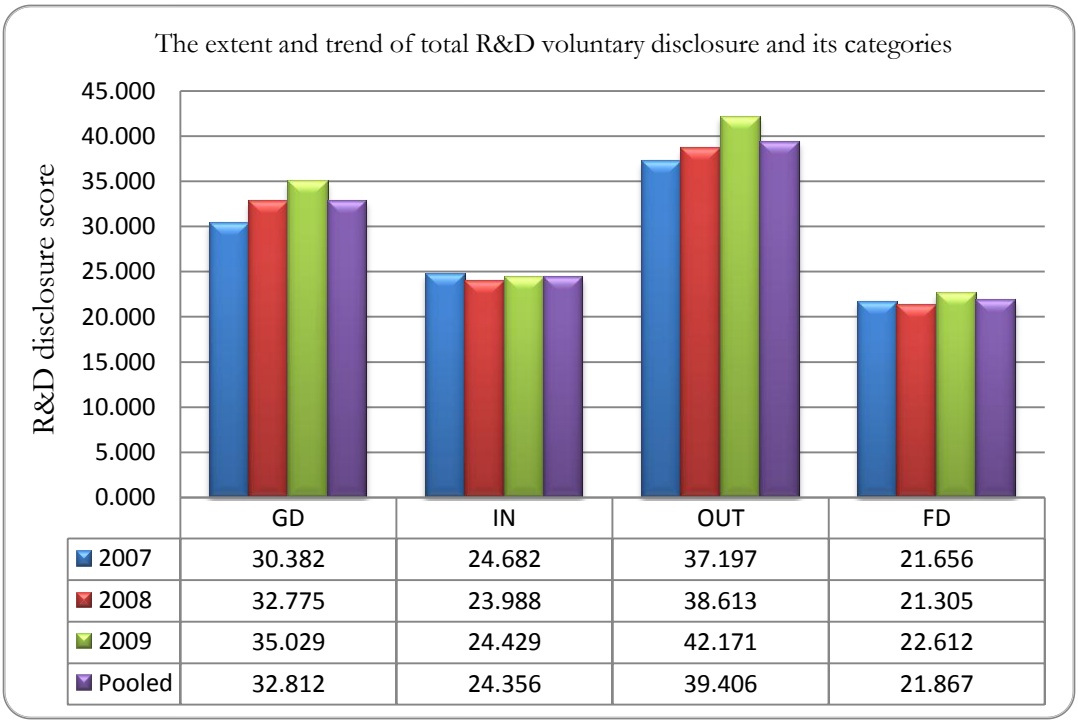
Table 6.4
The Extent and Trend of Total R&D voluntary Disclosure and its Categories

Years	2007	2008	2009	Pooled
General Disclosure (GDIS)	30.38	32.77	35.03	32.81
Input (INDIS)	24.68	23.99	24.43	24.36
Output (OUTDIS)	37.20	38.61	42.17	39.41
Financial Disclosure (FDIS)	21.66	21.30	22.61	21.87
Total R&D Voluntary Disclosure (RDDIS)	28.47	29.46	31.43	29.83

Table 6.4 presents the averages of R&D disclosure for each category, and for overall R&D disclosure. The table also illustrates the trend of each category of R&D disclosure from the year 2007 to the year 2009.

It shows that the R&D output information (OUTDIS) represents the highest disclosure level with an average score just less than 40%, while the R&D financial disclosure (FDIS) represents the lowest disclosure level of 21.87%. This result could be explained by signalling theory, which suggests that firms may try to signal their successful efforts by introducing information about the outputs of their R&D activities.

The second most common type of information is general disclosure (GDIS), which provides, on average, about 33% of the examined items. The UK firms appear to provide slightly greater Input (INDIS) information at 24.36%, whilst financial disclosures stand at 21.87%.



	GD	IN	OUT	FD
2007	30.382	24.682	37.197	21.656
2008	32.775	23.988	38.613	21.305
2009	35.029	24.429	42.171	22.612
Pooled	32.812	24.356	39.406	21.867

Figure 6.4
R&D Disclosure Categories by Years

Figure 6.4 illustrates total R&D disclosure score and R&D disclosure score for each disclosure category by year. The figure shows a slight increase in the average of the disclosure score for general information and output information, while the input information and financial information are nearly stable over the three years.

6.2.2.2. The Analysing of R&D Disclosure Categories by Industry

The R&D disclosure categories were analysed for each of the nine industries. Table 6.5 presents the analysis of the R&D disclosure score for the four categories by industry.

Table 6.5
R&D Disclosure Categories by Industry

Industry	General Disclosure (GDIS)	Input (INDIS)	Output (OUTDIS)	Financial Disclosure (FDIS)	Total R&D Voluntary Disclosure (RDDIS)
Oil & Gas	15.38	23.08	26.15	17.58	19.23
Basic Materials	32.86	36.90	41.90	8.84	28.75
Industrials	32.40	25.00	35.54	21.88	29.03
Consumer Goods	30.47	19.05	42.54	15.42	26.98
Health Care	51.59	43.48	75.07	35.40	50.50
Consumer Services	7.39	3.80	12.17	4.35	6.94
Telecommunications	21.82	34.09	38.18	7.79	23.07
Utilities	16.84	11.84	26.31	21.05	19.03
Technology	41.25	21.31	35.45	30.68	34.22
Total	32.81	24.36	39.41	21.87	29.83

The table shows that the health care sector provides the highest average disclosure score in all disclosure categories. Regarding general disclosure, the technology sector introduces the second highest disclosure score at 41.25%; the disclosure scores in Consumer Goods, Industrials, and Basic Materials sectors are relatively similar (30.47%, 32.40%, 32.86%, respectively). The input information score ranged from 43.48% introduced by the health care sector to 3.80% introduced by Consumer Services. In respect to output information, the health care sector provides the largest amount of information by far at 75.07%, followed by Consumer Goods and Basic Materials sectors (42.54%, 41.90%, respectively). Finally, financial disclosure represents the lowest average total disclosure score and ranged from 35.40% introduced by the health care sector to 4.35% that introduced by the consumer services sector.

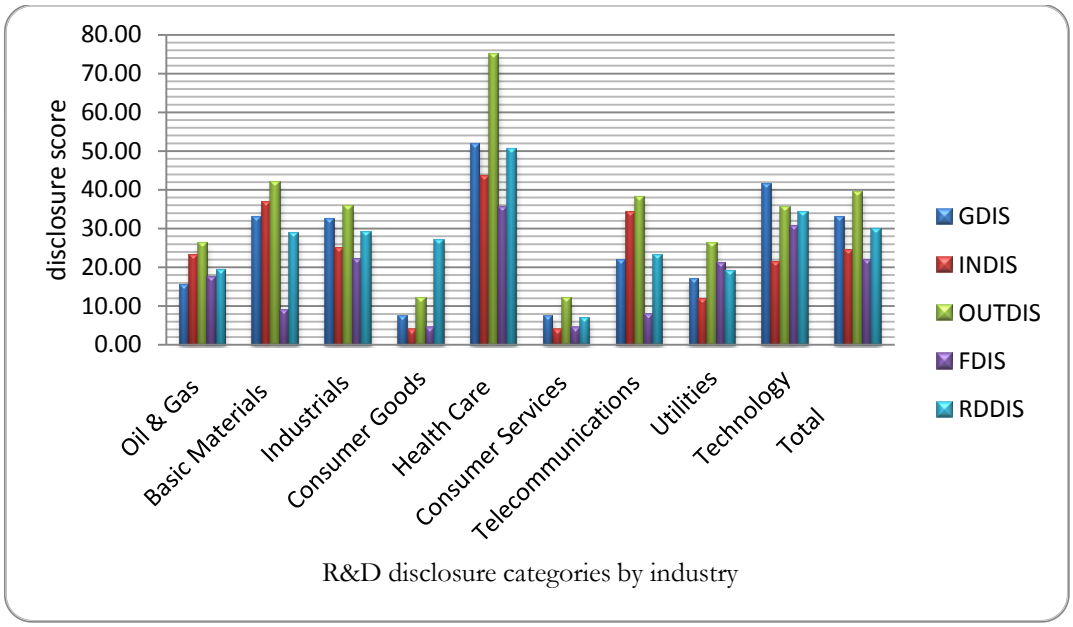


Figure 6.5
R&D Disclosure Categories by Industry

Figure 6.5 illustrates R&D disclosure categories by industry. The figure shows noticeable differences among the R&D disclosure score for each category.

6.2.3. Exploring the R&D Disclosure Types

The current study classified R&D-related information introduced by the UK firms into two main types of information: non-financial R&D disclosure (including general, input and output disclosure), and Financial R&D disclosure.

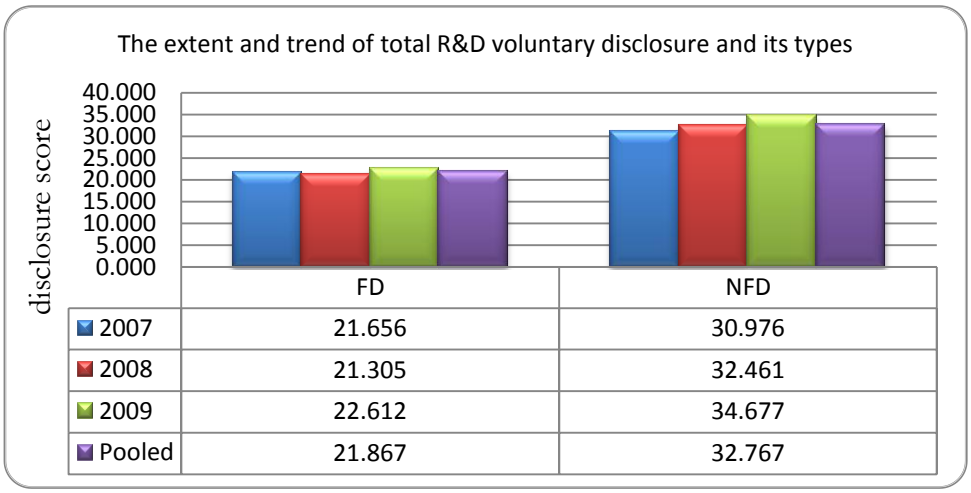
6.2.3.1. The Extent and Trend of R&D Voluntary Financial and Non-financial Disclosure

The following paragraphs analyse the financial and non-financial R&D disclosure, and explore the trend of each type of R&D information over the three years.

Table 6.6
The Extent and Trend of Total R&D Voluntary Disclosure and its Types

Years	2007	2008	2009	Pooled
Financial Disclosure (FDIS)	21.66	21.30	22.61	21.87
Non Financial Disclosure (NFDIS)	30.98	32.46	34.68	32.77
Total R&D Voluntary Disclosure (RDDIS)	28.47	29.46	31.43	29.83

Table 6.6 presents the average financial and non-financial R&D disclosure score by year. It shows that, on average, the UK firms introduce 32.77% non-financial R&D information, which is more than financial R&D information at 21.87%. These results are confirmed over the period of the study.



	FD	NFD
2007	21.656	30.976
2008	21.305	32.461
2009	22.612	34.677
Pooled	21.867	32.767

Figure 6.6
The Types of R&D Disclosure by Year

Figure 6.6 illustrates the extent and trend of R&D disclosure based on the type of information. On average, firms increase their R&D non-financial information gradually over the period of study from 30.98%, to 32.46%, and 34.68% for the years 2007, 2008, and 2009 respectively. Over the same time, the change in financial disclosure is very small.

6.2.3.2. The Analysing of R&D Disclosure Types by Industry

The R&D disclosure types were analysed for each of the nine industries. Table 6.7 presents the analysing of R&D disclosure score for the two disclosure types by industry.

Table 6.7
The Types of R&D Disclosure by Industry

Industry	Financial Disclosure (FDIS)	Non-financial Disclosure (NFDIS)	Total R&D Voluntary Disclosure (RDDIS)
Oil & Gas	17.58	19.84	19.23
Basic Materials	8.84	36.09	28.75
Industrials	21.88	31.67	29.03
Consumer Goods	15.42	31.24	28.98
Healthcare	35.40	56.06	50.50
Consumer Services	4.35	7.89	6.94
Telecommunications	7.79	28.71	23.08
Utilities	21.05	18.28	19.03
Technology	30.68	35.53	34.22
Total	21.87	32.77	29.83

The table shows that, the highest score for R&D financial disclosure is 35.40%, and for R&D non-financial disclosure is 56.06% introduced by the health care sector. While, the consumer services sector introduces the lowest level of both R&D financial and non-financial disclosure (4.35%; 7.89% respectively).

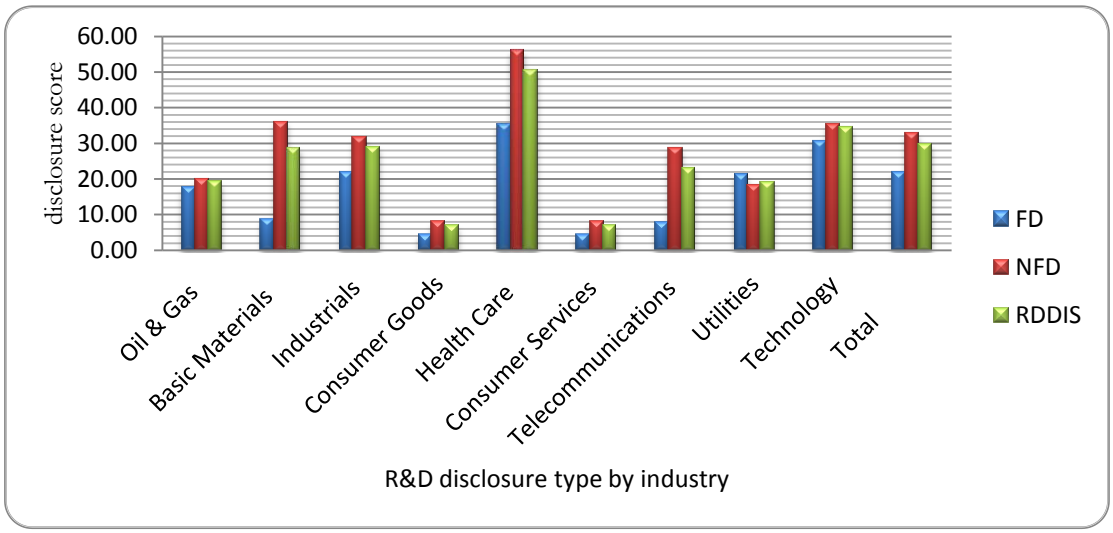


Figure 6.7
The Types of R&D Disclosure by Industry

Figure 6.7 illustrates the R&D disclosure types by industry. The figure shows noticeable differences between R&D disclosure scores for each type by industry.

6.2.4. The Analysing of R&D Disclosure by Item

The investigation of R&D disclosure practices in annual reports in detail could be helpful to gain deeper insights into the R&D disclosure environment in the UK. Therefore, it may be worth considering R&D disclosure for each item in each category in the disclosure checklist.

The R&D checklist employed in the current study consists of (26 items) classified into four categories: general Disclosure (10 items), Input R&D disclosure (4 items), output R&D disclosure (5 items), and financial R&D disclosure (7 items).

Table 6.8 presents the frequency of each R&D disclosure item in the examined disclosure index, and the percentage of the frequency of each item to the total number of examined annual reports; finally, it shows the rank of each item according to this percentage.

The table shows that, In respect to General disclosure, the most common information introduced in the sample of the current study is related to the firm's strategy, objective or vision about its R&D activities; this is followed by information about the competition and risks of R&D activities.

R&D-related information about the availability of the required inputs to carry out R&D activities contains four items: people, collaborations, infrastructure, and funds. The highest percentage was awarded to the R&D collaborations, while the information about R&D funding gets the lowest attention in the annual reports.

In terms of R&D outputs, the results indicate that firms in the sample tend to introduce information about their R&D present and past achievements more than their potential achievements.

Moreover, about 60% of examined annual reports introduce financial information about firms' R&D expenditures in the current year, while only 1.39% and 3.96% of the sample disclose financial information regarding firms' past and future R&D expenditures, respectively.

Table 6.8
R&D Disclosure by Item

No.	Information Item	Freq.	%	Rank
General Disclosure				
1	Statement of strategy or objectives or vision about R&D	336	66.53	1
2	R&D is a main activity	129	25.54	15
3	The focus of R&D activities	189	37.43	9
4	R&D and competition and market	240	47.52	5
5	R&D and Risk	236	46.53	6
6	The effect of R&D spending on other financial items	133	26.34	14
7	Explaining R&D spending changes	72	14.26	21
8	R&D accounting policy discussion outside the financial statements	146	28.91	12
9	R&D and future opportunities	128	25.35	16
10	Tax credit	47	9.31	23
Input				
11	Management and People	104	20.59	18
12	Other parties involved in R&D (R&D collaboration)	187	37.03	10
13	Infrastructure	121	23.96	17
14	Funding	80	15.84	20
Output : (in progress and achievement: new product or beyond product)				
15	Past achievement from R&D activities	214	42.38	7
16	R&D progress	195	38.61	8
17	This year achievement	269	53.27	4
18	Potential achievement	139	27.52	13
19	Patents	178	35.25	11
Financial Disclosure				
20	Past R&D expenditures	7	1.39	26
21	Present R&D expenditures	304	60.20	2
22	Future R&D expenditures	20	3.96	24
23	R&D Ratios	86	17.03	19
24	Comparison of R&D expenditures to those of prior year	281	55.64	3
25	Comparison of R&D expenditures to those of prior years	61	12.08	22
26	Comparison of R&D expenditures to those of target or to expectations	14	2.77	25

From the table, it can be noticed that, 336 observations of 505 annual reports investigated in the current study (nearly two-thirds of the sample) introduce non-financial information about R&D activities related to the firm's strategy, objectives, and vision. These firms may be aware of the importance of introducing information

about their R&D plans and strategies to externals, but at the same time, they may be concerned about introducing proprietary information to competitors. Therefore, they introduce general non-financial information about their R&D strategies. This explanation is supported by the low level of financial information about the R&D expenditures planned for the future (only 3.96% of the total observations).

Moreover, the detailed information about issues such as funding, and explaining R&D spending changes, does not get significant attention in the annual reports (15.84%, 14.26% of the total observations, respectively).

If we refer to the time orientation, the present trend related to R&D activities has the second highest reporting, with an average reporting over 50%. The present trend, including present R&D expenditures, the comparison between this year expenditures of R&D activities and those of prior year and this year achievement. However, financial information regarding past and future orientations is in the last place. Those including past R&D expenditures, future R&D expenditures and comparison of R&D expenditures to those of target or to expectations. Approximately, fewer than 4% of the examined annual reports include R&D disclosure related to the past, future or target R&D expenditures.

One explanation may be that, firms recognise that the disclosure benefits of introducing financial information about their past R&D efforts and about their plans in the future do not compensate for the risk of competitive disadvantage.

The third most common R&D information, after strategy and present oriented information, relates to competition and R&D risk. The table shows that, just less than 50% of the sample introduces information about risk and the market. The reason

behind introducing information about the market and competition may be to signal the superiority of the company or even its ability to continue and achieve the success. Regarding risk information, a noticeable number of annual reports (236 observations) provide information about R&D activities connected with risk. This attitude may be attributed to the recommendations of the accounting entities that emphasise the importance of risk disclosures, for example (ASB, 2006).

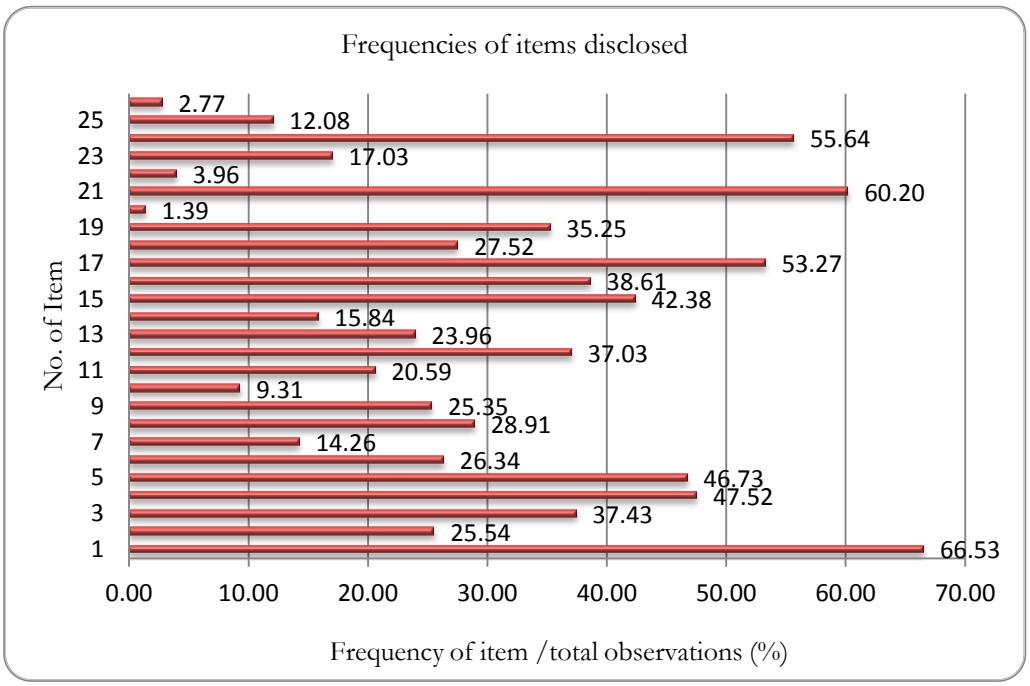


Figure 6.8
Frequencies of Items Disclosed

Figure 6.8 illustrates the frequency of each item (in the examined disclosure index) divided by the total number of observations. The disclosure ranges from the most common information in the sample (66.53% of total observations) to the lowest frequency (1.39% of the total observations). Eight items from 26 items in the examined disclosure index have been disclosed by less than 20% of the sample. While, seven items have been disclosed by more than 40% of the sample.

Table 6.9 presents the frequency of each R&D disclosure item and the percentage of the frequency of each item to total number of examined annual reports. This information is calculated for each industry. From the table, it can be noticed that, while all industries introduce information regarding their strategy and R&D activities and current R&D expenditures, most industries do not introduce any financial information about their R&D investments plans for the future.

