University of Southampton

Faculty of Social Sciences

Southampton Business School

Do Strategic Leaders Drive Success in Innovation Performance? An Empirical Analysis of Innovation in the US Hi-technology and Pharmaceutical Sectors and the Malaysian Palm Oil Industry

by

Margaret Kuyor

Thesis for the degree of Doctor of Philosophy

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Abstract

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This thesis investigates the relationships between strategic leaders and innovation performance as well as the ways in which governance mechanisms influence that relationship. Specifically, the **first core chapter** inspects the associations between a powerful CFO and innovation performance, and the effect of financial slack and CEO power on the association in US high-technology listed firms from 1998 to 2018. The findings show that a powerful CFO is associated with greater innovation performance and is further strengthened when firms have higher levels of financial slack. This implies that greater cash flow provides the powerful CFO with more opportunities to invest in innovation, producing greater outcomes and achieving higher innovation efficiency. On top of that, abundant financial slack motivates powerful CFOs to explore more internal innovation strategies. Nevertheless, the link between a powerful CFO and innovation performance is weakened when there is a conflict of power between CFO and CEO. The **second core chapter** examines the association between CEO compensation and innovation performance and the implications of government's regulations on the link in US pharmaceutical-listed firms from 1998 to 2018. The findings advocate that a CEO with high compensation is associated with greater R&D

investment and technology acquisition, and prefers internal innovation strategy over purchasing external technology. However, a highly paid CEO is linked with less expenditure both in R&D and technology purchasing in the event of the government introducing or amending the industry's regulations. Any introduction or amendment of the industry's regulations also causes the CEO to prefer acquiring external technology over investing in internal innovation strategies. The **third core chapter** explores the relationship between political affiliation and innovation input intensity and the impact of board diversity on the association in the Malaysian palm oil industry from 2008 to 2018. The findings suggest that firms with political affiliation are associated with lower innovation input intensity, thus, refutes the assumption of engaging politically connected directors are beneficial for industry that is closely related to the national policies. However, the presence of more female directors on board has brought a positive impact on the link. This denotes greater gender diversity is able to align the interests of politically affiliated directors with firms' innovation agenda.

Table of Contents

Table of Tables

Table of Figures

Research Thesis: Declaration of Authorship

Print name:	Margaret Kuyor
Title of thesis:	Do strategic leaders drive success in innovation performance? An empirical analysis of innovation in the US hi-technology and pharmaceutical sectors and the Malaysian palm oil industry

I declare that this thesis and the work presented in it are my own. This thesis has been authored by me as the result of my own original research.

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Mr & Mrs Kuyor Anchoh

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without whom this endeavour would not have been possible.
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Margaret Kuyor
Southampton, United Kingdom
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Definitions and Abbreviations

2SLS	Two-Stage Least Squares
BoD	Board of Directors
CEO	Chief Executive Officer
CFO	Chief Financial Officer
FEM	Fixed Effect Model
IE	Innovation Efficiency
LTIP	Long-Term Incentive Plan
MPOB	Malaysian Palm Oil Board
OER	Oil Extraction Rate
OLS	Ordinary Least Squares
R&D	Research and Development
ROA	Return on Assets
ROE	Return on Equity
TA	Technology Acquisition
TMT	Top Management Team
USFDA	US Food and Drug Administration
VIF	Variation Inflation Factor

Chapter 1 Introduction

1.1 Introduction

Relying on upper echelons and agency theory, this thesis aims at investigating whether strategic leaders drive success in innovation. First, the investigation focuses on the direct links between the strategic leaders' characteristics such as power, compensation, political affiliation background and innovation performance. Second, the research examines the impact of internal and external governance mechanisms such as the capital structure – financial slack, regulations and board diversity on the associations. The research applies longitudinal data of U.S. high-technology and pharmaceuticals, and the Malaysian palm oil industry as illustrations.

The thesis focuses on the US high-technology and pharmaceutical sectors, as well as the Malaysian palm oil industry as examples to accomplish the aims of this thesis for several reasons. Indeed, each industry has unique features that allow the present study to provide fresh insights into the link between strategic leaders' characteristics and innovation. Firstly, the US high-technology industry is an appropriate illustration because of the industry's reliance on abundant financial slack to safeguard against cash flow volatility and eventually to sustain continuous innovation investment (O'Brien, 2003). In relation to the CFO's role, it is by virtue of CFO's formal structural and expertise roles, CFOs are directly involved in the firm's financial matters as example managing the financial slack such as tracking cash flow, planning, and proposing strategic directions. The findings are valuable for organizations to understand how the level of cash flow can influence powerful CFO in driving innovation performance.

Secondly, despite the well-researched link between CEO compensation and innovation, little is known about how government regulation affects the link. Indeed, regulation aspect is a top concern of many organizations today (Oliver, 2017). It is evident that the US pharmaceutical industry provides an excellent setting for demonstrating the relationship between CEO compensation, regulation, and innovation performance since the industry is widely known as a highly regulated industry (Grabowski, 2011). Thus, by focusing on the industry, the study is able to provide a precise understanding of the relationships and useful for many other organizations relating to their top concern.

Thirdly, this thesis also includes a major emerging market sector, namely the Malaysian palm oil industry, in demonstrating the relationship between strategic leaders' political affiliation and innovation. The inclusion of a non-western perspective in this study is vital because the western data, as an example, from the US high-technology and pharmaceutical sectors do not yield insights into political dimensions. Furthermore, the agency relationships within firms in Asia are slightly different from in the west and the claim that political connections in the region in driving business is more common (Fisman, 2001). Ultimately, each of the industries in this thesis has its own distinct features that provide an excellent platform for the study in exploring the relationship between strategic leaders' characteristics and innovation performance, and how governance mechanisms impact the links.

1.2 Thesis conceptual framework

Upper echelons theory states that the strategic leaders' characteristics like power, financial position and functional background have a profound impact on the organisation outcomes, such as strategic choices and performance levels (Hambrick and Mason, 1984). Their characteristics can greatly influence the way they interpret and react to situations and in turn affect their decision-making (Hambrick, 2007). In short, the organisational outcome is a reflection of its top strategic leaders (Hambrick and Mason, 1984; Cannella et al., 2009).

In organization, when there is a delegation of functions from principals (owners) to agents (executives/ strategic leaders), there is a 'separation of ownership and control'. This creates a general problem of agency, namely the agency cost if there is conflicting interest between the two parties. Thus, governance mechanisms are needed to either align the interests of agents with the principals or to monitor the agents. This is to ensure the agents act in the greatest interest of the organisation (Jensen and Meckling, 1976; Eisenhardt, 1989).

Therefore, based on the upper echelons theory and agency theory, and the literature of strategic leadership, corporate governance and innovation, the present study designs its conceptual framework to illustrate the variables involved in addressing the research questions and to provide direction for the study. Figure 1-1 below is the author's illustration of the thesis conceptual framework on the associations between strategic leadership, governance mechanisms and innovation performance in the US high-technology and pharmaceutical sectors and the Malaysian palm oil industry.

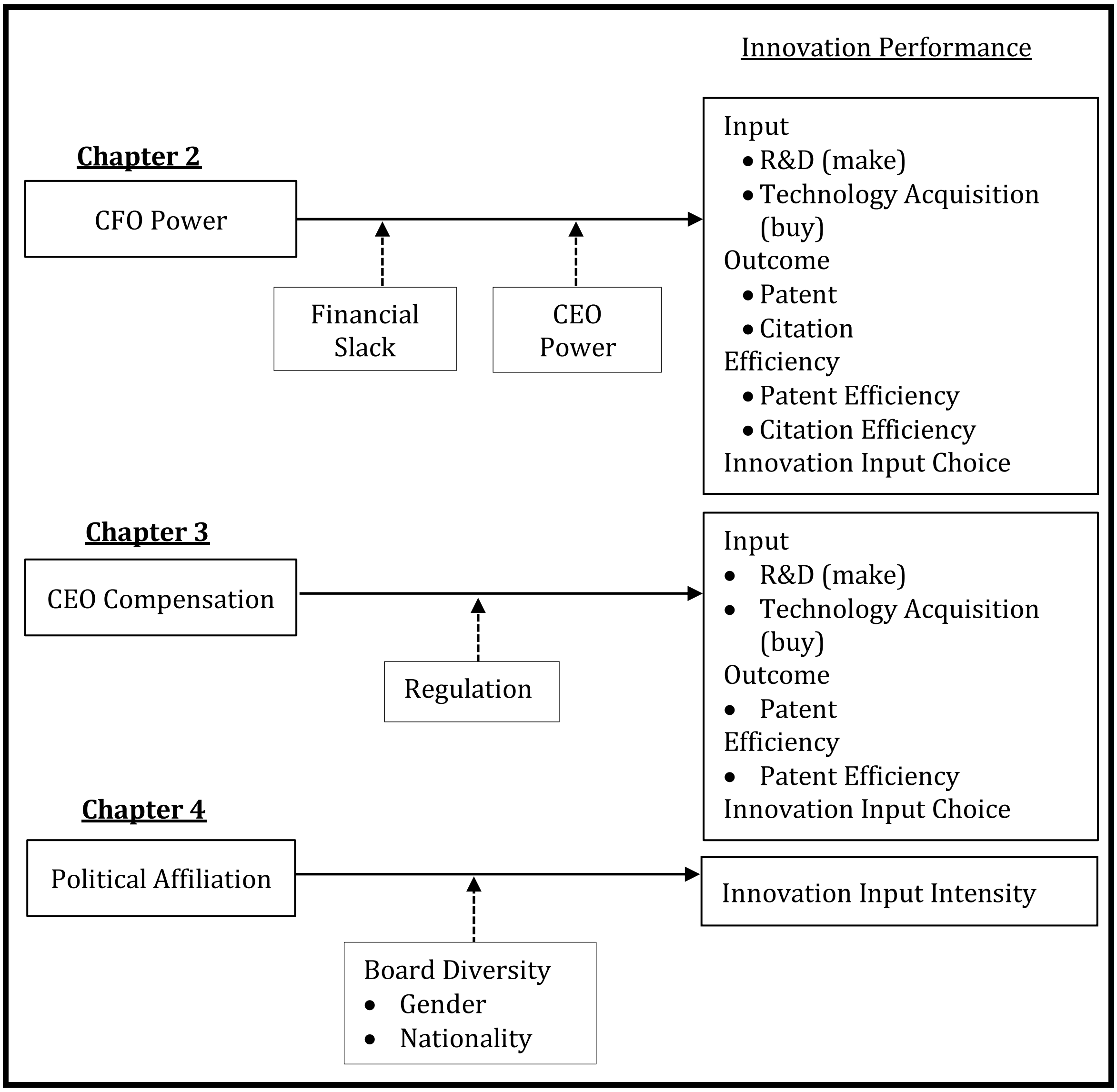

Figure 1-1 Thesis conceptual framework

1.3 Research focus, aims and questions

Research focus

The research focuses on the associations between strategic leaders' characteristics like power, compensation and political affiliation and innovation performance and how governance mechanisms such as capital structure, regulations and board diversity influence the associations. This thesis concentrates on three different industries, namely the U.S. high-technology and pharmaceutical industries, and the Malaysian palm oil industry as illustrations.

Research aims and questions

The dissertation aims to examine the association between strategic leaders, governance mechanisms and innovation performance by extending the upper-echelon theory in three different ways. In specific, the aim of the **first core chapter** (Chapter 2) is to investigate the association between CFO power and innovation performance and to extend the upper echelons theory by scrutinizing the role of firms' capital structure (financial slack) and CFO-CEO power in influencing the association based on 150 listed firms in the US high-technology industry from 1998 to 2018.

Indeed, there is a growing trend wherein CFOs are rewarded for their CEO-likeness and similarity tasks and decision-making authority as the CEO (Caglio et al., 2018). While there is much emphasis put on the strategic role of CEOs on innovation, (Cho and Kim, 2017; Sunder et al., 2017; Zhang et al., 2017; Cummings and Knott, 2018; Fralich and Papadopoulos, 2018; Shaikh et al., 2018; Nguyen, 2018; Tabesh et al., 2019; Chan et al., 2020; You et al., 2020), there is scarce evidence on the association between CFOs and innovation performance.

The study also includes an investigation into the role of financial slack on the CFO power-innovation association. Firms and CFOs in this industry are known for their preference for financial slack as their capital structure (Grinblatt and Titman, 2002; O'Brien and Folta, 2009). Yet, financial slack is a debatable innovation determination. It has the ability to foster innovation (Bourgeois, 1981; Cyert and March, 1963), but it also causes inefficiency and hoards due to the self-serving interests of executives (Jensen and Meckling, 1976; Nohria and Gulati, 1996). Moreover, too much cash leads to the abating of internal controls (Jensen, 1986). Despite the importance of financial slack to the high-technology industry, it is scarcely known to what extent the abundant cash flow influences the role of a powerful CFO on innovation performance.

Aside from that, CFOs have increasingly overstepped their fiduciary responsibilities to assist CEOs with the strategic management of their respective complex organisations as well as in challenging external business environments (Colbert et al., 2014; Zorn, 2004). It is not only that they are more influential than CEOs over financial reports (Geiger and North, 2006), their roles have increasingly involved corporate strategy-making (Datta and Iskandar-Data, 2014) and most CFOs are also second in command to the CEO in most firms (Hoitash et al., 2016). Thus, CFOs normally operate closely with the CEOs and often sit on the board of directors (Aggarwal and Samwick, 2003). Nevertheless, the partnership between CFOs and CEOs can lead to either a positive or negative impact on strategic decision-making, including innovation strategy (Amason, 1996). Still, how CEO-CFO power impacts the association between a powerful CFO and innovation performance is still known.

Taken together, chapter 2 aims to answer the following research questions by analysing 150 listed firms in the US high-technology industry from 1998 to 2018 as an illustration:

1. How does the CFO power associate with innovation performance at the firm level of the US high-technology industry?

2. Does the firm's financial slack have any influence on CFO power and innovation performance?

3. To what extent does CEO power affect the association between CFO power and innovation performance?

The **second core chapter** (Chapter 3) aims to extend the upper echelons theory by assessing the association between CEO compensation and innovation performance as well as to explore how the industry's regulation influences the association by taking 75 US pharmaceutical listed firms from 1998 to 2018 as an illustration.

Indeed, compensation is a significant feature in the US pharmaceutical industry and CEOs in this industry are paid higher compared to other industries (USA Today, 2016; Business Insider, 2018; Mendoza, 2019). However, existing studies pay less attention to strategic leadership characteristics such as CEO compensation in the industry (Cheah et al., 2007; Hess and Rothaermel, 2011; Houston et al., 2013; Ramaswamy and Banta, 2017). Nevertheless, Hara (2003) provides one point of data that project leaders are important in leading drug development in pharmaceutical firms. However, the role of CEO compensation in driving innovation performance in this industry is less known.

Apart from that, this chapter also seeks to explore the role of the pharmaceutical industry's regulation on the CEO compensation-innovation performance link. The pharmaceutical industry is heavily regulated. The regulatory environment affects nearly all aspects of pharmaceutical companies' operations, such as the processes and outcomes of R&D (Oliver, 2017), the approval of products and drugs, manufacturing and labelling, marketing communications as well as patent protection and enforcement (Martin et al., 2018). Thus, in driving innovation performance, CEOs in this industry are facing high challenges whenever there is an introduction or amendment of regulations because the new regulations may affect the ongoing R&D activities and projects. Yet, research in the pharmaceutical industry scarcely discusses how regulation can influence the role of the CEO on innovation performance.

Collectively, chapter 3 aims to answer the following research questions by using 75 pharmaceutical firms listed in the United States of America (US) from 1998 to 2018 as an example:

1. How does CEO compensation associate with innovation performance at the firm's level of the US pharmaceutical industry?

2. To what extent does the regulation in the US pharmaceutical industry influence the association between CEO compensation and innovation performance?

The **third core chapter** (Chapter 4) extends upper echelons theory by investigating the association between political affiliation and innovation performance and examines how board diversity affects the relationship through a study of 42 listed firms in Malaysia related to the palm oil industry from 2008 to 2018.

Existing research on political affiliation and firm performance (financial and innovation) put less emphasis on other Asian perspectives. In fact, most studies are based on Chinese data (Lin et al., 2011; Wu, 2011; Zhang et al., 2015; Song et al., 2015; Hou et al., 2017; Wang et al., 2018; McGuinness, 2019). Still, there is less emphasis put on the perspective of other Asian industries. Other Asian perspectives are needed because most of China's listed firms are state-owned. Thus, the approach of governance mechanisms might be different. Based on a recent study, China state-owned firms may serve to mitigate agency problems by reducing executive compensation (Elston, 2019). This approach is different to many who normally align the compensation with firm performance to minimise the agency problem (Jensen and Meckling, 1976).

Notably, the Malaysian palm oil industry is closely linked to government policies (Rasiah, 2006). According to Houston et al. (2014), firms that are closely related to government policies tend to engage politically affiliated directors for greater innovation performance. However, to what extent the politically affiliated directors influence innovation is less known. Apart from that, there is growing importance concerning board diversity in Malaysia. However, the existing literature on board diversity is mostly based on Western perspectives (Miller and Triana, 2009; Chapple and Humphrey, 2014; Kakabadse et al., 2015; Chen et al., 2016; García Lara et al., 2017; Bernile et al., 2018; Chen et al., 2018; Lu and Baoteng, 2018). Thus, the Asian perspective on the role of board diversity is limited. Indeed, as many emerging market countries experience a dramatic change in policy and regulation, the past agency relationship within firms may be altered—a phenomenon that is occurring in many countries (Elston, 2019). Therefore, it is feasible to include more perspectives from countries other than Western countries.

In sum, chapter 3 aims to answer the following research questions by a sample of 42 listed firms related to the palm oil industry in Malaysia from 2008 to 2018:

1. How does political affiliation associate with innovation input intensity?

2. To what extent does the board diversity such as gender and nationality diversity influence the association between political affiliation and innovation input intensity?

1.4 Background and research motivations

1.4.1 Overview of the US high-technology industry

Historically, for many decades, the US has maintained a strong competitive position for high-technology products globally. In the 1980s, the US high-technology exports almost doubled those of Japan or France and West Germany combined (McKinney and Rowley, 1985). In addition, an investigation in 2004-2009 shows that US high-technology firms generate significantly higher rates of return to R&D compared to other European firms (Cincera and Veugelers, 2014), implying the competitiveness of the US high-technology firms.

Despite the small number of US high-technology firms, the high-technology industry is vital to the US. The industry contributes significant income to the country, which generally focuses on cutting-edge technologies that drive sustainable economic growth (Haltiwanger et al., 2014). The total contribution is $5.3 trillion from high-technology products in 2016 to the US economy. It is projected to grow by $2.1 trillion and will support around 1.1 million new jobs from 2016 to 2026 (Roberts and Wolf, 2018). The sustainable growth of this industry is crucial to the US economy, and the success is dependent on the ability of high-technology firms to continuously innovate to maintain their respective competitive advantages (Schilling and Hill, 1998).

1.4.2 Overview of the pharmaceutical industry

The pharmaceutical industry is widely recognised as a highly innovative and regulated industry. Indeed, over the last half century, the industry has had an outstanding record of innovation performance (Grabowski, 2011). Specifically, the US pharmaceutical industry highly invests in R&D, accounting for USD 79.6 billion R&D spending out of a total global expenditure of USD 179 billion in 2018 (Evaluate, 2019; PhRMA, 2019). In addition, the US pharmaceutical industry is responsible for the highest number of new substances developed from 1998 to 2018. This industry is one of the most research-intensive industries (Grabowski and Vernon, 1994) and heavily relies on capital resources to fund its R&D programmes (Finkle, 1998).

Pharmaceutical and biotechnology have endeavoured to remain innovative. While the venture capital strategy has matured over the years, the majority of pharmaceutical and biotechnology firms now pursue collaboration strategies, which is believed to be the future landscape in the R&D of the industry, in particular collaborations with universities, research institutions, biotechnology and genomics-based companies as well as strategic alliances (Gassmann et al., 2008).

Apart from that, there are also different types of efforts adopted by individual pharmaceutical and biotechnology firms to stay competitive. As such, one firm in the industry takes two major initiatives. First, realigning incentives for their employees in order to foster innovation, and second, by systematically introducing outside talent and practices to inject fresh perspectives (Ramaswamy and Banta, 2017). Another big pharmaceutical firm focuses on more gender diversity in leadership, such as the CEO position. As a result, the firm becomes better positioned to increase diversity in their clinical trials, boost innovation as well as become more reliable and responsible in marketing their products (Fitzgerald, 2018).

1.4.3 Overview of the Malaysian palm oil industry

Malaysia, at that time British Malaya, is the responsible country that turned palm oil from a humble crop into a large-scale commercial crop. Introduced as an ornamental tree as early as 1871 by Westerners, it evolved into an industrial commodity with the establishment of the first oil palm estate in 1917 (Basiron and Chan, 2004). Over the last 50 years, the industry has adopted technological advances that have helped the industry to achieve higher productivity and become the world's largest exporter. Due to land and labour constraints, today, Malaysia is the world's second largest exporter of palm oil, which accounts for 30.9% of the world palm oil export, ranked second after Indonesia (Oil World Annual, 2017). Unlike Indonesia, Malaysia has limited land availability and labour supply; these limitations continue to force Malaysia to highly depend on new technology and mechanisation to increase productivity and remain competitive (Basiron, 2007; Craven, 2011).

The palm oil industry is vital to the development of Malaysia and other countries for several reasons. To Malaysia, the palm oil industry is used as a tool to eradicate rural poverty and as a significant source of employment. Economic Transformation Programme (ETP) Report 2012 indicates that the palm oil industry has been instrumental in addressing rural poverty and employment opportunities. Under the ETP, the oil palm industry is one of the critical sectors targeted towards transforming the economy into a high-income nation.

Apart from that, the palm oil industry is undeniably vital to Western countries. Palm oil is an essential input for the development of food as well as non-food sectors, such as pharmaceuticals and biotechnology, oleo-chemicals, beauty and personal care products (Aguiar et al., 2018) as well as renewable energy (Basiron, 2007). Furthermore, palm oil contributes to world food security. Based on population projections and per capita consumption, the demand for its edible use globally in 2050 can be met by palm oil alone (Corley, 2009). Indeed, technology adoption is critically dependent on the market incentive, thereby implying the importance of the continuous pursuit of technology within the industry to fulfil the market need. In sum, the industry is significant not only to Malaysia but also to other parts of the world.

Government intervention and control through legislation and the introduction of many programmes and assistance by agencies such as the Ministry of Primary Industries and

Malaysian Palm Oil Board have resulted in two unique advantages to this industry. In short, through assistance from government agencies, the industry has become the most highly organised of any agriculture sector in the world (Basiron, 2007), and the governance of the industry is widely recognised by scholarly research (Craven, 2011).

1.4.4 Innovation, strategic leadership and corporate governance mechanisms

Innovation

Innovation refers to '*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*' (OECD, 2005 p.46).

A recent study recaps the development and research focus on innovation for the past 60 years. In the field of innovation, research has largely focused on technological innovation followed by product or service innovation, but management and marketing innovation are less explored. Furthermore, research on innovation has extensively used a variety of perspectives (contingency theory, organisational economics, behavioural theory, resource dependence and resources-based view). Innovation is also studied from multiple levels of analysis such as individual, group, unit and organisations as well as a multi-stage construct such as development, commercialisation, adoption and implementation (Damanpour, 2020).

Damanpour (2017) highlights that innovation comes from several sources, e.g. environmental, organisational and individual. The environmental factors such as market competition, industry structure, political, technology, supplier power and customer demand, while the organisational factors are financial, human resources, work climate and culture. The individual factors are the role of strategic leaders in formulating policy, controlling change, allocating resources, developing culture and shaping capabilities to encourage innovation. The leadership characteristics include demographics (age, gender, education, experience, personality), behavioural (inspirational motivation, championing innovation) and compensation.

The thesis builds on the advancements in innovation research and delves into a less explored aspect, the management dimension, specifically in the area of strategic leadership. A particular emphasis of this research is put on investigating the association between strategic leadership's characteristics, such as directors with political affiliation backgrounds, powerful CFOs and highly compensated CEOs, and innovation performance. To conduct this study, the focus is on major industries that heavily rely on innovation activities and success to remain competitive, both from a Western and Asian perspective. Therefore, the research takes the high-technology and pharmaceutical industries in the US and the palm oil industry in Malaysia as illustrations.

Strategic leadership

The scope of strategic leadership emphasises those executives who have total responsibility for their organisation by looking at their characteristics, actions, way of doing things and, principally, how they affect organisational outcomes. People involved as subjects of strategic leadership research can be individuals such as CEOs or other executives, or a group, e.g. the top management teams or other governance bodies, namely the boards of directors (Cannella et al., 2009). It is the individual characteristics, e.g. their aspirations, beliefs, cognitive ability, control, power and political acumen, that determine the executive's discretion and action (Banzato and Sierra, 2016).

The CEO is the executive who has overall responsibility for the conduct and performance of an entire organisation (Cannella et al., 2009). Through individual characteristics, CEOs can influence strategic decisions and bring in a new perspective to an organisation and the greater the CEO's dominance is, the greater their influence is on the top management team, even to reduce the level of consensus of the team when it comes to a strategic matter (Banzato and Sierra, 2016).

The role of the CFO has significantly evolved from traditionally being a financial caretaker to an adviser and a strategic partner to the CEO. Based on the upper echelons theory (Hambrick and Mason, 1984; Hambrick, 2007), this research presents a theoretical framework to address the research question by relating CFO power to various innovation performance measures and strategic innovation choice. As a TMT protagonist, the CFO is primarily responsible for the strategic allocation of financial resources through their depth of power. This research develops a theoretical model that links CFO power and R&D innovation performance.

Corporate governance mechanisms

Thomsen and Conyon (2012) define corporate governance as 'the control and direction of companies by ownership, boards, incentives, company law and other mechanisms'. Others refer to it as 'the system of rules, practices and processes by which a firm is operated and controlled' (Elston, 2019). Basically, corporate governance entails hiring the best executives, motivating them, giving them the freedom to make decisions as well as balancing that freedom with the checks and balances that prevent abuse of power. Corporate governance mechanisms often lead to better economic performance due to the fact that they force executives to work harder or enable shareholders to make smarter decisions (Thomsen and Conyon, 2012).

Capital structure – financial slack

Capital structure is a combination of capital sources, such as debt, internally generated equity and new equity. If firms finance their projects via debt, then the creditors expect to be paid back as contracted. However, if the firms finance their activities through equity, then the shareholders expect a return such as cash dividends or an appreciation of the value of the equity interest or both (Fabozzi and Drake, 2009).

However, debt or leverage is not only for financing firms' activities, but it is also for governance mechanisms. It is a disciplining device and motivates executives to fulfil future commitments to repay creditors by generating cash flows beyond the future debt repayments or any claims. Debt also works as a force to disgorge cash flow. Reducing cash prevents executives from using it for personal benefits or futile negative net present value investments (Tirole, 2006).

The use of debt as a governance mechanism has limitations. For instance, the cost of limiting cash may deprive firms of financing ongoing projects and starting new ones (Myers, 1977). In addition, the capital market may be uncertain about the firm's prospects and the value of existing assets and, therefore, may worry about adverse selection and the possibility that securities are of low value. Thus, the capital market may be reluctant to refinance the firm. Apart from that, firms that are unable to repay debt may face bankruptcy (Tirole, 2006).

Concerning innovation, innovative firms prefer financial slack as the capital structure. O'Brien (2003) points out that innovative firms with R&D investment intensity and competitiveness prefer finance slack over debt as the capital structure. Based on the behavioural theory of firm arguments, financial slack facilitates research and new opportunity as well as managers' risk-taking behaviour. It is noteworthy that R&D investments are risky with uncertain outcomes and, hence, firms with higher financial slack are in a better position to undertake investments as it provides firms with a safety net (Cyert and March, 1963).

In other words, financial slack enables risk-seeking managers to endeavour new R&D prospects as it provides security for high-risk projects. At the same time, firms with abundant financial slack have greater agency costs. Jensen (1986) claims that, by reducing the amount of free cash flow managers have discretion over, increased leverage may reduce the total agency costs within a firm. This perspective also means firms which have more financial slack than debt as their capital structure face more severe agency costs.

Regulation

In the pharmaceutical industry, regulations are developed by the US Food and Drug Administration (USFDA) according to the laws set forth by the Food, Drug, and Cosmetic Act (FD&C Act). Some government regulations, such as the USFDA's pharmaceutical regulation, may cause firms to pay closer attention to stakeholder concerns. Rational executives will recognise current and potential challenges of this kind as they relate to maximising the value of the company, and they will de facto integrate these into the value-maximising process as well (Thomsen and Conyon, 2012).

Board of directors

Board of directors (BoD) is a group that consists of a limited number of individuals, e.g. 10 or even 30 to 40 directors for medium to large companies. The board directors are appointed by shareholders and as an intermediary between the organisation's shareholders and TMT (Thomsen and Conyon, 2012). BoD does not deal with the routine administration of the firm, but BoD is responsible for reviewing major policy and strategic choices presented by TMT, such as a major decision on investment (Tirole, 2006), acquisitions, diversification, divestitures, R&D expenditure, strategic change, executive compensation as well as the dismissal of top executives (Cannella et al., 2009). Based on agency theory, BoD influences innovation by monitoring managers 'self-interest' behaviour (Fama and Jensen, 1983). Thus, effective monitoring can indeed improve firm performance such as innovation by reducing agency cost (Hillman and Dalziel, 2003).

Board members with diverse ethnicities, genders, experiences, education and backgrounds possess a broad set of skills and knowledge. Diversity on the board is a mixed blessing. Diversity among the board can reduce 'groupthink,' a situation where members too easily reach consensus due to their similarity. An excessively diverse board, on the other hand, can hinder teamwork, impede agreement on mutual goals and result in conflict and less sharing of information (Thomsen and Conyon, 2012).

1.4.5 Research motivation

Apart from the importance of US high technology, the industries have been selected in this study for several reasons. First, innovation performance in this industry is important; to survive in this competitive field, continuous innovation is crucial (Schilling and Hill, 1998). However, managing financial resources for R&D projects to sustain innovation performance is challenging (Satta et al., 2016). The challenge comes in the form of the large amounts of capital needed to fund the lengthy process of R&D activities and a long period to take the product to market (Finkle, 1998). Therefore, high-technology firms must ensure sufficient funding to sustain a continuous and long process of innovation.

Second, US high technology firms tend to maintain a large amount of cash reserves as a capital structure to ensure sufficient funds for R&D activities. A high level of free cash flow exposes firms to more severe agency problems (O'Brien and Folta, 2009). Hence, it can become a drawback for the firm if there is an insufficient and ineffective monitoring mechanism. Florackis and Saisani (2018) highlight that CFOs have a significant role in corporate cash policies, where the CFOs with high power tend to hold less cash compared to the less powerful CFOs, and those with broad affiliation are known as effective corporate internal control managers (Yu et al., 2019). However, it is not known if a powerful CFO is also an effective internal controller for innovation investment performance given the excessive amount of cash that the firm possessed. Shleifer and Vishny (1997) highlight a concern that professional executives may effectively divert abundant financial slack from the organisation for self-interest rather than return it to investors. Given the CFO has direct handling of financial matters through structural role and expertise, thus, the **first motivation** is to provide deeper understanding of how CFO power associates with innovation performance in a setting where financial slack is abundant in US high technology industry.

Apart from that, this study has selected the US pharmaceutical industry to illustrate the association between CEO compensation, regulation and innovation for several reasons. Indeed, the innovation process in the pharmaceutical industry is challenging. The most challenging issue facing the pharmaceutical industry is uncertainties and the cost of innovation. The nature of innovation and R&D efforts in this industry involves high risks and uncertainties, and it requires substantial resource capital (Finkle, 1998) to survive the long process, while the outcomes remain uncertain (Grabowski, 2011). However, the R&D efforts are mainly confronted by high failure risk, where the failure risk becomes evident only at the end of stages (Gassmann et al., 2008).

Moreover, the cost of innovation, in particular conducting R&D, has increased about twofold to threefold from the 1970s to 2013 due to the increasing costs in developing specific drugs and the growing failure rate (DiMasi et al., 2016). However, Mendoza (2019) argues that cost is just a fraction of the innovation problem. Drug innovation is indeed very much driven by economic incentives, in particular by the 'fat cat' CEOs' compensation. Third, the pharmaceutical industry is heavily regulated (Oliver, 2017). On top of that, regulation matters can consume up to 25% of firms' financial budget, and most of the CEOs' time is spent in dealing with regulation oversight (Martin et al., 2018). Taking into consideration, the industry has been burdened with high costs associated with innovation, CEO compensation and regulations. Thus, the **second motivation** is to provide a fresh insight into how the highly compensated CEO relates to innovation performance in the event of new regulations introduction or amendment in the US pharmaceutical industry.

Likewise, apart from its significant contribution to the country and globally, the Malaysian palm oil industry has been selected in this study due to several motives. First, the industry receives many benefits from government policy instruments and connections, in particular those relating to assisting knowledge and information flows (Rasiah, 2006). Therefore, firms that are closely related to government policies tend to engage politically connected individual directors for greater corporate performance (Houston et al., 2014). Thus, it is common that firms in this industry to seek political affiliation. Second, there is a growing importance of board diversity in Malaysia in particular in relation to gender diversity (Ariff et al., 2017), which provides an interesting Asian perspective, on how board diversity influence innovation performance. Hence, the **third motivation** is to provide a better understanding of the link between political affiliation and innovation and whether board diversity can be an effective governance tool to align the interests of politically connected directors with firms' innovation agenda.

1.5 Research philosophy, approach and method

1.5.1 Research philosophy

A research philosophy refers to "a system of beliefs and assumptions about the development of knowledge" (Saunders et al., 2016 p.124). There are five major philosophies, namely, positivism, critical realism, interpretivism, postmodernism and pragmatism. This research applies to positivism. Under the positivism paradigm, the research ontology assumes the subjects of study such as organisations, the board of directors, shareholders and executives are realistic, universal and independent. The epistemology of this research views innovation performance, governance mechanisms and executives as factual, observable, measurable and law-like generalisations. The contribution of knowledge under this research can be explained as a causal relationship and be generalised. As a positivist researcher, the axiology is that the researcher is detached, neutral and independent from what is studied. For instance, concerning the impact of strategic leadership on innovation performance, it can be empirically investigated by using the researcher’s analysis tools rather than the researcher’s values (Saunders et al., 2016).

In summary, Sekaran and Bougie (2016) describe positivist researchers as advocators in objective truth that the world operates by the law of cause and effect and can be determined by using a scientific research approach. As a positivist researcher, this thesis focuses on advocating the importance of strategic leadership in championing innovation while taking into account unique variables to the industries that moderate the impact of their top executives and board of directors on innovation.

1.5.2 Research approach

Choosing a precise philosophy allows this thesis to select the most appropriate of three research approaches: deductive, inductive or abductive. The deductive approach starts with an existing theory to develop hypotheses, and then tests those hypotheses (Saunders et al., 2016). In contrast, researchers who adopt the inductive approach started from a more explicit to general approach, e.g. it starts from observations and looks for patterns in the data to generate new theories (Saunders et al., 2016). An abductive approach follows a back and forth movement rather than going from theory to data (the deductive approach) or from data to theory (the inductive approach), thereby combining deductive and inductive reasoning (Suddaby, 2006). Accordingly, this thesis uses the deductive approach in all three core chapters, based on the upper echelons and agency theory, to test the hypotheses and generalise the results by examining the underlying relationships among the variables (Saunders et al., 2016).

1.5.3 Research method

There are three methodological choices: quantitative, qualitative and mixed methods research designs. Quantitative research is based on the measurement of quantity or amount and associates with any data collection technique, e.g. questionnaire or data analysis procedures such as graphs and statistics that uses numbers. In contrast, qualitative is associated with non-numbers and subjective assessment of attitudes, opinions and behaviour. Many data collection techniques use interviews or data analysis techniques like categorising data based on non-numerical data, e.g. words or images. A mixed method combines quantitative and qualitative methods (Kothari, 2004; Saunders et al., 2016).

This thesis employs quantitative research design methods. All three core chapters in this thesis apply longitudinal data for empirical analysis. Over a period of time, data from a variety of entities has been gathered in order to investigate the associations between strategic leaders, governance mechanisms and various innovation performance indicators. Data for this research is primarily collected from secondary data sources such as annual reports, Boardex, WRDS Compustat and Bloomberg.

1.6 Research contributions

Essentially, this research complements other studies and contributes to upper echelons theory, and to the existing literature of innovation, strategic leadership and corporate governance in a number of ways. The first contribution is to the theory of upper echelons. The upper echelons theory suggests that organisational outcomes are reflective of top executive's characteristics (Hambrick and Mason, 1984; Cannella et al., 2009). This thesis extends the upper echelons theory by integrating internal and external corporate governance mechanisms, namely the capital structure - financial slack, the board of directors and regulation. It provides valuable insights into how financial slack, regulation and board diversity can foster or hinder the relationship between a powerful CFO, highly paid CEO and politically connected director and innovation performance.

Second, this thesis contributes to the innovation literature. The findings fill the void in the literature over the role of strategic leadership in innovation management. The contribution is made by identifying and presenting valuable understandings on the association between CFO power, CFO-CEO power, CEO compensation and politically affiliated directors and the firm's commitment to innovation using a range of innovation performance measures. In relation to the measurement, the thesis's contribution is through the creation of measurement to indicate the preferences towards types of innovation input strategic choice, to 'make' or 'buy' technology. Unlike most other research focusing on innovation input, such as R&D investment, this thesis also includes technology acquisition investment (the 'buy' strategy) as one of the innovation inputs measures. In sum, the thesis applies a more holistic dimension of innovation performance by employing four innovation measures, namely the innovation input strategies, innovation outcome, innovation efficiency and formulation of a new variable to indicate firms' preference of strategic innovation input choice, whether to 'make' their own technology through internal R&D or to 'buy' technology from outside.

The third contribution is to the strategic leadership literature. Indeed, the thesis adds insights on the interaction effects of governance mechanisms such as capital structure – financial slack, industry's regulation and board diversity with the role of a powerful CFO, highly paid CEO and directors with a political affiliation background on innovation performance, respectively. More importantly, as far as the researcher is aware, this thesis is the first to investigate how CFO-CEO power conflict impacts the association between CFO and innovation performance. This thesis highlights the importance of a power balance, in other words, a 'power ideal' between the CFO and CEO to ensure that the firm meets its innovation agenda. Any dysfunctional power balance could lead to struggles between the two top strategic leaders. Thus, it can hinder innovation performance through poor or even wrong decision making.

Apart from that, the fourth contribution is to the literature of corporate governance. The agency theory states the conflicting interest between the owner and manager due to the 'separation of ownership and control' creating agency problems and subsequently leading to agency cost if there is insufficient monitoring. Therefore, governance mechanisms are needed either to align the interests of managers with the owners or to monitor the managers (Jensen and Meckling, 1976; Eisenhardt, 1989). In relation to this, the findings provide insights on the effectiveness of governance tools in raising innovation performance. Specifically, the internal governance tools, namely the capital structure and board diversity (gender diversity), play a vital role in fostering innovation performance by aligning the interests of a powerful CFO and politically affiliated directors, respectively, with firms' innovation agenda. Surprisingly, the industry's regulations imposed by the government seem to be unable to nurture the association between highly paid CEOs and innovation performance. It seems to be not as effective governance tool compared to capital structure and board gender diversity in fostering innovation.

Fifth, the thesis contributes to varieties of outlooks other than the Western viewpoint by adding perspective from a gigantic industry from the Southeast Asia region. Many scholarly researchers focus on the Western position when it comes to studies on innovation. Indeed, many emerging economy countries are now experiencing a change in policy and regulation where there is a possible adjustment to the agency relationship at the firm's level (Elston, 2019), including in terms of how they get things done. Therefore, this present study adds to innovation and corporate governance literature via contributing insights from Southeast Asia.

Sixth, unlike other studies, this thesis extends board diversity by including nationality diversity. The existing literature on board diversity focuses more on gender diversity (Miller and Triana, 2009; Zona et al., 2013). To this date, research on nationality diversity is scarce. Thus, the present thesis contributes to the literature on board diversity and it offers empirical evidence on the association between nationality diversity and innovation.

Seventh, the thesis serves as a valuable reference for innovative industries which is not limited to the high-technology, pharmaceutical and palm oil industries. This study offers an overview of the best practices that stakeholders, top management and the board of directors can use to determine the level of compensation and power of executives, align the power between CFOs and CEOs as well as review the policy pertaining to the appointment of directors with political ties to the company. Apart from that, the findings suggest capital structure and board gender diversity as an effective governing tools for stakeholders. External governance mechanism such as regulation seems to have mixed effects on CEO compensation and innovation performance. As a whole amount of compensation, regulations demote highly paid CEOs to further pursue innovation goals. However, exclusively on the cash component, CEOs that receive high salaries and bonuses focused more on driving success in innovation in the event of regulation changes.

Eighth, the research presents relevant courses of action for government and industry players. Notably, the Malaysian government put into practise political appointments as board of directors. The finding reveals political affiliation hinders the innovation agenda. However, the interaction between politically affiliated directors and board gender diversity fosters firms' innovation performance. Therefore, if the government wishes to continue the practices of appointing politically affiliated directors as board members, thus, there is a need to increase board gender diversity, specifically to have more female directors as board members to drive innovation goals.

Ninth, the present research highlights relevant courses of action for the shareholders, firms' policymakers and the government. The findings provide valuable information to shareholders and firms' policymakers concerning the role of capital structure, in particular financial slack on various levels of innovation performance. The existing literature indicates that financial slack adversely impacts firm performance in the US because of corporate governance structures, specifically, large-scale companies, dispersed ownership and short-term positioning (Lee, 2012). Because of this, the agency costs are higher in the United States. However, the findings of this thesis reveal the importance of financial slack in fostering the association between a powerful CFO and innovation. Shareholders and firms' policymakers may consider adjusting an appropriate level of CFO power and financial slack to nurture firms' innovation performance.

In addition, the study provides a course of action to the shareholders and firms' policymakers concerning compensation and regulation, in particular, and the findings help the Search and Compensation Committees and Board of Directors in deciding on a suitable candidate for the CEO post, offering suitable compensation packages to attract the best and most capable candidates for the CEO position. Furthermore, the study highlights the significant impact of the industry regulation by the USFDA on innovation input strategy. Board of Directors and stakeholders should be cautious when there is a regulation amendment because, to some extent, it dampens the motivation of highly paid CEOs to invest in internal innovation projects.

Tenth, the study contributes to the construction of a more extensive dataset for three significant industries. In particular, the study manually collected a dataset for firms related to palm oil in Malaysia from 2008 to 2018. For the US pharmaceutical and high-technology industry, the study covered a wide range of data stretching from 1998 to 2018. Apart from commonly used data, such as financial, board and firm characteristics in the cross-industries study, the present study's dataset also includes the industries' evident characteristics.

In sum, this thesis is of significant value and provides practical implications for policymakers, shareholders and the executives of firms who desire to enhance firm innovation performance to adopt best corporate governance mechanisms in order to mitigate agency costs, and in turn achieve greater innovation performance and shareholders' wealth. Hence, this study suggests that policymakers and shareholders should draw on the findings of this thesis to review the composition of board of directors, level of compensation and type of capital structure that have not been associated with improved innovation performance.

1.7 Structure of the thesis

In sum, this chapter presents the background and main focus of the whole thesis, research aims, objectives, questions and motivations of the three core chapters of the dissertation. In addition, this section also discusses the research philosophy, approach and method as well as highlighting its contributions.

The rest of the dissertation continues as follows. Chapters 2, 3 and 4 present the three core chapters. Each core chapter includes an introduction, literature review, data and methodology, empirical analysis, discussions and conclusion section. The final chapter, chapter 5, presents a summary of the key research findings of the three core chapters, emphasises the policy implications and thesis limitations and, finally, offers recommendations for further research.

Chapter 2 Does CFO power drive innovation performance? The role of financial slack and CEO-CFO conflict

Abstract

Despite considerable work having shown that CEOs in top management teams (TMT) play crucial roles in influencing innovation performance, the idea that Chief Financial Officer (CFO) power may be an important driver of innovation performance has been underexplored in the innovation literature. This study seeks to assess the direct and indirect links between CFO power in US high-technology firms and innovation performance, as measured by input strategy, outcome, efficiency and input choice. The study finds support for both the main effect and indirect effects of CFO power on innovation performance by means of financial slack and CEO-CFO power conflict. These results have several implications for innovation management theory and managerial policy in respect of search and compensation committees responsible for the appointment and reward of key individuals in TMT.