Table 6.9
R&D Disclosure by Item for each Industry

No.	Information Item	Industry																	
		1		2		3		4		5		6		7		8		9	
General Disclosure		**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
1	Statement of strategy or objectives or vision about R&D	4	30.8	17	81.0	124	70.9	42	66.7	54	78.3	13	28.3	9	81.8	10	52.6	63	71.6
2	R&D is a main activity	0	0.0	4	19.0	50	28.6	10	15.9	34	49.3	0	0.0	0	0.0	0	0.0	31	35.2
3	The focus of R&D activities	5	38.5	11	52.4	62	35.4	26	41.3	41	59.4	1	2.2	2	18.2	8	42.1	33	37.5
4	R&D and competition and market	4	30.8	9	42.9	90	51.4	32	50.8	36	52.2	6	13.0	4	36.4	2	10.5	57	64.8
5	R&D and Risk	3	23.1	8	38.1	78	44.6	32	50.8	54	78.3	4	8.7	4	36.4	1	5.3	52	59.1
6	The effect of R&D spending on other financial items	0	0.0	7	33.3	45	25.7	22	22.0	27	39.1	4	8.7	3	27.3	2	10.5	23	26.1
7	Explaining R&D spending changes	2	15.4	2	9.5	11	6.3	3	4.8	35	50.7	3	6.5	0	0.0	0	0.0	16	18.2
8	R&D accounting policy discussion outside the financial statements	0	0.0	2	9.5	50	28.6	13	20.6	25	36.2	2	4.3	1	9.1	4	21.1	49	55.7
9	R&D and future opportunities	0	0.0	9	42.9	46	26.3	9	14.3	30	43.5	1	2.2	1	9.1	5	26.3	27	30.7
10	Tax credit	2	15.4	0	0.0	10	5.7	3	4.8	20	29.0	0	0.0	0	0.0	0	0.0	12	13.6
Input																			
11	Management and People	1	7.7	4	19.0	34	19.4	13	20.6	22	31.9	0	0.0	4	36.4	1	5.3	25	28.4
12	Other parties involved in R&D (R&D collaboration)	5	38.5	12	57.1	69	39.4	18	2.9	45	65.2	2	4.3	6	54.5	7	36.8	23	26.1
13	Infrastructure	4	30.8	11	52.4	36	20.6	15	23.8	31	44.9	4	8.7	4	36.4	0	0.0	16	18.2
14	Funding	2	15.4	4	19.0	36	20.6	2	3.2	22	31.9	1	2.2	1	9.1	1	5.3	11	12.5
Output: (in progress and achievement: new product or beyond product)																			
15	Past achievement from R&D activities	3	23.1	12	57.1	75	42.9	34	54.0	39	56.5	8	17.4	4	36.4	6	31.6	33	37.5
16	R&D progress	4	30.8	10	47.6	55	31.4	26	41.3	58	84.1	6	13.0	4	36.4	10	52.6	22	25.0
17	This year achievement	4	30.8	10	47.6	92	52.6	33	52.4	54	78.3	13	28.3	8	72.7	5	26.3	50	56.8
18	Potential achievement	1	7.7	5	23.8	39	22.3	20	31.7	47	68.1	1	0.2	2	18.2	1	5.3	23	26.1
19	Patents	5	38.5	7	33.3	50	28.6	21	33.3	61	88.4	0	0.0	3	27.3	3	15.8	28	31.8
Financial Disclosure																			
20	Past R&D expenditures	0	0.0	0	0.0	5	2.9	1	1.6	0	0.0	0	0.0	0	0.0	0	0.0	1	1.1
21	Present R&D expenditures	5	38.5	8	38.1	103	58.9	34	54.0	62	89.9	6	13.0	3	27.3	12	63.2	71	80.7
22	Future R&D expenditures	1	7.7	0	0.0	3	1.7	0	0.0	9	13.0	0	0.0	0	0.0	1	5.3	6	6.8
23	R&D Ratios	1	7.7	0	0.0	34	19.4	5	7.9	19	27.5	0	0.0	0	0.0	0	0.0	27	30.7
24	Comparison of R&D expenditures to those of prior year	5	38.5	5	23.8	98	56.0	24	38.1	61	88.4	5	10.9	3	27.3	11	57.9	69	78.4
25	Comparison of R&D expenditures to those of prior years	3	23.1	0	0.0	14	8.0	2	3.2	20	29.0	3	6.5	0	0.0	4	21.1	15	17.0
26	Comparison of R&D expenditures to those of target or to expectations	1	7.7	0	0.0	11	6.3	2	3.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

1= Oil & Gas; 2 = Basic Materials; 3 = Industrials; 4 = Consumer Goods; 5 = Health Care; 6 = Consumer Services; 7 = Telecommunications; 8 = Utilities; 9= Technology

6.3. DESCRIPTIVE STATISTICS

The following two sections present the descriptive statistics of the dependent and independent variables included in the current study.

6.3.1 Descriptive Statistics of the R&D Disclosure Score

The following paragraphs present the descriptive statistics of the total R&D disclosure, and R&D disclosure for each disclosure category and for each disclosure type.

Table 6.10
Descriptive Statistics of the Dependent Variables

Panel A: The Descriptive Statistics of Total R&D Disclosure Score and its Categories

Variables	Mean	Median	Std. Dev.	Min	Max	Skewness	Kurtosis
RDDIS	29.83	30.77	19.57	0.00	80.77	0.270	2.301
GDIS	32.81	30.00	21.94	0.00	90.00	0.220	2.242
INDIS	24.36	25.00	27.34	0.00	100.00	0.899	2.805
OUTDIS	39.41	40.00	31.95	0.00	100.00	0.314	1.948
FDIS	21.87	28.57	19.82	0.00	85.71	0.343	2.238

Panel B: The Descriptive Statistics of total R&D disclosure Score & its Classification According to type of Information

Variables	Mean	Median	Std. Dev.	Min	Max	Skewness	Kurtosis
RDDIS	29.83	30.77	19.57	0.00	80.77	0.270	2.301
FDIS	21.87	28.57	19.82	0.00	85.71	0.343	2.238
NFDIS	32.77	31.58	22.16	0.00	89.47	0.302	2.263

RDDIS = R&D disclosure score; GDIS = general disclosure score; INDIS = input disclosure score; OUTDIS = output disclosure score; FDIS = financial disclosure score; NFDIS = non-financial disclosure score.

Table 6.10 presents the descriptive statistics for the dependent variables in the current study. Panel A shows the descriptive statistics of the total R&D disclosure score and its categories. As indicated in the table, the average overall R&D disclosure level has 29.83% of the examined disclosure index. The disclosure of the output of R&D activities represents the highest average disclosure score at 39.41%; this indicates that the UK firms made considerable disclosures about the actual and

expected achievements of their R&D activities to signal the successful efforts of the firm's management.

On the other hand, the R&D financial disclosure carries the lowest average disclosure score 21.87% indicating that the UK firms have some concerns regarding to this type of information; they may decide not to introduce financial information about their future plans for R&D activities and their resulting expectations.

In respect to skewness and kurtosis, the skewness of total R&D disclosure and that of all disclosure categories are within the range of (±1.96) and kurtosis of total R&D disclosure and that of all its categories are within the range (±3). This is the normality range according to Haniffa and Hudaib, (2006). In addition, the skewness and kurtosis of total R&D disclosure are nearly within the normality range of (±0.8) for skewness and closer to (3) for kurtosis (Osborn, 2010).

Panel B shows the descriptive statistics of R&D disclosure scores for financial information and non-financial information. The results specify that the non-financial disclosure score is higher than the financial disclosure score, indicating that the UK firms prefer to introduce non-financial information about their R&D activities rather than financial information. This result is consistent with (Jones, 2007) who exposes that only 16% of the sample provides R&D numerical disclosure, while 99% of the firms introduce non-financial disclosure in their annual reports. Regarding skewness and kurtosis, the data of the two types of information (financial and non-financial) are within the normality range of (±0.8) for skewness closer to (3) for kurtosis (Osborn, 2010).

6.3.2 Descriptive Statistics of the Explanatory and Control Variables

The following paragraphs present the descriptive statistics of the explanatory and control variables.

Table 6.11
Descriptive Statistics for Independent Variables

Panel A: Continuous Variables

Variables	Mean (Median)	Std. Dev.	Min (Max)	Skewness	Kurtosis
Explanatory Variables					
BS	8.28 (8)	2.61	2 (17)	0.888	3.772
BI	54.76 (57.14)	13.95	0 (83.3)	- 0.75	3.97
BM	9.20 (9)	3.11	1 (24)	0.97	5.56
MONR	2.03 (0.2)	6.73	0 (62.72)	6.06	44.96
ONRC	32.99 (32.73)	19.91	0 (92.4)	0.29	2.62
Control Variables					
SIZE	4685978 (440400)	16089752	33250 (156343030)	6.93	57.59
R&D	75060 (9200)	367823	790 (3708000)	8.13	72.24
LEV	21.41 (19.96)	19.12	0 (160.22)	1.82	11.78
PROFIT	5.01 (6.76)	13.04	- 86.77 (75.09)	-1.80	14.87
LIQUID	1.75 (1.44)	1.32	0.4 (15.38)	4.15	31.29
GROW	16.50 (7.83)	63.76	- 68.03 (884.77)	9.29	112.57

Panel B: Binary Variables

Variable	Score	Frequency	Percentage
DUL	0	456	90.3%
	1	49	9.7%
AQUAL	0	197	39%
	1	308	61%

BS=Board size; BI= Board independence; BM= Board meetings; MONR= Managerial ownership; ONRC = Ownership concentration; Size= Firm size; R&D= R&D investments; LEV = Leverage; PROFIT = Profitability; LIQUID = Liquidity; GROW = Firm's growth; DUL = Role duality; AQUAL = Audit committee quality.

Table 6.11 presents the descriptive statistics for corporate governance and control variables examined in the current study. Panel A shows the descriptive statistics for continuous variables, and Panel B presents the frequencies of the binary variables.

Regarding corporate governance variables, the mean of board size is about 8 members with a minimum of two members and a maximum of seventeen members. The mean of board independence is 54.76% indicating that more than half of the directors are independent non-executive. In addition, the number of board meetings held during the year ranges from only one meeting to 24 with a mean of 9 meetings.

With respect to ownership variables, the mean of managerial ownership (shares held by executive directors) is about 2% ranging from zero to 62.72%. The mean of ownership concentration (shareholders owning 5% or more of the firm's share capital) is 32.99% with a minimum of zero and a maximum 92.4%.

In terms of control variables, the mean of total assets as a proxy for firm size is 4685978 thousand pounds. The amount of R&D investments ranges widely from (790) to (3708000) thousand pounds with an average of 75060 thousand pounds. The average of profitability is 5.01 ranges from -86.77 to 75.09. While, leverage ranges from zero to 160.22 with an average of 21.4. The average values of growth and liquidity are 16.50 and 1.75 respectively.

Panel B shows that only 9.7% of the sample have role duality. In addition, 61% of the sample has an effective audit committee.

Regarding the skewness statistics, most corporate governance and control variables exceed the range of (±1.96) for skewness (Haniffa and Hadaib, 2006). The kurtosis results also confirm that most corporate governance and control variables exceed the

range of (±3) for kurtosis, (Haniffa and Hadaib, 2006), indicating that the observations have some outliers and most of the data are not normally distributed.

Tabachnick and Fidell (2003) argue that data transformation is recommended as a treatment for outliers and for failures of normality, linearity, and homoscedasticity. They advise trying several transformations until the most helpful one is found: the transformation that improves normality and recovers skewness and kurtosis to obtain the best data picture.

Empirically, data transformation is widely used in literature (e.g. Li et al., 2012; Elshandidy et al., 2013; La Rosa and Liberatore, 2014; Merkley, 2014). Some of the researchers reveal the reasons behind transforming their data. For example, Li et al., (2012), transforms some of the independent variables using natural logarithms and square roots to improve the normality of the distribution. While, Elshandidy et al., (2013) transform nearly all the data to natural logarithms to minimise the effect of outliers and to improve the variables' distributions. Merkley (2014) uses the square transformation to control for nonlinearity.

Following the prior literature, the current study has employed data transformation to improve the variables' distributions and produce the best skewness and kurtosis values. The following steps have been followed to find the most suitable transformation for each variable:

Firstly, using STATA "ladder" command which demonstrates the normality test for various transformations. Secondly, the transformation with the lowest (Chi^2) statistics has been selected. Thirdly, using STATA "gladder" command to investigate the graphical views of the different transformations. Finally, as recommended by

Tabachnic and Fidell (2003) after applying the transformation, it should be ensured that there is an advantage from this transformation.

Based on the above discussion, some of the independent variables were transformed as follows: firm size, R&D investments and liquidity are transformed using natural logarithm transformation, while square roots transformation is more effective for board meetings and managerial ownership.

6.4. CHECKING NORMALITY, HOMOSCEDASTICITY, AND MULTICOLLINEARITY

The basic assumptions of OLS regression were tested, before running the multiple regression analysis.

6.4.1. Checking Normality

Under the normality assumption, the residuals (the deviations of the observations from the prediction values) should be normally distributed. The normality can be tested by graphical and numerical methods.

6.4.1.1. Checking Normality for the Main Model

(This includes the corporate governance variables and control variables)

- ***Graphical Methods***

Using STATA, after running the regression analysis, the "predict" command is used to create residuals. After that, the "Kdensity" command is applied to produce a Kernel density plot with the normal density.

Figure 6.9 illustrates the distribution of the residuals compared to the normal distribution curve. This graph allows a quick and simple evaluation of the

distribution. From the graph, it can be observed that there is no major departure from the bell shape.

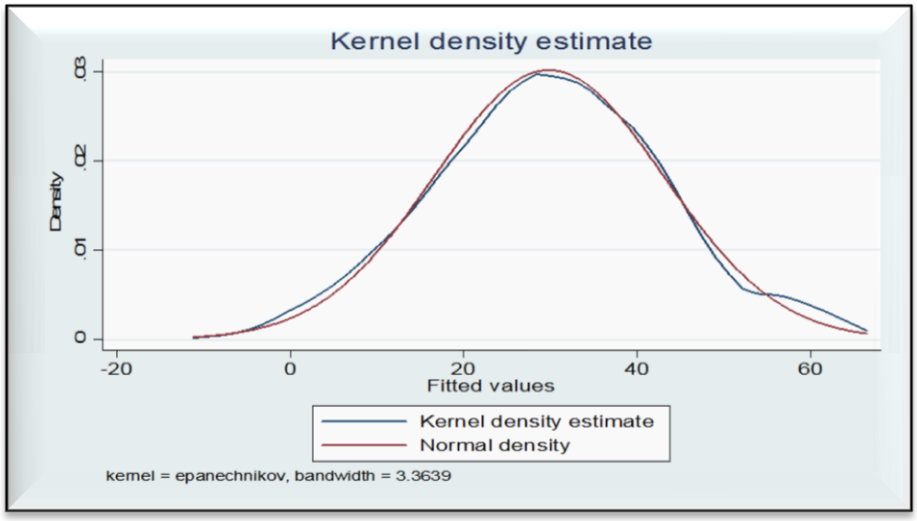


Figure 6.9
Normal Curve and Kernel Density Estimate for the Main Model

In addition, the STATA "pnorm" command is used to graph a standardized normal probabilities plot (p-p) which is sensitive to non normality in the middle range of data.

The horizontal axis shows the values of OLS residuals and the vertical axis shows the expected values of the residuals if it were normally distributed, consequently, if the residuals are from the normal distribution, the (P-P) will be approximately straight line (Gujarati, 2003). Figure 6.10 shows that the points plotted fall approximately on the straight line.

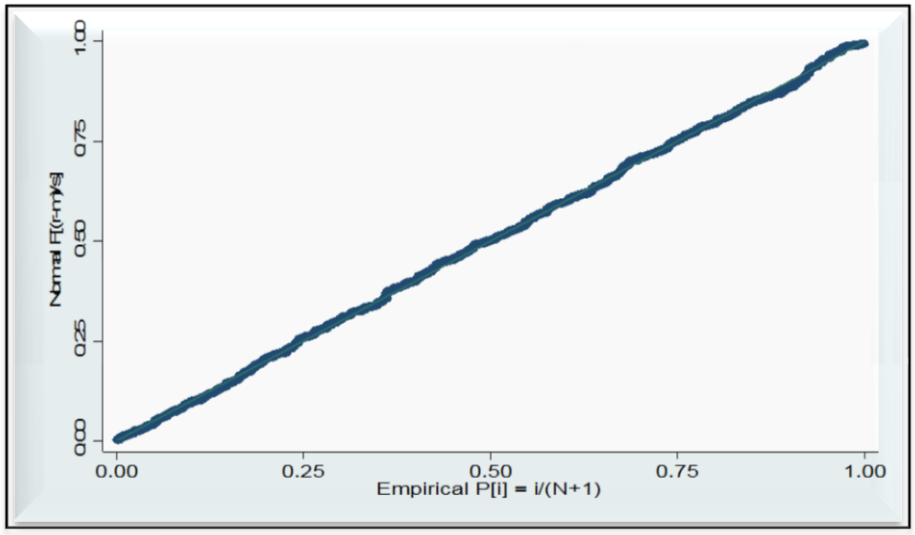


Figure 6.10
P-P Plot for the Main Model

Moreover, the STATA "qnorm" command is used to illustrate the quantiles of a variable against the quantiles of a normal distribution (Q-Q plot), which is sensitive to non normality near the tail.

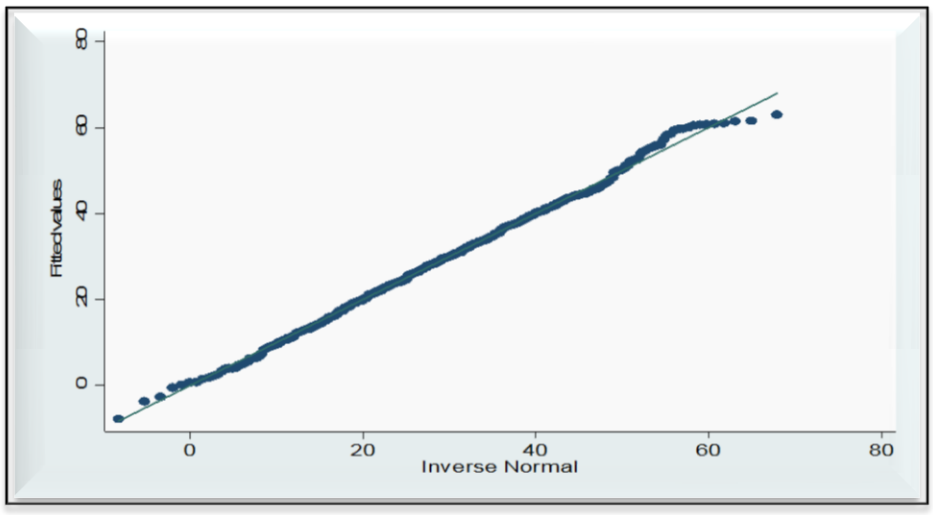


Figure 6.11
Q-Q Plot for the Main Model

Figure 6.11 shows that the points plotted fall approximately on the straight line with a little deviation on the tails. The graphical method for assessing the normality of residuals suggests that the residuals are normally distributed.

- ***Numerically Methods***

To test the residuals for normality numerically, the current study employs two tests, Skewness/Kurtosis tests for normality and Shapiro-wilk W test for normal data. The assumption of the both tests is that the distribution is normal.

Skewness/Kurtosis Tests for Normality

Variable	Obs.	Pr (Skewness)	Pr (Kurtosis)	Adj Chi^2 (2)	Prob > Chi^2
Residuals	505	0.8819	0.5539	0.38	0.8287

Shapiro-wilk W Test for Normal Data

Variable	Obs.	W	V	Z	Prob > Z
Residuals	505	0.99635	1.238	0.513	0.30389

From the table, we can notice that the probability is more than 0.05%, indicating that we cannot reject the null hypothesis. These results validate the conclusion of the graphical method for assessing the normality of residuals. Consequently, the normality of the errors, as an important assumption of OLS regression, is confirmed.

6.4.1.2. Checking Normality for the Model with Year & Industry Dummy Variables

(This includes the corporate governance variables and control variables, in addition to dummy variables to control for year and industry fixed effect).

- ***Graphical Methods***

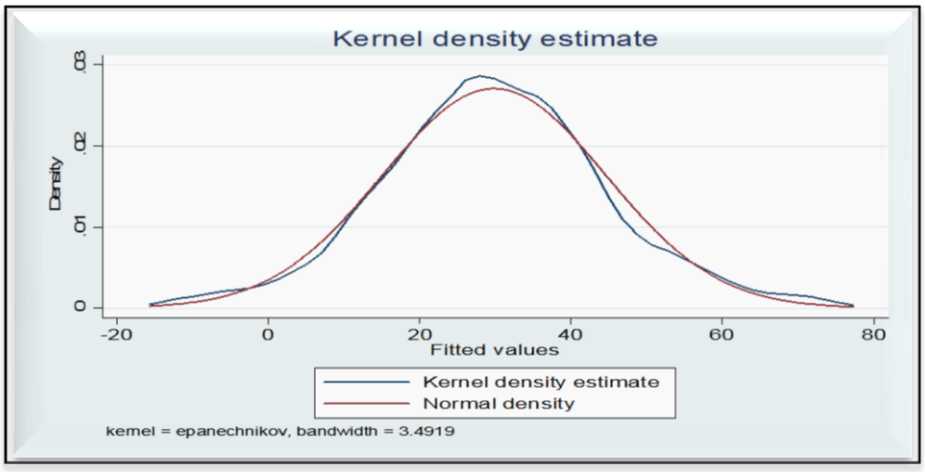


Figure 6.12
Normal curve and kernel density estimate for the model with year & industry dummy variables.

Figure 6.12 demonstrates the distribution of the residuals compared to the normal distribution curve. From the graph, it can be observed that there is no major departure from the bell shape.

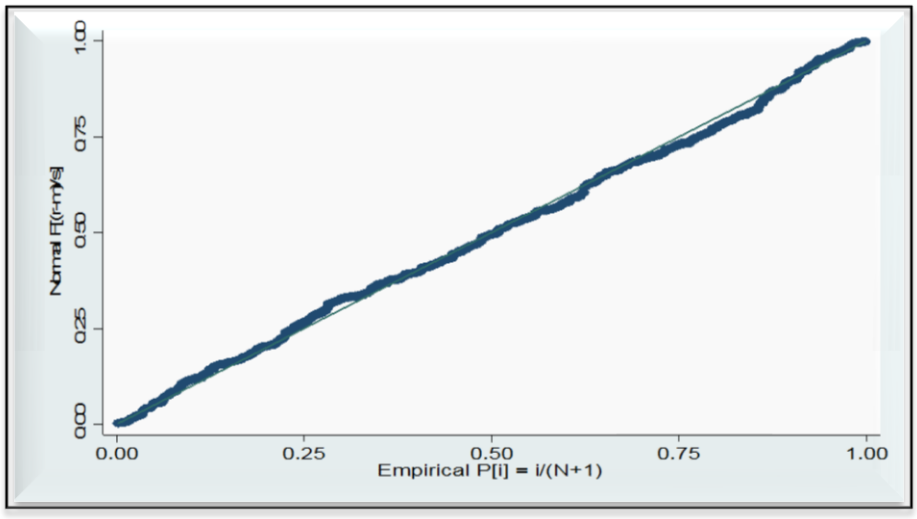


Figure 6.13
P-P Plot for the Model with Year & Industry Dummy Variables

Figure 6.13 shows the standardized normal probabilities plot (P-P), and it can be seen that, the points plotted fall approximately on the straight line.

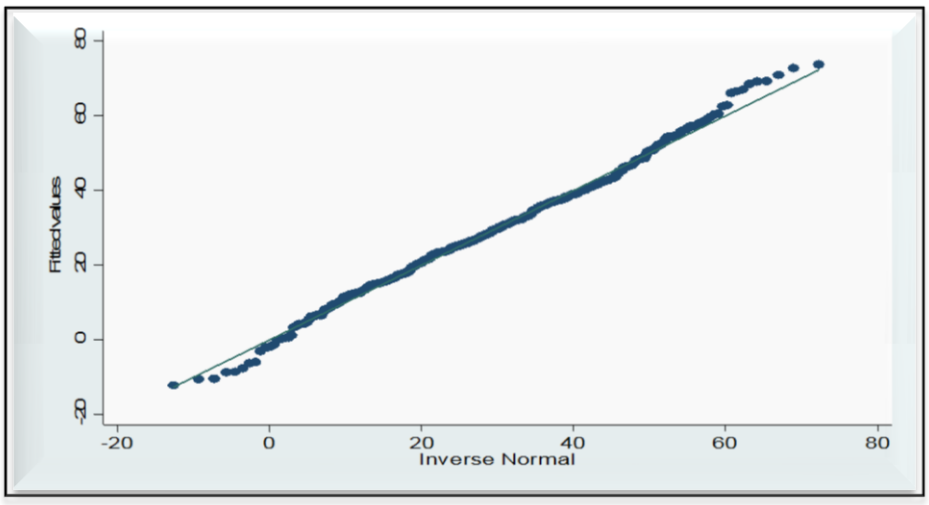


Figure 6.14
Q-Q Plot for the Model with Year & Industry Dummy Variables

Figure 6.14 illustrates the quantiles of the residuals against the quantiles of a normal distribution (Q-Q plot), and shows that while, there is a slight curved trend in the

plot; the points are still close enough to the line to not disqualify the residuals from being normal distribution.

The graphical method for assessing the normality of residuals suggests that the residuals are normally distributed.

- ***Numerically Methods***

The assumption of the Skewness/Kurtosis tests for normality and Shapiro-wilk W test for normal data is that the distribution is normal.

Skewness/Kurtosis Tests for Normality

Variable	Obs.	Pr (Skewness)	Pr (Kurtosis)	Adj Chi^2 (2)	Prob > Chi^2
Residuals	505	0.4457	0.1053	3.21	0.2010

Shapiro-wilk W Test for Normal Data

Variable	Obs.	W	V	Z	Prob > Z
Residuals	505	0.99436	1.916	1.563	0.05899

From the table, we can notice that the probability is more than 0.05%, indicating that we cannot reject the null hypothesis. These results validate the conclusion of the graphical method for assessing the normality of residuals.

6.4.2. Checking Homoscedasticity

Homoscedasticity of residuals means the variance of the residuals is constant for each observation.

6.4.2.1 Checking Homoscedasticity for the Main Model

(This includes the corporate governance variables and control variables).