Keywords: Innovation, CFO Power, Financial Slack, CEO Power

2.1 Introduction

Firms tend to prefer a combination of high financial slack with low leverage because it promotes experimentation, risk-taking and a long-term orientation, which in turn facilitates R&D investment (Grinblatt and Titman, 2002; O'Brien and Folta, 2009). Financial slack, or excess resources, is the residual cash flow available after meeting the firm's commitments to fund all projects with positive net present value. The availability of financial slack facilitates the maintenance of R&D investment during bad times, the purchase and adoption of innovations (Damanpour 1987, 1991) as well as safeguarding against cash flow volatility (O'Brien, 2003). Clearly, a powerful top management team (TMT) plays a crucial role in navigating, deciding and ensuring the commitment of financial resources appropriately in the 'Make-or-Buy' strategy continuum whilst holding appropriate financial slack.

Notably, within a TMT, the CFO is more significant and powerful compared to others top executive including the CEO when it comes to strategic decision making and handling of financial matters. The CFO power comes from their formal structural role and expertise. CFOs are often seen as a powerful, key decision-maker in providing the much-needed leadership on these strategic resource allocation decisions. Empirical evidence points to the importance of technology acquisition (TA) activities (Blonigen and Taylor, 2000), namely the 'Buy' strategy, which is a choice firms have alongside the 'Make' strategy, which relies on internal R&D innovation; firms may also opt for a combination of the two as part of their R&D innovation input strategy (Xue, 2007). An assertive CFO is someone with the necessary financial acumen, industry expertise and sphere of influence to convince TMT colleagues to push through their innovation agendas. In contrast, a weak CFO is easily influenced by and unable to influence their peers in the TMT or middle managers and provide the necessary financial commitment and positive support to drive innovative activities in the firm. Therefore, this chapter aims to answer the question of '*How does the CFO power associate with innovation performance at the firm level of the US high-technology industry*?'

A powerful CFO is also someone able to raise and deploy capital to support innovation activities with the highest potential to yield a high future return and to appropriately balance these spending commitments against other pressing investments. However, there is less known from the literature on how financial slack, as managed by CFOs, affects innovation performance at the firm level in any industry premised on innovation activities. This is problematic for two reasons. First, assertive CFOs can use their power to influence strategic decision-making processes to produce the outcomes they seek. The CFO, for example, may align R&D budget allocations and financial slack levels in accordance with their objectives and preferences, especially when it comes to analysing short- and long-term debt and managing risky projects (Finkelstein, 1992; Pettigrew and McNulty, 1995; Garms and Engelen, 2019). The CFO's objective and preference and acceptance of a certain level of risk may be different from the CEO's. Therefore, the extent to which CFOs can exert their power in designing and implementing their innovation input strategy, efficiency and outcomes are contingent upon the financial slack levels within their firms. Therefore, it is important to develop an understanding of the exact interaction between financial slack and CFO power. Financial slack can strengthen or weaken how assertive CFOs can be in driving their innovation input strategy, efficiency and outcomes to the desired level.

Second, a misguided understanding by CFOs regarding the role financial slack plays can be detrimental to increasing investment in pursuing the internal ('Make' strategy) and external ('Buy' strategy) acquisition of technologies as well as to outcomes, efficiencies and the process of choosing between the competing R&D innovation input strategies ('Make' vs 'Buy'). For example, financial slack can provide the much-needed flexibility to explore new solutions and opportunities, thereby facilitating risk-taking. Consequently, it renders a firm sufficiently agile to adapt to environmental shifts and to invest in risky projects to pursue a competitive advantage. In the same vein, these excess resources can also be used by firms to invest in dubious projects, potentially arising out of a sense of complacency and an overly optimistic outlook, inevitably resulting in fewer resources channelled into sound R&D investments (Jensen, 1986). Therefore, it is crucial for CFOs have the utmost clarity on how financial slack can be deployed optimally in support of the R&D innovation activity. This chapter seeks to find the answer to the research question of '*Does the firm's financial slack have any influence on CFO power and innovation performance?*'

Apart from determining the appropriate level of financial slack to be held, CFOs increasingly exceed their fiduciary roles in financial management that assist CEOs who must deal with challenging external business environments with the strategic management aspects of their respective complex organisations (Colbert et al., 2014; Zorn, 2004). However, the partnership between CFOs and CEOs can lead to either a positive or negative impact on the aspects of strategic decision-making, including innovation strategy (Amason, 1996). In an optimal working relationship, a more assertive CEO is more likely to ensure their CFO's advisory role is played effectively. For example, such a CEO may have the CFO provide an informed assessment of the financial implications and quantification of the risks attached to the CEO's strategic choices. Similarly, CFOs can utilise their specialised understanding of business economics in innovation to offer unique insights and advice to CEOs regarding the underlying forces that drive value creation from innovation. Furthermore, in positioning the organisation towards this, a CFO's competencies can be fully utilised by the assertive CEO to help assess 'Buy' or 'Make' innovation input strategies, to change course as necessary within financial boundaries and to control cost deviations from plans during the implementation stage to cut down on wasteful spending (Zorn, 2004).

However, the upper echelons theory predicts that dysfunctional conflicts arising from the inherent power struggles between CEOs and CFOs can be detrimental to strategic decision-making on innovation strategy and performance (Garms and Engelen, 2019). The heterogeneity in personalities, leadership styles, communication skills and strategic vision between CEOs and CFOs can lead to animosity or mistrust between these two most senior individuals in TMTs. The effective power the CEO has over the CFO can be derived from various sources, including hierarchical structure, the CEO being a blockholder, the perceived loyalty of others to the CEO and the CEO's personality and prestige (Adams et al., 2005; Feng et al., 2011; Haleblian and Finkelstein, 1993; Lambert et al., 1993). Friedman (2014) and Feng et al. (2011) found that CEO power can be used to pressure the CFO into manipulating the financial reporting system and overstating performance. Consequently, effective power calibration and conflict management between CFOs and CEOs would reduce the risk of making poor or low-quality strategic decisions. Thus, this study seeks to answer the question '*To what extent does CEO power affect the association between CFO power and innovation performance?'*.

This chapter applies the upper echelons theory in explaining the association between CFOs' power and innovation performance and how the link is affected by firms' financial slack and conflict of power. The upper echelons theory explains that organisational outcome is a reflection of top executives' characteristics, such as the CEO compensation (Hambrick and Mason, 1984; Cannella et al., 2009), and as a TMT protagonist, the CFO is primarily responsible for the strategic allocation of financial resources through their depth of power. Thus, this study suggests an extension of the upper echelons theoretical framework in a research model to address the research questions by integrating an internal corporate governance mechanism, namely the financial slack, and conflict of power to the theoretical framework. The present study develops a theoretical model that links CFO power and innovation performance and proposes a series of hypotheses for empirical testing on a multisource secondary data set consisting of 1,656 firm-year observations from 150 firms between 1998 and 2018 to validate the research model empirically. The study offers three major contributions. First, it focuses on the role assertive CFOs play in producing innovation performance through the management of financial slack. High financial slack with low leverage can promote greater innovation success through support for experimentation, risk-taking and long-term orientation (Grinblatt and Titman, 2002; O'Brien and Folta, 2009). However, maintaining a high level of financial slack could equally likely deprive an organisation of the financial resources required to invest in R&D leading to a slowdown in its ability to innovate for the future and a reduction in potential cash flow generation from such lost R&D activity. Therefore, CFOs should design and determine their financial slack levels based on precautionary- (Bates et al., 2009), transactionary- (Opler et al., 1999) and agency-based reasons (Jensen, 1986). They need to carefully consider the appropriate balance between a 'Make' or 'Buy' strategy, and the appropriate apportionment between a high level of R&D investment and financial slack. In examining the links between a CFO's power and R&D innovation performance, this study provides the first empirical evidence into how financial slack may influence the ability of CFOs to influence R&D activities. The study shifts research from observing the extent to which CFOs affect financial slack (Florackis and Sainani, 2018) towards observing how the interactions between CFOs and financial slack determine R&D activity at the firm level.

Second, the study informs broader research on innovation performance, where power struggles and conflict between TMT members can have a positive or negative impact on firm-level resource allocation. The upper echelons theory posits that organisational complexity and challenging business environments require more skill than individual leaders can provide (Colbert et al., 2014). However, intense cognitive and affective conflicts between a CFO and CEO can damage the decision-making processes, poison working relationships among TMT members and ultimately distort a firm's outcomes and threaten organisational success (Amason, 1996). The theoretical model predicts that a CFO's power helps explain the TMT's commitment to R&D innovation (Baysinger and Hoskisson, 1989; Choi et al., 2015; Stock and Reiferscheid, 2014) but that such power can play a moderating role on CFO power. Consequently, this research extends the existing findings on power conflict within TMTs to their wider impact on innovation performance. In so doing, the study shifts the research stream from investigating the extent to which CEO-CFO interactions can affect firm performance towards their implications for innovation performance. In particular, the study documents the first empirical evidence on how power struggles and conflicts between CEOs and CFOs are likely to impact R&D activities.

Third, the study contributes to the innovation performance literature, where strategic decision making on resource allocation to innovation efforts remains a largely unresolved but significant question (Barker and Mueller, 2002). Numerous existing studies have focused on the use of R&D expenditure or intensity as proxies for R&D innovation input (Kim et al., 2008; Lee, 2015; Shaikh et al., 2018), but rather few have linked R&D innovation input to technology acquisition (TA) or 'Buy' strategy. This is a particularly important question for industries involved in R&D innovation where TA is a crucial alternative to the 'Make' strategy' (Blonigen and Taylor, 2000). Consequently, the study presents a large-scale empirical investigation into the 'Buy' strategy aspect of R&D innovation input, which has been largely neglected in the relevant literature. In fact, TA is key when firms need to innovate particularly rapidly because it can cut the time required to bring products to market (Ford and Probert, 2010; Mortara and Ford, 2012). Consequently, the study shifts from research investigating a CFO's influence on 'Make' strategy to their influence on 'Buy' strategy. More importantly, it provides the first empirical insights into how a CFO should choose between the two strategies. It also facilitates conclusions on how a CFO might use their influence to affect, directly or indirectly, the perceptions around strategic decision-making among other TMT members (Park and Tzabbar, 2016). The remainder of the present paper is organised as follows: The next section provides a review of the relevant literature and then outlines a set of hypotheses suggesting a relationship between CFO power and R&D innovation input, efficiency and outcomes. This relationship is moderated by a firm's financial slack and CEO power. A report of the empirical results follows, and this leads to a discussion of the implications for research and practice.

2.2 Literature review

2.2.1 Theoretical background

This section discusses the elements of the theoretical model and how the variables are related. The dependent variables are innovation input 'make' (R&D investment) and 'buy' (technology acquisition) strategy, innovation outcome (number of patents granted), innovation efficiency and innovation input choice, as expressed in firm-wide financial resource allocation for innovation performance. Figure 2.1 shows the study's conceptual framework linking a CFO's power to innovation performance.

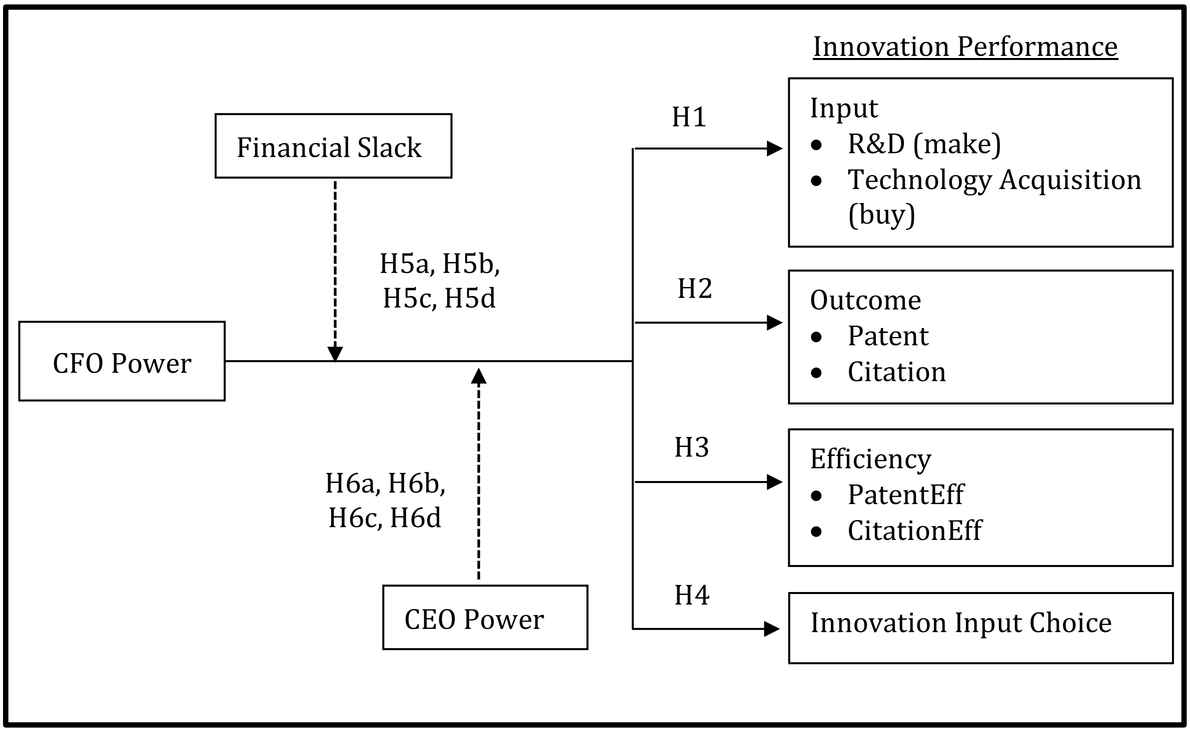

Figure 2-1 Conceptual framework on the association between CFO power, financial slack, CEO power and innovation performance

Research on TMT and innovation performance is well established, yet less is known about the link between CFOs and innovation performance in a setting where there is abundant free cash flow available, such as in US high-technology firms. The gap in the literature indeed provides motivation for the present study to establish a link between CFOs and innovation performance through upper-echelon theory, which suggests the element of power as one of strategic leaders' characteristics that reflects organizations' outcome. Therefore, the present study scrutinizes CFO power as a channel to establish the link between CFO and innovation performance. Indeed, power has been classified by the source as structural as well as expertise power (Finkelstein, 1992).

The US high-technology industry has been selected for this study for several reasons. First, innovation performance in this industry is important. In order to survive in this competitive field, continuous innovation is crucial (Schilling and Hill, 1998). Therefore, US high technology firms tend to maintain a large amount of cash reserves as a capital structure to ensure sufficient funds for R&D activities. Second, however, a high level of free cash flow exposes firms to more severe agency problems (O'Brien and Folta, 2009). It surely can become a drawback for the firm if there is an insufficient and ineffective monitoring mechanism. Shleifer and Vishny (1997) highlight a concern that professional executives may effectively divert abundant financial slack from the organisation for self-interest rather than return it to investors. Given that CFOs have the direct handling of financial matters through structural role and expertise, which are a source of power for CFOs, thus, this core chapter is motivated to provide a deeper understanding of how CFO power is associated with innovation performance in a setting where financial slack is abundant in the US high technology industry.

The literature on the influence of a firm's TMT on innovation performance argues that the presence of powerful advocates of innovation is required to ensure TMT commitment to innovation (Felekoglu and Moultrie, 2014). Their power is described as "the capacity of individual actors to exert their will" (Finkelstein, 1992) "to initiate, constrain, circumscribe, or terminate action either directly or indirectly or by influence exercised on those with […] decision-making authority" (Herman, 1981 p. 17). Furthermore, a multidimensional view of power is in line with the wider literature suggesting that an individual's power can be derived from multiple sources (Daily and Johnson, 1997; Finkelstein, 1992) with varying impacts (Park and Tzabbar, 2016).

This study follows Florackis and Sainani (2018) in delineating a CFO's power according to structural and expert power. Structural power refers to the ability of a CFO to influence other TMT members' behaviour by their hierarchical position, while expert power can be derived from the CFO's capability in accounting and finance and their wide networks and related spheres of influence, which are sometimes built from years in the finance and investment-related industry. For a clearer understanding of how CFO power influences innovation performance, it is essential to identify the impact of each of the sources.

The study also identifies two interaction variables, namely financial slack and CEO power. These can mitigate the assertiveness level of a CFO. First, low financial slack would curtail the ability of a CFO to influence other TMT members towards undertaking large, risky but innovative projects. However, high financial slack may signal to competitor firms that they could more readily convince colleagues in the TMT to invest in R&D projects over a sustained period, thereby increasing the innovation performance of the firm. Second, the CFO's ability to influence other TMT members also depends on how powerful they are. An assertive CEO may enter power struggles or conflicts with a powerful CFO, while an organisation with a CEO and CFO with low power could indicate a lack of commitment in the TMT to pursue the R&D agenda. In both cases, commitment to R&D could decline because of poor or inadequate decision-making within the TMT.

Informed by the upper echelons theory (Hambrick and Mason, 1984; Hambrick, 2007), we propose a series of hypotheses linking CFO power to R&D innovation performance in the theoretical model as follows.

2.2.2 Direct effects of CFO power on innovation input strategy

As one of two protagonists in any TMT, an assertive CFO can influence innovation performance through two potential channels. First, to a large extent, they can influence the perceptions around strategic decision making among other TMT members. Structural power gives CFOs significant influence over other members' behaviour by virtue of their authority and position, concerning innovation agenda commitments (Daily and Johnson, 1997). Second, CFOs are better versed than CEOs in the financial affairs of their firms (Geiger and North, 2006). CFOs tend to hold professional qualifications in accounting and finance as a source of expert power and many have accumulated years of experience in industries such as finance and banking that give them particular advantages over CEOs in relation to financial decision making, financial reporting and tax, and cash flow planning (Caglio et al., 2018; Chen et al., 2020). Furthermore, many are more able to raise external financing more readily during periods of financial distress from the banking and investment community given any first-hand experience of corporate finance, debt structuring, debt finance and other capital markets, and through their personal networks developed over time, for example from working in the finance and banking industry.

For firms involved in R&D activity, CFOs with considerable discretion in their decision making (Finkelstein and Boyd, 1998), especially concerning the innovation input strategy, are more able to influence such activity. The greater the discretion, the more their managerial characteristics will be reflected in the R&D strategy and performance (Hambrick, 2007) and, therefore, the greater their power to influence decision making (Adam et al., 2005). A firm's ability to identify, assimilate, transform and exploit external knowledge, research and practice, or its 'absorptive capacity' (Cohen and Levinthal, 1990), requires the CFO's discretion in determining the level of innovation investment. The ability to exploit new knowledge developed internally ('Make' strategy) or acquired externally ('Buy' strategy) depends on the in-house R&D capability (Makri and Scandura, 2010; Cohen and Levinthal, 1990). Hence, the more assertive the CFO is, the greater their ability is to exert influence over other key TMT members. The same can be said for their power (Barker and Mueller, 2002) to invest in internal R&D spending and external TA in order to enhance innovative capability (Chen, 2014).

In line with upper echelons theory, the source of CFO power comes from structural role and expertise, and the firm's performance is a reflection of the power that the CFO has. Therefore, this chapter proposes that a greater level of CFO power is associated with higher innovation performance. Greater power means the CFO is more dominant in terms of strategic decision making and handling of financial matters. The powerful CFO who stems from a strong structural role and expertise will "put the firm's money where their mouth is" to demonstrate commitment to investing in innovation projects. Thus, the hypothesis is as below:

H1: CFO power is positively associated with innovation input (spending on R&D and technology acquisition).

2.2.3 Direct effects of CFO power and innovation outcome

A firm is likely to increase its resource allocation to R&D activities when aiming to enhance its technological advantage (Arora et al., 2001). Therefore, strategically focused employees such as CFOs play a crucial role in the development of sustained competitive advantage and legitimate strategic direction (Hill and Snell 1988) and decision making (Finkelstein, 1992). Existing studies have shown that research intensity and input are predictors of compensation systems for strategic employee groups such as CFOs (Yanadori and Marler, 2006). CFOs have the managerial ability to manage the risk associated with innovation (Chen et al. 2015) and to take risks in exploratory R&D activities which may produce the technological advantage to sustain a firm's competitive advantage (Sariol and Abebe, 2017). However, research intensity is a measure of intention to pursue innovation and does not capture the actual innovation activities or capabilities. As a measure of research intensity, the number of patents produced (Balkin et al., 2000) and citations generated are frequently used as tangible measures of innovation output as well as performance indicators when designing compensation packages for CFOs. Consequently, assertive CFOs are more likely to be inclined towards maximising the number of patents and generating the greatest number of citations from their R&D expenditure. Therein, we test the following hypothesis.

H2: CFO power is positively associated with innovation outcomes (number of patents produced and citations generated).

2.2.4 Direct effects of CFO power and innovation efficiency

Innovation performance is exemplified by innovation efficiency, which is a measure of the capacity of innovation output given a certain quantity of input (Cruz-Cázares et al., 2013), for instance, in calculating how many patents are produced or citations generated against total R&D investment spent on innovation activity. Higher innovation efficiency suggests either the number of patents produced or citations generated has increased per dollar of R&D expenditure, or the same number are produced or generated from reduced R&D investment, or a combination of both. Assertive CFOs are better assessors of R&D projects that are more likely to produce more innovation outcomes, as measured in this way (Fralich and Papadopoulos, 2018; Hirshleifer et al., 2013). As effective and powerful in corporate internal control (Yu et al., 2019), CFOs will change course as necessary within certain financial boundaries (Guldiken and Darendeli, 2016), and control the cost deviations from plans during implementation to reduce unnecessary expenditure using their specialist accounting and finance skills (Zorn, 2004). Based on this related literature, we test the following hypothesis:

H3: CFO power is positively related to innovation efficiency.