To check the homoscedasticity two tests have been applied. The Breusch-pagan/Cook-Weisberg test and the White's test. The null hypothesis of both tests is that the error variances are constant.

Breusch-pagan/Cook-Weisberg Test for Heteroskasticity

Chi^2 (1)	Prob. > chi^2
0.33	0.5673

According to the result of the test, the chi-square value is small and the probability is large 0.56 indicating Heteroskedasticity is probably not a problem.

White's Test for Heteroskedasticity

Chi ^{2} (102)	Prob. > chi^2
124.73	0.0627

The results of White's test also confirm that we cannot reject the null hypnosis.

6.4.2.2. Checking Homoscedasticity for the Model Year & Industry Dummy Variables

(This includes the corporate governance variables and control variables, in addition to dummy variables to control for year and industry fixed effect)

Breusch-pagan/Cook-Weisberg Test for Heteroskasticity

Chi^2 (1)	Prob. > chi^2
0.15	0.7004

White's Test for Heteroskedasticity

Chi^2 (248)	Prob. > chi^2
235.47	0.7062

From the table, we can notice that, the probability is more than 0.05% for both Breusch-pagan/Cook-Weisberg test and White's test, indicating that we cannot reject the null hypothesis, and **Heteroskedasticity** is probably not a problem.

6.4.3. Checking for Multicollinearity

Multicollinearity implies the existence of a linear relationship between two or more independent variables. The possible existence of multicollinearity is tested through computing the variance inflation factor (VIF).

Table 6.12
Variance Inflation Factor (VIF)

Variable	VIF	1/VIF (Tolerance)
SIZE	4.28	0.233429
BS	2.48	0.403233
RD	1.66	0.603110
BI	1.54	0.648849
ONRC	1.52	0.658829
LIQUID	1.44	0.692128
AQUAL	1.39	0.718754
MONR	1.36	0.735338
LEV	1.31	0.766271
DUL	1.23	0.814403
PROFIT	1.14	0.873468
GROW	1.11	0.904444
BM	1.09	0.920168
Mean VIF	1.66	

The multicollinearity is suggested to be a problem, if the variance inflation factor for any variable is more than 10, or if the tolerance of any variable is less than 0.1 (Gujarati, 2003).

The table 6.12 shows that the highest VIF is 4.28, and the mean VIF is 1.66. In addition, the lowest value of Tolerance is 0.233. Therefore, the results indicate that there is no intercorrelation among the independent variables.

Multicollinearity is also tested depends on Pair-wise Correlation Matrix. A rule of thumb suggested by (Gujarati, 2003) is that, if the Pair-wise Correlation coefficient between two regressors is higher than 0.8, then multicolinearity is a serious problem.

Table 6-13 shows the Pair wise Correlation coefficients. It can be noticed from the table that the correlation coefficients of all independent variables are less than 0.80. The correlation coefficient of 0.713 between board size and log total assets is the highest in the correlation matrix, which is still smaller than 0.80. Therefore, it can be concluded that there is no need to be concerned about multicollinearity problem in this study.

Table 6.13
Pair wise Correlation Matrix for Dependent and Independent Variables

Variables	RDDIS	FDIS	NFDIS	BS	DUL	BI	BM	MONR	ONRC	AQUAL	SIZE	RD	LEV	PROFIT	LIQUID	GROW
RDDIS	1															
FDIS	0.714***	1														
	0.000															
NFDIS	0.973***	0.534***	1													
	0.000	0.000														
BS	0.021	0.104**	-0.009	1												
	0.636	0.018	0.840													
DUL	-0.134***	-0.173***	-0.105**	0.037	1											
	0.002	0.000	0.018	0.406												
BI	0.020	0.060	0.004	0.066	-0.300***	1										
	0.646	0.176	0.912	0.133	0.000											
BM	0.045	0.064	0.033**	-0.128***	-0.058	0.071	1									
	0.310	0.147	0.453	0.003	0.191	0.108										
MONR	-0.103**	-0.062	-0.104**	-0.098**	0.335***	-0.304***	-0.209***	1								
	0.020	0.160	0.019	0.027	0.000	0.000	0.000									
ONRC	-0.021**	-0.088**	0.003	-0.313***	0.118***	-0.246***	0.012	0.153***	1							
	0.635	0.045	0.933	0.000	0.007	0.000	0.774	0.000								
AQUAL	0.095**	0.089**	0.085*	0.206***	-0.094**	0.450***	0.061	-0.172***	-0.258***	1						
	0.032	0.044	0.055	0.000	0.033	0.000	0.166	0.000	0.000							
SIZE	-0.148***	-0.017	-0.173***	0.713***	-0.029	0.313***	-0.047	-0.226***	-0.540***	0.357***	1					
	0.008	0.690	0.000	0.000	0.508	0.000	0.287	0.000	0.000	0.000						
RD	0.413***	0.426***	0.359***	0.514***	-0.050	0.197***	-0.022	-0.189***	-0.388***	0.285***	0.549***	1				
	0.000	0.000	0.000	0.000	0.262	0.000	0.613	0.000	0.000	0.000	0.000					
LEV	-0.120***	-0.093**	-0.115***	0.174***	0.033	0.079*	-0.061	-0.136***	-0.183***	0.131***	0.362***	0.031	1			
	0.006	0.036	0.009	0.000	0.447	0.073	0.168	0.002	0.000	0.003	0.000	0.487				
PROFIT	-0.043	0.080*	-0.079*	0.133***	-0.030	0.054	-0.023	0.012	-0.232***	0.160***	0.263***	0.177	-0.004	1		
	0.329	0.069	0.075	0.002	0.498	0.220	0.598	0.784	0.000	0.000	0.000	0.000	0.915			
LIQUID	0.311***	0.184***	0.315***	-0.307***	-0.006	-0.151***	-0.034	0.165***	0.216***	-0.223***	-0.498***	-0.164***	-0.337***	-0.138***	1	
	0.000	0.000	0.000	0.000	0.891	0.000	0.433	0.002	0.000	0.000	0.000	0.000	0.000	0.001		
GROW	0.031	0.011	0.034	-0.064	-0.003	-0.030	-0.041	0.171***	0.013	-0.058	0.042	-0.003	-0.075*	0.082*	0.080*	1
	0.480	0.798	0.441	0.149	0.930	0.493	0.348	0.000	0.769	0.186	0.336	0.943	0.091	0.064	0.071	

*** indicates p<.01, ** p<.05, * p<0.10
Variables: **BS =** board size; **DUL** = role duality; **BI** = board independence; **BM** = board meetings; **MONR** = managerial ownership; **ONRC =** ownership concentration; **AQUAL**= audit committee quality; **SIZE =** firm size; **RD** = R&D investments; **LEV** = leverage; **PROFIT** = profitability; **LIQUID** = liquidity; **GROWTH** = firm' growth.

6.5. REGRESSION ANALYSIS

The current study employs two methods to examine the relationship between R&D voluntary disclosure and the independent variables:

- Ordinary Least Squares (OLS) regression.
- Tobit regression.

6.5.1. OLS Regression Analysis (Total R&D Disclosure)

This study employs (OLS) regression to examine the relationship between R&D voluntary disclosure in annual reports and the explanatory variables.

Table 6.14 presents the results of OLS regression of the association between R&D voluntary disclosure and corporate governance, controlling for corporate characteristics, and considering the year and industry fixed effects by including two dummy variables for year effect and eight dummy variables for industry effect.

Although the test of multicollinearity indicates that there is no unacceptable level of correlation between explanatory variables, the analysis still considers any concerns regarding the potential hidden correlations among the corporate governance variables. Accordingly, the corporate governance variables are grouped into three sets: board characteristics, ownership structure, and audit committee quality, so, six models are produced.

Model (1) examines the relationship between the level of R&D disclosure and the control variables. Model (2) examines the same relationship after considering the impact of board characteristics on R&D voluntary disclosure. Model (3) includes board characteristics and ownership structure in addition to, the control variables. Finally,

model (4) which is the main model includes all the corporate governance variables and control variables that are examined in the current study.

Moreover, two further models are employed to consider the year and industry fixed effects. Model (5) controls for the year fixed effect by adding two dummy variables to the main model. Model (6) controls for the year and industry fixed effects by including two dummy variables for year effect and eight dummy variables for industry effect. The following sections introduce a discussion of the results of the six models.

Model (1) presents the association between R&D disclosure and the six control variables. The adjusted R Square of model (1) is 41.07%, indicating that 41.07 of the changes in R&D voluntary disclosure can be explained by the control variables.

The results reveal that firm size (SIZE) has a significant negative influence on R&D voluntary disclosure at the 1% level. However, a significant positive association between R&D disclosure and each of R&D investments (RD), Leverage (LEV), and liquidity (LIQUID) is found at the 1% level. The results cannot detect any significant influence of both profitability (PROFIT) and firm's growth (GROW) on R&D voluntary disclosure.

Model (2) includes the board characteristics, in addition to the control variables. The adjusted R Square slightly increases from 41.07% in model (1) to 43.02% in model (2). The results show a strong significant positive association between R&D voluntary disclosure and board size (BS) at the 1% level. The results also reveal that role duality (DUL) has a significant negative association with R&D disclosure at the 1% level. While board meetings (BM) have a marginally positive impact on R&D

disclosure at the 10% level, no significant association is found between board independence (BI) and R&D voluntary disclosure.

Model (3) shows the effects of ownership structure, including managerial ownership (MONR) and ownership concentration (ONRC), in addition to, control variables and board characteristics on R&D voluntary disclosure. While, managerial ownership (MONR) has a significant negative impact on R&D disclosure at the 5% level, no significant association between ownership concentration (ONRC) and R&D voluntary disclosure is detected.

Model (4) is the full model that includes all the corporate governance variables and control variables that are examined in the current study. The audit committee quality is added in model (4), hence a slightly increases in adjusted R Square (R^2) from 43.39% in model (3) to 44.20% in model (4) is noticed. The results show a strong positive association between the audit committee quality and R&D voluntary disclosure at the 1% level.

Model (5) explains the association between the same variables that are included in model (4), with considering the year fixed effect by including two dummy variables for the year effect.

Model (6) presents the results of the relationship between R&D voluntary disclosure and corporate governance, controlling for corporate characteristics, and considering the year and industry fixed effects by including two dummy variables for year effect and eight dummy variables for industry effect.

Table 6.14
OLS Regression Analysis (Total R&D Disclosure)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4) Full Model		Model (5)		Model (6) Full Model with Year, Industry Dummies	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.036***	0.009	1.131***	0.004	1.118***	0.005	1.239***	0.002	1.193***	0.001
DUL			-7.163***	0.002	-5.458**	0.026	-5.685**	0.020	-5.751**	0.018	-2.930	0.195
BI			0.061	0.258	0.044	0.411	-0.015	0.790	-0.004	0.942	-0.062	0.246
BM			2.296*	0.081	1.749	0.191	1.542	0.246	1.636	0.217	1.751	0.163
MONR					-1.374**	0.038	-1.404**	0.033	-1.390**	0.034	-0.916	0.128
ONRC					-0.040	0.315	-0.037	0.357	-0.043	0.283	0.039	0.292
AQUAL							4.492***	0.004	4.305***	0.006	4.772***	0.001
Control Variables												
SIZE	-4.341***	0.000	-5.401***	0.000	-5.753***	0.000	-5.840***	0.000	-6.046***	0.000	-4.127***	0.000
RD	8.481***	0.000	8.169***	0.000	7.992***	0.000	7.824***	0.000	7.819***	0.000	6.942***	0.000
LEV	0.104***	0.008	0.126***	0.001	0.119***	0.002	0.115***	0.003	0.115***	0.003	0.027	0.459
PROFIT	-0.022	0.670	-0.007	0.893	-0.004	0.940	-0.017	0.737	-0.004	0.930	0.033	0.502
LIQUID	8.325***	0.000	8.268***	0.000	8.276***	0.000	8.541***	0.000	8.431***	0.000	5.988***	0.000
GROW	0.013	0.210	0.018*	0.077	0.023**	0.030	0.025**	0.020	0.029***	0.006	0.023**	0.016
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	3.289	0.558	1.477	0.837	11.903	0.189	15.851*	0.082	19.231**	0.036	7.519	0.464
Adj. R Square (R^2)	0.4107		0.4302		0.4339		0.4420		0.4483		0.5464	
F-Statistics	59.54		39.05		33.19		31.71		28.31		27.39	
Prob. (F-Statistics)	0.000		0.000		0.000		0.000		0.000		0.000	
No. of observations	505		505		505		505		505		505	

– *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
– Variables: **BS=**Board size; **DUL**=Role duality; **BI**=Board independence; **BM**=Board meetings ; **MONR**=Managerial ownership; **ONRC** = Ownership concentration; **AQUAL**=Audit committee quality; **SIZE**=Firm size; **RD**=R&D investments; **LEV**=Leverage; **PROFIT**=Profitability; **LIQUID** =Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

The adjusted R Square of model (6) is 54.64% indicating that 54.64 of the changes in R&D disclosure score are explained by the changes in the examined variables; this suggests that the overall model has a reasonably strong explanatory power. The explanatory power of the overall model is comparable to Entwistle, (1999) 50.5%, and higher than Jones (2007) 35% and Nekhili, et al., (2012) 33.85%, but it is lower than Merkly, (2014) 89.6%.

In terms of the impact of corporate governance on overall R&D disclosure, three main aspects were examined: The Board characteristics, Ownership Structure, and Audit Committee quality.

The results show that board size (BS) is significantly and positively associated with the overall R&D disclosure at the 1% level. This result is consistent with the findings of Abdelbadi and Elshandidy (2013) which provide evidence that UK firms with large board sizes tend to introduce more R&D information in their annual reports. However, it is not in the line with the findings of Nekhili et al., (2015), who does not find any significant impact of board size on R&D narrative disclosure in France context.

The positive influence of large board size on intellectual capital disclosure is supported by the findings of Hidalgo et al., (2011). In contrast, Cerbioni and Parbonetti (2007) find a negative relationship between board size and intellectual capital disclosure.

The findings of the current study confirm the effective role of the large board size in enhancing R&D voluntary disclosure; this supports the positive influence of large

board size on the board's monitoring capacity by increasing the group of expertise and skills in the board. Consequently, the hypothesis H1 is supported.

The role duality (DUL) shows a significant negative impact on R&D disclosure in models 2, 3, 4, and 5; whereas after considering the industry effect, model (6) does not reveal any significant influence of role duality on R&D disclosure. This result could be explained by the impact of proprietary cost, captured by industry type, which moderate the influence of role duality on the level of R&D disclosure.

The insignificant association between role duality and R&D disclosure is in the line with the findings of Nor et al., (2012), Abdelbadie and Elshandidy, (2013) and Nekhili et al., (2015). However, the negative impact of role duality on R&D disclosure is documented by Zeghal et al., (2007).

Consequently, the findings do not support agency theory regarding the expected positive impact of separating the roles of chairman of the board and CEO on the level of disclosure. So, the hypothesis H2 is not supported.

Surprisingly, the results do not confirm any significant relationship between board independence (BI) and R&D narrative disclosure. Hence, hypothesis (H3) is not supported. Regarding R&D disclosure, this result does not validate the argument that supports the role of independent directors as a mechanism to monitor management's performance and decrease the information asymmetry between managers and owners (Lim et al., 2007).

Although this unexpected result contradicts many previous studies that consider the overall corporate disclosure or other types of disclosure rather than R&D information (e.g. Cerbioni and Parbonetti, 2007; Huafang and Jianguo, 2007; Lim et al., 2007; Li

et al., 2012; Gisbert and Navallas, 2013), it is in the line with the most studies that investigate the relationship between board independence and R&D disclosure. These studies also cannot detect any significant relationship between board independence and R&D voluntary disclosure in annual reports (e.g. Zegal et al., 2007; Nor et al., 2010; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015).

These mixed findings support the argument of Merkly (2014) who suggests that narrative disclosure should not be generalised as a whole and every type of disclosure should be considered in the development of hypotheses and in the empirical investigations.

Regarding the frequency of board meetings (BM), the results do not show any significant influence of the square root of frequency of board meetings on R&D disclosure. This result does not support the hypothesis (H4). This result does not support the positive role of frequency of board meetings on the board's effectiveness in implementing its monitoring role. Empirically, to the best of my knowledge, the relationship between the number of board meetings and R&D disclosure has not been previously examined.

On the subject of Ownership Structure, the relationship between the square root of managerial ownership (MONR) and overall R&D disclosure is negative and significant at the 5% level in models 3, 4, and 5. Furthermore, it is negative but not significant in model 6.

Accordingly, the result of the current study, after controlling for industry effect, does not support agency theory regarding the negative influence of higher managerial ownership on the level of R&D disclosure. So, hypothesis (H5) is not supported.

The insignificant association between managerial ownership and the level of disclosure is not consistent with (Eng and Mak, 2003), but consistent with the studies that examined the impact of managerial ownership on the level of R&D disclosure (e.g. Nor et al., 2010; Nekhili et al., 2012; Nekhili et al., 2015). These studies cannot detect any significant association between managerial ownership and voluntary R&D disclosure in annual reports.

The results for ownership structure do not support the existence of any significant relationship between ownership concentration (ONRC) and R&D voluntary disclosure. This result is conflicted with the prior expectation of the current study, based on agency theory; it is also inconsistent with prior studies that found a negative association between ownership concentration and voluntary disclosure (e.g. Gracia-Meca and Sanchez-Ballesta, 2010). However, it is consistent with other studies that also do not confirm any significant association between disclosure and ownership concentration (e.g. Eng and Mak, 2003; Hidalgo et al., 2010; Nekhili et al., 2012; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015). Hence, hypothesis (H6) is not supported.

Finally, the relationship between audit committee quality (AQUAL) and R&D voluntary disclosure is positive and significant at the 1% level, indicating that the interaction effect between the audit committee characteristics that captures a committee's overall quality has a significant influence on R&D disclosure. Therefore, hypothesis (H7) is supported. This result also supports the monitoring role of the audit committee, which can be considered as a tool to mitigate the agency costs (Ho and Wong, 2001), and reduce the information asymmetry problem (Li et al., 2012).

In respect to control variables, six corporate characteristics have been considered in the current study. Firm size (SIZE), R&D investment (RD), leverage (LEV), profitability (PROFIT), liquidity (LIQUID), and firm's growth (GROW). Three control variables have a strong significant influence on R&D disclosure at the 1% level, according to the findings of the six models. These are: Firm size (SIZE), R&D investment (RD), and liquidity (LIQUID).

The results show a negative and significant association between firm size measured by the logarithm of total assets, and R&D disclosure. This unexpected relationship contradicts the arguments that suggested a positive influence of firm size on voluntary disclosure (e.g. Cooke, 1989; Lang & Lundholm, 1993; Raffournier, 1995 Chavent et al., 2006) and also disagrees with previous studies that confirm a positive relationship between firm size and voluntary disclosure (e.g. Cooke 1989; Hossain et al., 1995; Raffournier, 1995; Depoers, 2000; Watson et al., 2002; Merkley, 2014). However, in the R&D context, the negative relationship between firm size and R&D disclosure is documented by Nor et al., (2010) and Nekhili et al., (2015).

The logarithm R&D investments shows a significant positive association with R&D disclosure. Consequently, the firms with higher level of R&D investments are more likely to introduce more R&D-related information in their annual reports. These findings support the argument that R&D activities are associated with the existence of considerable information asymmetry (Tasker, 1998; Barth et al., 1998; Aboody and Lev, 2000, Merkly, 2014), and management uses R&D voluntary disclosure to signal positive prospects to the market to reduce the information gap between managers and stakeholders (Percy, 2000; Jones, 2007; Zeghal et al., 2007).

This result is consistent with most empirical studies that addressed R&D disclosure. A significant positive relationship is found between R&D disclosure and each of, R&D expenditures to total sales (Zeghal et al., 2007; Nekhili et al., 2012; Nekhili et al., 2015), R&D expense to total operating expense (Entwistle, 1999; Abdelbadi and Elshandidy, 2013; Merkley, 2014). However, other studies cannot find a significant association between R&D disclosure, and each of R&D capitalised over total assets (Nor et al., 2010), amount of R&D expenses (La Rosa and Liberatore, 2014), R&D expenditures to total sales (Jones, 2007).

Liquidity measured by the logarithm of current ratio is positively associated with overall R&D disclosure at the 1% level. This result is in the line with the argument that managers of highly-liquid firms will introduce more disclosure to signal their ability in managing liquidity compared with managers in companies with low liquidity ratios (Elzahar and Hussainey, 2012). It is also consistent with the findings of Elshandidy et al., (2013) who confirm a positive association between the liquidity and voluntary risk disclosure. However, it is not consistent with Nor et al., (2010) who are not able to confirm any significant influence of liquidity on the level of R&D voluntary disclosure in annual reports.

The results also show a positive relationship between a firm's growth and R&D disclosure. This association is significant at the 5% level in both model (4) and model (6). This result supports the argument that firms with higher growth rates may have higher information asymmetry; so they have a greater incentive to disclose more information to reduce this information gap (Gul and Leung, 2004).

However, it is not consistent with the findings of La Rosa and Liberattore (2014) who confirm a negative association between the firm's growth, measured by market

to book ratio, and the level of R&D voluntary disclosure. It is also not in the line with Nekhili et al., (2012) who find a marginally negative impact of a firm's growth, measured by sales growth, on the level of R&D disclosure.

While the results indicate a strong positive relationship between R&D disclosure and leverage (LEV) in all models, which do not consider the industry effect, model (6) that controls for industry effect does not reveal any significant influence of leverage on R&D disclosure. The insignificant impact of leverage on R&D disclosure in annual reports is confirmed by many studies (e.g Entwistle, 1999; Zegal et al., 2007; Nor et al., 2010; Nekhili et al., 2012; Nekhili et al., 2015). However, other studies document a positive association between leverage and R&D disclosure (e.g. Merkley, 2014; La Rosa and Liberator, 2014).

The current study cannot find any significant association between R&D voluntary disclosures and profitability. Although the insignificant association between profitability and corporate disclosure does not support the arguments of signalling theory, which would suggest that a firm is more likely to provide information about its high profitability to investors (Watson et al., 2002). This result is in the line with the findings of Ahmed and Courtis, (1999) and La Rosa and Liberator, (2014).

However, it is inconsistent with some studies that provide evidence of a positive relationship between profitability and the level of disclosure (e.g. Cerbioni and Parbonetti, 2007; Li et al., 2012), and other studies that find a negative association between profitability and R&D disclosure (e.g. Abdelbadie & Elshandidy, 2013; Merkly, 2014). Table 6.15 presents a comparative summary of the results of the prior studies that examined the determinants of R&D disclosure in annual reports based only on the corporate governance variables and corporate characteristics that are considered in the current study.

Table 6.15
Summary of the Findings of Prior Studies

Variables	Corporate Governance Variables							Control Variables					
	BS	**DUL**	**BI**	**BM**	**MONR**	**ONRC**	**AQUAL**	**SIZE**	**RD**	**LEV**	**PROFIT**	**LIQUID**	**GROW**
Entwistle (1999), Canada	NC	NC	NC	NC	NC	NC	NC	None	(+)	None	NC	NC	NC
Zeghal et al., (2007), Canada	NC	(-)	None	NC	NC	NC	NC	(+)	(+)	None	NC	NC	NC
Jones (2007) , US	NC	NC	NC	NC	NC	NC	NC	None	None	NC	NC	NC	NC
Nor et al., (2010), Malaysia	NC	None	None	NC	None	NC	NC	(-)	None	None	None	None	NC
Nekhili et al., (2012), France	NC	NC	NC	NC	None	None	NC	(+)	(+)	None	(-)	NC	(-)
Abdelbadie and Elshandidy (2013) UK	(+)	None	None	NC	NC	None	NC	(+)	(+)	(-)	(-)	NC	NC
Merkely (2014), US	NC	NC	NC	NC	NC	NC	NC	(+)	(+)	(+)	(-)	NC	NC
La Rosa and Liberator, (2014) 8 countries	NC	NC	NC	NC	NC	NC	NC	(+)	None	(+)	None	NC	(-)
Nekhili et al., (2015), France	None	None	None	NC	None	None	NC	(-)	(+)	None	None	NC	NC

(+) = positive ;
(-) = negative ;
None = not significant ;
NC = not considered in the study.

Variables: **BS =** Board size; **DUL** = Role duality; **BI**= Board independence; **BM**= Board meetings; **MONR**= Managerial ownership; **ONRC**= Ownership concentration; **AQUAL** = Audit committee quality; **SIZE =** Firm size; **RD**= R&D investments; **LEV** = Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH** = Firm's growth.

6.5.2. Tobit Regression Analysis (Total R&D Disclosure)

The Tobit model is known as a censored regression model, also called a limited dependent variable regression model because of the restriction put on the values of the dependent variable (Gujarati, 2003). It is assumed that a number of values of the dependent variable are grouped at a limiting value, usually zero (McDonald and Moffitt, 1980). The dependent variable in the current study is censored because 9.9% of the sample did not introduce any R&D disclosure in annual reports, therefore, their disclosure score is zero.

Table 6.16 presents the results of Tobit regression of the association between R&D voluntary disclosure and corporate governance, controlling for corporate characteristics, and considering the year and industry fixed effects.

Table 6.16
Tobit Regression Analysis (Total R&D Disclosure)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.066**	0.014	1.175***	0.007	1.166***	0.007	1.292***	0.003	1.427***	0.000
DUL			-7.565***	0.003	- 5.730**	0.033	-5.984**	0.025	-6.010**	0.023	-2.500	0.303
BI			0.081	0.165	0.064	0.273	-0.003	0.953	0.007	0.904	-0.052	0.356
BM			1.998	0.161	1.431	0.323	1.184	0.410	1.272	0.373	1.130	0.398
MONR					-1.413**	0.049	-1.445**	0.042	-1.434**	0.042	-0.930	0.145
ONRC					- 0.049	0.261	-0.045	0.299	-0.052	0.231	0.039	0.326
AQUAL							5.205***	0.002	4.997***	0.003	5.274***	0.001
Control Variables												
SIZE	-4.836***	0.000	-5.944***	0.000	- 6.347***	0.000	-6.466***	0.000	-6.677***	0.000	-4.843***	0.000
RD	9.090***	0.000	8.743***	0.000	8.543***	0.000	8.354***	0.000	8.344***	0.000	7.456***	0.000
LEV	0.121***	0.005	0.143***	0.001	0.135***	0.001	0.131***	0.002	0.130***	0.002	0.039	0.328
PROFIT	-0.013	0.818	0.002	0.962	0.004	0.932	-0.011	0.845	0.002	0.969	0.041	0.439
LIQUID	8.591***	0.000	8.491***	0.000	8.488***	0.000	8.786***	0.000	8.658***	0.000	5.913***	0.000
GROW	0.015	0.175	0.212*	0.064	0.026**	0.025	0.028**	0.015	0.032***	0.005	0.029***	0.005
Year Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Exclude		Include	
Constant	2.793	0.647	1.557	0.842	13.177	0.180	17.805*	0.071	21.396**	0.031	12.105	0.270
LR (chi2-Statistics)	260.96		280.39		285.39		294.63		301.37		420.65	
Prob (chi2-Statistics)	0.000		0.000		0.0000		0.0000		0.0000		0.0000	
Pseudo R2	0.0622		0.0668		0.0680		0.0702		0.0718		0.1002	
No. of observations	505		505		505		505		505		505	

- 50 left-censored observations RDDIS <=0 - 455 uncensored observations - 0 right-censored observations
- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS=**Board size; **DUL**=Role duality; **BI**= Board independence; **BM** = Board meetings ; **MONR**= Managerial ownership; **ONRC**=Ownership concentration; **AQUAL**=Audit committee quality ; **SIZE**= Firm size ; **RD** =R&D investments; **LEV**= Leverage; **PROFIT**=Profitability; **LIQUID**=Liquidity ; **GROWTH**= Firm's growth. (all variables are as defined in table 5.9).

The results of Tobit regression support the results of OLS regression. In terms of the main explanatory variables, there is a strong statistically significant positive influence of both board size and audit committee quality on the total R&D disclosure at the 1% level. Moreover, the role duality (DUL) shows a significant negative impact on R&D disclosure in all the models that have been examined in the current study except model, (6) which does not reveal any significant influence of role duality on R&D disclosure.

While the results cannot document any significant influence of board independence, board meetings, and ownership concentration on R&D disclosure, the findings reveal a moderate negative relationship between managerial ownership and R&D disclosure. This relationship is significant at the level 5% in all examined models, except in model (6) that controls for industry effect.

Considering control variables, two were found to have a strong positive significant association with R&D disclosure. These variables are R&D investments, and liquidity. However, a strong negative relationship is detected between firm size and R&D disclosure. Furthermore, the results are also identical with the results of OLS regression regarding to the leverage and profitability. The only difference is related to the coefficient of firm's growth that was found to be significant at the 1% level according to the results of Tobit regression, and at the 5% level according to the results of OLS regression.

A summary of the results of the statistical techniques that have been employed in the current study is presented in table 6.17.

Table 6.17
Summary of Hypotheses Test

Variables	H	Expected Sign	Model (4)		Model (6)	
			OLS	Tobit	OLS	Tobit
Corporate Governance						
BS	H1	+	+ (S)	+ (S)	+ (S)	+(S)
DUL	H2	-	- (M)	- (M)	None	None
BI	H3	+	None	None	None	None
BM	H4	+	None	None	None	None
MONR	H5	-	- (M)	- (M)	None	None
ONRC	H6	-	None	None	None	None
AQUAL	H7	+	+ (S)	+ (S)	+ (S)	+ (S)
Control Variables						
SIZE			- (S)	- (S)	- (S)	- (S)
RD			+ (S)	+ (S)	+(S)	+ (S)
LEV			+ (S)	+(S)	None	None
PROFIT			None	None	None	None
LIQUID			+ (S)	+ (S)	+ (S)	+ (S)
GROW			+ (M)	+ (M)	+ M)	+ (S)

(S) = significant at 0.01 level;
(M) = significant at 0.05 level;
(W) = significant at 0.10 level;
None = no significant association.

6.5.3. Regression Analysis of R&D Disclosure Types

This section presents the results of regression analysis of the association between corporate governance and each of R&D financial disclosure and R&D non-financial disclosure.

6.5.3.1. R&D Financial Disclosure

The next paragraphs discuss the findings of the analysis of the relationship between R&D financial disclosure and corporate governance, controlling for firm characteristics and considering the year and industry effects. Both OLS and Tobit regressions are employed. Table 6.18 reports the results of OLS regression. The table shows the following results:

Model (1) presents the association between R&D financial disclosure and the six control variables. The results show a significant negative association between firm

size and R&D financial disclosure at the 1% level. The results also indicate a significant positive relationship between R&D financial disclosure and each of R&D investments at the 1% level, profitability at the 5% level, and liquidity at 1% level. However, leverage and firm growth have no significant influence on R&D financial disclosure.

Model (2) includes the board characteristics, in addition to the control variables, the adjusted R Squared increases from 28.79% in model (1) to 32% in model (2).

Regarding the influence of board characteristics on R&D financial disclosure, the results reveal that there is a strong positive association between board size and R&D financial disclosure at the 1% level. Moreover, the R&D financial disclosure is negatively related to role duality at the 1% level, while, the frequency of board meetings is positively associated with the R&D financial disclosure at the 5% level. No significant impact of board independence on R&D financial disclosure is detected.

Model (3) shows the impact of ownership structure, in addition to, board characteristics and control variables on R&D financial disclosure. The results indicate that, both managerial ownership and ownership concentration have insignificant association with the R&D financial disclosure.

Model (4) includes audit committee quality, as well as all other corporate governance and control variables, which are examined in the current study. Surprisingly, while the results show a strong positive association between the audit committee quality and the overall R&D voluntary disclosure at the 1% level, the

audit committee quality does not have any significant influence on the R&D financial disclosure.

Model (5) explains the association between the same variables that are included in model (4), with a consideration of the year fixed effect by including two dummy variables for year.

Model (6) presents the results of the relationship between R&D financial disclosure and corporate governance, controlling for corporate characteristics, and considering the year and industry fixed effects.

Regarding the effects of corporate governance on R&D financial disclosure, the results show that, both board size and frequency of board meetings have a positive association with R&D financial disclosure at the 1% level and 10% level respectively. Role duality is associated negatively with R&D financial disclosure at the 1% level. However, no significance is detected for other corporate governance variables.

The results concerning the control variables show that, both R&D investments and liquidity are positively associated with R&D financial disclosure at the 1% level. Profitability is also positively associated with R&D financial disclosure but at the 5% level. Finally, Firm size is negatively associated with R&D financial disclosure at the 1% level. However, no significance is detected for other control variables.

Table 6.19 reports the results of Tobit regression concerning the relationship between R&D financial disclosure and corporate governance, controlling for firm characteristics, and considering the effects of the year and industry.

Table 6.18
OLS Regression (R&D Financial Disclosure) [10]

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.167***	0.008	1.198***	0.007	1.195***	0.007	1.270***	0.004	1.275***	0.003
DUL			-9.856***	0.000	-10.148***	0.000	-10.215***	0.000	-10.259***	0.000	-7.877***	0.003
BI			0.048	0.417	0.051	0.391	0.034	0.597	0.041	0.520	-0.014	0.811
BM			3.080**	0.034	3.265**	0.028	3.205**	0.031	3.245**	0.030	2.521*	0.083
MONR					0.432	0.557	0.423	0.565	0.432	0.557	0.703	0.313
ONRC					-0.034	0.449	-0.033	0.463	-0.036	0.419	0.018	0.668
AQUAL							1.308	0.458	1.177	0.505	1.958	0.243
Control Variables												
SIZE	-3.105***	0.000	-4.254***	0.000	-4.408***	0.000	-4.434***	0.000	-4.560***	0.000	-2.561***	0.003
RD	7.507***	0.000	7.149***	0.000	7.120***	0.000	7.071***	0.000	7.068***	0.000	6.021***	0.000
LEV	0.059	0.179	0.085**	0.050	0.086**	0.047	0.085*	0.051	0.085**	0.050	0.060	0.162
PROFIT	0.122**	0.042	0.138**	0.019	0.131**	0.027	0.127**	0.033	0.135**	0.024	0.122**	0.035
LIQUID	5.672***	0.001	5.634***	0.001	5.511***	0.001	5.588***	0.001	5.527***	0.001	4.149***	0.009
GROW	0.003	0.747	0.009	0.398	0.009	0.436	0.009	0.414	0.012	0.293	0.007	0.535
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	-10.576*	0.091	-13.375	0.093	-11.198	0.266	-10.048	0.324	-7.847	0.445	-14.385	0.227
Adj. R Square (R^2)	0.2879		0.3200		0.3185		0.3179		0.3185		0.4077	
F-Statistics	34.96		24.71		20.63		19.07		16.70		16.08	
Prob (F-Statistics)	0.000		0.000		0.000		0.000		0.000		0.000	
No. of observations	505		505		505		505		505		505	

- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS=**Board size;**DUL**=Role duality; **BI**=Board independence; **BM**= Board meetings; **MONR**=Managerial ownership;**ONRC**=Ownership concentration; **AQUAL**=Audit committee quality; **SIZE** = Firm size; **RD**=R&D investments; **LEV**= Leverage ; **PROFIT**=Profitability ; **LIQUID**=Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

[10] In addition to the main analysis, the OLS regression with robust standard error is carried out, and the results are virtually identical.

Table 6.19
Tobit Regression (R&D Financial Disclosure) [11]

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.615**	0.018	1.657**	0.016	1.165**	0.016	1.758**	0.011	2.302***	0.001
DUL			-18.845***	0.000	-19.597***	0.000	-19.811***	0.000	-19.677***	0.000	-14.723***	0.001
BI			0.126	0.180	0.129	0.169	0.093	0.353	0.101	0.314	0.033	0.722
BM			4.640**	0.043	4.984**	0.033	4.855**	0.038	4.895**	0.036	2.666	0.226
MONR					0.838	0.475	0.820	0.485	0.844	0.471	1.053	0.339
ONRC					-0.056	0.433	-0.054	0.447	-0.061	0.395	0.034	0.615
AQUAL							2.911	0.286	2.736	0.315	2.983	0.240
Control Variables												
SIZE	-5.108***	0.000	-6.756***	0.000	-6.995***	0.000	-7.081***	0.000	-7.250***	0.000	-5.405***	0.000
RD	11.429***	0.000	10.820***	0.000	10.791***	0.000	10.704***	0.000	10.689***	0.000	9.717***	0.000
LEV	0.111	0.104	0.144**	0.031	0.147**	0.028	0.145**	0.031	0.144**	0.031	0.112*	0.089
PROFIT	0.180*	0.056	0.205**	0.027	0.193**	0.038	0.184**	0.049	0.193**	0.039	0.175**	0.050
LIQUID	7.530***	0.003	7.573***	0.003	7.411***	0.003	7.546***	0.003	7.396***	0.003	3.809	0.119
GROW	0.002	0.889	0.009	0.634	0.008	0.690	0.009	0.649	0.013	0.508	0.011	0.577
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	-29.448***	0.003	-35.395***	0.005	-32.229**	0.042	-29.640*	0.064	-26.412	0.101	-21.813	0.229
LR (chi^2-Statistics)	164.69		196.12		197.31		198.45		200.23		293.88	
Prob (chi^2-Statistics)	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.0492		0.0586		0.0589		0.0593		0.0598		0.0878	
No. of observations	505		505		55		505		505		505	

- 193 left-censored observations F-DIS<=0 - 312 uncensored observations - 0 right-censored observations
- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS=**Board size; **DUL**= Role duality; **BI** = Board independence; **BM** = Board meetings; **MONR** = Managerial ownership; **ONRC** = Ownership concentration; **AQUAL** = Audit committee quality; **SIZE** = Firm size; **RD** = R&D investments; **LEV** = Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH**= Firm's growth. (all variables are as defined in table 5.9).

[11] In addition to the main analysis, the TOBIT regression with robust standard error is carried out, and the results are virtually identical.

In general, the results of Tobit regression support the findings of OLS regression regarding the impact of most independent variables. In terms of corporate governance variables, the results of Tobit regression show that the board size is significantly positively associated with R&D financial disclosure at the 5% level in all models except model (6) which reveals the same relationship but at the 1% level. The results of OLS regression suggest a positive relationship between board size and R&D financial disclosure at the 1% level in all models.

Both OLS regression and Tobit regression show a significant positive relationship between the frequency of board meetings and R&D financial disclosure at the 5% level. However, after controlling for the industry effect, this relationship turns out to be insignificant (as suggested by Tobit regression), and less significant (as suggested by OLS regression).

The results of OLS regression and Tobit regression are identical regarding the strong negative association between role duality and R&D financial disclosure and the insignificant impact of other corporate governance variables on the R&D financial disclosure.

In respect to control variables, the results of Tobit regression show a positive significant association between R&D financial disclosure and each of R&D investments, and profitability at the level 1% and 5% respectively. The results of Tobit regression also confirm the findings of OLS regression concerning the strong negative influence of firm size on R&D financial disclosure. Both OLS regression and Tobit regression could not find any association between the R&D financial disclosure and firm growth.

The main difference between the results of the two techniques is related to liquidity. While, after controlling for the industry effect, the findings of OLS regression show a strong positive influence of liquidity on R&D financial disclosure, the results of Tobit regression could not find any significant association between R&D financial disclosure and liquidity. A summary of the results regarding R&D financial disclosure is summarised in table 6.20.

Table 6.20
Summary of the Results of R&D Financial Disclosure

Variables	Model (4) Full Model		Model (6) Full Model with the Year and Industry Dummies	
	OLS	**Tobit**	**OLS**	**Tobit**
Corporate Governance				
BS	+ (S)	+ (M)	+ (S)	+ (S)
DUL	- (S)	- (S)	- (S)	- (S)
BI	None	None	None	None
BM	+ (M)	+(M)	+ (W)	None
MONR	None	None	None	None
ONRC	None	None	None	None
AQUAL	None	None	None	None
Control Variables				
SIZE	- (S)	- (S)	- (S)	- (S)
RD	+ (S)	+ (S)	+ (S)	+ (S)
LEV	+ (W)	+ (M)	None	+ (W)
PROFIT	+ (M)	+ (M)	+ (M)	+ (M)
LIQUID	+ (S)	+ (S)	+ (S)	None
GROW	None	None	None	None

(S) = significant at 0.01 level ;
(M) = significant at 0.05 level ;
(W) = significant at 0.10 level ;
None = no significant association.

6.5.3.2. R&D Non-financial Disclosure.

The next paragraphs discuss the findings of the analysis of the relationship between R&D non-financial disclosure and corporate governance, controlling for firm characteristics and considering the year and industry effects. Both OLS and Tobit regressions are employed. Table 6.21 reports the results of OLS regression. The table shows the following results:

Model (1) presents the association between R&D non-financial disclosure and the six control variables. The results indicate a significant positive relationship between R&D non-financial disclosure and each of R&D investments, leverage and liquidity at the 1% level. The results also show a strong significant negative association between firm size and R&D non-financial disclosure. Other control variables do not have any significant influence on R&D non-financial disclosure.

Model (2) includes board characteristics, in addition to, control variables. Regarding the influence of board characteristics on R&D non-financial disclosure, board size is positively associated with R&D non-financial disclosure at the 5% level. Moreover, there is a significant negative relationship between role duality and R&D non-financial disclosure at the 5% level. However, no significant association is found between R&D non-financial disclosure and each of board independence and frequency of board meetings.

Model (3) shows the impact of ownership structure, in addition to, board characteristics and control variables on R&D non-financial disclosure. While, managerial ownership is negatively significantly associated with the R&D non-financial disclosure at the 1% level, the coefficient of ownership concentration is negative but not significant.

Model (4) includes audit committee quality, as well as, all other corporate governance and control variables considered in the current study. In the line with the results regarding the overall R&D disclosure, audit committee quality has a significant positive influence on R&D non-financial disclosure at the 1% level.

Model (5) shows the association between the same variables that are included in model (4), considering the year fixed effect by including two dummy variables for year.

Model (6) presents the results of the relationship between R&D non-financial disclosure and corporate governance, controlling for corporate characteristics, and considering the year and industry fixed effects.

In terms of the impact of corporate governance on R&D non-financial disclosure, the results show that, both board size and audit committee quality have a significant positive influence on R&D non-financial disclosure at the 1% level. A significant negative association is found between managerial ownership and R&D non-financial disclosure. However, no significance is detected for other corporate governance variables.

Finally, for control variables, three variables have a strong significant association with R&D non-financial disclosure at the 1% level. These variables are firm size, R&D investments and liquidity. While, firm size is negatively associated with R&D non-financial disclosure, both R&D investments and liquidity have a positive influence on it. There is also a relatively less significant positive association between R&D non-financial disclosure and firm's growth at the 5% level.

Table 6.21
OLS Regression (R&D Non-financial Disclosure) [12]

Independent Variables	Model (1)		Model(2)		Model(3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			0.987**	0.035	1.106**	0.019	1.090**	0.019	1.227***	0.009	1.163***	0.008
DUL			-6.171**	0.026	-3.730	0.199	-4.016	0.163	-4.090	0.154	-1.107	0.681
BI			0.065	0.304	0.042	0.512	-0.033	0.622	-0.021	0.757	-0.080	0.213
BM			2.007	0.197	1.191	0.451	0.929	0.553	1.043	0.505	1.467	0.326
MONR					-2.040***	0.009	-2.077***	0.008	-2.061***	0.008	-1.513**	0.035
ONRC					-0.043	0.368	-0.038	0.417	-0.045	0.337	0.047	0.290
AQUAL							5.666***	0.002	5.457***	0.003	5.808***	0.001
Control Variables												
SIZE	-4.796***	0.000	-5.823***	0.000	-6.248***	0.000	-6.358***	0.000	-6.594***	0.000	-4.704***	0.000
RD	8.840***	0.000	8.545***	0.000	8.313***	0.000	8.101***	0.000	8.096***	0.000	7.282***	0.000
LEV	0.121***	0.009	0.141***	0.002	0.131***	0.005	0.126***	0.006	0.126***	0.006	0.015	0.727
PROFIT	-0.076	0.228	-0.060	0.336	-0.054	0.394	-0.071	0.257	-0.056	0.371	0.0009	0.987
LIQUID	9.303***	0.000	9.238***	0.000	9.295***	0.000	9.629***	0.000	9.501***	0.000	6.665***	0.000
GROW	0.016	0.178	0.022*	0.080	0.028**	0.025	0.030**	0.015	0.035***	0.005	0.030**	0.011
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	8.397	0.203	6.949	0.415	20.414 *	0.057	25.393**	0.018	29.207***	0.007	15.589	0.204
Adj. R Square ($R^{2)}$	0.3652		0.3757		0.3825		0.3927		0.3990		0.4969	
F-Statistics	49.32		31.33		27.02		26.07		23.30		22.64	
Prob (F-Statistics)	0.000		0.000		0.000		0.000		0.000		0.000	
No. of observations	505		505		505		505		505		505	

– *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.

– Variables:**BS =** Board size; **DUL**= Role duality; **BI**= Board independence; **BM**= Board meetings; **MONR**= Managerial ownership; **ONRC** = Ownership concentration; **AQUAL** = Audit committee quality; **SIZE** = Firm size; **RD** =R&D investments; **LEV**= Leverage; **PROFIT**= profitability; **LIQUID** = Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

[12] In addition to the main analysis, the OLS regression with robust standard error is carried out, and the results are virtually identical.

Table 6.22 reports the results of Tobit regression concerning the relationship between R&D non-financial disclosure and corporate governance, controlling for firm characteristics, and considering the effects of the year and industry.

In terms of the impact of corporate governance on R&D non-financial disclosure, both board size and audit committee quality have a positive significant association with R&D non-financial disclosure. Moreover, managerial ownership has a marginally negative association with R&D non-financial disclosure. However, the results of Tobit regression do not reveal any significant influence of other corporate governance variables on R&D non-financial disclosure.

Regarding control variables, the results of Tobit regression show a significant positive association between R&D non-financial disclosure and each of, R&D investments and liquidity at the 1% level in all models. Moreover, R&D non-financial disclosure is negatively associated with firm size at the 1% level in all models.

While the results reveal that leverage has a positive significant influence on R&D non-financial disclosure, this significant relation is not detected after controlling for the effect of industry.

Furthermore, the results indicate a positive significant association between R&D non-financial disclosure and firm's growth. However, no significant association is found between R&D non-financial disclosure and profitability. A summary of the results regarding R&D non-financial disclosure is found in table 6.23.

Table 6.22

Tobit Regression (R&D non-financial Disclosure) [13]

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			0.949*	0.066	1.089**	0.036	1.077**	0.036	1.222**	0.017	1.343***	0.005
DUL			-6.479**	0.034	-3.874	0.224	-4.194	0.185	-4.225	0.178	-0.365	0.900
BI			0.090	0.198	0.066	0.348	-0.021	0.776	-0.008	0.908	-0.073	0.285
BM			1.621	0.341	0.782	0.650	0.467	0.785	0.576	0.735	0.738	0.645
MONR					-2.080**	0.015	-2.121**	0.012	-2.107**	0.012	-1.498*	0.051
ONRC					-0.556	0.292	-0.050	0.334	-0.058	0.262	0.046	0.337
AQUAL							6.648***	0.001	6.414***	0.002	6.628***	0.000
Control Variables												
SIZE	-5.409***	0.000	-6.439***	0.000	-6.932***	0.000	-7.082***	0.000	-7.328***	0.000	-5.411***	0.000
RD	9.551***	0.000	9.243***	0.000	8.979***	0.000	8.736***	0.000	8.726***	0.000	7.827***	0.000
LEV	0.136***	0.008	0.156***	0.002	0.145***	0.004	0.139***	0.006	0.138***	0.006	0.019	0.690
PROFIT	-0.065	0.342	-0.050	0.462	-0.045	0.510	-0.066	0.334	-0.050	0.459	0.006	0.924
LIQUID	9.582***	0.000	9.483***	0.000	9.521***	0.000	9.904***	0.000	9.748***	0.000	6.571***	0.000
GROW	0.019	0.150	0.024*	0.070	0.031**	0.022	0.034**	0.013	0.039***	0.004	0.036***	0.004
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	8.318	0.250	7.216	0.439	22.277*	0.057	28.199**	0.016	32.288***	0.006	20.320	0.123
LR (chi^2-Statistics)	224.93		236.01		242.85		253.47		259.75		372.64	
Prob (chi^2-Statistics)	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.0525		0.0550		0.0566		0.0591		0.0606		0.0869	
No. of observations	505		505		505		505		505		505	

- 54 left-censored observations NF-DIS< =0 - 451 uncensored observations - 0 right-censored observations
- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS**=Board size; **DUL** = Role duality; **BI** = Board independence; **BM**= Board meetings; **MONR** = Managerial ownership; **ONRC**= Ownership concentration; **AQUAL**=Audit committee quality; **SIZE** = Firm size ; **RD** =R&D investments; **LEV**= Leverage; **PROFIT**=Profitability ; **LIQUID** =Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

[13] In addition to the main analysis, the TOBIT regression with robust standard error is carried out, and the results are virtually identical.