2.2.5 Direct effects of CFO power and innovation input choice

As delineated earlier, there are two input strategies which firms pursue in their innovation agendas. The first is to rely on internal R&D strategy, a 'closed technology strategy', to innovate within the firm. The second is to acquire ready-made technology, an 'open technology strategy', external to the firm. The former or 'Make' strategy involves investing R&D in-house with the firm bearing the risk of failure as the outcome is uncertain and the time extended (Grabowski, 2011). The latter or 'Buy' strategy is more certain as the acquired technology is generally more fully developed and trailed (Xue, 2007). In situations where firms need to innovate more rapidly, this external TA could be a better strategy as it can reduce the time to bring products to market (Ford and Probert, 2010; Mortara and Ford, 2012). Unsurprisingly, powerful CFOs are likely to invest in both strategies to ensure the success of their firms' R&D innovation agenda: However, in terms of preference, a powerful CFO, they are more likely to take risks and more confident, therefore, would prefer an internal 'Make' strategy which is more advantageous in the long term. The literature on innovation strategy has largely focused on examining the relationship between TMT-related factors and internal R&D 'Make' strategies (Felekoglu and Moultrie, 2014). This study is the first attempt to reveal a CFO strategic preference on this. It is envisaged that a powerful CFO would prefer an internal 'Make' strategy over a 'Buy' strategy for R&D, given the advantages it brings to the firm in the long run. Therefore, a powerful CFO would align R&D budget allocations to reflect firms' objectives for greater organization outcome (Finkelstein, 1992; Pettigrew and McNulty, 1995; Garms and Engelen, 2019). Therefore, based on the literature, the study proposes the following hypothesis:

H4: CFO power is positively related to a 'Make' strategy as the preferred input innovation choice.

2.2.6 Interaction between CFO power and financial slack and the effects on innovation performance

Innovation allows the pursuit of new ideas and projects with risky outcomes (Bourgeois, 1981), which may result in high failure rates (Lind and Barner, 2017). However, it is crucial to the survival of firms, especially those driven by R&D activity.

Hence, a high level of financial slack signals a sufficient and uninterrupted flow of R&D expenditure, to perhaps experiment (Damanpour, 1987; 1991), to take risks (Grinblatt and Titman, 2002; O'Brien and Folta, 2009), and to weather cash flow volatility (O'Brien, 2003) through the pursuit of 'Make' and 'Buy' strategies (Jelinek and Schoonhoven, 1993). These arise because the slack provides greater financial resilience to tolerate failure (Bromiley, 1991). However, the singular objective of maintaining a high degree of financial slack can be counterintuitive. In particular, it could stifle the R&D investment required to outmanoeuvre competitors by rendering their own technologies obsolete (Tushman and Anderson, 1986). Hence, managing the level of financial slack held in a firm is critical and requires a highly experienced CFO with specific expertise. They should have the nuance and wherewithal to determine the optimality between R&D investment and financial slack to address objectives and support innovation activities with the potential to yield the highest possible returns for the firm (Finkelstein, 1992; Pettigrew and McNulty, 1995; Garms and Engelen, 2018). A low level of financial slack could hamper their efforts in influencing other TMT members, as this would undermine the firm's agility and scope to pursue more ambitious but risky R&D strategies. Overall, it becomes clear that an assertive CFO with relatively high financial slack is likely to support investment in a 'Make' strategy, resulting in more patents produced and citations generated, and higher innovation efficiency. Therefore, it is likely that the interaction between CFO power and financial slack can influence the innovation performance of a firm. Consequently, we test the following hypothesis:

H5a, 5b, 5c and 5d: The relationship between CFO power and innovation performance (input, output, efficiency and choice) is positively moderated by financial slack.

2.2.7 Interaction between CFO and CEO power and the effects on innovation performance

The empirical evidence on the influence of CFOs and CEOs separately on organisational outcomes is well documented. For example, the influence of CEOs on innovation performance (Sariol and Abebe, 2017; Tabesh et al., 2019) and CFOs on financial performance (Florackis and Sainani, 2018; Baker et al., 2019) show that both are central to TMT. However, empirical evidence of the effect of interaction between the power of these two concerning innovation performances is almost non-existent. A few preliminary studies show that cognitive and affective conflict between CEOs and CFOs arises during decision-making over a firm's innovativeness (Wang et al., 2019; Camelo-Ordaz et al., 2015). An assertive CEO often bypasses consensus, making key decisions unilaterally (Harris and Helfat, 1998) or 'arm twisting' other TMTs, including the CFO, into conforming to their decisions (Adams et al., 2005). The heterogeneity in personalities, leadership styles, communication skills and strategic vision between CEOs and CFOs can lead to animosity or mistrust between these two most senior individuals in TMTs. On top of that, there is evidence to demonstrate that CEOs pressure CFOs to manipulate financial systems to overstate firm performance (Friedman, 2014), as example to pressure CFOs to present bias performance measures and eventually has negative implication on reporting and firm value. As the CEOs is above other executives, thus, we suggest that a powerful CEO can make ultimate strategic decision-making on innovation strategy such as the budget amount of allocation for innovation investment, and eventually reduce the influence of CFOs on innovation performance. The following hypotheses as below:

H6a, 6b, 6c and 6d: The relationship between CFO power and innovation performance (input, output, efficiency and choice) is negatively moderated by CEO power.

2.3 Data and methodology

2.3.1 Sample and data

Secondary panel data research is designed to test the hypotheses developed in Section 2 to help validate the theoretical model. As a sampling frame, US high-technology firms identified by the US Department of Commerce were selected (Select USA, 2017). Focusing on publicly listed firms ensures that the available public company filings and the capital market performance data, such as financial results, CFO compensation and budget data, are all comparable. Focusing on US firms provides a basis for predicting R&D innovation performance based on the upper echelons theory, as CFOs operate with a high degree of managerial discretion (Hambrick, 2007; Talke et al., 2011; Garms and Engelen, 2019).

As a starting point for building the sample, a directory was developed of all high-technology firms listed on the NYSE and NASDAQ from 1998 to 2018, together with financial and CEO/CFO compensation data from the Compustat database. An initial data set of 267 firms and 3,371 firm-year observations were gathered. After excluding firms without R&D expenditure and technology acquisition (TA), a total of 254 firms with 3,116 firm-year observations was obtained. Firms with less than four years of observations and missing data points from CFOs', CEOs' and board of directors' background data from Boardex were excluded. The remaining final sample contains 1,656 firm-year observations from 150 firms. The sample size in this study is consistent with those from other studies on CEOs using upper echelons research. For example, a study by Tabesh et al. (2019) is based on 350 firm-year observations from 97 firms, and a study of CFOs as a means of corporate internal control in the US high-technology industry by Yu et al., (2019) was based on 1,573 firm-year observations from 338 firms. Other studies examining the influence of TMTs in the marketing and management literature, used similar or smaller sample sizes (Connelly et al., 2016; Feng et al., 2015). For example, studies of Chief Marketing Officers and Chief Strategy Officers power are based on 299 firm years from 77 firms (Nath and Mahajan, 2011) and 126 firm years (Menz and Scheef, 2014), respectively.

2.3.2 Variable description and measurement

Dependent variable

A firm's R&D innovation activities are commonly proxied by their innovation input (Input), innovation outcome measured by number patent granted (Outcome), efficiency measures (Satta et al., 2016; Xie et al., 2020) and innovation input choice. For the innovation input strategy, the 'Make' strategy is measured as the natural logarithm of R&D investment expenditure (Chen et al., 2018), and the 'Buy' strategy is measured as the natural logarithm of intangible assets and goodwill (Xue, 2007), using annual financial data available from Compustat. We measure innovation outcome as the natural logarithm of the number of patents applied for by a firm during a year which were eventually granted (Satta et al., 2016; Shen and Zhang, 2018), using US Patent data and citations from Google Patents (Kogan et al., 2017). As there is an average two-year lag between patent application and grant, this led to truncation bias in the number of patents towards the end of the sample period. Following Hall et al. (2001), we include year-fixed effects to the regression models to address this issue. Furthermore, we measure CFO choice (Choice) between 'Make' and 'Buy' strategies by the ratio of R&D investment expenditure ('Make' strategy) to TA expenditure ('Buy' strategy).

An often neglected but important innovation indicator is a firm's efficiency in producing innovative output. Innovation efficiency measures the maximum innovation output capacity given a certain quantity of R&D input (Cruz-Cázares et al., 2013). We employ two measures of a firm's R&D efficiency, namely Patents' Efficiency (PatentEff) and Citation Efficiency (CitationEff). These two efficiency measures are computed as the ratio of the natural logarithm of the number of patents or citations to the total R&D investment expenditure (the sum of 'Make' and 'Buy' strategies), respectively. They provide a measure for the number of patents and patent citations generated per USD 1 million of total R&D investment expenditure, respectively.

This research creates another measure for the dependent variable, namely Innovation Input Choice. The variable is calculated by using the ratio of the natural logarithm of R&D expenditure to the natural logarithm of TA expenditure. This variable is to indicate a firm's choice of innovation input strategy, which is to choose 'make' over 'buy' or vice versa.

Independent variable

CFO power

This study uses six CFO measures of power, namely those referred to by Florackis and Sainani (2018): CFO Executive Director, Outside Director, Seniority, Financial Expertise, Pay Status and CFO-CEO Relative Pay. The CFO may sit as an executive member of the board of directors. Board membership increases their power as they are closer to the shareholders (Zoni and Pippo, 2017), which helps them gain early access to information as well as prestige (Daily and Johnson, 1997). The coding for CFO Executive Director is given if the CFO is an executive director (1) or otherwise (0). A second measure of CFO power is whether they are appointed as a director outside of the firm. If the CFO has a wider external reputation as an expert, they are seen to be more powerful (Fama and Jensen, 1983). In this case, the code for CFO is Outside Director (1) or otherwise (0). As leadership skills and qualities are developed over time, a more senior CFO is seen to be more powerful (Finkelstein and Hambrick, 1996). The coding scheme follows Sariol and Abebe (2017) by coding Seniority as the number of years the individual has served in the role. A fourth measure involves the financial expertise the CFO possesses. A CFO is seen as more powerful if they have sufficient knowledge or training in finance and accounting (Cannella et al., 2009). If the CFO holds a professional qualification in accounting or financial analysis (such as an ACA, FCA, CMA or CFA), Financial Expertise is coded 1 and 0 otherwise.

Research widely accepts that executive compensation reflects external opportunities (Fama, 1980). By extension, it underscores their formal standing and power within the TMT. Therefore, a fifth measure of CFO power is whether they are among the top three highest-paid executives in the TMT. If so, Pay Status is given a code of 1 and 0 otherwise. Finally, a more powerful CFO is generally one who earns a higher total compensation. Therefore, CFO-CEO Relative Pay is measured as the ratio of CFO total compensation to CEO total compensation (Florackis and Sainani, 2018).

To aggregate these six measures of CFO power, a principal component factor analysis was conducted, which confirmed that all six measures load on one factor with an eigenvalue greater than 1, and the six measures were aggregated using the regression factor score method to obtain the accurate factor scores of CFO power in each firm-year with high validity (Feng et al., 2015). The regression factor scoring coefficients are all positive, so the six items influence the CFO power construct in the same direction (0.24 for Pay Status, 0.18 for Seniority, 0.17 for Financial Expertise, 0.15 for CFO Executive Director, 0.13 for Outside Director, and 0.13 for CFO-CEO Relative Pay).

Interaction variable

Financial slack and CEO power

The literature characterises high-technology firms as preferring a combination of high financial slack and low leverage, as it promotes experimentation, risk-taking and long-term orientation in their pursuit of R&D investment (Grinblatt and Titman, 2002; O'Brien and Folta, 2009). Furthermore, it has been argued that harmonious working relationships between CEOs and CFOs and the conflicts arising from power struggles between them can moderate the assertiveness of a CFO in influencing R&D commitments when facing organisational complexity and a challenging business environment (Colbert et al., 2014; Amason, 1996). Therefore, Financial Slack held by high-technology firms and CEO Power were included as interaction variables in our regression analyses. Financial Slack is measured as the ratio of cash and marketable securities to current liabilities (Shaikh et al., 2018) while CEO Power is measured as an aggregate of the six measures, namely CEO Executive Director, Outside Director, Seniority, Financial Expertise, Pay Status and CEO-CFO Relative Pay, by using principal component factor analysis.

Control variable

To avoid problems arising from omitted variables and minimise variances not directly attributed to the research question, we include financial, board, firm and TMT characteristics as control variables. These measures include absorbed and potential slack (Lu and Wong, 2019). Absorbed Slack quantifies the resources already absorbed as organisational excess costs. Potential Slack quantifies the future resources generated through borrowing (Bourgeois and Singh, 1983). Moreover, TMT characteristics included CEO and CFO turnover (Hennes et al., 2008) as variables to control for strategic decision-making by TMT members (Adams et al., 2005). The regression analyses also included Capital Intensity, Altman-Z score, Return on Assets (ROA), Leverage (Shaikh et al., 2018) and Return on Equity (ROE) (Lu and Wong, 2019). The Altman-Z score predicts the probability of bankruptcy of the high-technology firms within two years (Altman, 1968). Board Size (Florackis and Sainani, 2018), Board Independence and Duality (DeBoskey et al., 2019) were included to capture board characteristics. The number of employees is included in the additional analysis for a robustness check. Table 2.1 summarises all the dependent, independent, interaction, control variables and variables used to construct CEO and CFO power indices and the Altman-Z score.

Table 2.1 Summary of variables and measures

Variable	Description	Source
Panel A: Dependent Variables		
ln(1+*R&D*)	Natural logarithm of *R&D* expenditure as a measure of 'Make' input strategy where *R&D* is the research and development expenditure in USD million	Compustat
ln(1+*TA*)	Natural logarithm of *TA* expenditure as a measure of 'Buy' input strategy where *TA* is the technology acquisition in million USD dollars. *TA* is calculated as: *Intangibles + Amortisation of Intangibles + Change in Goodwill + Amortisation of Goodwill where Intangibles, Amortisation of Intangibles*, *Change in Goodwill* and *Amortisation of Goodwill* are in USD million	Compustat
ln(1+*Patent*)	Natural logarithm of *Patent* where *Patent* is the number of patents applied and were eventually granted	Google Patent
ln(1+*Citation*)	Natural logarithm of *Citation* where *Citation* is the number of citations received by each patent	Google Patent
PatentEff	Measure of innovation of efficiency using the number of patents. *PatentEff* is measured as: $$\frac{ln(1+Patent)}{[ln(1+R\&D)+ln(1+TA)]}$$	Google Patent Compustat
CitationEff	Measure of innovation of efficiency using the number of citations. *CitationEff* is measured as: $$\frac{ln(1+Citation)}{[ln(1+R\&D)+ln(1+TA)]}$$	Google Patent Compustat

Table 2.1 (Continued)

Variable	**Description**	**Source**
Choice	Ratio of natural logarithm of R&D expenditure to natural logarithm of TA expenditure as a measure to indicate choice of innovation input strategy. Choice is calculated as: $$\frac{ln(1+R\&D)}{ln(1+TA)}$$	Compustat
Panel B: Independent Variables		
CFO Power	Measure of CFO power is a dummy variable with '1' if CFO index is equal to or above the mean and '0' if below the mean. It is constructed using principal component analysis of six variables listed in Panel E.	Boardex
Panel C: Moderating Variables		
Financial Slack	Measure of financial slack and is calculated as the ratio of *Cash and Marketable Securities* to *Current Liabilities* where *Cash and Marketable Securities* and *Current Liabilities* in USD million	Compustat
CEO Power	Measure of CEO power and is a dummy variable with '1' if CEO index is equal to or above the mean and '0' if below the mean. It is constructed using principal component analysis of six variables listed in Panel E.	Boardex
Panel D: Control Variables		
Absorbed Slack	Measure of agency cost and is calculated as the ratio of *Selling, General and Administrative (SGA)* to *Sales*.	Compustat
Potential Slack	Measure of future resources generated through debt borrowing and is calculated as the ratio of *Total Liabilities* to *Total Common Equity* where *Total Common Equity* is in USD million.	Compustat

Table 2.1 (Continued)

Variable	**Description**	**Source**
Potential Slack	Measure of future resources generated through debt borrowing and is calculated as the ratio of *Total Liabilities* to *Total Common Equity* where *Total Common Equity* is in USD million.	Compustat
CFO (CEO) Turnover	Measure of CFO (CEO) turnover in the firm. The dummy variable takes the value of '1' when the firm replaces its CFO (CEO) and '0' if otherwise.	Boardex
Altman-Z	Measures the probability of the firm going to bankruptcy using the Altman's Z-score. It is measured as: $1.2T_1 + 1.4\,T_2 + 3.3\,T_3 + 0.6T_4 + 1.0T_5$. The T_1 to T_5 variables are listed in Panel F	Compustat
Board Size	Number of individuals sitting on the board of directors in the firm.	Boardex
Board Independence	Measure the number of independent directors on board and it is calculated as ratio of the number of independent directors to the total number of board members.	Boardex
Capital Intensity	Measure of amount of capital needed per dollar of total assets. It is calculated as the ratio of *Capital Expenditure* to *Total Assets* where *Capital Expenditure* and *Total Assets* are in USD million	Compustat
Duality	Measure of whether the CEO is also the Chairman of the board of directors and is a dummy variable with '1' if CEO is also the Chairman, and '0' if otherwise.	Boardex
Leverage	Measure of leverage of firms. It is calculated as the ratio of *Total Liabilities* to *Total Assets* where *Total Liabilities* is in USD million.	Compustat

Table 2.1 (Continued)

Variable	Description	Source
ROA	Measure of return on assets of the firm. It is calculated as the ratio of *Net Income* to *Total Assets* where *Net Income* is in USD million.	Compustat
ROE	Measure of return on equity of the firm. It is calculated as the ratio of *Net Income* divided by the *Total Common Equity.*	Compustat
Employees	Measure of the number of employees of the firm. It is measured as natural logarithm of total number of employees (in thousands).	Compustat
Panel E: Principal Component Analysis of CFO and CEO Power		
CFO (CEO) Executive Director	Measure of CFO as executive director. It is measured by dummy variable coded '1' if the CFO (CEO) sits on the board of directors and '0' otherwise.	Boardex
CFO (CEO) Outside Director	Measure of CFO as outside director. It is measured by dummy variable coded '1' if the CFO (CEO) sits on at least one outside board and '0' otherwise.	Boardex
CFO (CEO) Seniority	Measure of CFO (CEO) seniority by taking the number of years CFO (CEO) in the firm.	Boardex
CFO (CEO) Financial Expertise	Measure of financial expertise of CFO(CEO). It is measured by dummy variable coded '1' if the CFO (CEO) has a chartered qualification in accounting or financial analysis (Chartered Accountant (CA), Associate Chartered Accountant (ACA), Fellow Chartered Accountant (FCA), Chartered Financial Analyst (CFA), Chartered Management Accountant (CMA) and Chartered Secretary) and '0' otherwise.	Boardex

Table 2.1 (Continued)

Variable	**Description**	**Source**
CFO (CEO) Top Three	Measure of CFO (CEO) as top three ranking. It is operationalised by dummy variable coded '1' if the CFO (CEO) is among the three highest paid executives and '0' otherwise.	Compustat
CFO (CEO) Relative Pay	Measure of the relative pay of CFO (CEO). It is measured by the ratio of the total compensation of CFO (CEO), excluding equity-based awards, to the (CEO) CFO total compensation.	Compustat
Panel F: Altman Z-Score		
T_1	Measured as $T_1 = \frac{Working\ Capital}{Total\ Assets}$ where *Working Capital* is in USD million	Compustat
T_2	Measured as $T_2 = \frac{Retained\ Earnings}{Total\ Assets}$ where *Retained Earnings* are in USD million	Compustat
T_3	Measured as $T_3 = \frac{Earnings\ before\ Interests\ and\ Taxes}{Total\ Assets}$ where *Earnings before Interests and Taxes* are in USD million	Compustat
T_4	Measured as $T_4 = \frac{Total\ Common\ Equity}{Total\ Liabilities}$ where *Total Common Equity* is in USD million	Compustat
T_5	Measured as $T_5 = \frac{Sales}{Total\ Assets}$ where *Sales* is in USD million	Compustat

2.3.3 Empirical model

This study used panel data to investigate the association between strategic leadership, governance mechanisms and innovation performance. Some specification tests were conducted to select the most appropriate panel model. The tests are the Hausman test[1] (Hausman, 1978). Testparm[2] testing, Breusch-Pagan/Cook-Weisberg, White's test and VIF test. Thus, the fixed-effect model was selected based on the Hausman test ($p<0.05$) for all models of dependent variables (R&D, TA, Patent, Citation, PatentEff, CitationEff, Input Choice).

The specified model may suffer from endogeneity; prior upper echelons studies that draw from Compustat have shown that heteroskedasticity and autocorrelation are expected to be present in the observations (Garms and Engelen, 2019). The Wooldridge test for autocorrelation and Breusch-Pagan/Cook-Weisberg and White's test for heteroscedasticity. With $p<0.05$ for both tests, we reject the null hypothesis for both no autocorrelation and heteroskedasticity. Therefore, robust standard errors were used during the estimation of the panel data regression to obtain unbiased standard errors of OLS coefficients under heteroskedasticity (Arellano, 1987). A second potential source of endogeneity may exist from the unobserved variables being correlated with the main independent variable and the dependent variables being

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[1] **Hausman Test**

The Hausman test is calculated as follows:

$H = (\beta_c - \beta_e)' (V_c - V_e)^{-1} (\beta_c - \beta_e)$

Where:

β_c is the coefficient vector from the consistent estimator
β_e is the coefficient vector from the efficient estimator
V_c is the covariance matrix of the consistent estimator
V_e is the covariance matrix of the efficient estimator

The null hypothesis is that the preferred model is random effects; The alternate hypothesis is that the model is fixed effects. If H is significant (equal or less than 0.05), the null hypothesis is rejected and *Fixed Effects Model* should be used.

[2] **Testing for Time-Fixed Effects (Testparm)**

Testparm is conducted to see if time fixed effects are needed. A joint test is conducted to check whether the time dummies for all years are equal to zero or not (Torres-Reyna, 2007). If the Prob>F is equal or less than 0.05, the null hypothesis is rejected, which means that the coefficients for all years are not jointly equal to zero. Therefore, time fixed effects are needed.

constant over time. However, this concern is addressed by adding the year-fixed effects in the model (Ebbes et al., 2017).