Table 6.23 shows that there is an agreement between the results of OLS regression and Tobit regression. The sign of the coefficients is identical according to the results of the two techniques. The only difference is related to the level of significance of some relations.

Table 6.23
Summary of the Results of the R&D Non-financial Disclosure

Variables	Model (4)		Model (6)	
	OLS	**Tobit**	**OLS**	**Tobit**
Corporate Governance				
BS	+ (M)	+ (M)	+ (S)	+ (S)
DUL	None	None	None	None
BI	None	None	None	None
BM	None	None	None	None
MONR	- (S)	- (M)	- (M)	- (W)
ONRC	None	None	None	None
AQUAL	+ (S)	+ (S)	+ (S)	+ (S)
Control Variables				
SIZE	- (S)	- (S)	- (S)	- (S)
RD	+ (S)	+ (S)	+ (S)	+ (S)
LEV	+ (S)	+ (S)	None	None
PROFIT	None	None	None	None
LIQUID	+ (S)	+ (S)	+ (S)	+ (S)
GROW	+ (M)	+ (M)	+ (M)	+ (S)

(S) = significant at 0.01 level;
(M) = significant at 0.05 level;
(W)= significant at 0.10 level;
None = no significant association.

6.6. FURTHER ANALYSIS

The next paragraphs introduce the sensitivity analysis for the full model, dependent and independent variables.

6.6.1. Sensitivity Tests for the Full Model

The sensitivity analysis of the full model includes carrying out the analysis using robust standard errors, in addition to clustering the standard errors at the firm level.

6.6.1.1. The Analysis with Robust Standard Error

King and Roberts (2015:177), state that*"The bigger the difference robust Standard errors make, the stronger the evidence for misspecification"*. And added (p.177) *"If you have succeeded in choosing a better model, your robust and classical standard errors should now approximately coincide."*.

In this sensitivity analysis, the analysis is carried out using robust standard errors. Table 6.24 presents the results of OLS regression with robust standard errors. Table 6.25 presents the results of Tobit regression with robust standard errors. Table 6.26 presents the comparison between the results of the main analysis using both OLS regression and Tobit regression, and the results of the sensitivity analysis using both OLS regression and Tobit regression with robust standard errors.

Regarding model (4) that contains all corporate governance variables and control variables, there are no considerable differences between the main OLS regression findings and the results of OLS regression using robust standard errors. The coefficients show the same direction for all variables. The significance levels are the same for all variables except for role duality and firm's growth, where the significance level increases from the 5% level to the 1% level after employing robust standard errors.

Moreover, there are no substantial differences between the main Tobit regression findings and the results of Tobit regression using robust standard errors. The coefficients show the same direction for all variables. The significance levels differ for only two variables: board size and firm's growth. After using robust standard errors, the significance level for board size decreases from the 1% level to the 5%

level and the significance level for firm growth increase from the 5% level to the 1% level.

Regarding model (6) which includes all corporate governance and control variables, in addition to the year and industry dummy variables, the results of OLS regression with robust standard errors confirm the findings of the main analysis regarding the sign of the coefficients and the levels of the significance for all variables. The findings of Tobit regression with robust standard errors also confirm the results of the main analysis.

From the above discussion, it can be concluded that, there is agreement between the results of the analysis performed using classical standard error, and the findings of the analysis carried out with robust standard error. As indicating by King and Roberts (2015), this agreement can be considered as an indicator of the robustness of the findings.

Table 6.24
OLS Regression Analysis with Robust Standard Error

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	P-value (t)	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.036**	0.012	1.131***	0.005	1.118***	0.006	1.239***	0.002	1.193***	0.001
DUL			-7.163***	0.000	-5.548***	0.007	-5.685***	0.005	-5.751**	0.018	-2.930	0.195
BI			0.061	0.194	0.044	0.349	-0.015	0.756	-0.004	0.942	-0.062	0.246
BM			2.296*	0.052	1.749	0.158	1.542	0.216	1.636	0.217	1.751	0.163
MONR					-1.374**	0.017	-1.404**	0.012	-1.390**	0.034	-0.916	0.128
ONRC					-0.040	0.268	-0.037	0.314	-0.043	0.283	0.039	0.292
AQUAL							4.492***	0.005	4.305***	0.006	4.772***	0.001
Control Variables												
SIZE	-4.341***	0.000	-5.401***	0.000	-5.753***	0.000	-5.840***	0.000	-6.046***	0.000	-4.127***	0.000
RD	8.481***	0.000	8.169***	0.000	7.992***	0.000	7.824***	0.000	7.819***	0.000	6.942***	0.000
LEV	0.104***	0.006	0.126***	0.001	0.119***	0.001	0.115***	0.001	0.115***	0.003	0.027	0.459
PROFIT	-0.022	0.622	-0.007	0.872	-0.004	0.928	-0.017	0.692	-0.004	0.930	0.033	0.502
LIQUID	8.325***	0.000	8.268***	0.000	8.276***	0.000	8.541***	0.000	8.431***	0.000	5.988***	0.000
GROW	0.013	0.144	0.018**	0.034	0.023***	0.001	0.025***	0.000	0.029***	0.000	0.023**	0.016
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	3.289	0.543	1.477	0.824	11.903	0.141	15.851**	0.050	19.231**	0.036	7.519	0.464
R- Squared (R^2)	0.4177		0.4415		0.4474		0.4564		0.4483		0.5671	
F-Statistics	74.44		49.94		44.08		40.49		28.31		27.39	
Prob (F-Statistics)	0.000		0.0000		0.0000		0.000		0.000		0.000	
No. of observations	505		505		505		505		505		505	

– *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
– Variables: **BS =** Board size; **DUL** = Role duality; **BI**= Board independence; **BM**= Board meetings; **MONR**= Managerial ownership; **ONRC**= Ownership concentration; **AQUAL** = Audit committee quality; **SIZE** = Firm size; **RD** =R&D investments; **LEV** = Leverage; **PROFIT** = Profitability; **LIQUID** =Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.25
Tobit Regression with Robust Standard Error

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.066**	0.024	1.175**	0.011	1.166**	0.012	1.292***	0.006	1.427***	0.000
DUL			-7.565***	0.001	-5.73**	0.016	-5.984**	0.011	-6.010**	0.012	-2.500	0.316
BI			0.081	0.117	0.064	0.218	-0.003	0.944	0.007	0.888	-0.052	0.323
BM			1.998	0.119	1.413	0.289	1.184	0.382	1.272	0.349	1.130	0.414
MONR					-1.413**	0.024	-1.445**	0.019	-1.434**	0.021	-0.930	0.130
ONRC					-0.049	0.234	-0.045	0.276	-0.052	0.210	0.039	0.287
AQUAL							5.205***	0.003	4.997***	0.004	5.274***	0.001
Control Variables												
SIZE	-4.836***	0.000	-5.944***	0.000	-6.347***	0.000	-6.466***	0.000	-6.677***	0.000	-4.843***	0.000
RD	9.092***	0.000	8.743***	0.000	8.543***	0.000	8.354***	0.000	8.344***	0.000	7.456***	0.000
LEV	0.121***	0.002	0.143***	0.000	0.135***	0.001	0.131***	0.001	0.130***	0.001	0.039	0.272
PROFIT	-0.013	0.792	0.002	0.955	0.004	0.920	-0.011	0.819	0.002	0.964	0.041	0.318
LIQUID	8.591***	0.000	8.491***	0.000	8.488***	0.000	8.786***	0.000	8.658***	0.000	5.913***	0.000
GROW	0.015*	0.078	0.021**	0.015	0.026***	0.000	0.028***	0.000	0.032***	0.000	0.029***	0.000
Year Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Exclude		Include	
Constant	2.793	0.628	1.557	0.829	13.177	0.133	17.805**	0.043	21.396**	0.014	12.105	0.254
F-Statistics	63.73		43.15		38.25		34.90		32.08		33.87	
Prob (F-Statistics)	0.000		0.000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.0622		0.0668		0.0680		0.0702		0.0718		0.1002	
No. of observations	505		505		505		505		505		505	

– 50 left-censored observations RDDIS < =0 - 455 uncensored observations - 0 right-censored observations

– *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.

– Variables: **BS =** Board size; **DUL** = Role duality; **BI**= Board independence; **BM**= Board meetings; **MONR**= Managerial ownership; **ONRC** = Ownership concentration; **AQUAL** =Audit committee quality; **SIZE** = Firm size; **RD** = R&D investments; **LEV** = Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.26
Summary of the Results of Analysis with Robust Standard Error

Variables	H	Expected Sign	Model (4)				Model (6)			
			OLS	OLS (Robust)	Tobit	Tobit (Robust)	OLS	OLS (Robust)	Tobit	Tobit (Robust)
Corporate Governance										
BS	H1	+	+ (S)	+ (S)	+ (S)	+ (M)	+ (S)	+ (S)	+ (S)	+ (S)
DUL	H2	-	- (M)	- (S)	- (M)	- (M)	None	None	None	None
BI	H3	+	None	None	None	None	None	None	None	None
BM	H4	+	None	None	None	None	None	None	None	None
MONR	H5	-	- (M)	- (M)	- (M)	- (M)	None	None	None	None
ONRC	H6	-	None	None	None	None	None	None	None	None
AQUAL	H7	+	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
Control Variables										
SIZE			- (S)	- (S)	- (S)	- (S)	- (S)	- (S)	- (S)	- (S)
RD			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
LEV			+ (S)	+ (S)	+ (S)	+ (S)	None	None	None	None
PROFIT			None	None	None	None	None	None	None	None
LIQUID			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
GROW			+ (M)	+ (S)	+ (M)	+ (S)	+ (M)	+ (M)	+ (S)	+ (S)

(S) = significant at 0.01 level;
(M) = significant at 0.05 level;
(W) = significant at 0.10 level;
None = no significant association.

6.6.1.2. The Analysis with Clustering the Standard Error at the Firm Level

To account for the changes associated with the individual firms, a sensitivity analysis is carried out with clustering the standard error at the firm level.

Petersen (2009) argues that, in the panel data set the residual may be correlated across time and across firms, so the clustered standard error is used to account for this possible correlation. He suggests that when the panel data set has more firms than years, it is common to include dummy variables for each year and then clustered by the firm . This approach will be used in the following analysis.

Petersen (2009) suggestes that, since the OLS standard errors can be biased because the residuals may be correlated across time or across firms, the researchers can use techniques such as fixed effect or GLS to test whether their model is correctly

specified. After evaluating the methods that are applied in the empirical literature to estimate the standard error when the residuals are correlated across years or firms. Petersen (2009:475) stated that *"The standard errors clustered by firm are unbiased and produce correctly sized confidence intervals whether the firm effect is permanent or temporary, The fixed effect and random effects model also produces unbiased standard errors but only when the firm effect is permanent ".*

Table 6.27 presents the results of OLS regression with clustering the standard error at the firm level. Table 6.28 presents the results of Tobit regression with clustering the standard error at the firm level. Table 6.29 presents the comparison between the results of the main analysis using both OLS regression and Tobit regression, and the results of the sensitivity analysis using both OLS regression and Tobit regression with clustering the standard error at the firm level.

From table 6.29, it can be noticed that, generally, there is agreement between the results of the analysis performed using classical standard error, and the findings of the analysis carried out with clustering the standard error at the firm level.

This agreement can be considered as an indicator that the model is correctly specified, and the unobserved time effect or firm effect does not influence the findings.

Table 6.27
OLS Regression Analysis with (Clustering the Standard Error at the Firm Level)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	P-value (t)	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.036*	0.092	1.131*	0.058	1.118*	0.063	1.239**	0.043	1.193**	0.013
DUL			-7.163***	0.005	-5.458**	0.034	-5.685**	0.025	-5.751**	0.028	-2.930	0.274
BI			0.061	0.301	0.044	0.451	-0.015	0.789	-0.004	0.943	-0.062	0. 270
BM			2.296	0.144	1.749	0.295	1.542	0.357	1.636	0.329	1.751	0.305
MONR					-1.374*	0.089	-1.404*	0.076	-1.390*	0.090	-0.916	0.242
ONRC					-0.040	0.419	-0.037	0.459	-0.043	0.394	0.039	0.364
AQUAL							4.492**	0.025	4.305**	0.032	4.772***	0.007
Control Variables												
SIZE	-4.341***	0.000	-5.401***	0.000	-5.753***	0.000	-5.840***	0.000	-6.046***	0.000	-4.127***	0.000
RD	8.481***	0.000	8.169***	0.000	7.992***	0.000	7.824***	0.000	7.819***	0.000	6.942***	0.000
LEV	0.104*	0.054	0.126**	0.015	0.119**	0.020	0.115**	0.024	0.115**	0.026	0.027	0.562
PROFIT	-0.022	0.680	-0.007	0.892	-0.004	0.939	-0.017	0.734	-0.004	0.929	0.033	0.450
LIQUID	8.325***	0.000	8.268***	0.000	8.276***	0.000	8.541***	0.000	8.431***	0.000	5.988***	0.001
GROW	0.013	0.140	0.018**	0.033	0.023***	0.001	0.025***	0.000	0.029***	0.000	0.023***	0.000
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	3.289	0.678	1.477	0.869	11.903	0.282	15.851	0.153	19.231*	0.083	7.519	0.595
R- Squared (R^2)	0.4177		0.4415		0.4474		0.4564		0.4648		0.5671	
F-Statistics	32.61		23.62		21.09		19.40		18.71		20.64	
Prob (F-Statistics)	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
No. of observations	505		505		505		505		505		505	

- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS =** Board size; **DUL** = Role duality; **BI** = Board independence; **BM**= Board meetings; **MONR** = Managerial ownership; **ONRC**= Ownership concentration; **AQUAL**=Audit committee quality; **SIZE**= Firm size; **RD** =R&D investments; **LEV**= Leverage; **PROFIT**=Profitability; **LIQUID** =Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.28
Tobit Regression with (Clustering the Standard Error at the Firm Level)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.066	0.123	1.175*	0.080	1.166*	0.084	1.292*	0.059	1.427***	0.008
DUL			-7.565**	0.011	-5.730*	0.058	-5.984**	0.045	-6.010**	0.048	-2.500	0.434
BI			0.081	0.223	0.064	0.332	-0.003	0.953	0.007	0.906	-0.052	0.385
BM			1.998	0.236	1.413	0.427	1.184	0.512	1.272	0.480	1.130	0.528
MONR					-1.413	0.107	-1.445*	0.092	-1.434	0.105	-0.930	0.278
ONRC					-0.049	0.375	-0.045	0.413	-0.052	0.352	0.039	0.404
AQUAL							5.205**	0.017	4.997**	0.022	5.274***	0.004
Control Variables												
SIZE	-4.836***	0.000	-5.944***	0.000	-6.347***	0.000	-6.466***	0.000	-6.677***	0.000	-4.843***	0.000
RD	9.092***	0.000	8.743***	0.000	8.543***	0.000	8.354***	0.000	8.344***	0.000	7.456***	0.000
LEV	0.121**	0.031	0.143***	0.008	0.135**	0.012	0.131**	0.014	0.130**	0.015	0.039	0.424
PROFIT	-0.013	0.825	0.002	0.962	0.004	0.932	-0.011	0.844	0.002	0.969	0.041	0.379
LIQUID	8.591***	0.000	8.491***	0.000	8.488***	0.000	8.786***	0.000	8.658***	0.000	5.913***	0.001
GROW	0.015*	0.079	0.021**	0.016	0.026***	0.000	0.028***	0.000	0.032***	0.003	0.029***	0.000
Year Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Exclude		Include	
Constant	2.793	0.740	1.557	0.872	13.177	0.272	17.805	0.139	21.396*	0.076	12.105	0.414
F-Statistics	28.68		20.61		18.41		16.87		16.33		18.04	
Prob (F-Statistics)	0.000		0.000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.0622		0.0668		0.0680		0.0702		0.0718		0.1002	
No. of observations	505		505		505		505		505		505	

- 50 left-censored observations RDDIS < = 0 - 455 uncensored observations - 0 right-censored observations
- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS =** Board size; **DUL** = Role duality; **BI** = Board independence; **BM** = Board meetings; **MONR** = Managerial ownership; **ONRC**= Ownership concentration; **AQUAL** = Audit committee quality; **SIZE** = Firm size; **RD** = R&D investments; **LEV** = Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.29
Summary of the Results of Analysis (Clustering the Standard Error at the Firm Level)

Variables	H	Expected Sign	Model (4)				Model (6)			
			OLS	OLS (Clustering the Standard Error at the Firm Level)	Tobit	Tobit (Clustering the Standard Error at the Firm Level)	OLS	OLS (Clustering the Standard Error at the Firm Level)	Tobit	Tobit (Clustering the Standard Error at the Firm Level)
Corporate Governance										
BS	H1	+	+ (S)	+ (W)	+ (S)	+ (W)	+ (S)	+ (M)	+ (S)	+ (S)
DUL	H2	-	- (M)	- (M)	- (M)	- (M)	None	None	None	None
BI	H3	+	None	None	None	None	None	None	None	None
BM	H4	+	None	None	None	None	None	None	None	None
MONR	H5	-	- (M)	- (W)	- (M)	- (W)	None	None	None	None
ONRC	H6	-	None	None	None	None	None	None	None	None
AQUAL	H7	+	+ (S)	+ (M)	+ (S)	+ (M)	+ (S)	+ (S)	+ (S)	+ (S)
Control Variables										
SIZE			- (S)	- (S)	- (S)	- (S)	- (S)	- (S)	- (S)	- (S)
RD			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
LEV			+ (S)	+ (M)	+ (S)	+ (M)	None	None	None	None
PROFIT			None	None	None	None	None	None	None	None
LIQUID			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
GROW			+ (M)	+ (S)	+ (M)	+ (S)	+ (M)	+ (S)	+ (S)	+ (S)

(S) = significant at 0.01 level;
(M) = significant at 0.05 level;
(W) = significant at 0.10 level;
None = no significant association.

6.6.2. Sensitivity Analysis for the Dependent Variable

The next paragraphs introduce the sensitivity analysis for the dependent variable. Two further analysis are carried out: first, conducting the analysis using the weighted disclosure score to measure the dependent variable and second, conducting the analysis using ordered logistic regression where three levels of the dependent variable can be identified.

6.6.2.1. Weighted Disclosure Score

This study measures the dependent variable using a self-constructed unweighted disclosure index. The next section presents the sensitivity analysis that was conducted to check the sensitivity of measuring the dependent variable by using the weighted disclosure score. The weighted score calculated by giving a score of (one) to each item has non-financial information, and a score of (two) to each item has financial information.

Table 6.30 presents the results of OLS regression of the association between R&D voluntary disclosure weighted score and corporate governance, controlling for corporate characteristics, and considering the year and industry fixed effects. The same relationship is also examined using Tobit regression and the results are presented in table 6.31. Table 6.32 summarises the results of OLS and Tobit regression analysis employing both weighted and unweighted R&D disclosure score to calculate the dependent variable. From the table, it can be noticed that, generally, there is agreement between the results of the analysis performed using the weighted and unweighted R&D disclosure score.

Table 6.30
OLS Regression Analysis (Weighted Score)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef	P-value (t)	Coef	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.064***	0.004	1.145***	0.002	1.134***	0.002	1.246***	0.001	1.210***	0.001
DUL			-7.734***	0.000	-6.453***	0.005	-6.645***	0.004	-6.707***	0.004	-3.979*	0.063
BI			0.058	0.251	0.046	0.367	-0.004	0.929	0.005	0.919	-0.052	0.302
BM			2.462**	0.047	2.071	0.101	1.895	0.131	1.977	0.114	1.914	0.106
MONR					-0.991	0.113	-1.016	0.102	-1.003	0.105	-0.573	0.313
ONRC					-0.039	0.304	-0.036	0.340	-0.041	0.272	0.035	0.321
AQUAL							3.817**	0.010	3.641**	0.014	4.175***	0.002
Control Variables												
SIZE	-4.078***	0.000	-5.157***	0.000	-5.467***	0.000	-5.542***	0.000	-5.731***	0.000	-3.795***	0.000
RD	8.275***	0.000	7.953***	0.000	7.807***	0.000	7.664***	0.000	7.660***	0.000	6.747***	0.000
LEV	0.094**	0.011	0.117***	0.001	0.112***	0.002	0.108***	0.003	0.108***	0.003	0.034	0.326
PROFIT	0.007	0.878	0.023	0.637	0.024	0.624	0.012	0.798	0.025	0.618	0.052	0.268
LIQUID	7.763***	0.000	7.710***	0.000	7.691***	0.000	7.916***	0.000	7.816***	0.000	5.599***	0.000
GROW	0.011	0.261	0.016*	0.091	0.020**	0.045	0.021**	0.031	0.026**	0.011	0.020**	0.030
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	0.341	0.949	-1.677	0.804	6.998	0.412	10.353	0.228	13.483	0.118	-2.866	0.767
Adj. R Square (R^2)	0.4195		0.4445		0.4462		0.4524		0.4582		0.5554	
F-Statistics	61.70		41.33		34.84		33.03		29.42		28.38	
Prob (F-Statistics)	0.000		0.000		0.000		0.000		0.000		0.000	
No. of observations	505		505		505		505		505		505	

- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS =** Board size; **DUL**= Role duality; **BI** = Board independence; **BM** = Board meetings; **MONR**= Managerial ownership; **ONRC** = Ownership concentration; **AQUAL** = Audit committee quality; **SIZE** = Firm size; **RD** = R&D investments; **LEV**= Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.31
Tobit Regression Analysis (Weighted Score)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.093***	0.007	1.187***	0.004	1.179***	0.004	1.296***	0.001	1.437[	0.000
DUL			-8.159***	0.001	-6.770***	0.008	-6.990***	0.006	-7.013***	0.005	-3.639	0.113
BI			0.077	0.160	0.065	0.242	0.006	0.916	0.016	0.777	-0.043	0.425
BM			2.179	0.104	1.773	0.194	1.560	0.250	1.637	0.225	1.318	0.296
MONR					-1.020	0.131	-1.047	0.119	-1.038	0.119	-0.581	0.334
ONRC					-0.047	0.252	-0.044	0.286	-0.050	0.222	0.034	0.355
AQUAL							4.483***	0.006	4.289***	0.008	4.635***	0.002
Control Variables												
SIZE	-4.550***	0.000	-5.670***	0.000	-6.029***	0.000	-6.131***	0.000	-6.326***	0.000	-4.474***	0.000
RD	8.859***	0.000	8.497***	0.000	8.332***	0.000	8.170***	0.000	8.161***	0.000	7.233***	0.000
LEV	0.111***	0.006	0.133***	0.001	0.127***	0.001	0.123***	0.002	0.123***	0.002	0.045	0.228
PROFIT	.0170	0.758	0.033	0.539	0.033	0.539	0.019	0.719	0.031	0.556	0.060	0.231
LIQUID	8.015***	0.000	7.920***	0.000	7.890***	0.000	8.147***	0.000	8.030***	0.000	5.517***	0.000
GROW	- 0.135	0.215	0.019*	0.074	0.023**	0.036	0.024**	0.023	0.029***	0.008	0.025***	0.009
Year Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Exclude		Include	
Constant	-0.156	0.978	-1.626	0.825	8.141	0.379	12.122	0.193	15.452*	0.098	7.264	0.482
LR (chi^2-Statistics)	267.98		292.06		295.54		303.25		309.66		429.80	
Prob (chi^2-Statistics)	0.000		0.000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.0645		0.0703		0.0712		0.0730		0.0746		0.1035	
No. of observations	505		505		505		505		505		505	

- 54 left-censored observations RDDIS < = 0 - 451 uncensored observations - 0 right-censored observations
- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS =** Board size; **DUL** = Role duality; **BI** = Board independence; **BM** = Board meetings; **MONR** = Managerial ownership; **ONRC** = Ownership concentration; **AQUAL** = Audit committee quality; **SIZE** = Firm size; **RD** =R&D investments; **LEV**= Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity ; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.32
Summary of the Results of Analysis (Weighted Score)

Variables	H	Expected Sign	Model (4)				Model (6)			
			OLS	OLS (weighted Score)	Tobit	Tobit (weighted Score)	OLS	OLS (weighted Score)	Tobit	Tobit (weighted Score)
Corporate Governance										
BS	H1	+	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
DUL	H2	-	- (M)	- (S)	- (M)	- (S)	None	- (W)	None	None
BI	H3	+	None	None	None	None	None	None	None	None
BM	H4	+	None	None	None	None	None	None	None	None
MONR	H5	-	- (M)	None	- (M)	None	None	None	None	None
ONRC	H6	-	None	None	None	None	None	None	None	None
AQUAL	H7	+	+ (S)	+ (M)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
Control Variables										
SIZE			- (S)	- (S)	- (S)	- (S)	- (S)	- (S)	- (S)	- (S)
RD			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
LEV			+ (S)	+ (S)	+ (S)	+ (S)	None	None	None	None
PROFIT			None	None	None	None	None	None	None	None
LIQUID			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
GROW			+ (M)	+ (M)	+ (M)	+ (M)	+ (M)	+ (M)	+ (S)	+ (S)

(S) = significant at 0.01 level; (M) = significant at 0.05 level; (W) = significant at 0.10 level;
None = no significant association.

6.6.2.2. Ordered Logistic Regression

Howell (2013:556) defines Logistic regression as *"a technique for fitting a regression surface to data in which the dependent variable is a dichotomy"*, and states (p.556) "*Logistic regression can also be applied in situations where there are three or more levels of the dependent variable."*.

The level of R&D disclosure introduced by the UK firms can be classified into three categories:

- Firms that do not introduce any R&D-related information.
- Firms that introduce a low level of R&D disclosure (less than the average of R&D disclosure score for firms that introduced R&D-related information in their annual reports).

- Firms that introduce a high level of R&D disclosure (more than the average of R&D disclosure score for firms that introduced R&D-related information in their annual reports).

To examine R&D disclosure, the bivariate logit model can be extended to take into account the three ranked categories of the level of R&D disclosure. Therefore, the firms that do not introduce any R&D-related information were coded (zero), the firms that introduce low level of R&D disclosure were coded (one), and the firms that introduce high level of R&D disclosure were coded (two).

Table 6.33
R&D Disclosure Ranking

Disclosure Level	Order	Freq.	Percent	Cum.
No R&D Disclosure	0	50	9.90	9.90
Low level of R&D disclosure.	1	235	46.53	56.44
High level of R&D disclosure	2	220	43.56	100
Total		505	100	

Table 6.34 presents the results of ordered logistic regression, it shows that board size has a significant positive association with R&D disclosure; the coefficient is significant at the level of 5% in models 2, 3 and 4 (at the 1% level as suggested by OLS regression and Tobit regression) and at the 1% level in model 5 and 6 (as suggested by OLS regression and Tobit regression).

Role duality and managerial ownership have a marginally negative impact on R&D disclosure at the 10% level in model 4 (at the 5% level as suggested by OLS regression and Tobit regression), while, this influence is not found in model 6 after controlling for the industry effect (as suggested by OLS regression and Tobit regression).

The results of ordered logistic regression confirm the absence of any significant association between R&D disclosure and board meetings or ownership concentration.

Regarding the audit committee quality, the results of ordered logistic regression are identical with both OLS regression and Tobit regression. The only difference is related to model (6); while both OLS regression and Tobit regression confirm a positive association between audit committee quality and R&D voluntary disclosure at the 1% level, the ordered logistic regression suggests that the coefficient is significant at the 5% leve.

In terms of control variables, the results of the three models are similar in general. A summary of the results of OLS regression, Tobit regression and ordered logistic regression are summarized in table 6.35.

Table 6.34
Ordered Logistic Regression Analysis

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4) Full Model		Model (5)		Model (6) Full Model	
	Coef.	P-value (z)	Coef.	P-value (z)	Coef.	P-value (z)	Coef.	P-Value (z)	Coef.	P-value (z)	Coef.	P-value (z)
Corporate Governance												
BS			0.121**	0.041	0.141**	0.019	0.148**	0.015	0.171***	0.006	0.216***	0.002
DUL			-0.785**	0.020	-0.567	0.110	-0.612*	0.087	-0.633*	0.076	-0.176	0.668
BI			0.013*	0.089	0.011	0.157	0.002	0.738	0.005	0.557	0.0003	0.972
BM			0.235	0.204	0.177	0.350	0.150	0.432	0.167	0.386	0.215	0.316
MONR					-0.158*	0.091	-0.161*	0.088	-0.163*	0.082	-0.104	0.318
ONRC					-0.009	0.107	-0.009	0.124	-0.010*	0.093	0.004	0.447
AQUAL							0.640***	0.007	0.620**	0.010	0.651**	0.014
Control Variables												
SIZE	-0.552***	0.000	-0.697***	0.000	-0.772***	0.000	-0.801***	0.000	-0.845***	0.000	-0.696***	0.000
RD	0.923***	0.000	0.905***	0.000	0.886***	0.000	0.867***	0.000	0.877***	0.000	0.953***	0.000
LEV	0.013**	0.028	0.016**	0.011	0.015**	0.015	0.014**	0.024	0.014**	0.024	-0.0003	0.967
PROFIT	8.251	0.999	0.001	0.892	-0.0007	0.934	-0.002	0.744	-0.00003	0.997	0.005	0.587
LIQUID	0.984***	0.000	1.023***	0.000	1.038***	0.000	1.062***	0.000	1.061***	0.000	0.784***	0.003
GROW	0.001	0.315	0.002	0.139	0.003*	0.057	0.003**	0.043	0.004**	0.016	0.004**	0.013
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
LR (chi^2-Statistics)	193.29		208.39		213.66		220.95		229.52		327.45	
Prob (chi^2-Statistics)	0.000		0.0000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.2021		0.2179		0.2234		0.2310		0.2400		0.3424	
No. of observations	505		505		505		505		505		505	

- *** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
- Variables: **BS =** Board size; **DUL** = Role duality; **BI** = Board independence; **BM**= Board meetings; **MONR** = Managerial ownership; **ONRC**= Ownership concentration; **AQUAL** = Audit committee quality; **SIZE**= Firm size; **RD** =R&D investments; **LEV**= Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH** = Firm's growth. (all variables are as defined in table 5.9).

Table 6.35
Summary of the Results of Ordered Logistic Regression Analysis

Variables	H	Expected Sign	Model (4)			Model (6)		
			OLS	Tobit	Logistic	OLS	Tobit	Logistic
Corporate Governance								
BS	H1	+	+ (S)	+ (S)	+ (M)	+ (S)	+ (S)	+ (S)
DUL	H2	-	- (M)	- (M)	- (W)	None	None	None
BI	H3	+	None	None	None	None	None	None
BM	H4	+	None	None	None	None	None	None
MONR	H5	-	- (M)	- (M)	- (W)	None	None	None
ONRC	H6	-	None	None	None	None	None	None
AQUAL	H7	+	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+(M)
Control Variables								
SIZE			- (S)	- (S)	- (S)	- (S)	- (S)	- (S)
RD			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
LEV			+ (S)	+ (S)	+ (M)	None	None	None
PROFIT			None	None	None	None	None	None
LIQUID			+ (S)	+ (S)	+ (S)	+ (S)	+ (S)	+ (S)
GROW			+ (M)	+ (M)	+ (M)	+ (M)	+ (S)	+ (M)

(S) = significant at 0.01 level;
(M) = significant at 0.05 level;
(W) = significant at 0.10 level;
None = no significant association.

6.6.3. Sensitivity Analysis for the Independent Variables

The next paragraphs introduce the sensitivity analysis of the independent variables. Two further analysis are carried out: first, conducting the analysis using the audit committee characteristics rather than the composite score of the audit committee quality, and second, conducting the analysis considering the impact of cross listing on R&D disclosure.

6.6.3.1. Audit Committee Characteristics

The current study measures the audit committee effectiveness using a composite measure based on four audit committee characteristics: audit committee size, the frequency of audit committee meetings, the number of independent directors on the audit committee, and the number of financial experts on the audit committee.

In this sensitivity analysis, the impact of each of these characteristics on R&D voluntary disclosure is examined separately. This test aims to investigate whether the audit committee characteristics affect R&D voluntary disclosure individually or as a composite score.

Table 6.36 presents the impact of board characteristics, ownership structure, and four audit committee characteristics (audit committee size, the frequency of audit committee meetings, the number of independent directors on the audit committee, and the number of financial experts on the audit committee) on R&D voluntary disclosure using OLS regression. The same relationship is examined using Tobit regression, and the results introduced in table 6.37.

The results indicate that both audit committee size (AS) and audit committee experts number (AE) do not have any significant influence on R&D voluntary disclosure. While, the frequency of audit committee meetings (AM) has a marginal effect on R&D voluntary disclosure according to OLS regression (not significant according to Tobit regression). Audit committee independence (AI) is positively associated with R&D voluntary disclosure at the 5% level, after considering the year and industry fixed effect.

These findings indicate that, in general, when the audit committee components were tested separately, they do not have a significant association with R&D voluntary disclosure. The exception is the audit committee independence which is positively associated with R&D voluntary disclosure. This result is consistent with Nekhili et al., (2015) that addressed only audit committee independence, and concluded that audit committee independence is one of the most important drivers of R&D disclosure in annual reports of a sample of French firms.

Table 6.36
OLS Regression Analysis (Audit Committee Characteristics)

Independent Variables	Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance						
BS	0.944**	0.031	1.052**	0.016	1.145***	0.005
DUL	-5.882**	0.017	-5.931**	0.016	-2.897	0.205
BI	-0.023	0.719	-0.010	0.866	-0.054	0.352
BM	0.961	0.486	1.069	0.436	1.193	0.357
MONR	-1.315**	0.048	-1.315**	0.047	-0.744	0.221
ONRC	-0.050	0.225	-0.056	0.170	0.025	0.505
AS	0.644	0.473	0.702	0.433	0.099	0.904
AM	0.776	0.135	0.814	0.115	0.888*	0.075
AI	0.073*	0.070	0.065	0.102	0.079**	0.032
AE	0.017	0.589	0.018	0.568	-0.002	0.943
Control Variables						
SIZE	-6.006***	0.000	-6.233***	0.000	-4.384***	0.000
RD	7.843***	0.000	7.829***	0.000	7.022***	0.000
LEV	0.107***	0.007	0.107***	0.007	0.018	0.636
PROFIT	-0.015	0.767	-0.002	0.965	0.033	0.510
LIQUID	7.869***	0.000	7.771***	0.000	5.477***	0.000
GROW	0.024**	0.021	0.029***	0.006	0.024**	0.015
Year Dummies	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Include	
Constant	12.485	0.185	16.508*	0.082	5.616	0.601
Adj. R Square (R^2)	0.4364		0.4432		0.5408	
F-Statistics	25.39		23.29		23.83	
Prob (F-Statistics)	0.000		0.000		0.000	
No. of observations	505		505		505	

*** Significant at the 1% level or better;
** Significant at the 5% level or better;
* Significant at the 10% level or better.

Variables: **BS =** Board size; **DUL**= Role duality; **BI** = Board independence; **BM** = Board meetings; **MONR** = Managerial ownership; **ONRC** = Ownership concentration; **AS** = Number of directors on audit committee; **AM** = Total number of audit committee meetings held within the year; **AI** = Proportion of independent non executive directors on audit committee; **AE** = Proportion of financial expertise directors on the audit committee; **SIZE =** Firm size; **RD =** R&D investments; **LE V** =Leverage; **PROFIT** = Profitability; **LIQUID** = Liquidity; **GROWTH** = Firm' growth.

- All variables are as defined in table 5.9.

Table 6.37
Tobit Regression Analysis (Audit Committee Characteristics)

Independent Variables	Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance						
BS	1.050**	0.027	1.163**	0.014	1.462***	0.001
DUL	-6.251**	0.020	-6.250**	0.019	-2. 432	0.321
BI	-0.007	0.915	0.004	0.942	-0.039	0.527
BM	0.624	0.674	0.724	0.624	0.578	0.674
MONR	-1.312*	0.067	-1.318*	0.064	-0. 712	0.269
ONRC	- 0.060	0.180	-0.067	0.132	0.021	0.593
AS	0.431	0.657	0.480	0.619	-0.304	0.732
AM	0.681	0.223	0.725	0.192	0.873	0.101
AI	0.089**	0.043	0.081*	0.063	0.093**	0.018
AE	0.021	0.540	0.022	0.519	0.0007	0981
Control Variables						
SIZE	-6.587***	0.000	-6.819***	0.000	-5.064***	0.000
RD	8.411***	0.000	8.388***	0.000	7.550 ***	0.000
LEV	0.124***	0.004	0.123***	0.004	0.031	0.448
PROFIT	- 0.008	0.889	0.005	0.922	0.042	0.435
LIQUID	8.066***	0.000	7.954***	0.000	5.403***	0.000
GROW	0.027**	0.017	0.032***	0.005	0.029***	0.005
Year Dummies	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Include	
Constant	12.700	0.211	16.999*	0.096	8.914	0.435
LR (chi^2-Statistics)	291.59		298.59		417.85	
Prob (chi^2-Statistics)	0.0000		0.0000		0.0000	
Pseudo R^2	0.0695		0.0711		0.0995	
No. of observations	505		505		505	

50 left-censored observations RDDIS < = 0
455 uncensored observations
0 right-censored observations

*** Significant at the 1% level or better;
** Significant at the 5% level or better;
* Significant at the 10% level or better.

Variables: **BS=** Board size; **DUL** = Role duality; **BI** =Board independence; **BM**= Board meetings; **MONR**= Managerial ownership; **ONRC**=Ownership concentration; **AS** = Number of directors on audit committee; **AM** =Total number of audit committee meetings held within the year; **AI** = Proportion of independent non executive directors on audit committee; **AE** = Proportion of financial expertise directors on the audit committee; **SIZE =** Firmsize; **RD=**R&D investments; **LEV** = Leverage; **PROFIT** = Profitability; **IIQUID** = Liquidity; **GROWTH** = Firm' growth.

- All variables are as defined in table 5.9.

6.6.3.2. Cross Listing

To control for the non-UK regulatory influence, the main analysis is repeated considering the cross listing by adding a dummy variable coded (zero) if the firm is listed in London Stock Exchange only, and coded (one) if the firm listed in multiple stock exchanges.

Table 6.38 presents the results of OLS regression considering the impact of cross listing, and table 6.39 presents the results of Tobit regression.

By comparing the results of the main analysis and the results of the analysis after controlling for cross listing, it can be noticed that the results are identical.

Moreover, there is no significant association between cross listing and the level of R&D disclosure according to the results of both OLS regression and Tobit regression, suggesting the insignificant influence of the cross listing on R&D disclosure.

Table 6.38
OLS Regression Analysis (Cross Listing)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef	P-value (t)	Coef	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.081 ***	0.006	1.185 ***	0.003	1.156 ***	0.004	1.276 ***	0.001	1.218 ***	0.001
DUL			-7.208***	0.002	-5.450 **	0.027	-5.670**	0.020	-5.736**	0.018	-2.939	0.194
BI			0.060	0.261	0.043	0.421	-0.013	0.815	-0.002	0.966	-0.062	0.249
BM			2.369 *	0.072	1.812	0.175	1.594	0.231	1.687	0.203	1.797	0.152
MONR					-1.424 **	0.032	-1.437**	0.030	-1.423**	0.030	-0.947	0.117
ONRC					-0.041	0.306	-0.037	0.348	-0.043	0.276	0.038	0.303
AQUAL							4.304***	0.007	4.121***	0.009	4.638 ***	0.002
Control Variables												
SIZE	-4.275***	0.000	-5.341***	0.000	-5.694***	0.000	-5.796 ***	0.000	-6.003 ***	0.000	-4.055***	0.000
RD	8.516 ***	0.000	8.210 ***	0.000	8.033 ***	0.000	7.859 ***	0.000	7.854 ***	0.000	6.944 ***	0.000
LEV	0.103 ***	0.009	0.126 ***	0.001	0.118 ***	0.003	0.114 ***	0.003	0.114 ***	0.003	0.027	0.464
PROFIT	-0.021	0.684	-0.005	0.924	-0.001	0.979	-0.015	0.771	-0.002	0.965	0.036	0.470
LIQUID	8.354 ***	0.000	8.308 ***	0.000	8.324 ***	0.000	8.563***	0.000	8.452 ***	0.000	6.026***	0.000
GROW	0.012	0.225	0.018 *	0.084	0.023 **	0.032	0.024**	0.021	0.029 ***	0.007	0.023**	0.019
LS	-1.689	0.468	-2.504	0.277	-2.837	0.218	-1.965	0.395	-1.915	0.404	-1.704	0.418
Year Dummies	Exclude		Exclude		Exclude		Exclude		Include		Include	
Industry Dummies	Exclude		Exclude		Exclude		Exclude		Exclude		Include	
Constant	2.268	0.695	-0.005	0.999	10.519	0.249	14.726	0.110	18.126 **	0.050	6.279	0.546
Adj. R Square (R^2)	0.4101		0.4304		0.4345		0.4417		0.4480		0.5460	
F-Statistics	51.06		35.62		30.78		29.48		26.57		26.26	
Prob (F-Statistics)	0.000		0.000		0.000		0.000		0.000		0.000	
No. of observations	505		505		505		505		505		505	

*** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.
Variables: BS = Board size; DUL= Role duality; BI = Board independence; BM= Board meetings; MONR= Managerial ownership; ONRC= Ownership concentration; AQUAL=Audit committee quality ; SIZE = Firm size; RD =R&D investments; LEV= Leverage ; PROFIT=Profitability; LIQUID = Liquidity; GROWTH = Firm's growth; **LS** = Dummy variable coded (0) if the firm is listed in London Stock Exchange only, and coded (1) if the firm listed in multiple stock exchanges. (all variables are as defined in table 5.9).

Table 6.39
Tobit Regression Analysis (Cross Listing)

Independent Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-value (t)	Coef.	P-Value (t)	Coef.	P-value (t)	Coef.	P-value (t)
Corporate Governance												
BS			1.105**	0.011	1.223 ***	0.005	1.192 ***	0.006	1.318***	0.002	1.439***	0.000
DUL			-7.602***	0.003	-5.725**	0.033	-5.975**	0.025	-6.002**	0.023	-2.509	0.301
BI			0.081	0.167	0.063	0.281	- 0.002	0.968	0.008	0.890	-0.052	0.358
BM			2.063	0.148	1.490	0.303	1.222	0.395	1.310	0.359	1.157	0.387
MONR					-1.455**	0.043	-1.467**	0.040	-1.455**	0.040	-0.944	0.140
ONRC					-0.050	0.256	-0.045	0.295	-0.052	0.228	0.039	0.329
AQUAL							5.071***	0.003	4.867***	0.005	5.203***	0.001
Control Variables												
SIZE	-4.787***	0.000	-5.894***	0.000	-6.295***	0.000	-6.433***	0.000	-6.640***	0.000	-4.804***	0.000
RD	9.114 ***	0.000	8.771 ***	0.000	8.572 ***	0.000	8.375 ***	0.000	8.364 ***	0.000	7.453 ***	0.000
LEV	0.121 ***	0.005	0.143 ***	0.001	0.135 ***	0.002	0.130 ***	0.002	0.130 ***	0.002	0.039	0.329
PROFIT	- 0.012	0.827	0.004	0.938	0.007	0.902	-0.009	0.867	0.003	0.948	0.042	0.426
LIQUID	8.612 ***	0.000	8.524 ***	0.000	8.529 ***	0.000	8.800 ***	0.000	8.672 ***	0.000	5.932 ***	0.000
GROW	0.015	0.184	0.020 *	0.068	0.025 **	0.026	0.027 **	0.016	0.032 ***	0.005	0.029 ***	0.005
LS	-1.208	0.633	-2.046	0.413	-2.383	0.339	-1.302	0.602	-1.273	0.670	-0.810	0.719
Year Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Include		Include	
Industry Dummies	Exclude		Exclude	Exclude	Exclude	Exclude	Exclude		Exclude		Include	
Constant	2.059	0.743	0.341	0.966	11.986	0.225	17.034*	0.087	20.637**	0.039	11.461	0.302
LR (chi^2-Statistics)	261.18		281.06		286.30		294.90		301.63		420.78	
Prob (chi^2-Statistics)	0.0000		0.0000		0.0000		0.0000		0.0000		0.0000	
Pseudo R^2	0.0622		0.0670		0.0682		0.0703		0.0719		0.1002	
No. of observations	505		505		505		505		505		505	

54 left-censored observations RD-DIS<=0 451 uncensored observations 0 right-censored observations

*** Significant at the 1% level or better; ** Significant at the 5% level or better; * Significant at the 10% level or better.

Variables: BS = Board size; DUL = Role duality; BI = Board independence; BM= Board meetings; MONR = Managerial ownership; ONRC= Ownership concentration; AQUAL=Audit committee quality; SIZE=Firm size; RD=R&D investments; LEV= Leverage; PROFIT= Profitability; LIQUID=Liquidity ; GROWTH = Firm's growth; **LS** = Dummy variable coded (0) if the firm is listed in London Stock Exchange only, and coded (1) if the firm listed in multiple stock exchanges. (all variables are as defined in table 5.9).

6.7. SUMMARY

This chapter presents the results of investigating the extent and trend of R&D voluntary disclosure. Four levels of analysis are considered: overall R&D disclosure, R&D disclosure categories, R&D disclosure types and R&D disclosure items. This followed by descriptive statistics of the dependent and independent variables. It also presents the examining of the basic assumptions of OLS regression.

Finally, the chapter reports the results of the empirical findings of the association between corporate governance and R&D voluntary disclosure introduced by the UK firms in their annual reports over the three years from 2007 to 2009. Two techniques, OLS regression and Tobit regression have been employed to examine the data in the current study.

Based on the findings of the empirical analysis, it is concluded that the variations of the level of R&D voluntary disclosure in the UK firms can be explained by the variations in board size and the effectiveness of the audit committee. However, after controlling for the effect of the year and industry, the other board characteristics and ownership structure, do not have any significant influence on the level of R&D voluntary disclosure.

Regarding the control variables, four variables can explain the differences in the level of R&D voluntary disclosure. While R&D voluntary disclosure is negatively related to firm size, it has a positive association with each of R&D investments, liquidity, and firm's growth.

CHAPTER SEVEN

CONCLUSION

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CONCLUSION

7.1. INTRODUCTION

The distinctive nature of R&D investments and the limited of mandated informative disclosure requirements concerning R&D activities create an information problem (Lev, 1999; Merkley, 2014). Moreover, the formal requirements and recommendations concerning enhancement of narrative reporting, that have come into force for UK listed companies with the Companies ACT 2006, are too generic and difficult to interpret (Deloitte, 2009). In addition, these requirements do not identify specific needs in order to enhance the narrative disclosure of R&D activities.

This situation has led to deviations in R&D disclosure practices between firms. Moreover, managers need to make difficult decisions in order to determine the type and the level of R&D disclosure, depending on the trade-off between the costs and benefits of disclosure.

Therefore, studying R&D narrative disclosure practices in annual reports is considered a useful research area. The current study explored R&D narrative disclosure practices in annual reports of a sample of the UK firms. In addition, it investigated the influence of corporate governance on R&D disclosure decisions, considering the other potential drivers of R&D reporting.

This chapter introduces the concluding remarks of this study. The remainder of this chapter is organised as follows: section (2) summarizes the research methodology; section (3) presents a summary of the findings of the study, and section (4) outlines the implications of the study; section (5) highlights the limitations of the research, and section (6) introduces some suggestions for future research.

7.2. RESEARCH METHODOLOGY

The next paragraphs summarize the methodology employed to carry out the empirical part of this study.

A self constructed disclosure index was established by considering the list of R&D information items introduced by Entwistle (1999), and reviewing 100 annual reports of the UK non-financial listed firms. Hence, the final checklist includes all types of R&D information that are relevant to the UK environment.

Manual content analysis was used to identify every piece of information that revealed any R&D disclosure. This information was classified into the relevant item in the disclosure index. The research instrument was employed to calculate the disclosure score for a sample of 505 annual reports across three years 2007, 2008, and 2009.

The first two research questions were answered by applying a descriptive analysis of the total R&D disclosure; its categories (general, input, output, financial); its types (financial and non-financial); and of each item presented in annual reports and included in the disclosure index (26 items).