To address concerns about multicollinearity among the variables in the estimation, the variance inflation factor (VIF) was analysed. All variables, other than financial slack and the square of financial slack variables, were found not to be correlated, as the VIF values ranged between 1.01 and 2.70 (Hair et al., 1995). Following Aiken and West (1991), both the financial slack and financial slack squared variables were centred on their mean.

The research applies OLS fixed effects model that capture firm-year effects, and robust standard errors are clustered at the firm level (Schaffer, 2010; Wooldridge, 2016) as shown below, and apart from that, following other previous studies, this thesis also considers the two-stage least squares (2SLS) firm-year fixed effects model with instrumental variables as a further/additional/robustness test (Aghion et al., 2013; Bernile et al., 2018; Kang et al., 2018):

$$IP_{i,t} = \beta_1 \text{CFO Power}_{i,t} + \beta_2 \text{Financial Slack} + \beta_3(\text{CFO Power x Financial Slack})_{i,t} +$$
$$B_4(\text{CFO Power x CEO Power})_{i,t} + \beta_5 Z_{i,t} + \alpha_i + u_{i,t} \quad \text{……………………………} \quad (1)$$

Where $IP_{i,t}$ represents firm I's innovation performance at time t with several proxies, namely innovation input strategies (R&D expenditure and technology acquisition), innovation output performance (Patent and Citation) and innovative efficiency (PatentEff and CitationEff), and innovation input choice. β_0 is the intercept term, β_1, β_2 and β_3 are the regression coefficients for independent variables, β_4 is the regression coefficients for control variables and CFO $Power_{i,t}$ is the main independent variables. Financial $Slack_{i,t}$ and CEO $Power_{i,t}$ are interaction variables, $Z_{i,t}$ is the control variables, while α_i is the intercept and, finally, $u_{i,t}$ represents the model error term.

2.4 Data analysis and discussion

2.4.1 Descriptive statistics

Table 2.2 shows the descriptive statistics for the untransformed variables. Notably, the standard deviation for R&D, technology acquisition, patent and citation are higher the mean. This implies the data are more spread out. Hence, the data are log transformed for regression analysis.

Table 2.2 Summary statistics among unstandardised regression variables

Variables	**Mean**	**Standard Deviation**	**Min**	**P25**	**P50**	**P75**	**Max**
R&D	376.80	1413.47	0	0	0	13948	21419
Technology Acquisition	3933.68	9716.33	0	86.69	538.32	79540	87862
Patent	32.33	163.06	0	0	0	1499	2121
Citation	1478.22	15978.53	0	0	0	235552	314817
PatentEff	9.16	5.29	1.04	5.67	7.63	26.88	27
CitationEff	9.94	6.07	1.04	5.76	7.97	30.82	31.56
Innovation Input Choice	1.41	1.92	0	0	0	7.10	7.61
CFO Power	0.41	0.49	0	0	0	1	1
Financial Slack	0.66	1.02	0	0.07	0.29	0.83	10.37
CEO Power	0.48	0.49	0	0	0	1	1
Absorbed Slack	0.22	0.49	0	0	0.12	0.31	1.21
Potential Slack	1.45	10.47	-222.2	-52.41	1.37	38.51	266.55
CFO Turnover	0.16	0.37	0	0	0	0	1
CEO Turnover	0.10	0.30	0	0	0	0	1
AltmanZ	2.95	14.79	-19.65	0.99	2.03	3.76	36.38
Board Size	9.85	2.38	5	8	10	12	17
Board Independence (%)	1.21	6.04	0.30	0.75	0.83	0.89	0.93
Capital Intensity	0.07	0.07	0.001	0.02	0.05	0.09	0.32
Duality	0.58	0.49	0	0	1	1	1
Leverage	0.54	0.62	-21.84	-1.16	0.59	0.73	3.49

Table 2.2 (Continued)

Variables	**Mean**	**Standard Deviation**	**Min**	**P25**	**P50**	**P75**	**Max**
ROA	0.01	0.27	-0.78	0.01	0.04	0.08	0.27
ROE	0.05	3.84	-2.76	0.04	0.10	0.18	1.38
Employees	18.07	47.05	0.104	1.610	5.02	426.75	434.25

Note: R&D, technology acquisition, patent and citation are transformed into natural logarithm in the regression analysis.

Table 2.3, Table 2.4 and Table 2.5 show the pairwise Pearson correlation coefficients of variables used in the study. As shown in Panel A, the R&D expenditure is positively and significantly correlated with technology acquisition, number of patents granted, innovation efficiency and innovation input choice. The main independent, namely the CFO power variables, is positively and significantly correlated with technology acquisition, patents and citations. Financial slack is negatively and significantly correlated with technology acquisition, but positively associated with innovation input choice. Similarly, the CFO power and CEO power are positive and significant. In Panel B, the associations between all the dependent variables with firm size (market capitalisation), assets and number of employees are positive and significant, except the association between innovation input choice and assets is insignificant. In Panel C, likewise the size of board is positively associated with firm size (market capitalisation), assets and number of employees. In sum, the level of correlation among all variables ranges from low to medium, implies that there is no serious multi-collinearity concern.

Table 2.3 Pairwise correlation analysis (panel A)

Panel A

Variables	R&D	Technology Acquisition	Patent	Citation	PatentEff	CitationEff	Input Choice	CFO Power	Financial Slack	CEO Power	Absorbed Slack	Potential Slack	CFO Turnover	CEO Turnover
R&D	1													
Technology Acquisition	*0.60	1												
Patent	*0.61	*0.34	1											
Citation	*0.43	*0.07	*0.66	1										
PatentEff	*0.58	*0.58	*0.50	*0.23	1									
CitationEff	*0.52	*0.49	*0.41	*0.26	*0.96	1								
Input Choice	*0.61	*0.46	*0.44	*0.22	*0.87	*0.83	1							
CFO Power	0.04	*0.05	*0.08	*0.08	0.03	0.03	-0.01	1						
Financial Slack	0.01	*-0.06	-0.04	-0.02	-0.02	-0.01	*0.17	0.00	1					
CEO Power	*-0.18	*-0.12	*-0.16	*-0.07	*-0.25	*-0.22	*-0.27	*0.05	*-0.10	1				
Absorbed Slack	*0.05	0.03	0.01	-0.01	*0.10	*0.10	*0.49	-0.02	*0.21	*-0.11	1			
Potential Slack	0.01	0.03	0.01	0.00	-0.02	-0.04	-0.04	0.00	-0.04	*0.05	-0.02	1		

Table 2.3 (Continued)

Panel A														
Variables	**R&D**	**Technology Acquisition**	**Patent**	**Citation**	**PatentEff**	**CitationEff**	**Input Choice**	**CFO Power**	**Financial Slack**	**CEO Power**	**Absorbed Slack**	**Potential Slack**	**CFO Turnover**	**CEO Turnover**
CFO Turnover	0.01	0.00	0.00	-0.01	0.01	0.01	0.00	***-0.32**	-0.03	0.01	0.00	-0.02	1	
CEO Turnover	-0.01	0.01	0.00	-0.01	0.01	0.01	0.00	***-0.05**	-0.04	***-0.09**	0.00	0.01	***0.13**	1

N = 1656 firm-year observations from 150 companies. *Statistically significant at the 5% level.

Table 2.4 Pairwise correlation analysis (panel B)

Panel B

Variables	**R&D**	**Technology Acquisition**	**Patent**	**Citation**	**PatentEff**	**CitationEff**	**Input Choice**	**CFO Power**	**Financial Slack**	**CEO Power**	**Absorbed Slack**	**Potential Slack**	**CFO Turnover**	**CEO Turnover**
Altman-Z	***0.07**	0.03	0.02	0.02	***0.11**	***0.11**	***0.17**	0.03	***0.18**	***-0.11**	***-0.13**	-0.01	***-0.05**	0.001
Board Size	***0.12**	***0.27**	***0.07**	***-0.04**	***0.21**	***0.17**	-0.03	***0.06**	***-0.39**	***0.11**	***-0.20**	***0.05**	0.00	***0.05**
Board Independent	0.004	-0.02	0.003	0.00	***0.09**	***0.10**	***0.10**	-0.04	0.03	***-0.06**	***0.06**	0.00	0.02	-0.02
Capital Intensity	***-0.11**	***-0.15**	***-0.09**	-0.04	***-0.35**	***-0.34**	***-0.39**	***0.09**	***-0.20**	***0.20**	***-0.16**	0.01	-0.03	-0.02
Duality	-0.01	***0.05**	-0.02	***-0.07**	-0.01	-0.04	0.02	-0.03	***-0.06**	***0.26**	-0.03	0.00	-0.03	***-0.14**
Leverage	-0.01	0.02	0.03	0.001	0.00	0.00	-0.02	0.00	***-0.13**	***0.09**	-0.02	0.01	0.02	0.01
ROA	***0.08**	***0.08**	***0.06**	0.05	***0.12**	***0.12**	0.02	0.03	-0.03	***-0.05**	***-0.26**	-0.03	0.01	-0.02
ROE	0.02	0.03	0.02	0.01	0.01	0.01	-0.01	0.04	-0.01	-0.02	***-0.06**	***-0.07**	-0.01	0.02
Employees	***0.39**	***0.49**	***0.41**	***0.17**	***0.57**	***0.50**	***0.34**	0.05	***-0.29**	***-0.05**	***-0.13**	0.05	0.03	0.02

N = 1656 firm-year observations from 150 companies. *Statistically significant at the 5% level.

Table 2.5 Pairwise correlation analysis (panel C)

Panel C									
Variables	**Altman-Z**	**Board Size**	**Board Independent**	**Capital Intensity**	**Duality**	**Leverage**	**ROA**	**ROE**	**Employees**
Altman-Z	1								
Board Size	***0.07**	1							
Board Independent	0.02	-0.01	1						
Capital Intensity	0.01	***0.09**	***-0.05**	1					
Duality	***-0.05**	0.04	-0.03	***-0.05**	1				
Leverage	***-0.08**	***0.09**	-0.01	-0.03	***0.08**	1			
ROA	***0.31**	***0.13**	0.03	-0.01	-0.03	-0.04	1		
ROE	***0.06**	0.03	0.01	-0.01	-0.03	-0.01	***0.53**	1	
Employees	***0.06**	***0.48**	0.00	***-0.21**	***0.10**	***0.09**	***0.16**	0.05	1

N = 1656 firm-year observations from 150 companies. *Statistically significant at the 5% level.

2.4.2 Main analysis, results and discussion

Main analyses

Direct effects

Table 2.6 provides the results from the fixed-effect regression analyses with the input ('Make' and 'Buy') strategies and R&D outcome as the dependent variables. Hypothesis 1 posits that CFO power is positively associated with innovation input. The coefficient estimates for CFO Power are significant and positive for the 'Make' strategy models without ($\beta = 0.10; p < 0.05$) and with ($\beta = 0.07; p < 0.10$) the control variables in Models 1B and 1C, respectively. However, the coefficient estimates for CFO Power have no significant effect on the 'Buy' strategy models without and with the control variables in Models 2B and 2C, respectively. The result of positive and significant association between CFO Power and 'Make' strategy leads the study to accept Hypothesis 1.

Hypothesis 2 provides that CFO Power is positively associated with the innovation outcomes. The R&D outcome (Patent and Citation) measures are the dependent variable, and the coefficient estimates for CFO Power are significant and positive for the Patent models without ($\beta = 0.12; p < 0.05$) and with ($\beta = 0.09; p < 0.05$) the control variables in Models 3B and 3C, respectively. These results support Hypothesis 2. Similarly, the coefficient estimates for CFO power are significant and positive for the Citation models without ($\beta = 0.30; p < 0.01$) and with ($\beta = 0.22; p < 0.05$) the control variables in Models 4B and 4C, respectively. These results provide support for Hypothesis 2.

Table 2.7 presents the results from fixed-effect regression analyses with innovation efficiency, and choice between input strategies as the dependent variables. Hypothesis 3 states that CFO Power is positively associated with innovation efficiency. The coefficient estimates for CFO Power are positive and significant for the PatentEff model without ($\beta = 0.66; p < 0.01$) and with ($\beta = 0.09; p < 0.10$) the control variables in Model 1B and 1C, respectively. Subsequently, for CitationEff, the coefficient estimates for CFO Power are significant and positive without ($\beta = 0.92; p < 0.01$) and with ($\beta = 0.22; p < 0.10$) the control variables in Models 2B and 2C, respectively. The results are able to support Hypothesis 3.

Hypothesis 4 proposes a positive association between CFO Power and innovation input choice. In the Choice model, the coefficient estimates for CFO Power are significant and positive without $(\beta = 0.08; p < 0.05)$ and $(\beta = 0.04; p < 0.1)$ with the control variables in Models 3B and 3C, respectively. Thus, the results from the input choice model provide support to Hypothesis 4.

Table 2.6 The association between CFO power and innovation (input and outcome)

Dependent Variable	**Innovation Input**						**Innovation Outcome**					
	Make Strategy (R&D)			**Buy Strategy (TA)**			**Patent**			**Citation**		
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**	**Model 4A**	**Model 4B**	**Model 4C**
CFO Power		**0.10	*0.07		0.08	-0.09		**0.12	**0.09		***0.30	**0.22
		(2.25)	(1.87)		(0.60)	(-0.86)		(2.30)	(2.10)		(2.82)	(2.18)
CEO Power	0.001		-0.01	0.06		0.07	0.02		0.01	0.23		0.20
	(0.04)		(-0.23)	(0.26)		(0.32)	(0.35)		(0.14)	(1.38)		(1.20)
Potential Slack	0.001		0.001	0.001		0.001	-0.001		-0.001	**-0.003		**-0.003
	(1.23)		(1.22)	(0.30)		(0.30)	(-0.69)		(-0.71)	(-1.98)		(-2.08)
Absorbed Slack	-0.01		-0.01	-0.001		-0.001	-0.007		-0.007	-0.02		-0.02
	(-0.69)		(-0.69)	(-0.02)		(-0.02)	(-0.22)		(-0.23)	(-0.33)		(-0.34)
ROA	-0.11		*-0.11	-0.12		-0.12	***0.50		***0.50	***1.10		***1.09
	(-1.64)		(-1.67)	(-0.42)		(-0.42)	(2.85)		(2.88)	(2.95)		(2.99)
Leverage	-0.003		-0.01	-0.04		-0.04	0.02		0.01	0.04		0.03

Table 2.6 (Continued)

Dependent Variable	**Innovation Input**						**Innovation Outcome**					
	Make Strategy (R&D)			**Buy Strategy (TA)**			**Patent**			**Citation**		
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**	**Model 4A**	**Model 4B**	**Model 4C**
	(-0.26)		(-0.44)	(-1.28)		(-1.20)	(0.77)		(0.65)	(0.86)		(0.72)
Altman-Z	-0.002		-0.001	**-0.01		**-0.01	***-0.004		***-0.004	***-0.01		**-0.01
	(-0.91)		(-0.90)	(-2.36)		(-2.37)	(-3.11)		(-3.09)	(-2.61)		(-2.60)
Board Size	*0.38		*0.37	0.38		0.39	0.16		0.15	0.33		0.30
	(1.95)		(1.93)	(0.64)		(0.66)	(1.04)		(0.97)	(0.78)		(0.72)
Board Independence	***0.001		***0.001	-0.002		-0.002	0.0002		0.0003	-0.002		-0.001
	(2.65)		(2.77)	(-1.36)		(-1.39)	(0.33)		(0.47)	(-1.43)		(-1.28)
CFO Turnover	0.01		0.03	-0.14		**-0.17	-0.02		0.002	-0.08		-0.02
	(0.20)		(1.07)	(-1.64)		(-2.20)	(-0.65)		(0.05)	(-1.16)		(-0.26)
CEO Turnover	0.08		0.07	0.03		0.03	-0.04		-0.05	-0.03		-0.03

Table 2.6 (Continued)

Dependent Variable	Innovation Input						Innovation Outcome					
	Make Strategy (R&D)			Buy Strategy (TA)			Patent			Citation		
Model	Model 1A	Model 1B	Model 1C	Model 2A	Model 2B	Model 2C	Model 3A	Model 3B	Model 3C	Model 4A	Model 4B	Model 4C
	(1.23)		(1.22)	(0.30)		(0.32)	(-0.91)		(-0.96)	(-0.23)		(-0.27)
Duality	0.06		0.06	0.11		0.12	-0.06		-0.07	-0.01		-0.02
	(1.10)		(1.02)	(0.62)		(0.65)	(-0.73)		(-0.78)	(-0.07)		(-0.13)
Capital Intensity	0.39		0.38	**-2.71		**-2.71	0.18		0.18	-0.01		-0.02
	(0.98)		(0.98)	(-2.05)		(-2.07)	(0.40)		(0.39)	(-0.01)		(-0.02)
ROE	0.001		0.0004	0.002		0.002	-0.01		-0.01	-0.01		-0.01
	(0.21)		(0.14)	(0.17)		(0.18)	(-1.04)		(-1.09)	(-1.17)		(-1.22)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	*-1.51	***1.73	*-1.47	***-9.09	*2.54	***-9.15	**-1.96	0.33	**-1.90	***-4.34	0.84	***-4.22
	(-1.87)	(6.94)	(-1.84)	(-3.24)	(1.86)	(-3.27)	(-2.47)	(1.38)	(-2.45)	(-2.66)	(1.53)	(-2.62)

Table 2.6 (Continued)

Dependent Variable	**Innovation Input**						**Innovation Outcome**					
	Make Strategy (R&D)			**Buy Strategy (TA)**			**Patent**			**Citation**		
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**	**Model 4A**	**Model 4B**	**Model 4C**
No. of observations	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.19	0.10	0.20	0.34	0.13	0.34	0.17	0.10	0.20	0.14	0.10	0.14

The table presents the results from OLS regression on the association between CFO Power and Innovation Performance as measured by innovation input (R&D or 'make' strategy - model 1A, 1B, 1C and Technology Acquisition or 'buy' strategy – model 2A, 2B, 2C) and outcome (patent - model 3A, 3B, 3C) and (citation – model 4A, 4B, 4C). In model 1A, 2A, 3A, 4A we add all control variables. In model 1B, 2B, 3B, 4B we add CFO Power. Model 1C, 2C, 3C, 4C we add CFO Power and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 2.7 The association between CFO power and innovation (input efficiency and input choice)

Dependent Variable	**Innovation Efficiency**						**Innovation Input Choice**		
	PatentEff			**CitationEff**					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
CFO Power		*****0.66**	***0.09**		*****0.92**	***0.22**		****0.08**	***0.04**
		(2.91)	(1.61)		(3.38)	(1.26)		(2.39)	(1.45)
CEO Power	0.09		0.07	0.28		0.25	**0.07		*0.06
	(0.35)		(0.29)	(0.90)		(0.80)	(2.11)		(1.96)
Potential Slack	0.0004		0.001	-0.002		-0.002	0.0002		0.0001
	(0.25)		(0.27)	(-1.06)		(-1.07)	(0.29)		(0.22)
Absorbed Slack	0.01		0.01	-0.003		-0.003	-0.17		-0.17
	(0.14)		(0.13)	(-0.03)		(-0.03)	(-0.87)		(-0.84)
ROA	0.35		0.35	*0.95		*0.95	-0.04		-0.04
	(0.96)		(0.97)	(1.89)		(1.91)	(-0.45)		(-0.50)
Leverage	-0.01		-0.01	0.01		0.01	0.0003		-0.001
	(-0.25)		(-0.32)	(0.26)		(0.13)	(0.04)		(-0.15)
Altman-Z	***-0.02		***-0.02	***-0.02		***-0.02	***-0.02		***-0.02

Table 2.7 (Continued)

Dependent Variable	**Innovation Efficiency**						**Innovation Input Choice**		
	PatentEff			**CitationEff**					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
	(-3.26)		(-3.25)	(-3.59)		(-3.57)	(-3.60)		(-3.66)
Board Size	0.75		0.75	0.81		0.81	0.16		0.15
	(1.09)		(1.08)	(0.99)		(0.98)	(1.08)		(1.08)
Board Independence	***0.002		***0.003	-0.0002		-0.0001	0.0002		0.0002
	(4.71)		(4.76)	(-0.29)		(-0.08)	(0.93)		(1.06)
CFO Turnover	*-0.18		*-0.16	**-0.25		-0.18	0.001		0.01
	(-1.80)		(-1.76)	(-2.05)		(-1.58)	(0.02)		(0.61)
CEO Turnover	0.06		0.06	0.09		0.08	0.07		0.07
	(0.40)		(0.39)	(0.42)		(0.40)	(1.37)		(1.35)
Duality	0.05		0.05	0.07		0.06	-0.001		-0.003
	(0.20)		(0.19)	(0.21)		(0.19)	(-0.04)		(-0.07)
Capital Intensity	*-3.15		*-3.16	*-3.66		*-3.69	*0.41		0.39
	(-1.90)		(-1.90)	(-1.82)		(-1.83)	(1.66)		(1.64)

Table 2.7 (Continued)

Dependent Variable	Innovation Efficiency						Innovation Input Choice		
	PatentEff			CitationEff					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
ROE	-0.01		-0.01	-0.02		-0.02	0.0001		0.0002
	(-0.51)		(-0.53)	(-0.77)		(-0.81)	(0.04)		(0.09)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-11.23	***8.91	***-11.15	***-14.20	***9.59	***-13.99	-0.44	1.38***	-0.40
	(-4.59)	(103.34)	(-4.60)	(-4.50)	(93.29)	(-4.52)	(-0.69)	(110.60)	(-0.64)
No. of observations	1656	1656	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.42	0.02	0.42	0.38	0.03	0.38	0.14	0.01	0.15

The table presents the results from OLS regression on the association between CFO Power and Innovation Performance as measured by innovation efficiency (PatentEff - model 1A, 1B, 1C and CitationEff – model 2A, 2B, 2C) and innovation input choice (model 3A, 3B, 3C). In model 1A, 2A, 3A we add all control variables. In model 1B, 2B, 3B we add CFO Power. Model 1C, 2C, 3C we add CFO Power and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Interaction Effects

To test Hypotheses 5 and 6, the interaction terms of *Financial Slack* and *CEO Power* were added to the regression analyses. These hypotheses argue that *Financial Slack* and *CEO Power* interact with *CFO Power* on innovation performance with respect to innovation input, outcome, efficiency and choice, respectively.