The third research question was answered by tracking the R&D disclosure score over the examined period. A statistical test was applied to investigate whether there is a significant change in the extent of R&D disclosure practices over the period of the study.

The fourth research question was answered by reviewing the relevant literature to identify the potential impact of corporate governance on R&D voluntary disclosure. Firm characteristics that may influence the management decision to introduce more

or less R&D information are considered. Finally, drawing on agency and signalling theories and on understanding the benefits and costs involved in R&D disclosure decision, seven explanatory variables and six control variables are identified.

The study formulated the hypotheses based on the proposed integrated theoretical framework and prior studies in order to answer the fourth question. These hypotheses have been tested using OLS regression and Tobit regression.

Further analysis is conducted using a sensitivity analysis for the full model, the dependent variable, and the independent variables. For the full model, the analysis is carried out using robust standard errors; in addition, it is conducted with clustering the standard error at the firm level. Regarding the dependent variable, the analysis is carried out using the weighted disclosure score to measure the level of R&D voluntary disclosure. Moreover, the level of R&D disclosure is classified into three categories and Logistic regression is performed. In terms of the independent variables, the impact of audit committee characteristics on R&D voluntary disclosure is examined separately. Moreover, the main analysis is repeated considering cross listing to control for the possible influence of cross listing on R&D disclosure.

7.3. RESEARCH FINDINGS

This section introduces the main findings of the current study:

The first part of the empirical analysis aims to explore and identify R&D-related information introduced discretionarily by the UK firms in annual reports. It also seeks to track the variations in the level of R&D narrative disclosure across the period of the study. Applying a descriptive analysis of the total R&D disclosure, its categories, its types and for each R&D information item presented in annual reports reveals the following main findings:

- In terms of the level of R&D disclosure in annual reports, the findings reveal that, in average the UK firms introduce about 30% of the examined R&D disclosure index items. This result is in line with Nekhili et al., (2012) who provides evidence from France and La Rosa and Liberatore (2014) who examine eight western European countries. The average R&D disclosure score according to these studies is 22.64 and 28.5 respectively.
- The R&D disclosure score in the current study increases gradually over the examined period. However, the variations in R&D disclosure score among the three years of the study are insignificant. On the other hand, the deviations in R&D disclosure score according to the industry type are significant, and ranged from slightly more than 50% for the health care sector to slightly less than 7% for the consumer services sector.
- Regarding the frequency of each item that has been disclosed by the UK firms, the most common R&D information is related to the firm's strategy, objective and vision. This is followed by the competition and the risk of R&D activities. However, financial information about past and future R&D expenditures is in last place, suggesting that the disclosure benefits of introducing such information do not compensate the risk of competitive disadvantage.

The second part of the empirical analysis aims to investigate the potential drivers of R&D narrative disclosure practices, particularly the impact of corporate governance and ownership structure on the level of R&D voluntary disclosure in annual reports. Examining the research hypotheses using OLS regression and Tobit regression shows the following main findings:

- In terms of the influence of corporate governance on the overall level of R&D disclosure, the statistical results indicate that, board size does affect positively R&D voluntary disclosure in annual reports. This result validates the argument that a large number of directors on the board increases the diversity of the experience and skills (Hidalgo et al., 2011). This variety may help in gaining a clear understanding of R&D activities. This result is consistent with the findings of Abdelbadi and Elshandidy (2013); however, it is not in the line with Nekhili et al., (2015) who did not find any significant impact of board size on R&D narrative disclosure.
- Regarding the role duality, after considering the industry effect, no significant impact of it is detected on the level of R&D disclosure. This result is in the line with most studies that address the association between role duality and the level of R&D disclosure in annual reports (e.g. Nor et al., 2012; Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015). However, Zeghal et al., (2007) introduce evidence from Canada on the association between the role duality and R&D disclosure in annual reports at the 5% level.
- Interestingly, the results do not confirm any significant influence of board independence on the level of R&D disclosure. Although this result contradicts the expected monitoring role of the independent directors which is grounded in agency theory, it is similar to the findings of other studies that address this variable in examining the drivers of R&D voluntary disclosure in annual reports (e.g. Zegal et al., 2007; Nor et al., 2010; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015). Moreover, no significant association is found between the frequency of board meetings and the level of R&D

disclosure in annual reports. To the best of my knowledge, this relationship has not been previously examined.

- In respect of the ownership structure, the results do not support the existence of a significant association between R&D disclosure in annual reports and managerial ownership or ownership concentration. This result is similar to that found by (e.g. Nor et al., 2010; Nekhili et al., 2012; Nekhili et al., 2015) that addressed the managerial ownership. It is also comparable to studies that consider the ownership concentration (e.g. Nekhili et al., 2012; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015).
- Finally, the results reveal that, the audit committee quality does affect positively R&D voluntary disclosure in annual reports. This result validates the audit committee role regarding narrative reporting, which was identified by the FRC (2012) which recommended that the audit committee should review the annual report and assess whether it provides the essential information for shareholders to evaluate the firm's performance and strategy. To the best of my knowledge, the only study examining the association between audit committee characteristics and R&D voluntary disclosure is Nekhili et al., (2015). The study addressed only audit committee independence. It concludes that audit committee independence is one of the most important drivers of R&D disclosure in annual reports of a sample of French firms.
- In addition to the composite measure that is employed in the current study to assess the audit committee quality; the impact of these characteristics on R&D voluntary disclosure is examined separately as one of the sensitivity analysis employed in the current study. The results indicate that, the audit

committee independence is positively associated with R&D voluntary disclosure at the 5% level. This result confirms the findings of Nekhili et al., (2015). However, other audit committee characteristics did not have any significant influence on R&D disclosure.

- The most interesting results are related to the impact of audit committee quality on R&D financial disclosure and R&D non-financial disclosure. While the findings confirm a positive association between the audit committee quality and R&D non-financial disclosure, no significant impact of audit committee quality on R&D financial disclosure is found. A possible explanation for these results might be the nature of financial R&D information. Some financial R&D information that is introduced in narrative reporting is already mentioned in the financial statements in the back of the annual reports. This information is already reviewed by the audit committee within its judgement of the financial statements, for example, current R&D expenditure. Other types of R&D financial disclosure, for example, future estimates of R&D expenditure, may include proprietary information. Introducing this kind of information could lead to competitive disadvantage such as, R&D expenditure in the future. Consequently, the audit committee may not consider repeated or confidential financial information.

To sum up, board size, and audit committee quality have a positive significant association with the level of R&D disclosure in annual reports of the UK firms. The other variables (role duality, board independence, frequency of board meetings, ownership concentration, managerial ownership) did not have a significant impact on R&D disclosure.

In general, the results of the current study do not validate the monitoring role of corporate governance concerning board independence, role duality, and frequency of board meetings. Moreover, the results do not support the suggestions of agency theory regarding the association between the level of R&D disclosure in annual reports and each of ownership concentration and managerial ownership.

Interestingly, although, these findings do not confirm the majority of theoretical arguments drawing on agency theory, they are in the line with the majority of the studies that addressed the association between corporate governance and R&D voluntary disclosure in annual reports (e.g. Zegal et al., 2007; Nor et al., 2010; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015). A possible explanation for these results could be the effect of the disclosure costs which may work as forces against informative voluntary disclosure that is supported by the corporate governance. A consideration of disclosure costs is emphasised by Steering Committee (FASB, 2001b), and highlighted by most prior studies that addressed R&D disclosure practices in annual reports (e.g. Entwistle, 1999; Jones, 2007; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015).

These findings support the view of The Companies Act 2006 that does not mandate any particular disclosures related to R&D activities. It also, guarantees the firm's flexibility to withhold the information that could be seriously harmful to the interests of the company according to the opinion of the directors (Part 15, chapter 5, Section 417, 10).

- Finally, in terms of the control variables, the findings indicate that the level of R&D disclosure is associated with the majority of firm characteristics that are examined in the current study. Of the six firm characteristics that have been

examined in the current study, four variables were found to be associated with the level of R&D voluntary disclosure. Firm size was found to have a negative significant association with the level of R&D voluntary disclosure. R&D investments, liquidity, and firm growth were found to have a positive association with the level of R&D voluntary disclosure. However, no significance is detected for both leverage and profitability after controlling for the year and industry effects.

In general, these results are consistent with the arguments that suggest the possibility of using disclosure as an effective tool to decrease information asymmetry measured by R&D intensity (e.g. Lev, 2000; Aboody and Lev, 2000).

7.4. THE THEORETICAL AND PRACTICAL IMPLICATIONS

The next paragraphs present the theoretical and practical implications of the current study.

7.4.1. Theoretical Implications

Previous studies employed many theories and concepts to explain R&D disclosure practices in annual reports, and to draw their hypotheses about its drivers. Drawing on agency and signalling theories, many researchers examine R&D disclosure in annual reports (e.g. Zegal et al., 2007; Nor et al., 2010; Abdelbadie and Elshandidy, 2013; Nekhili et al., 2015), while other studies employ a theoretical base such as cost-benefit analysis (e.g. Entwistle, 1999), or proprietary costs and information asymmetry (e.g. Jones, 2007; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015).

The current study employs an integrated theoretical framework based on agency and signalling theories. It also considers cost-benefit analysis and pays more attention to proprietary costs and information asymmetry.

In general, the results reveal that, R&D voluntary disclosure decisions could not be explained drawing on agency or signalling theory without considering the costs of R&D disclosure. These findings are consistent with the vision of the professional accounting entities; they consider the complexity of the trade-off between costs and benefits of disclosure decisions (e.g. FASB, 2001b; The Companies Act 2006).

To sum up, whilst the theoretical framework based on agency and signalling theories claim that corporate governance attributes are highly associated with the managers' incentives to provide greater disclosure, this claim needs to be made with care regarding R&D disclosure.

The current study highlights the importance of considering the cost-benefit analysis of the disclosure decisions to get a better explanation of R&D disclosure practices.

The findings of the current study suggested that researchers should pay more attention to the impact of disclosure costs on the managers' incentives to provide R&D voluntary disclosure.

This conclusion may be also helpful when researchers investigate voluntary disclosure of other types of activities rather than R&D activities.

7.4.2. Practical Implications

Investigating the types of information introduced discretionarily by firms, is one of the recommended research areas that suggested by the Jenkins Committee. The committee believes that this type of study would provide helpful information to

standard setters, regulators, and other parties interested in improving business reporting (AICPA, 1994). The current study contributes to this research area as follows:

The results of this study increase the understanding of R&D voluntary disclosure introduced by UK firms in annual reports. Providing the accounting standard setters and financial market regulators with better insights about R&D disclosure practices in the UK may be useful in enhancing the guidelines regarding the disclosure of this type of information leading to greater transparency.

In addition, the study provides a deep investigation of the R&D-related information introduced discretionarily in annual reports of the UK firms by analysing the overall R&D disclosure, its categories, its types and each item in the constructed disclosure index. This helpful insight into the R&D disclosure practices provides managers with a benchmark to improve business reporting regarding R&D activities disclosure.

Moreover, the current study introduces a valid and reliable measure of R&D disclosure in annual reports by constructing an R&D disclosure index that considers the UK context. To the best of my knowledge, there is no previous R&D disclosure index established to measure R&D disclosure practices in annual reports of the UK firms, providing this index can help interested parties to assess R&D disclosure practices in annual reports.

The study provides evidence of the significant association between R&D disclosure in annual reports and each of firm size, liquidity, R&D investments and growth rate.

The empirical results reveal a weak influence of corporate governance attributes on R&D disclosure in annual reports (only board size and audit committee quality have

a significant impact on R&D disclosure). While these results contradict the control role of corporate governance that draws on the agency theory, they are in the line with the majority of studies that addressed the impact of corporate governance on R&D disclosure in annual reports (e.g. Zegal et al., 2007; Nor et al., 2010; Abdelbadi and Elshandidy, 2013; Nekhili et al., 2015). These findings could be explained by R&D disclosure costs, which moderate the influence of corporate governance. Understanding the incentives of managers to disclose or not disclose R&D information in firms' annual reports can help the standard setters, regulators, and other parties interested in improving business reporting to enhance R&D narrative disclosure.

To sum up, the findings of this study provide standard setters, regulators in the UK with a deep investigation of the R&D information introduced by UK firms in their annual report. This could help them to improve the disclosure recommendations leading to enhance the firm's transparency.

The study also analysis the disclosure practices in the UK annual reports. This could help managers of the UK firms to understand the best practices regarding R&D disclosure.

Moreover, the R&D disclosure index introduced in the current study could be valid and reliable measure of R&D disclosure in other countries rather than the UK after considering the regulations of each country.

7.5. THE RESEARCH LIMITATIONS

The current study has some limitations, so some restrictions should be taken into consideration when interpreting its findings. Firstly, the disclosure index used in this study applies the quantity of disclosure as a proxy of the quality. Secondly, the current study focuses on only one disclosure means, that is firm's annual report, while research and development disclosure can be made through a range of channels of communications such as conference calls, press releases and announcements. Therefore, firms can use different kinds of communications to introduce a particular type of information to various external stakeholder groups rather than annual reports. Thirdly, there are other variables that may affect R&D disclosure practices in annual reports that have not been examined in the current study. These include institutional ownership and family ownership.

7.6. FUTURE RESEARCH

According to Beattie (2014) the framework of research in narrative disclosure can be classified into five types of studies. These types include exploring the narrative disclosure practices, investigating the determinants of disclosure, the author's explanations of the observed practices, the consequences of the existence practices and recommendations on what should be reported. The current study contributes to the literature by addressing the first and second research areas. Hence, the current study explores R&D disclosure practices in annual reports in the UK firms and examines the determinants of the observed practices.

Further research in this field is needed to complement the current study, by considering the consequences of R&D voluntary disclosure in annual reports, such as the influence of R&D disclosure on market value, cost of capital and on information asymmetry. In addition, the management's explanation of the existence disclosures

and the researchers' recommendations for the best practices of R&D disclosure in annual reports are important issues for future research.

The current study suggests that the focus needs to be expanded to the impact of proprietary costs on the managers' incentives to introduce R&D-related information discretionarily. Graham et al., (2005) concluded from their survey that the concern about proprietary information is one of the biggest obstacles to providing voluntary disclosure.

The majority of studies that investigate R&D disclosure in annual reports highlight the importance of proprietary costs on managers' disclosure decisions (e.g. Jones, 2007; Merkley, 2014; La Rosa and Liberator, 2014; Nekhili et al., 2015). Therefore, a systematic evidence of the impact of proprietary costs on the management incentive to introduce R&D voluntary disclosure is required. Moreover, Beyer et al., (2010) recommend that additional work is required to assess the importance of proprietary costs on firms' disclosure decisions in general, and argue that the main challenge in this area is measuring and quantifying proprietary costs.

In future research, considering the textual properties such as R&D disclosure readability and tone could introduce a better understanding of R&D disclosure practices. To the best of my knowledge, the only study addressing this issue is Merkly (2014) who uses computerised content analysis to measure R&D disclosure tone and readability in US. Therefore, additional work is required in this area to gain a better assessment of R&D-related information introduced discretionarily by firms in annual reports.

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APPENDICES

Appendix A Types of R&D Disclosure Information

Main & Subcategories	Examples (taken from annual reports)
General Disclosure	
Statement of strategy or objectives or vision about R&D.	" Our success depends on our ability to identify where new value can be created, to encourage the search for new products and services, to endorse bold strategies within our Group, to win new alliances, acquire successful businesses and attract farsighted people to our side. In this way we innovate constantly ". UMECO plc, annual report 2008, p. 6.
	"Our strategy is to become the world leader in pyrotechnics, through focused investment in new products that displace existing incumbents and better meet our customers' requirements ". Chemring Group plc, annual report 2008, p. 25.
R&D is the main activity.	" We design, develop and supply the technology that allows people, organisations and electronic devices to connect effectively and efficiently, locally and globally – key requirements in today's increasingly connected world." Laird Group plc , annual report 2008, p.4.
The focus of R&D activities.	" As part of the Group's commitment to ongoing product development, Victrex is focused on bringing customers new material solutions". Victrex plc, annual report 2007, p. 2.
R&D and competition and market.	" Competitive advantage and market share in OPE is driven through product innovation ". Torotrak plc, annual report 2007, p. 8.
	" rapid response to the changed market environment, Infinitrak has developed a new, complementary and lower cost transmission, the Single Toroidal Transmission (STT), which is now being tested in prototype form for intended market introduction in time for next year's grass-cutting season – an extremely challenging timetable ". Torotrak plc, annual report 2009, p.4.
R&D and Risk.	" If the Group is not successful in developing competitive new products and services, its revenues may decline". UMECO plc, annual report 2007, p. 22.
	" Robust research and development processes, both in house and where undertaken in co-operation with our customers minimise product development risks". Morgan plc, annual report 2008,p.44.
The effect of R&D spending on other financial items.	" Return on sales in the division fell from 15.4% in 2007 to 12.1% in 2008, with the decline due to a number of factors. These included the effect of adverse currency movements in the first half of 2008, reduced volumes in the second half, temporarily higher materials and sales administration costs resulting from our North American restructuring, increased investment in 2008 in engineering, R&D and account management, and pricing pressure in signal integrity products". Laird plc, annual report 2008, p. 14.

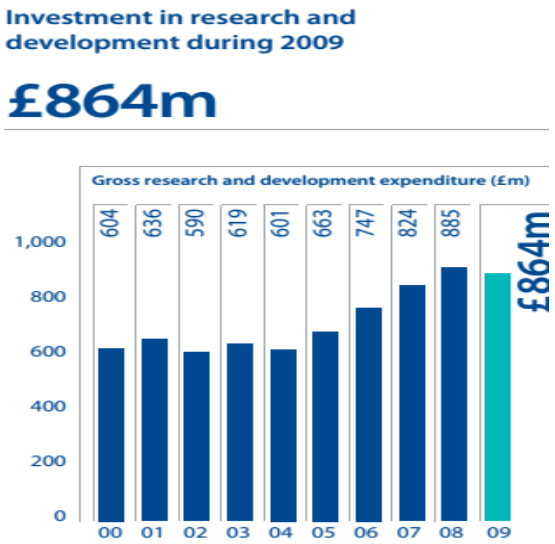
Appendix A (Continued)

Main & Subcategories	Examples (taken from annual reports)
Explaining R&D spending changes.	" Research and development expenditure in 2009 was £15.6m (2008: £16.5m), the decrease reflecting the completion of the Cerepro ® study 904 during 2008 offset partially by the additional depreciation following the opening of the GMP3 biologics manufacturing facility in Finland ". Ark Therapeutics Group plc, annual report 2009, p.12.
R&D accounting policy discussion outside the financial statements.	" The Group's policy is to write-off capitalised development costs over a three year period. Amortisation of development costs was £1.5 million (2008: £0.7 million) ". Chemring Group plc, annual report 2009, p. 23.
R&D and future opportunities.	" This leading edge technology increases disk drive capacity by 15-20%, opening up opportunities for Morgan and its customers". Morgan plc, annual report 2008, p.7.
Input	
Management & People.	"The Group has also announced a new and simplified organisational structure which will enhance business Performance, leverage divisional capabilities and accelerate research and development activities". Cobham plc, annual report 2007, p. 4.
	" We have over 280 people in our R&D team worldwide working to develop innovative ingredients from renewable resources". Tate & Lyle plc, annual report 2009, p. 20.
Other parties involved in R&D (R&D collaboration).	"We are participating in an ongoing collaborative project evaluating the prospects of using biodegradable oils in power transformers. The project is investigating the extent to which existing transformer designs would need to be modified, as well as considering the use of biodegradable oils to retro-fill existing units". National grid plc, annual report 2008, p.11.
Infrastructure.	"Our investment in a new cheese packing facility at Nuneaton is progressing well. This gives us the opportunity to develop new and innovative packaging formats as it becomes operational this year". Dairy Crest plc, annual report 2009, p. 8.
	"Thermal Ceramics is building on its success in high temperature bio-soluble insulating fibre having invested in 2008 in a new global R&D centre at Bromborough,UK". Morgan Advanced Materials plc, annual report 2008, p. 6.
Funding.	"The Board believes that the Group has more than adequate financial resources to meet its current expansion plans, including significant planned capital expenditure and continuing research and development investment". Chemring Group plc, annual report 2008, p. 3.

Appendix A (Continued)

Main & Subcategories	Examples (taken from annual reports)
Output : (in progress and achievement : new product or beyond product)	
Past achievement from R&D activities.	"Your company has continued to benefit from its long term commitment to investment in R&D and capital expenditure and its focus on products and technologies that benefit the environment and help to make the most efficient use of increasingly expensive energy resources". Johnson Matthey plc, annual report 2007, p. 3.
R&D progress.	"The significant engineering programme being undertaken by Torotrak with this customer is progressing to plan and is now moving from the design stage into the procurement phase which will, in turn, lead to prototype transmission build". Torotrak plc, annual report 2009, p. 8.
This year achievement.	"Johnson Matthey introduced new MEA products in 2006/07 that significantly improve the durability and cost of fuel cells used in the very demanding transport sector" . Johnson Matthey plc, plc, annual report 2007,p.11.
	"In sales terms, we out-performed the British soft drinks market, building on the strength of our brands, and our innovation programme delivered in line with expectations". Britvic plc , annual report 2007,p. 8.
Potential achievement.	"A number of potential applications are being explored with automotive VMs which will increase the powder metallurgy content of automatic transmissions". GKN plc, annual report 2007,p. 27.
	"Going forward into 2008, sales revenue is expected to continue to grow organically as a result of new programmes moving into production, notably the B787 and the A380, together with increased levels of development work including the CH-53K and the A350 XWB." GKN plc, annual report 2007,p. 35.
Patents.	"We maintain a significant number of patents to support our businesses and protect our competitive advantage ". Tate & Lyle plc, annual report 2007,p. 28.
	"During the year, Dialight's technical staff filed 19 patents and had 7 granted with 47 pending approval". Dialight plc, annual report 2007,p. 18.
Financial Disclosure	
Past R&D expenditures.	"Over the past five years, we have invested £4 billion in R&D". Rolls-Royce plc, annual report 2009,p. 6.
present R&D expenditures.	"In 2009, Rolls-Royce invested a total of £864 million in research and development". Rolls-Royce plc, annual report 2009, p. 25.
Future R&D expenditures.	"Our target is to spend 4% to 5% of value added turnover on research and development" . Tate & Lyle plc, annual report 2007, p. 29.

Appendix A (Continued)

Main & Subcategories	Examples (taken from annual reports)
Amount of tax credit.	"The tax credit of £328k (2006: £434k) reflects mainly the claim to be made for research and development tax credits net of overseas withholding taxes" . Torotrak plc, annual report 2007,p. 13.
R&D Ratios.	**Analysis of R&D costs** (Table 4) 2009 Aerospace equipment £'m / 2009 Sensing systems £'m / 2009 Defence systems £'m / **2009 Group £'m** / 2008 Group £'m Total R&D expenditure: 42.3 / 31.7 / 11.2 / **85.2** / 78.8 % of revenue: 6% / 12% / 8% / **7%** / 7% Customer funded R&D: (5.4) / (7.9) / (5.9) / **(19.2)** / (19.4) Capitalised: (20.2) / (12.4) / (2.5) / **(35.1)** / (23.7) Amortisation: 2.3 / 3.6 / 0.6 / **6.5** / 3.5 Charge to income statement: 19.0 / 15.0 / 3.4 / **37.4** / 39.2 Meggitt plc, annual report 2009, p. 14.
Comparison of R&D expenditures to those of prior year.	"Expenditure on research and development during 2007 was €8.9 million (2006: €6.8 million)". Mondi Group plc, annual report 2007, p. 37.
Comparison of R&D expenditures to those of prior years.	 Rolls-Royce plc, annual report 2009, p.11.
Comparison of R&D expenditures to those of target or to expectations	"R&D as a percentage of revenue 2009:5.0%Target > 4%". Halma plc, annual report 2009, p. 19.

Appendix B R&D Disclosure Checklist

Company Name	
General Disclosure	
1	Statement of strategy or objectives or vision about R&D
2	R&D is a main activity
3	The focus of R&D activities
4	R&D and competition and market
5	R&D and Risk
6	The effect of R&D spending on other financial items
7	Explaining R&D spending changes
8	R&D accounting policy discussion outside the financial statements
9	R&D and future opportunities
10	Tax credit
Input	
11	Management and People
12	Other parties involved in R&D (R&D collaboration)
13	Infrastructure
14	Funding
Output : (in progress and achievement : new product or beyond product)	
15	Past achievement from R&D activities
16	R&D progress
17	This year achievement
18	Potential achievement
19	Patents
Financial Disclosure	
20	Past R&D expenditures
21	Present R&D expenditures
22	Future R&D expenditures
23	R&D Ratios
24	Comparison of R&D expenditures to those of prior year
25	Comparison of R&D expenditures to those of prior years
26	Comparison of R&D expenditures to those of target or to expectations
Total Score	

Appendix C Sample Companies List (Year 2007)

N0.	Company Name	DATA STREAM CODE	INDUSTRY
1	Rolls-Royce Holdings plc	940793	Industrials
2	BAE Systems plc	901419	Industrials
3	Cobham plc	904313	Industrials
4	Meggitt plc	910509	Industrials
5	Ultra Electronics Holdings plc	882275	Industrials
6	Qinetiq Group plc	29088D	Industrials
7	Chemring Group plc	914073	Industrials
8	UMECO plc	940763	Industrials
9	GKN plc	900754	Consumer Goods
10	Torotrak plc	681961	Consumer Goods
11	Diageo plc	900251	Consumer Goods
12	SAB Miller plc	695504	Consumer Goods
13	Britvic plc	32480C	Consumer Goods
14	Johnson Matthey plc	901152	Basic Materials
15	Croda International plc	900476	Basic Materials
16	Yule Catto & Co plc	74653N	Basic Materials
17	Elementis plc	901023	Basic Materials
18	Victrex plc	870364	Basic Materials
19	Porvair plc	940860	Industrials
2	Marshalls plc	910500	Industrials
21	Low & Bonar plc	901352	Industrials
22	Balfour Beatty plc	900494	Industrials
23	British Energy plc	29905D	Utilities
24	Scottish & Southern Energy plc	928738	Utilities
25	Invensys plc	905110	Technology
26	Spectris plc	953203	Industrials
27	Laird Group plc	901107	Technology
28	Renishaw plc	917076	Industrials
29	Halma plc	910821	Industrials
30	Oxford Instruments plc	940013	Industrials
31	Domino Printing Sciences plc	910043	Industrials
32	TT Electronics plc	901830	Industrials
33	MORGAN ADVANCED MATERIAL plc	900408	Industrials
34	Xaar plc	896457	Industrials
35	Chloride Group plc	900930	Industrials
36	Pv Crystalox Solar plc	50604X	Oil & Gas
37	Dialight plc	312742	Industrials
38	Volex Group plc	900528	Industrials
39	BT Group plc	900888	Telecommunications
40	Tesco plc	900803	Consumer Services
41	Unilever plc	900789	Consumer Goods
42	Tate & Lyle plc	900819	Consumer Goods

43	Devro plc	319802	Consumer Goods
44	Premier Foods plc	28961T	Consumer Goods
45	Dairy Crest Group plc	882065	Consumer Goods
46	Mondi plc	50629V	Basic Materials
47	Centrica plc	888276	Utilities
48	Severn Trent plc	904373	Utilities
49	National Grid plc	870181	Utilities
50	Northumbrian Water Group plc	27057U	Utilities
51	United Utilities Group plc	904367	Utilities
52	Smiths Group plc	900943	Industrials
53	Tomkins plc	911258	Industrials
54	Cookson Group plc	13946T	Industrials
55	Rexam plc	901065	Industrials
56	Avon Rubber plc	900925	Industrials
57	Marks & Spencer Group plc	901207	Consumer Services
58	Kesa Electricals plc	29046E	Consumer Services
59	DIXONS RETAIL plc (DSG international)	900906	Consumer Services
60	Photo-Me International plc	900917	Consumer Goods
61	Smith & Nephew plc	900487	Health Care
62	Biocompatibles International plc	135215	Health Care
63	Consort Medical plc	926114	Health Care
64	Corin Group plc	258023	Health Care
65	Puricore plc	36204R	Health Care
66	Optos plc	870841	Health Care
67	Bioquell plc	903495	Health Care
68	Reckitt Benckiser Group plc	900484	Consumer Goods
69	McBride plc	134982	Consumer Goods
70	Aga Rangemaster Group plc	900737	Consumer Goods
71	IMI plc	901704	Industrials
72	Vitec Group plc	926712	Industrials
73	Weir Group plc	900699	Industrials
74	SENIOR plc	900600	Industrials
75	Spirax-Sarco Engineering plc	900741	Industrials
76	Rotork plc	910649	Industrials
77	Fenner plc	900575	Industrials
78	Molins plc	900558	Industrials
79	Manganese Bronze plc	901155	Industrials
80	600 Group	900589	Industrials
81	Hill & Smith Hldgs plc	911998	Industrials
82	BBA Aviation plc	900293	Industrials
83	Games Workshop Group plc	136751	Consumer Goods
84	Hornby plc	917541	Consumer Goods
85	British Sky Broadcasting Group plc	135116	Consumer Services
86	Daily Mail and General Trust plc	904283	Consumer Services
87	Aegis Group plc	917597	Consumer Services
88	Centaur Media plc	28571L	Consumer Services

89	Moneysupermarket Com GP.	50869K	Consumer Services
90	Vodafone Group plc	953133	Telecommunications
91	Inmarsat plc	30877H	Telecommunications
92	BP plc	900995	Oil & Gas
93	BG Group plc	911488	Oil & Gas
94	Wellstream Holdings plc	50450V	Oil & Gas
95	SSL International plc	914579	Consumer Goods
96	PZ Cussons plc	910580	Consumer Goods
97	Alexandra plc	900780	Consumer Goods
98	GlaxoSmithKline plc	900479	Health Care
99	AstraZeneca plc	319608	Health Care
100	SHIRE plc	870593	Health Care
101	SkyePharma plc	953686	Health Care
102	Oxford Biomedica plc	870449	Health Care
103	Protherics plc	914555	Health Care
104	Vernalis plc	507526	Health Care
105	Genus plc	296734	Health Care
106	Vectura Group plc	29100H	Health Care
107	Ark Therapeutics Group plc	29295U	Health Care
108	Prostrakan Group plc	30234L	Health Care
109	BTG plc	139996	Health Care
110	Hikma Pharmaceuticals plc	32273L	Health Care
111	Axis-Shield plc	323592	Health Care
112	Phytopharm plc	29264D	Health Care
113	Dechra Pharmaceuticals plc	264572	Health Care
114	Sage Group plc	904649	Technology
115	Misys plc	914192	Technology
116	Autonomy Corporation plc	269281	Technology
117	Logica plc	901940	Technology
118	AVEVA GROUP plc	882839	Technology
119	Fidessa Group plc	897412	Technology
120	Anite plc	917534	Technology
121	Kofax plc (Dicom)	870805	Technology
122	Intec Telecom Systems plc	295610	Technology
123	Micro Focus International plc	30857U	Technology
124	Kewill plc	910520	Technology
125	Microgen plc	926005	Technology
126	Innovation Group Plc	290355	Technology
127	Alterian plc	296870	Technology
128	DRS Data & Research Services plc	135564	Technology
129	Gresham Computing plc	940372	Technology
130	Service Power Technologies plc	291795	Technology
131	Serco Group plc	943663	Industrials
132	Experian plc	410124	Industrials
133	De La Rue plc	901343	Industrials
134	Ricardo PLC	902791	Industrials

135	Fiberweb plc	413032	Industrials
136	BSS Group plc	900578	Industrials
137	STHREE plc	32301X	Industrials
138	G4S PLC	871674	Industrials
139	Xchanging plc	50420K	Industrials
140	Rentokil Initial plc	906480	Industrials
141	Hogg Robinson Group plc	412630	Industrials
142	Brammer plc	901815	Industrials
143	Premier Farnell plc	905498	Industrials
144	Latchways plc	892927	Industrials
145	ARM Holdings plc	679297	Technology
146	CSR plc	28541P	Technology
147	Spirent Communications plc	900493	Technology
148	Imagination Technologies Group plc	135869	Technology
149	Wolfson Microelectronics plc	27886E	Technology
150	Filtronic plc	136904	Technology
151	Psion plc	943529	Technology
152	Plasmon plc	876296	Technology
153	Trafficmaster plc	135522	Technology
154	British American Tobacco plc	901295	Consumer Goods
155	888 Holdings plc	31762D	Consumer Services
156	Thomas Cook Group plc	30059W	Consumer Services
157	easyjet plc	280641	Consumer Services

Appendix C Sample Companies List (Continued) (Year 2008)

No.	Company Name	DATA STREAM CODE	INDUSTRY
1	BAE Systems plc	901419	Industrials
2	Cobham plc	904313	Industrials
3	Meggitt plc	910509	Industrials
4	Ultra Electronics Holdings plc	882275	Industrials
5	Qinetiq Group plc	29088D	Industrials
6	Chemring Group plc	914073	Industrials
7	SENIOR plc	900600	Industrials
8	UMECO plc	940763	Industrials
9	GKN plc	900754	Consumer Goods
10	Torotrak plc	681961	Consumer Goods
11	Diageo plc	900251	Consumer Goods
12	SAB Miller plc	695504	Consumer Goods
13	Britvic plc	32480C	Consumer Goods
14	Johnson Matthey plc	901152	Basic Materials
15	Croda International plc	900476	Basic Materials
16	Yule Catto & Co plc	74653N	Basic Materials
17	Elementis plc	901023	Basic Materials
18	Victrex plc	870364	Basic Materials
19	Dyson plc	901370	Basic Materials
2	Porvair plc	940860	Industrials
21	Carclo plc	905952	Basic Materials
22	Balfour Beatty plc	900494	Industrials
23	Marshalls plc	910500	Industrials
24	Low & Bonar plc	901352	Industrials
25	Norcros plc	50802U	Industrials
26	Scottish & Southern Energy plc	928738	Utilities
27	Spectris plc	953203	Industrials
28	Laird Group plc	901107	Technology
29	Renishaw plc	917076	Industrials
30	Halma plc	910821	Industrials
31	Oxford Instruments plc	940013	Industrials
32	e2v technologies plc	29109J	Industrials
33	Domino Printing Sciences plc	910043	Industrials
34	TT Electronics plc	901830	Industrials
35	MORGAN ADVANCED MATERIAL plc	900408	Industrials
36	Chloride Group plc	900930	Industrials
37	PV Crystalox Solar	50604X	Oil & Gas
38	Xaar plc	896457	Industrials
39	Dialight plc	312742	Industrials
40	Volex Group plc	900528	Industrials
41	BT Group plc	900888	Telecommunications
42	KCOM Group plc	671467	Telecommunications

43	Tesco plc	900803	Consumer Services
44	Unilever plc	900789	Consumer Goods
45	Cadbury plc	900286	Consumer Goods
46	Tate & Lyle plc	900819	Consumer Goods
47	Devro plc	319802	Consumer Goods
48	Premier Foods plc	28961T	Consumer Goods
49	Dairy Crest Group plc	882065	Consumer Goods
50	Mondi plc	50629V	Basic Materials
51	Severn Trent plc	904373	Utilities
52	National Grid plc	870181	Utilities
53	Centrica plc	888276	Utilities
54	Northumbrian Water Group plc	27057U	Utilities
55	United Utilities Group plc	904367	Utilities
56	Smiths Group plc	900943	Industrials
57	Tomkins plc	911258	Industrials
58	Cookson Group plc	13946T	Industrials
59	Rexam plc	901065	Industrials
60	Avon Rubber plc	900925	Industrials
61	Marks & Spencer Group plc	901207	Consumer Services
62	Kesa Electricals plc	29046E	Consumer Services
63	BROWN (N) GROUP plc	914327	Consumer Services
64	Findel plc	905712	Consumer Services
65	Debenhams plc	35793C	Consumer Services
66	Pendragon plc	904302	Consumer Services
67	Dixons Retail plc (DSG International)	900906	Consumer Services
68	Smith & Nephew plc	900487	Health Care
69	Biocompatibles International plc	135215	Health Care
70	Consort Medical plc	926114	Health Care
71	Puricore plc	36204R	Health Care
72	Optos plc	870841	Health Care
73	Corin Group plc	258023	Health Care
74	Bioquell plc	903495	Health Care
75	Celsis International plc	319938	Health Care
76	Reckitt Benckiser Group plc	900484	Consumer Goods
77	McBride plc	134982	Consumer Goods
78	Aga Rangemaster Group plc	900737	Consumer Goods
79	Taylor Wimpey plc	900345	Consumer Goods
80	IMI plc	901704	Industrials
81	Vitec Group plc	926712	Industrials
82	Weir Group plc	900699	Industrials
83	Spirax-Sarco Engineering plc	900741	Industrials
84	Rotork plc	910649	Industrials
85	Melrose plc	27922U	Industrials
86	Hill & Smith Hldgs plc	911998	Industrials
87	Molins plc	900558	Industrials
88	Fenner plc	900575	Industrials

89	Clean Air Power	32779E	Consumer Goods
90	600 Group plc	900589	Industrials
91	Manganess Bronze plc	901155	Industrials
92	BBA Aviation plc	900293	Industrials
93	UK Mail Group plc	319875	Industrials
94	Photo-Me International plc	900917	Consumer Goods
95	Games Workshop Group plc	136751	Consumer Goods
96	Hornby plc	917541	Consumer Goods
97	British Sky Broadcasting Group plc	135116	Consumer Services
98	Pearson plc	914021	Consumer Services
99	ITV plc	931524	Consumer Services
100	Daily Mail and General Trust plc	904283	Consumer Services
101	Aegis Group plc	917597	Consumer Services
102	MONEY SUPERMARKET COM GP.	50869K	Consumer Services
103	Vodafone Group plc	953133	Telecommunications
104	Inmarsat plc	30877H	Telecommunications
105	BP plc	900995	Oil & Gas
106	BG Group plc	911488	Oil & Gas
107	Wellstream Holdings plc	50450V	Oil & Gas
108	SSL International plc	914579	Consumer Goods
109	PZ Cussons plc	910580	Consumer Goods
110	Alexandra plc	900780	Consumer Goods
111	Glaxo SmithKline plc	900479	Health Care
112	Astra Zeneca plc	319608	Health Care
113	Vectura Group plc	29100H	Health Care
114	Oxford Biomedica plc	870449	Health Care
115	BTG plc	139996	Health Care
116	Renovo Group plc	30850M	Health Care
117	Genus plc	296734	Health Care
118	Ark Therapeutics plc	29295U	Health Care
119	Hikma Pharmaceuticals plc	32273L	Health Care
120	SkyePharma plc	953686	Health Care
121	Vernalis plc	507526	Health Care
122	Prostrakan Group plc	30234L	Health Care
123	Axis-Shield plc	323592	Health Care
124	Dechra Pharmaceuticals plc	264572	Health Care
125	Phytopharm plc	29264D	Health Care
126	Sinclair Pharma plc	28188Q	Health Care
127	Sage Group plc	904649	Technology
128	Invensys plc	905110	Technology
129	Misys plc	914192	Technology
130	Autonomy Corporation plc	269281	Technology
131	AVEVA GROUP plc	882839	Technology
132	Micro Focus International plc	30857U	Technology
133	Fidessa Group plc	897412	Technology
134	Kofax plc (Dicom)	870805	Technology

135	Logica plc	901940	Technology
136	Intec Telecom Systems plc	295610	Technology
137	Anite plc	917534	Technology
138	SDL plc	278833	Technology
139	Innovation Group PLC	290355	Technology
140	Kewill plc	910520	Technology
141	Microgen plc	926005	Technology
142	Alterian plc	296870	Technology
143	DRS Data & Research Services plc	135564	Technology
144	Gresham Computing plc	940372	Technology
145	Electronic Data Processing plc	911389	Technology
146	Serco Group plc	943663	Industrials
147	Experian plc	410124	Industrials
148	De La Rue plc	901343	Industrials
149	G4S PLC	871674	Industrials
150	Xchanging plc	50420K	Industrials
151	MITIE Group plc	910407	Industrials
152	Ricardo PLC	902791	Industrials
153	BSS Group plc	900578	Industrials
154	Fiberweb plc	413032	Industrials
155	Mouchel Group plc	25718M	Industrials
156	Rentokil Initial plc	906480	Industrials
157	Premier Farnell plc	905498	Industrials
158	Tribal Group plc	255285	Industrials
159	Brammer plc	901815	Industrials
160	Latchways plc	892927	Industrials
161	CSR plc	28541P	Technology
162	ARM Holdings plc	679297	Technology
163	Pace plc (Pace Micro Technology)	875854	Technology
164	Spirent Communications plc	900493	Technology
165	Imagination Technologies Group plc	135869	Technology
166	Wolfson Microelectronics plc	27886E	Technology
167	Sepura plc	50887P	Technology
168	Filtronic plc	136904	Technology
169	Trafficmaster plc	135522	Technology
170	CML Microsystems plc	974825	Technology
171	British American Tobacco plc	901295	Consumer Goods
172	888 Holdings plc	31762D	Consumer Services
173	TUI Travel plc	911448	Consumer Services

Appendix C Sample Companies List (Continued) (Year 2009)

No.	Company Name	DATA STREAM CODE	INDUSTRY
1	BAE Systems plc	901419	Industrials
2	Cobham plc	904313	Industrials
3	Meggitt plc	910509	Industrials
4	Ultra Electronics Holdings plc	882275	Industrials
5	Chemring Group plc	914073	Industrials
6	Senior plc	900600	Industrials
7	Qinetiq Group plc	29088D	Industrials
8	UMECO plc	940763	Industrials
9	Hampson Industries plc	910379	Industrials
10	Pv Crystalox Solar plc	50604X	Oil & Gas
11	Porvair plc	940860	Industrials
12	GKN plc	900754	Consumer Goods
13	Torotrak plc	681961	Consumer Goods
14	Diageo plc	900251	Consumer Goods
15	SAB Miller plc	695504	Consumer Goods
16	Britvic plc	32480C	Consumer Goods
17	Johnson Matthey plc	901152	Basic Materials
18	Croda International plc	900476	Basic Materials
19	Yule Catto & Co plc ((XETRA))	74653N	Basic Materials
2	Elementis plc	901023	Basic Materials
21	Victrex plc	870364	Basic Materials
22	Carclo plc	905952	Basic Materials
23	Balfour Beatty plc	900494	Industrials
24	Low & Bonar plc	901352	Industrials
25	Marshalls plc	910500	Industrials
26	Norcros plc	50802U	Industrials
27	Scottish & Southern Energy plc	928738	Utilities
28	Spectris plc	953203	Industrials
29	Laird Group plc	901107	Technology
30	Renishaw plc	917076	Industrials
31	Halma plc	910821	Industrials
32	MORGAN ADVANCED MATERIAL plc	900408	Industrials
33	Oxford Instruments plc	940013	Industrials
34	Domino Printing Sciences plc	910043	Industrials
35	e2v technologies plc	29109J	Industrials
36	TT Electronics plc	901830	Industrials
37	Chloride Group plc	900930	Industrials
38	Dialight plc	312742	Industrials
39	Volex Group plc	900528	Industrials
40	BT Group plc	900888	Telecommunications
41	KCOM Group plc	671467	Telecommunications
42	Tesco plc	900803	Consumer Services

43	Unilever plc	900789	Consumer Goods
44	Tate & Lyle plc	900819	Consumer Goods
45	Premier Foods plc	28961T	Consumer Goods
46	Dairy Crest Group plc	882065	Consumer Goods
47	Devro plc	319802	Consumer Goods
48	Uniq plc	900804	Consumer Goods
49	Mondi plc	50629V	Basic Materials
50	Centrica plc	888276	Utilities
51	Severn Trent plc	904373	Utilities
52	National Grid plc	870181	Utilities
53	Northumbrian Water Group plc	27057U	Utilities
54	United Utilities Group plc	904367	Utilities
55	Smiths Group plc	900943	Industrials
56	Tomkins plc	911258	Industrials
57	Cookson Group plc	13946T	Industrials
58	Rexam plc	901065	Industrials
59	Avon Rubber plc	900925	Industrials
60	Marks & Spencer Group plc	901207	Consumer Services
61	Kesa Electricals plc	29046E	Consumer Services
62	Dixons Retail plc (DSG International)	900906	Consumer Services
63	BROWN (N) GROUP plc	914327	Consumer Services
64	Debenhams plc	35793C	Consumer Services
65	Findel plc	905712	Consumer Services
66	Pendragon plc	904302	Consumer Services
67	Mothercare plc	905308	Consumer Services
68	Smith & Nephew plc	900487	Health Care
69	Biocompatibles International plc	135215	Health Care
70	Consort Medical plc	926114	Health Care
71	Corin Group plc	258023	Health Care
72	Puricore plc	36204R	Health Care
73	Optos plc	870841	Health Care
74	Bioquell plc	903495	Health Care
75	Reckitt Benckiser Group plc	900484	Consumer Goods
76	McBride plc	134982	Consumer Goods
77	Aga Rangemaster Group plc	900737	Consumer Goods
78	IMI plc	901704	Industrials
79	Vitec Group plc	926712	Industrials
80	Weir Group plc	900699	Industrials
81	Spirax-Sarco Engineering plc	900741	Industrials
82	Rotork plc	910649	Industrials
83	Melrose plc	27922U	Industrials
84	Fenner plc	900575	Industrials
85	Molins plc	900558	Industrials
86	Hill & Smith Hldgs plc	911998	Industrials
87	James Fisher & Sons plc	911391	Industrials
88	BBA Aviation plc	900293	Industrials

89	UK Mail Group plc	319875	Industrials
90	Photo-Me International plc	900917	Consumer Goods
91	Games Workshop Group plc	136751	Consumer Goods
92	Hornby plc	917541	Consumer Goods
93	British Sky Broadcasting Group plc	135116	Consumer Services
94	Pearson plc	914021	Consumer Services
95	Daily Mail and General Trust plc	904283	Consumer Services
96	ITV plc	931524	Consumer Services
97	Aegis Group plc	917597	Consumer Services
98	Centaur Media plc	28571L	Consumer Services
99	Vodafone Group plc	953133	Telecommunications
100	Inmarsat plc	30877H	Telecommunications
101	BP plc	900995	Oil & Gas
102	BG Group plc	911488	Oil & Gas
103	Wellstream Holdings plc	50450V	Oil & Gas
104	Hunting plc	917509	Oil & Gas
105	SSL International plc	914579	Consumer Goods
106	PZ Cussons plc	910580	Consumer Goods
107	Glaxo SmithKline plc	900479	Health Care
108	Astra Zeneca plc	319608	Health Care
109	Vectura Group plc	29100H	Health Care
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133	Kewill plc	910520	Technology
134	Alterian plc	296870	Technology

135	Microgen plc	926005	Technology
136	DRS Data & Research Services plc	135564	Technology
137	Dimension Data Holdings plc	298320	Technology
138	Gresham Computing plc	940372	Technology
139	Electronic Data Processing plc	911389	Technology
140	Serco Group plc	943663	Industrials
141	Experian plc	410124	Industrials
142	Xchanging plc	50420K	Industrials
143	G4S PLC	871674	Industrials
144	De La Rue plc	901343	Industrials
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146	Mouchel Group plc	25718M	Industrials
147	Premier Farnell plc	905498	Industrials
148	Fiberweb plc	413032	Industrials
149	MITIE Group plc	910407	Industrials
150	Hogg Robinson Group plc	412630	Industrials
151	BSS Group plc	900578	Industrials
152	Jarvis plc	911540	Industrials
153	Sthree plc	32301X	Industrials
154	Tribal Group plc	255285	Industrials
155	Rentokil Initial plc	906480	Industrials
156	Babcock International Group plc	900552	Industrials
157	Latchways plc	892927	Industrials
158	Brammer plc	901815	Industrials
159	Mears Group plc	882297	Industrials
160	ARM Holdings plc	679297	Technology
161	CSR plc	28541P	Technology
162	Pace plc (Pace Micro Technology)	875854	Technology
163	Spirent Communications plc	900493	Technology
164	Imagination Technologies Group plc	135869	Technology
165	Wolfson Microelectronics plc	27886E	Technology
166	Psion plc	943529	Technology
167	Sepura plc	50887P	Technology
168	Xaar plc	896457	Industrials
169	CML Microsystems plc	974825	Technology
170	Filtronic plc	136904	Technology
171	Network Technology plc	882050	Technology
172	British American Tobacco plc	901295	Consumer Goods
173	Thomas Cook Group plc	30059W	Consumer Services
174	TUI Travel plc	911448	Consumer Services
175	888 Holdings plc	31762D	Consumer Services