Table 2.8 shows the results from the fixed-effect regression analyses with *Financial Slack* as an interaction variable to *CFO Power*, and innovation input and outcome as dependent variables. The coefficient estimates for the interaction term are positive and significant for both 'Make' ($\beta = 0.07; p < 0.01$) and 'Buy' models ($\beta = 0.13; p < 0.1$) for the input strategy in Models 1C and 2C, respectively. These results support Hypothesis 5a. The coefficient estimates for the interaction term are positive and significant for the Patent ($\beta = 0.04; p < 0.10$) and Citation ($\beta = 0.15; p < 0.10$) models for outcome measures in Models 3C and 4C. These results support Hypothesis 5b. From Figure 2.2, it is clear that high levels of financial slack increase the 'Make' and 'Buy' input expenditures and increase the number of patents and citations at high levels of CFO power.

The potential nonlinear effect of financial slack is also analysed (Nohria and Gulati 1996). The coefficient estimate for the quadratic term for financial slack is positive and significant for the 'Buy' strategy ($\beta = 0.02; p < 0.1$) and Patent ($\beta = 0.01; p < 0.1$) in model 2B and model 3B, respectively, but there is no association between the quadratic financial slack term for the 'Make' strategy and Citation.

Table 2.9 shows the results from the fixed-effect regression analyses with *Financial Slack* as an interaction variable to *CFO Power*, and innovation efficiency and input choice as dependent variables. The coefficient estimates for the interaction terms are positive and significant for both *PatentEff* ($\beta = 0.25; p < 0.01$) and *CitationEf* ($\beta = 0.35; p < 0.01$) for innovation efficiency in Models 1C and 2C, respectively. In addition, for the input choice model, the coefficient estimates for the interaction term is positive and significant ($\beta = 0.05; p < 0.05$) in Model 3C. Figures 2.3 and 2.4 demonstrate that high levels of financial slack increase, respectively, the *Patent* and *Citation* and the innovation input *Choice,* at high levels of CFO power. These results offer support to Hypothesis 5c and 5d, respectively.

Apart from that, the coefficient estimate for the quadratic term for financial slack is positive and significant for the PatentEff ($\beta = 0.04; p < 0.05$), CitationEff ($\beta = 0.04; p < 0.10$) and Innovation Input Choice ($\beta = 0.01; p < 0.05$) in model 1B, 2B and 3B, respectively.

Table 2.8 The association between CFO power, financial slack and innovation (input and outcome)

Dependent Variable	Innovation Input						Innovation Outcome					
	Make Strategy (R&D)			Buy Strategy (TA)			Patent			Citation		
Model	Model 1A	Model 1B	Model 1C	Model 2A	Model 2B	Model 2C	Model 3A	Model 3B	Model 3C	Model 4A	Model 4B	Model 4C
CFO Power	*****0.08**	**0.08*****	**0.08*****	-0.09	-0.09	-0.09	*****0.10**	*****0.10**	*****0.10**	*****0.22**	*****0.22**	*****0.22**
	(2.86)	(2.85)	(2.86)	(-1.10)	(-1.12)	(-1.11)	(2.89)	(2.87)	(2.87)	(2.76)	(2.76)	(2.76)
Financial Slack	0.03	-0.001	-0.03	**-0.14	***-0.25	***-0.29	-0.02	**-0.07	**-0.09	-0.07	-0.10	*-0.15
	(1.57)	(-0.05)	(-0.86)	(-2.37)	(-2.84)	(-3.23)	(-0.99)	(-2.04)	(-2.32)	(-1.17)	(-1.14)	(-1.66)
Financial Slack^2		0.01			*0.02			*0.01			0.01	
		(1.45)			(1.70)			(1.84)			(0.49)	
CFO Power X Fin. Slack			**0.07*****			***0.13**			***0.04**			***0.15**
			(2.78)			(1.73)			(1.26)			(1.94)
CEO Power	-0.01	-0.01	-0.02	0.08	0.08	0.07	0.01	0.01	0.01	*0.21	*0.20	*0.20
	(-0.34)	(-0.40)	(-0.49)	(0.77)	(0.70)	(0.65)	(0.25)	(0.18)	(0.14)	(1.91)	(1.89)	(1.83)
Potential Slack	0.001	0.001	0.001	0.001	0.001	0.001	-0.001	-0.001	-0.001	-0.004	-0.003	-0.003

Table 2.8 (Continued)

Dependent Variable	**Innovation Input**						**Innovation Outcome**					
	Make Strategy (R&D)			**Buy Strategy (TA)**			**Patent**			**Citation**		
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**	**Model 4A**	**Model 4B**	**Model 4C**
	(0.88)	(0.89)	(1.00)	(0.17)	(0.18)	(0.24)	(-0.66)	(-0.65)	(-0.60)	(-1.26)	(-1.26)	(-1.18)
Absorbed Slack	-0.02	-0.02	-0.01	-0.002	-0.003	0.003	-0.01	-0.01	-0.01	-0.03	-0.03	-0.02
	(-0.65)	(-0.66)	(-0.54)	(-0.02)	(-0.04)	(0.04)	(-0.22)	(-0.24)	(-0.18)	(-0.34)	(-0.35)	(-0.26)
ROA	**-0.12	*-0.11	*-0.11	-0.13	-0.11	-0.10	***0.50	***0.51	***0.51	***1.10	***1.10	***1.12
	(-1.96)	(-1.90)	(-1.82)	(-0.69)	(-0.62)	(-0.57)	(6.57)	(6.65)	(6.68)	(6.15)	(6.16)	(6.23)
Leverage	-0.01	-0.01	-0.01	-0.05	-0.05	-0.05	0.02	0.02	0.02	0.04	0.04	0.04
	(-0.29)	(-0.31)	(-0.28)	(-0.77)	(-0.80)	(-0.77)	(0.69)	(0.66)	(0.67)	(0.63)	(0.62)	(0.65)
Altman-Z	**-0.002	**-0.002	**-0.002	***-0.01	***-0.01	***-0.01	***-0.004	***-0.004	***-0.004	**-0.01	**-0.01	**-0.01
	(-2.21)	(-2.28)	(-2.25)	(-2.80)	(-2.89)	(-2.87)	(-3.77)	(-3.86)	(-3.85)	(-2.29)	(-2.31)	(-2.28)
Board Size	***0.39	***0.37	***0.37	0.37	0.33	0.33	0.15	0.13	0.13	0.30	0.28	0.28

Table 2.8 (Continued)

Dependent Variable	Innovation Input						Innovation Outcome					
	Make Strategy (R&D)			Buy Strategy (TA)			Patent			Citation		
Model	Model 1A	Model 1B	Model 1C	Model 2A	Model 2B	Model 2C	Model 3A	Model 3B	Model 3C	Model 4A	Model 4B	Model 4C
	(4.19)	(4.05)	(4.04)	(1.33)	(1.17)	(1.16)	(1.24)	(1.07)	(1.07)	(1.05)	(1.01)	(1.00)
Board Independence	0.001	0.001	0.001	-0.002	-0.002	-0.001	0.0004	0.001	0.001	-0.001	-0.001	-0.001
	(0.54)	(0.59)	(0.67)	(-0.35)	(-0.30)	(-0.25)	(0.16)	(0.22)	(0.26)	(-0.25)	(-0.23)	(-0.17)
CFO Turnover	0.03	0.03	0.03	*-0.18	*-0.18	*-0.18	0.001	0.002	-0.0002	-0.02	-0.02	-0.03
	(0.97)	(0.98)	(0.86)	(-1.85)	(-1.84)	(-1.92)	(0.04)	(0.05)	(-0.01)	(-0.25)	(-0.24)	(-0.33)
CEO Turnover	**0.08	**0.08	**0.08	0.03	0.03	0.03	-0.05	-0.05	-0.05	-0.04	-0.04	-0.04
	(2.11)	(2.10)	(2.11)	(0.26)	(0.25)	(0.25)	(-1.06)	(-1.07)	(-1.07)	(-0.35)	(-0.35)	(-0.35)
Duality	*0.07	*0.07	*0.07	0.11	0.11	0.12	-0.08	-0.08	-0.07	-0.03	-0.03	-0.02
	(1.80)	(1.80)	(1.89)	(1.00)	(1.00)	(1.05)	(-1.58)	(-1.58)	(-1.54)	(-0.26)	(-0.26)	(-0.20)
Capital Intensity	0.44	0.41	0.40	***-2.96	***-3.08	***-3.10	0.14	0.08	0.08	-0.15	-0.18	-0.20
	(1.25)	(1.15)	(1.13)	(-2.74)	(-2.84)	(-2.86)	(0.29)	(0.18)	(0.16)	(-0.14)	(-0.17)	(-0.19)

Table 2.8 (Continued)

Dependent Variable	**Innovation Input**						**Innovation Outcome**					
	Make Strategy (R&D)			**Buy Strategy (TA)**			**Patent**			**Citation**		
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**	**Model 4A**	**Model 4B**	**Model 4C**
ROE	0.0003	0.0002	0.00004	0.002	0.002	0.002	-0.007	-0.01	*-0.01	-0.02	-0.02	-0.02
	(0.10)	(0.08)	(0.01)	(0.26)	(0.24)	(0.19)	(-1.61)	(-1.64)	(-1.67)	(-1.49)	(-1.49)	(-1.54)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-1.55	***-1.50	***-1.47	***-8.78	***-8.58	***-8.52	***-1.84	***-1.75	***-1.73	***-4.04	***-3.98	***-3.92
	(-4.98)	(-4.77)	(-4.68)	(-9.28)	(-9.00)	(-8.95)	(-4.58)	(-4.32)	(-4.28)	(-4.30)	(-4.20)	(-4.14)
No. of observations	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.21	0.21	0.22	0.35	0.35	0.35	0.19	0.19	0.19	0.16	0.16	0.17

The table presents the results from OLS regression on the association between CFO Power, Financial Slack and Innovation Performance as measured by innovation input (R&D or 'make' strategy - model 1A, 1B, 1C and Technology Acquisition or 'buy' strategy – model 2A, 2B, 2C), innovation outcome (patent - model 3A, 3B, 3C and citation – model 4A, 4B, 4C). In model 1A, 2A, 3A, 4A we add CFO Power, Financial Slack and all control variables. In model 1B, 2B, 3B, 4B we add CFO Power, Financial Slack, Squared Financial Variable and control variables. Model 1C, 2C, 3C, 4C we add CFO Power, Financial Slack and the interaction term between CFO

Power and Financial Slack, and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 2.9 The association between CFO power, financial slack and innovation (efficiency and input choice)

Dependent Variable	**Innovation Efficiency**						**Innovation Input Choice**		
	PatentEff			**CitationEff**					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
CFO Power	0.09	0.09	***0.09**	***0.21**	***0.21**	***0.21**	***0.04**	***0.04**	***0.04**
	(0.90)	(0.99)	(1.13)	(1.67)	(1.65)	(1.66)	(1.88)	(1.86)	(1.95)
Financial Slack	*-0.13	***-0.32	***-0.41	*-0.17	***-0.35	***-0.47	0.02	-0.02	-0.04
	(-1.91)	(-3.14)	(-3.79)	(-1.95)	(-2.58)	(-3.34)	(1.20)	(-0.99)	(-1.58)
Financial Slack^2		**0.04			*0.04			**0.01	
		(2.49)			(1.72)			(2.51)	
CFO Power X Fin. Slack			*****0.25**			*****0.35**			****0.05**
			(2.68)			(2.96)			(2.28)
CEO Power	0.08	0.07	0.06	*0.28	0.27	0.25	**0.07	**0.06	**0.06
	(0.64)	(0.54)	(0.46)	(1.65)	(1.58)	(1.49)	(2.50)	(2.34)	(2.34)

Table 2.9 (Continued)

Dependent Variable	**Innovation Efficiency**						**Innovation Input Choice**		
	PatentEff			**CitationEff**					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
Potential Slack	0.001	0.001	0.001	-0.002	-0.002	-0.001	0.0002	0.0002	0.0003
	(0.15)	(0.16)	(0.27)	(-0.51)	(-0.50)	(-0.39)	(0.21)	(0.28)	(0.33)
Absorbed Slack	-0.03	-0.03	-0.02	-0.05	-0.05	-0.03	**-0.21	**-0.19	**-0.19
	(-0.28)	(-0.30)	(-0.17)	(-0.38)	(-0.39)	(-0.25)	(-2.22)	(-2.09)	(-2.06)
ROA	0.26	0.29	0.30	***0.86	***0.88	***0.91	-0.04	-0.03	-0.03
	(1.22)	(1.33)	(1.42)	(3.08)	(3.15)	(3.25)	(-0.76)	(-0.60)	(-0.54)
Leverage	-0.03	-0.04	-0.03	-0.01	-0.02	-0.01	-0.001	-0.002	-0.001
	(-0.48)	(-0.52)	(-0.49)	(-0.15)	(-0.18)	(-0.14)	(-0.09)	(-0.16)	(-0.10)
Altman-Z	***-0.01	***-0.01	***-0.01	***-0.01	***-0.01	***-0.01	***-0.02	***-0.02	***-0.02
	(-4.32)	(-4.45)	(-4.42)	(-3.74)	(-3.83)	(-3.80)	(-8.54)	(-8.83)	(-8.86)
Board Size	***0.90	**0.83	**0.82	**1.05	**0.98	**0.97	**0.16	**0.15	**0.15
	(2.72)	(2.49)	(2.48)	(2.43)	(2.26)	(2.25)	(2.18)	(2.01)	(2.01)
Board Independence	-0.0007	-0.0001	0.0005	-0.002	-0.002	-0.001	0.0008	0.001	0.001

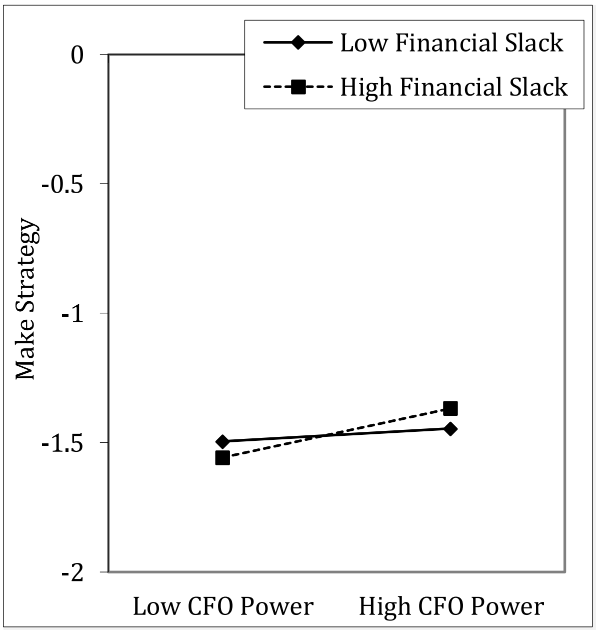
Table 2.9 (Continued)

Dependent Variable	Innovation Efficiency						Innovation Input Choice		
	PatentEff			CitationEff					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
	(-0.09)	(-0.01)	(0.07)	(-0.27)	(-0.21)	(-0.13)	(0.49)	(0.59)	(0.66)
CFO Turnover	-0.14	-0.14	-0.15	-0.17	-0.16	-0.18	0.01	0.01	0.01
	(-1.27)	(-1.26)	(-1.38)	(-1.15)	(-1.14)	(-1.27)	(0.60)	(0.61)	(0.50)
CEO Turnover	0.05	0.05	0.05	0.07	0.06	0.06	**0.07	**0.07	**0.074
	(0.43)	(0.41)	(0.41)	(0.40)	(0.39)	(0.39)	(2.44)	(2.45)	(2.48)
Duality	0.10	0.10	0.11	0.14	0.14	0.16	0.0008	0.001	0.002
	(0.77)	(0.77)	(0.86)	(0.86)	(0.86)	(0.95)	(0.03)	(0.05)	(0.09)
Capital Intensity	*-2.38	**-2.58	**-2.62	-2.66	*-2.84	*-2.90	0.38	0.35	0.34
	(-1.85)	(-2.01)	(-2.04)	(-1.59)	(-1.70)	(-1.74)	(1.35)	(1.24)	(1.20)
ROE	-0.004	-0.004	-0.005	-0.01	-0.01	-0.0	0.000003	-0.0001	-0.0003
	(-0.33)	(-0.37)	(-0.43)	(-0.77)	(-0.79)	(-0.86)	(0.00)	(-0.06)	(-0.10)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

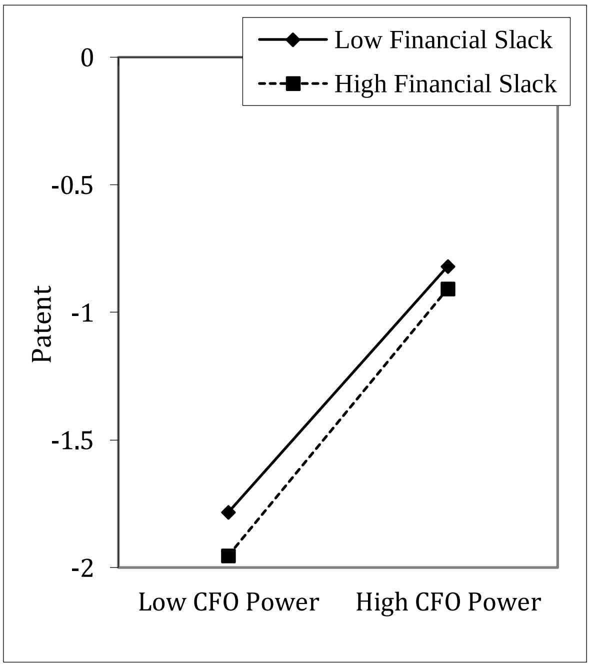
Table 2.9 (Continued)

Dependent Variable	**Innovation Efficiency**						**Innovation Input Choice**		
	PatentEff			**CitationEff**					
Model	**Model 1A**	**Model 1B**	**Model 1C**	**Model 2A**	**Model 2B**	**Model 2C**	**Model 3A**	**Model 3B**	**Model 3C**
Constant	***-12.17	***-11.83	***-11.72	***-14.37	***-14.05	***-13.91	-0.10	-0.10	-0.08
	(-10.82)	(-10.45)	(-10.38)	(-9.81)	(-9.53)	(-9.45)	(-0.60)	(-0.34)	(-0.28)
No. of observations	1656	1656	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.37	0.37	0.37	0.32	0.32	0.32	0.05	0.05	0.05

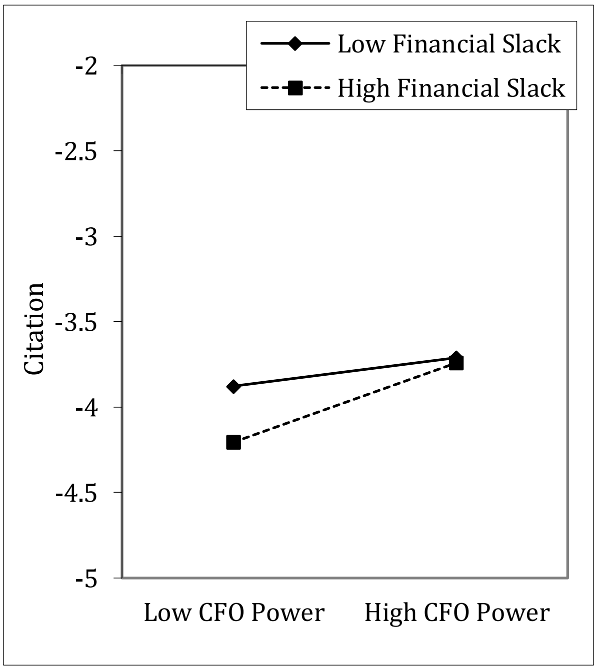
The table presents the results from OLS regression on the association between CFO Power, Financial Slack and Innovation Performance as measured by innovation efficiency (PatentEff – model 1A, 1B, 1C and CitationEff – model 2A, 2B, 2C) and innovation input choice – model 3A, 3B, 3C). In model 1A, 2A, 3A we add CFO Power, Financial Slack and all control variables. In model 1B, 2B, 3B we add CFO Power, Financial Slack, Squared Financial Variable and control variables. Model 1C, 2C, 3C we add CFO Power, Financial Slack and the interaction term between CFO Power and Financial Slack, and all control variables. t statistics (in parentheses); * $p<0.10$, ** $p<0.05$, *** $p<0.01$; All standard errors are subject to Huber/White adjustment.



(Based on Table 2.8 Model 1C)

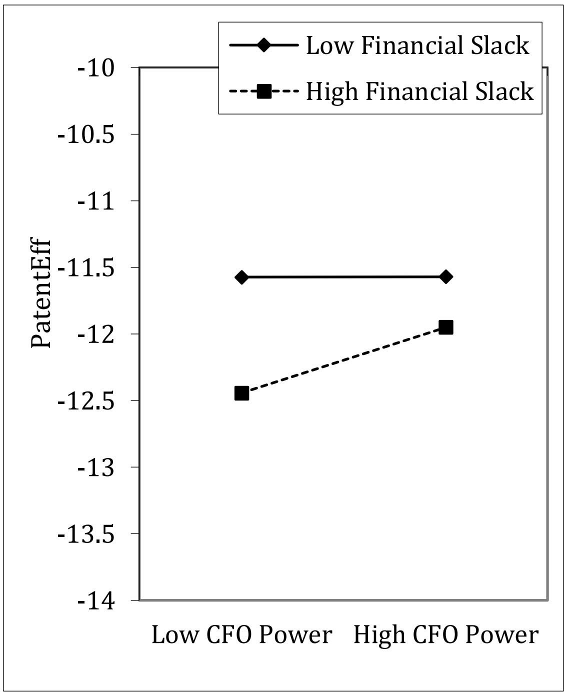


(Based on Table 2.8 Model 3C)

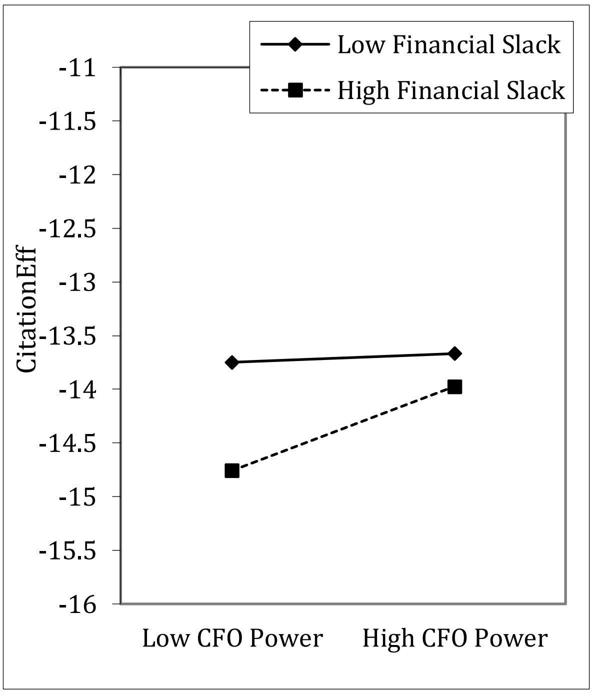


(Based on Table 2.8 Model 4C)

Figure 2-2 The interaction effects of CFO power and financial slack on innovation performance (input and outcome)

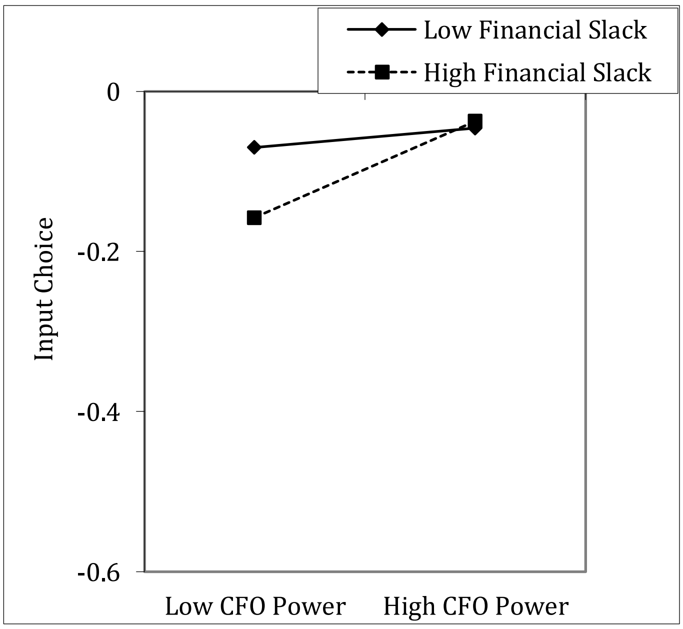


(Based on Table 2.9 Model 1C)



(Based on Table 2.9 Model 2C)

Figure 2-3 The interaction effects of CFO power and financial slack on innovation performance (efficiency)



(Based on Table 2.9 Model 3C)

Figure 2-4 The interaction effects of CFO power and financial slack on innovation input choice

Table 2.10 shows the results from the fixed-effect regression analyses with CEO Power as an interaction variable to CFO Power. The coefficient estimates for the interaction term are negative and significant for the 'Make' strategy ($\beta = -0.09; p < 0.05$) in model 1A and 'Buy' strategy ($\beta = -0.14; p < 0.10$) in model 1B for input innovation measure. These results support Hypothesis 6a. The coefficient estimates for the interaction term are negative and significant for Patent ($\beta = -0.17$; $p < 0.01$) and Citation ($\beta = -0.38$; $p < 0.05$) in model 2A and model 2B, respectively for the outcome measures, PatentEff ($\beta = -0.41; p < 0.05$) as in model 3A and CitationEff ($\beta = -0.62; p < 0.01$) in model 3B for the innovation efficiency measure and Choice ($\beta = -0.05; p < 0.10$) in model 4A for the Innovation Input Choice. These results offer support to Hypothesis 6b, 6c and 6d, respectively. Figures 2-5, 2-6 and 2-7, demonstrate that high levels of CEO Power decrease innovation performance at high levels of CFO Power. Hence, CEO Power interacts with CFO Power on innovation performance as measured by input, outcome, efficiency and choice.

Table 2.10 The association between CFO power, CEO power and innovation (input, outcome, efficiency, input choice)

Dependent Variable	Innovation Input		Innovation Outcome		Innovation Efficiency		Innovation Input Choice
	Make Strategy (R&D)	Buy Strategy (TA)	Patent	Citation	PatentEff	CitationEff	
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**
CFO Power	*****0.12**	-0.02	*****0.18**	*****0.41**	****0.29**	*****0.51**	****0.06**
	(3.48)	(-0.22)	(3.98)	(3.72)	(2.20)	(2.98)	(2.22)
CEO Power	0.02	0.12	0.07	***0.34	*0.23	***0.49	***0.09
	(0.63)	(1.05)	(1.46)	(2.82)	(1.58)	(2.63)	(2.82)
CFO Power X CEO Power	****-0.09**	***-0.14**	*****-0.17**	****-0.38**	****-0.41**	*****-0.62**	***-0.05**
	(-1.98)	(-1.94)	(-2.77)	(-2.53)	(-2.33)	(-2.65)	(-1.24)
Potential Slack	0.001	0.0004	-0.001	-0.004	0.0002	-0.003	0.0002
	(0.78)	(0.14)	(-0.78)	(-1.37)	(0.05)	(-0.62)	(0.19)
Absorbed Slack	-0.01	-0.001	-0.007	-0.02	-0.02	-0.04	**-0.19
	(-0.65)	(-0.02)	(-0.22)	(-0.34)	(-0.27)	(-0.37)	(-2.05)
ROA	**-0.12	-0.13	***0.49	***1.07	0.23	***0.81	-0.05
	(-2.05)	(-0.75)	(6.43)	(6.02)	(1.10)	(2.93)	(-0.74)

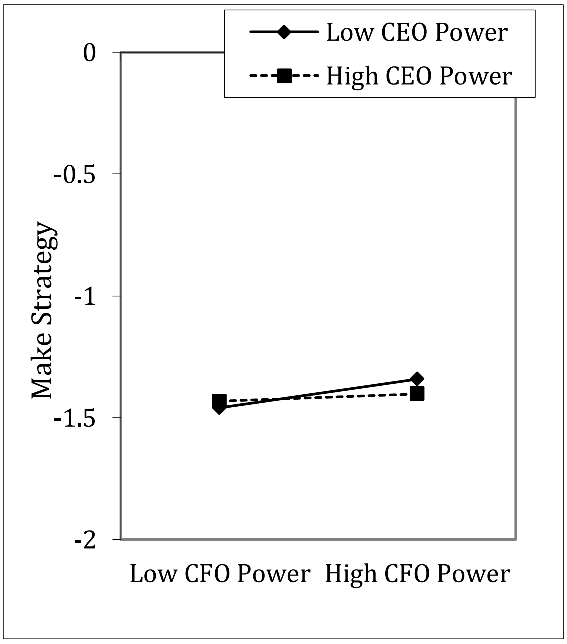
Table 2.10 (Continued)

Dependent Variable	Innovation Input		Innovation Outcome		Innovation Efficiency		Innovation Input Choice
	Make Strategy (R&D)	Buy Strategy (TA)	Patent	Citation	PatentEff	CitationEff	
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**
Leverage	-0.01	-0.04	0.01	0.02	-0.04	-0.02	-0.002
	(-0.43)	(-0.79)	(0.53)	(0.49)	(-0.60)	(-0.29)	(-0.16)
Altman-Z	*-0.001	***-0.01	***-0.004	**-0.01	***-0.01	***-0.01	***-0.02
	(-1.96)	(-3.03)	(-3.79)	(-2.32)	(-4.45)	(-3.87)	(-8.42)
Board Size	***0.38	0.401	0.15	0.31	***0.94	**1.09	**0.16
	(4.16)	(1.44)	(1.33)	(1.14)	(2.84)	(2.55)	(2.19)
Board Independence	0.001	-0.002	0.001	-0.001	-0.001	-0.003	0.001
	(0.63)	(-0.42)	(0.18)	(-0.24)	(-0.11)	(-0.29)	(0.57)
CFO Turnover	0.02	*-0.179	-0.001	-0.03	-0.15	-0.18	0.01
	(0.89)	(-1.85)	(-0.05)	(-0.32)	(-1.33)	(-1.22)	(0.52)
CEO Turnover	**0.07	0.03	-0.05	-0.03	0.06	0.07	**0.07
	(2.07)	(0.31)	(-1.04)	(-0.32)	(0.47)	(0.44)	(2.41)

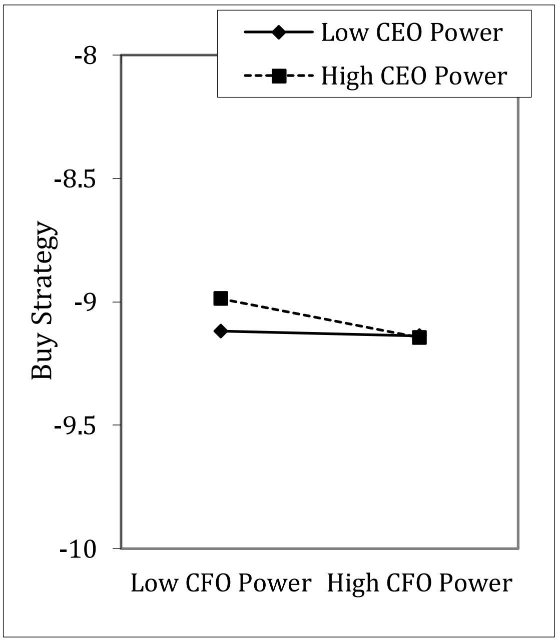
Table 2.10 (Continued)

Dependent Variable	**Innovation Input**		**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**
	Make Strategy (R&D)	**Buy Strategy (TA)**	**Patent**	**Citation**	**PatentEff**	**CitationEff**	
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**
Duality	*0.06	0.12	-0.07	-0.03	0.10	0.14	-0.001
	(1.70)	(1.04)	(-1.63)	(-0.30)	(0.77)	(0.85)	(-0.04)
Capital Intensity	0.36	**-2.749	0.13	-0.128	*-2.25	-2.51	0.34
	(1.02)	(-2.55)	(0.29)	(-0.12)	(-1.76)	(-1.51)	(1.20)
ROE	0.001	0.002	-0.01	-0.01	-0.003	-0.01	0.0001
	(0.21)	(0.26)	(-1.51)	(-1.40)	(-0.26)	(-0.68)	(0.02)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-1.45	***-9.12	***-1.88	***-4.16	***-12.47	***-14.75	-0.12
	(-4.74)	(-9.77)	(-4.75)	(-4.50)	(-11.24)	(-10.22)	(-0.43)
No. of observations	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.11	0.26	0.19	0.16	0.37	0.32	0.16

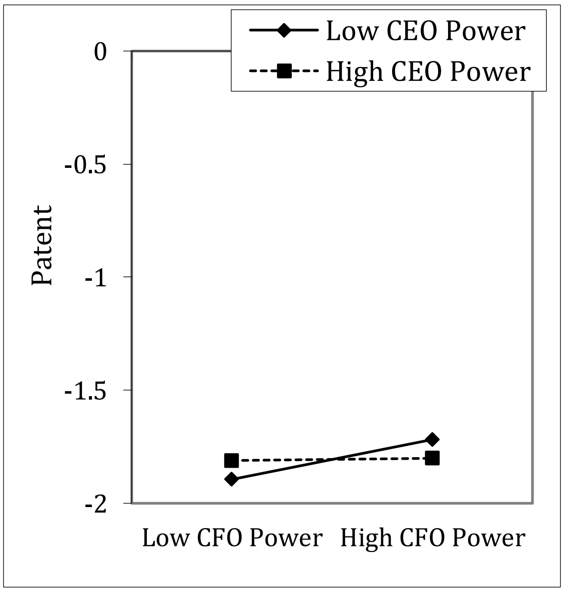
The table presents the results from OLS regression on the association between CFO Power, CEO Power and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1A and technology acquisition or 'buy' strategy – model 1B), innovation outcome (Patent – model 2A and Citation – model 2B), innovation efficiency (PatentEff – model 3A and CitationEff – model 3B) and innovation input choice – model 4A). t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.



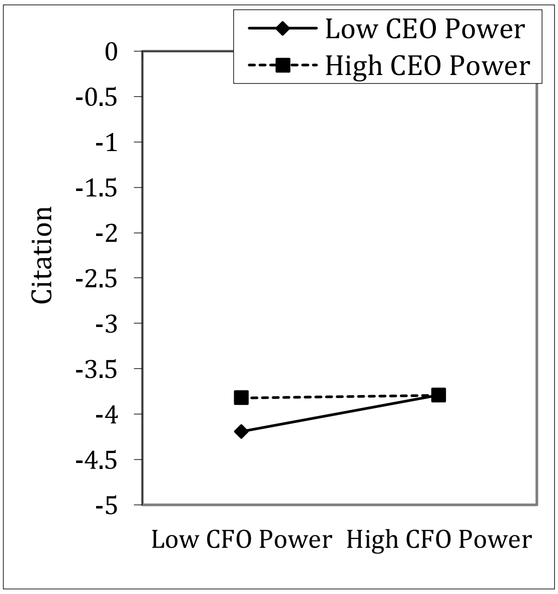
(Based on Table 2.10 Model 1A)



(Based on Table 2.10 Model 1B)

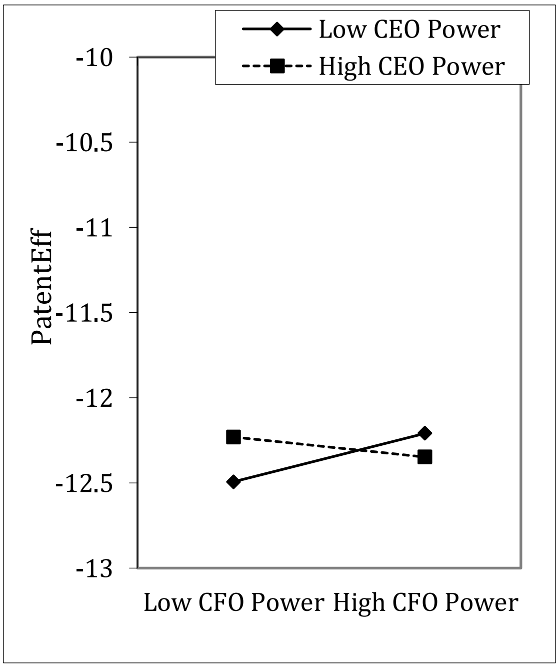


(Based on Table 2.10 Model 2A)

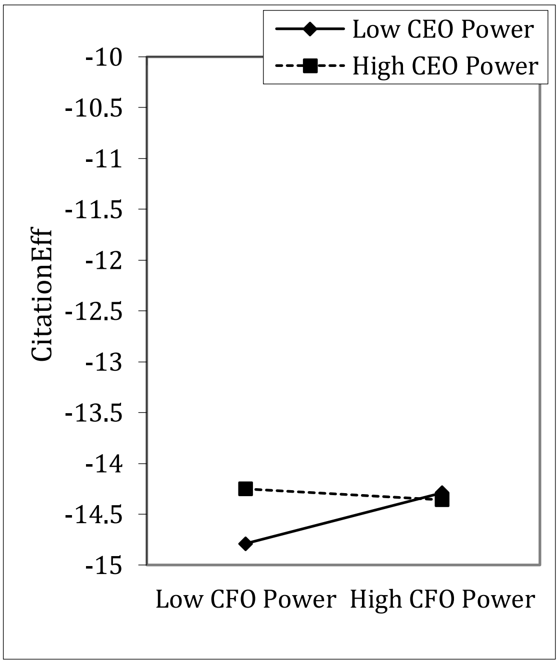


(Based on Table 2.10 Model 2B)

Figure 2-5 The interaction effects of CFO power and CEO power on innovation performance (input and outcome)

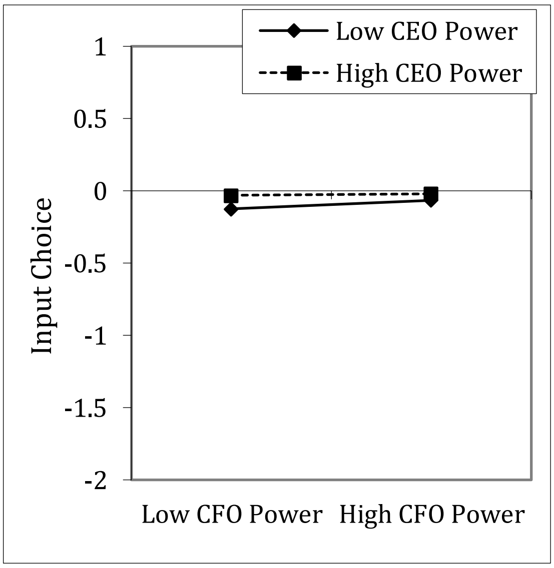


(Based on Table 2.10 Model 3A)



(Based on Table 2.10 Model 3B)

Figure 2-6 The interaction effects of CFO power and CEO power on innovation performance (efficiency)



(Based on Table 2.10 Model 4A)

Figure 2-7 The interaction effects of CFO power and CEO power on innovation input choice

Discussion

This paper investigates the power of CFO to impact innovation performance in the U.S high-technology industry. Thus, it addresses how CFO assertiveness is associated with input strategy, outcome, efficiency and strategic innovation choice at the firm level. In line with expectations from the upper echelon theory and power literature, the findings indicate that CFO power is associated with the CFO's commitment towards innovation performance. A powerful CFO is likely to commit to higher R&D expenditure, produce more patents and citations, yield higher outcomes per unit of input expenditure and prefer an internal growth strategy over acquiring external technologies. These findings resonate with the research on the role of powerful TMTs on innovation performance at the firm level (Garms and Engelen, 2019).

The ability of high-technology firms to innovate is key for their ability to survive and thrive at the cutting edge of technology (Jelinek and Schoonhoven, 1993). Accordingly, an uninterrupted flow of R&D expenditure is key as it allows for in-house R&D activity (the 'Make' strategy) and the acquisition of external technologies to outmanoeuvre competitors (the 'Buy' strategy) in aiming to render the technologies of other firms obsolete (Tushman and Anderson, 1986). Clearly, the tasks of managing the financing of R&D, acquiring external technologies and maintaining a healthy degree of financial slack require the expertise of a notably experienced and capable CFO (Chen et al., 2013; Henman, 2021), and the more assertive the CFO is, the more capable they may be in influencing these strategic decisions. The findings indicate that a powerful CFO will invest in an internal growth strategy by "putting their money where their mouth is" to demonstrate commitment to investing in internal R&D activities (Barker and Mueller, 2002).

Furthermore, the ability of the CFO to choose among competing innovation strategies and their ability to influence TMT peers and middle managers are measured by the outcome and their efficiency in utilising capital. A successful CFO is someone who can produce greater outcomes with the least input resources, thereby creating value for the firm from R&D activity (Mawhinney, 2007). For example, an assertive CFO would be able to effectively choose or balance between investing in internal R&D activities by pursuing a 'Make' strategy or acquiring external technologies by pursuing a 'Buy' strategy and would yield the highest number of patents and citations as a result. Our findings demonstrate that both the number and efficiency of patents and citations produced are higher when a CFO is powerful. Furthermore, the CFO is more likely to be able to influence their TMT peers and managers to pursue a 'Make' strategy over a 'Buy' strategy for example using their expert analysis, effectively changing course as necessary within financial boundaries and controlling cost deviations efficiently during the implementation stage (Zorn, 2004).

A lack of financial slack can curtail an assertive CFO from pursuing an ambitious innovation programme (Florackis and Sainani, 2018). It can also reduce a firm's scope for undertaking risky projects, such as acquiring external technologies and can render it less agile in adapting to shifting external environments. The findings indicate that a powerful CFO would be able to pursue both 'Make' and 'Buy' strategies, resulting in greater efficiency in patents and citations outcomes when financial slack is high. The results also suggest that an assertive CFO would prefer to invest in an internal innovation strategy (rather than a 'Buy' strategy) when financial slack levels are high.

The CFO is usually one of the two most influential figures within a TMT, but ultimately the 'buck stops with the CEO' as they assume the overall responsibility for the successes and failures of the firm. Hence, the balance of power between the CFO and CEO should be ideal to ensure that the firm meets its innovation agendas. In contrast, a dysfunctional power balance could lead to struggles between them. This is likely to result in poor or even wrong decisions being made (Camelo-Ordaz et al., 2015). The findings indicate that when the power of both the CFO and CEO is high, the firm will invest less in both internal ('Make') and external ('Buy') innovation strategies. Unsurprisingly, there were fewer patents and citations produced and the efficiency in patents and citations declined when both CFO and CEO are powerful. In addition, there was a preference to 'Buy' rather than 'Make' when both individuals exhibited high assertiveness.

Finally, a multidimensional analysis of CFO power, by demarcating it into structural power and expert power (Daily and Johnson, 1997; Finkelstein, 1992) revealed that each type plays an important role in pursuing 'Make' and 'Buy' strategies, respectively. The findings show that structural power is necessary to ensure the CFO pursues an internal 'Make' innovation strategy, produce higher patent and citation efficiency. The results also suggest structural power tends to lean towards 'Make' over 'Buy' strategies.

A CFO deeply rooted in the TMT who can, directly and indirectly, influence the TMT strategic decision making and is committed to a 'Make' strategy is crucial to the success of the internal innovation strategy. Expert power is more relevant to a 'Buy' strategy, as it involves the informed purchase of external technologies. A CFO with specific expertise, a finance track record including investment appraisal, and a wide external network of key specialist individuals is more likely to effectively evaluate technology cost-effectiveness and potential for the highest possible returns.

2.4.3 Additional analysis

Robustness check and endogeneity test

The regression analyses were repeated with the number of the firms' employees to control for potential resource scale and market power effects on innovation performance (Boone et al., 2018). In order to avoid multicollinearity with other firm size proxy, the study drop the Board Size variable. Table 2.11 reports the robustness results for *CFO Power* and the interaction term for *CFO Power* and *Financial Slack* and *CFO Power* and the interaction term between *CFO Power* and *CEO Power* on innovation input strategies, outcomes, efficiency, and input choice from Models 1A to 7A and 1B to 7B, respectively. The results confirm the robustness of our main results.

Table 2.11 The association between CFO power, financial slack, CEO power and innovation performance (robustness – add no. of employees)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation Input Choice**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**			
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
CFO Power	***0.07**	***0.12**	-0.07	-0.02	***0.10**	***0.18**	***0.24**	***0.41**	*0.09**	**0.29**	*0.23**	***0.51**	**0.04**	**0.06**
	(2.82)	(3.47)	(-0.99)	(-0.18)	(2.88)	(3.93)	(2.97)	(3.70)	(1.78)	(2.20)	(1.87)	(2.99)	(2.26)	(2.22)
Financial Slack	-0.005		***-0.22		-0.04		*-0.13		***-0.27		***-0.36		-0.002	
	(-0.26)		(-3.29)		(-1.37)		(-1.96)		(-3.33)		(-3.44)		(-0.11)	
CFO Power X Fin. Slack	***0.07**		**0.14**		*0.05**		**0.16**		***0.27**		***0.38**		***0.05**	
	(3.03)		(1.97)		(1.74)		(2.12)		(3.11)		(3.28)		(2.71)	
CEO Power		0.02		0.14		0.06		***0.33		0.23		***0.50		***0.09

Table 2.11 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation Input Choice**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**			
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
		(0.58)		(1.19)		(1.22)		(2.74)		(1.59)		(2.65)		(2.76)
CFO Pow. X CEO Power		***-0.09**		***-0.14**		*****-0.17**		****-0.37**		****-0.42**		*****-0.62**		***-0.04**
		(-1.96)		(-1.99)		(-2.70)		(-2.50)		(-2.33)		(-2.66)		(-1.23)
Employees	0.001	0.001	**-0.006	**-0.006	***0.004	***0.004	0.003	0.003	-0.001	-0.001	-0.001	-0.001	0.001	0.001
	(1.21)	(0.90)	(-2.46)	(-2.28)	(4.04)	(4.02)	(1.41)	(1.31)	(-0.29)	(-0.24)	(-0.42)	(-0.44)	(1.50)	(1.12)
Potential Slack	0.001	0.001	0.001	0.0005	-0.0008	-0.001	-0.003	-0.004	0.001	0.0002	-0.001	-0.003	0.0003	0.0001
	(0.98)	(0.78)	(0.29)	(0.16)	(-0.63)	(-0.82)	(-1.15)	(-1.38)	(0.29)	(0.06)	(-0.35)	(-0.62)	(0.28)	(0.18)
Absorbed Slack	-0.01	-0.01	0.005	-0.001	-0.01	-0.01	-0.02	-0.02	-0.01	-0.02	-0.02	-0.04	**-0.19	**-0.18

Table 2.11 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation Input Choice**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**			
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
	(-0.53)	(-0.66)	(0.07)	(-0.01)	(-0.15)	(-0.22)	(-0.25)	(-0.34)	(-0.14)	(-0.27)	(-0.22)	(-0.37)	(-2.12)	(-2.03)
ROA	*-0.10	**-0.12	-0.12	-0.14	***0.51	***0.49	***1.10	***1.08	0.28	0.23	***0.86	***0.81	-0.04	-0.04
	(-1.81)	(-2.04)	(-0.69)	(-0.78)	(6.73)	(6.51)	(6.15)	(6.04)	(1.32)	(1.09)	(3.12)	(2.93)	(-0.74)	(-0.73)
Leverage	-0.005	-0.008	-0.03	-0.04	0.01	0.01	0.04	0.02	-0.030	-0.041	-0.006	-0.02	-0.0003	-0.002
	(-0.30)	(-0.45)	(-0.67)	(-0.74)	(0.61)	(0.44)	(0.67)	(0.46)	(-0.43)	(-0.59)	(-0.07)	(-0.28)	(-0.02)	(-0.18)
Altman-Z	**-0.002	*-0.001	***-0.009	***-0.009	***-0.004	***-0.004	**-0.01	**-0.01	***-0.01	***-0.01	***-0.017	***-0.01	***-0.01	***-0.01
	(-2.06)	(-1.84)	(-3.07)	(-3.28)	(-3.34)	(-3.31)	(-2.16)	(-2.15)	(-4.34)	(-4.45)	(-3.80)	(-3.89)	(-8.52)	(-8.12)
Board Independence	0.001	0.001	-0.001	-0.002	0.001	0.001	-0.001	-0.001	0.0001	-0.001	-0.001	-0.003	0.001	0.001
	(0.64)	(0.63)	(-0.28)	(-0.42)	(0.20)	(0.18)	(-0.19)	(-0.24)	(0.01)	(-0.11)	(-0.17)	(-0.29)	(0.57)	(0.58)

Table 2.11 (Continued)

Dependent Variable	Innovation Input				Innovation Outcome				Innovation Efficiency				Innovation Input Choice	
	Make Strategy (R&D)		Buy Strategy (TA)		Patent		Citation		PatentEff		CitationEff			
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
CFO Turnover	0.02	0.02	*-0.18	*-0.17	-0.003	-0.004	-0.03	-0.03	-0.15	-0.15	-0.18	-0.18	0.01	0.012
	(0.82)	(0.87)	(-1.88)	(-1.82)	(-0.10)	(-0.11)	(-0.32)	(-0.34)	(-1.39)	(-1.33)	(-1.25)	(-1.21)	(0.50)	(0.50)
CEO Turnover	**0.08	**0.08	0.006	0.02	-0.04	-0.04	-0.05	-0.03	0.04	0.06	0.03	0.07	**0.06	**0.074
	(2.23)	(2.11)	(0.06)	(0.21)	(-0.87)	(-0.87)	(-0.46)	(-0.27)	(0.36)	(0.46)	(0.21)	(0.42)	(2.30)	(2.45)
Duality	*0.06	*0.06	0.12	0.11	-0.07	-0.08	0.0001	-0.03	0.12	0.10	0.19	0.14	0.01	-0.001
	(1.86)	(1.70)	(1.13)	(1.02)	(-1.50)	(-1.60)	(0.00)	(-0.29)	(0.93)	(0.76)	(1.12)	(0.84)	(0.37)	(-0.06)
Capital Intensity	0.44	0.37	***-3.17	***-2.85	0.22	0.21	-0.16	-0.06	*-2.50	*-2.26	*-2.88	-2.54	0.38	0.35
	(1.26)	(1.06)	(-2.94)	(-2.65)	(0.48)	(0.47)	(-0.15)	(-0.06)	(-1.96)	(-1.77)	(-1.73)	(-1.53)	(1.35)	(1.26)
ROE	0.0001	0.001	0.002	0.002	*-0.01	-0.01	-0.01	-0.01	-0.005	-0.003	-0.01	-0.01	-0.0001	0.0001
	(0.02)	(0.21)	(0.20)	(0.26)	(-1.67)	(-1.52)	(-1.55)	(-1.40)	(-0.42)	(-0.26)	(-0.86)	(-0.68)	(-0.05)	(0.02)

Table 2.11 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation Input Choice**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**			
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-1.39	***-1.36	***-9.32	***-9.83	***-1.30	***-1.35	***-3.39	***-3.76	***-12.03	***-12.56	***-14.12	***-14.96	0.006	-0.03
	(-4.30)	(-4.22)	(-9.47)	(-10.00)	(-3.13)	(-3.27)	(-3.47)	(-3.86)	(-10.27)	(-10.75)	(-9.25)	(-9.84)	(0.02)	(-0.10)
No. of observations	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.11	0.11	0.27	0.26	0.10	0.10	0.05	0.06	0.37	0.37	0.32	0.32	0.05	0.05

In Table 2.11 we add new variable, namely the number of firms' employees to check the consistency with the main results. In order to avoid multicollinearity with other firm size proxy, the study drop the Board Size variable. The table presents the results from OLS regression on the association between CFO Power, Financial Slack, CEO Power and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1A, 1B and technology acquisition or 'buy' strategy – model 2A, 2B), innovation outcome (Patent – model 3A, 3B and Citation – model 4A, 4B), innovation efficiency (PatentEff – model 5A, 5B and CitationEff – model 6A, 6B) and innovation input choice – model 7A). In model 1A, 2A, 3A, 4A, 5A, 6A, 7A we add CFO Power, Financial Slack, interaction term between CFO Power and Financial Slack and all control variables. In model 1B, 2B, 3B, 4B, 5B, 6B, 7B we add CFO power, CEO Power, interaction term between CFO Power and CEO Power and all control variables. t statistics (in parentheses); * $p<0.10$, ** $p<0.05$, *** $p<0.01$; All standard errors are subject to Huber/White adjustment.

Several approaches were employed to mitigate potential endogeneity problems. First, an extensive set of control variables were included in the regression analyses (Nguyen, 2018). Second, it has been shown that a fixed-effect panel data structure itself in a regression model can help correct any endogeneity problems (Wooldridge, 2016). Therefore, the inclusion of firm and year-fixed effects in the panel data regression model would have captured any unobserved firm and time-specific effects arising from omitted variables, especially when unobservable variables are correlated with CFO power and innovation performance measures that are constant over time (Ebbes et al., 2017; Nguyen, 2018).

To address endogeneity concern, two-stage instrumental variable approach fixed-effect regression analyses were carried out, by employing instrumental variables to test for endogeneity (Campbell and Minguez-Vera, 2008). These include the lag of CFO power (independent) and lag of financial slack variables. The use of lag variables is to avoid simultaneity (Reed, 2015).

Subsequently, the study proceeds with endogeneity test for the main independent variables, and underidentification and over-identifications test for the instrumental variables. The endogeneity test results show p-value = 0.068. Since it is more than a 5% level of significance, therefore, the study is unable to reject the null hypothesis that the variable is exogeneous, implying the dataset has endogeneity issue. Next, we examine for underidentification test for our instrumental variables. Result for Kleibergen-Paap rk LM test is p-value = 0.000. It denotes less than a 5% level of significance. Therefore, the study is able to reject the null hypothesis for underidentification. This implies that the instrumental variables are not weak. Subsequently, the study performs overidentification test for the instrumental variables. The Hansen J statistics presents p-value = 0.497, which is greater than a 5% level of significance. Hence, the research is unable to reject the null hypothesis for overidentification. This result suggests that the instrumental variables are valid.

Table 2.12 shows the results of CFO Power and Financial Slack on input and outcomes and Table 2.13 on efficiency and choice. Table 2.14 shows the results of CFO and CEO Power on innovation performance. The results of the two-stage instrumental variable fixed-effect regression analysis suggest that they are fairly robust to endogeneity.

Table 2.12 The association between CFO power, financial slack and innovation (input, outcome) from 2SLS fixed-effect regression

Dependent Variable	**Innovation Input**				**Innovation Outcome**			
	Make Strategy (R&D		**Buy Strategy (TA)**		**Patent**		**Citation**	
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**
CFO Power	*****0.07**	*****0.10**	-0.09	-0.03	*****0.10**	****0.13**	*****0.22**	***0.17**
	(2.86)	(2.61)	(-1.11)	(-0.25)	(2.87)	(2.20)	(2.76)	(1.40)
Financial Slack	-0.02	-0.11	***-0.29	***-0.55	**-0.09	-0.08	*-0.14	**-0.46
	(-0.86)	(-1.50)	(-3.23)	(-3.50)	(-2.32)	(-1.34)	(-1.66)	(-2.47)
CFO Power X Fin. Slack	*****0.07**	*****0.15**	***0.13**	*****0.38**	***0.04**	***0.06**	***0.14**	****0.32**
	(2.78)	(3.12)	(1.73)	(3.26)	(1.26)	(1.43)	(1.94)	(2.34)
Potential Slack	-0.01	0.0009	0.07	0.0009	0.006	-0.0006	*0.19	-0.003
	(-0.49)	(1.56)	(0.65)	(0.51)	(0.14)	(-0.69)	(1.83)	(-1.27)
CEO Power	0.001	-0.02	0.0007	0.07	-0.0008	-0.03	-0.003	0.06
	(1.00)	(-0.80)	(0.24)	(0.57)	(-0.60)	(-0.83)	(-1.18)	(0.60)
Absorbed Slack	-0.01	-0.006	0.003	-0.02	-0.006	0.01	-0.02	0.03
	(-0.54)	(-0.41)	(0.04)	(-0.41)	(-0.18)	(0.81)	(-0.26)	(0.81)

Table 2.12 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**			
	Make Strategy (R&D		**Buy Strategy (TA)**		**Patent**		**Citation**	
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**
ROA	*-0.10	-0.11	-0.10	-0.22	***0.51	***0.53	***1.11	***1.20
	(-1.82)	(-1.19)	(-0.57)	(-0.78)	(6.68)	(3.45)	(6.23)	(3.68)
Leverage	-0.005	-0.007	-0.04	-0.05	0.01	0.008	0.03	0.02
	(-0.28)	(-0.68)	(-0.77)	(-0.97)	(0.67)	(0.64)	(0.65)	(0.96)
Altman-Z	**-0.002	-0.001	***-0.008	***-0.006	***-0.004	***-0.004	**-0.006	***-0.006
	(-2.25)	(-1.13)	(-2.87)	(-2.99)	(-3.85)	(-4.99)	(-2.28)	(-3.25)
Board Size	***0.37	*0.21	0.32	0.25	0.12	0.02	0.27	0.04
	(4.04)	(1.65)	(1.16)	(0.70)	(1.07)	(0.21)	(1.00)	(0.15)
Board Independence	0.001	0.001	-0.001	-0.001	0.0007	0.0004	-0.001	0.0006
	(0.67)	(0.80)	(-0.25)	(-0.43)	(0.26)	(0.30)	(-0.17)	(0.20)
CFO Turnover	0.02	0.04	*-0.18	*-0.20	-0.0002	0.04	-0.03	0.01
	(0.86)	(1.50)	(-1.92)	(-1.88)	(-0.01)	(0.89)	(-0.33)	(0.13)

Table 2.12 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**			
	Make Strategy (R&D		**Buy Strategy (TA)**		**Patent**		**Citation**	
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**
CEO Turnover	**0.08	0.05	0.03	-0.01	-0.05	-0.03	-0.04	0.03
	(2.11)	(1.18)	(0.25)	(-0.10)	(-1.07)	(-0.77)	(-0.35)	(0.31)
Duality	*0.06	0.01	0.12	0.13	-0.07	-0.05	-0.02	0.008
	(1.89)	(0.29)	(1.05)	(0.95)	(-1.54)	(-1.08)	(-0.20)	(0.06)
Capital Intensity	0.40	**0.69	***-3.09	**-2.37	0.07	0.33	-0.20	-0.35
	(1.13)	(2.14)	(-2.86)	(-1.97)	(0.16)	(0.84)	(-0.19)	(-0.33)
ROE	0.00004	-0.0008	0.002	0.004	*-0.007	-0.007	-0.01	-0.01
	(0.01)	(-0.28)	(0.19)	(0.44)	(-1.67)	(-1.36)	(-1.54)	(-1.47)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-1.46		***-8.52		***-1.73		***-3.91	
	(-4.68)		(-8.95)		(-4.28)		(-4.14)	

Table 2.12 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**			
	Make Strategy (R&D		**Buy Strategy (TA)**		**Patent**		**Citation**	
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**
No. of observations	1656	1490	1656	1490	1656	1490	1656	1490
Adjusted R^2	0.22	0.26	0.35	0.22	0.20	0.19	0.17	0.15

The table presents the results from OLS (as in model 1A, 2A, 3A, 4A) and 2SLS (as in model 1B, 2B, 3B, 4B) regression on the association between CFO Power, Financial Slack and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1A, 1B and technology acquisition or 'buy' strategy – model 2A, 2B) and innovation outcome (Patent – model 3A, 3B and Citation – model 4A, 4B). t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 2.13 The association between CFO power, financial slack and innovation (efficiency and input choice) from 2SLS fixed-effect regression

Dependent Variable	**Innovation Efficiency**				**Innovation Input Choice**	
	PatentEff		**CitationEff**			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**
CFO Power	***0.09**	***0.19**	***0.20**	***0.23**	***0.04**	****0.05**
	(1.13)	(1.27)	(1.66)	(1.19)	(1.95)	(1.96)
Financial Slack	***-0.40	***-0.74	***-0.46	***-1.13	-0.03	0.006
	(-3.79)	(-3.77)	(-3.34)	(-3.71)	(-1.58)	(0.11)
CFO Power X Financial Slack	*****0.24**	*****0.60**	*****0.35**	*****0.86**	****0.04**	***0.06**
	(2.68)	(3.91)	(2.96)	(3.70)	(2.28)	(1.84)
Potential Slack	0.05	0.001	0.25	-0.001	**0.06	0.00001
	(0.46)	(0.60)	(1.49)	(-0.35)	(2.34)	(0.02)
CEO Power	0.001	0.01	-0.001	0.11	0.0003	**0.07
	(0.27)	(0.08)	(-0.39)	(0.64)	(0.33)	(2.57)
Absorbed Slack	-0.01	-0.01	-0.03	0.007	**-0.19	-0.08
	(-0.17)	(-0.16)	(-0.25)	(0.09)	(-2.06)	(-0.32)

Table 2.13 (Continued)

Dependent Variable	**Innovation Efficiency**				**Innovation Input Choice**	
	PatentEff		**CitationEff**			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**
ROA	0.30	0.20	***0.90	*0.87	-0.03	-0.06
	(1.42)	(0.59)	(3.25)	(1.82)	(-0.54)	(-0.54)
Leverage	-0.03	-0.05	-0.01	-0.04	-0.001	-0.00005
	(-0.49)	(-0.90)	(-0.14)	(-0.62)	(-0.10)	(-0.01)
Altman-Z	***-0.01	***-0.01	***-0.01	***-0.01	***-0.01	***-0.01
	(-4.42)	(-4.13)	(-3.80)	(-4.10)	(-8.86)	(-5.82)
Board Size	**0.82	0.48	**0.97	0.51	**0.14	0.06
	(2.48)	(1.18)	(2.25)	(0.94)	(2.01)	(0.66)
Board Independence	0.0005	0.0005	-0.001	0.0008	0.001	0.0006
	(0.07)	(0.16)	(-0.13)	(0.21)	(0.66)	(0.60)
CFO Turnover	-0.15	-0.11	-0.18	-0.14	0.01	0.02
	(-1.38)	(-0.96)	(-1.27)	(-0.94)	(0.50)	(1.13)

Table 2.13 (Continued)

Dependent Variable	**Innovation Efficiency**				**Innovation Input Choice**	
	PatentEff		**CitationEff**			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**
CEO Turnover	0.05	0.0001	0.06	0.07	**0.07	0.04
	(0.41)	(0.00)	(0.39)	(0.42)	(2.48)	(1.33)
Duality	0.11	0.08	0.16	0.15	0.002	-0.03
	(0.86)	(0.49)	(0.95)	(0.66)	(0.09)	(-1.29)
Capital Intensity	**-2.62	-1.34	*-2.90	-2.03	0.34	***0.58
	(-2.04)	(-0.95)	(-1.74)	(-1.10)	(1.20)	(2.63)
ROE	-0.005	-0.003	-0.01	-0.01	-0.0003	0.0008
	(-0.43)	(-0.25)	(-0.86)	(-0.72)	(-0.10)	(0.19)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-11.72		***-13.91		-0.08	
	(-10.38)		(-9.45)		(-0.28)	

Table 2.13 (Continued)

Dependent Variable	**Innovation Efficiency**				**Innovation Input Choice**	
	PatentEff		**CitationEff**			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**
No. of observations	1656	1490	1656	1490	1656	1490
Adjusted R^2	0.37	0.35	0.32	0.30	0.05	0.08

The table presents the results from OLS (as in model 1A, 2A, 3A) and 2SLS (as in model 1B, 2B, 3B) regression on the association between CFO Power, Financial Slack and Innovation Performance as measured by innovation efficiency (PatentEff – model 1A, 1B and CitationEff – model 2A, 2B), innovation input choice (model 3A, 3B). t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 2.14 The association between CFO power, CEO power and innovation performance from 2SLS fixed-effect regression

Dependent Variable	Innovation Input				Innovation Outcome				Innovation Efficiency				Innovation Input Choice	
	Make Strategy (R&D)		Buy Strategy (TA)		Patent		Citation		PatentEff		CitationEff			
Model	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
	Model 1A	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
CFO Power	*****0.12**	****0.09**	-0.02	0.03	*****0.18**	*****0.19**	*****0.41**	*****0.40**	****0.29**	****0.31**	*****0.51**	*****0.53**	****0.06**	***0.06**
	(3.48)	(2.46)	(-0.22)	(0.23)	(3.98)	(3.40)	(3.72)	(3.14)	(2.20)	(2.14)	(2.98)	(2.71)	(2.22)	(1.94)
CEO Power	0.02	0.01	0.12	0.22	0.07	0.08	***0.34	0.20	*0.23	0.32	***0.49	0.441	***0.09	***0.16
	(0.63)	(0.15)	(1.05)	(0.85)	(1.46)	(0.94)	(2.82)	(0.88)	(1.58)	(1.08)	(2.63)	(1.17)	(2.82)	(2.98)
CFO Power X CEO Power	****-0.09**	***-0.05**	***-0.14**	****-0.20**	*****-0.17**	****-0.17**	****-0.38**	***-0.32**	****-0.41**	****-0.46**	*****-0.62**	****-0.60**	***-0.04**	****-0.05**
	(-1.98)	(-1.97)	(-1.94)	(-2.12)	(-2.77)	(-2.24)	(-2.53)	(-1.74)	(-2.33)	(-2.04)	(-2.65)	(-2.09)	(-1.24)	(-1.96)
Potential Slack	0.0008	0.0008	0.0004	0.001	-0.001	-0.001	-0.004	*-0.004	0.0002	0.0006	-0.003	-0.002	0.0002	-0.0001
	(0.78)	(1.23)	(0.14)	(0.74)	(-0.78)	(-1.50)	(-1.37)	(-1.81)	(0.05)	(0.40)	(-0.62)	(-0.85)	(0.19)	(-0.23)
Absorbed Slack	-0.01	-0.01	-0.001	0.03	-0.007	0.01	-0.02	0.03	-0.02	0.03	-0.04	0.05	**-0.19	-0.001

Table 2.14 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**		**Input Choice**	
Model	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
	Model 1A	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
	(-0.65)	(-0.75)	(-0.02)	(0.77)	(-0.22)	(0.61)	(-0.34)	(0.78)	(-0.27)	(0.54)	(-0.37)	(0.69)	(-2.05)	(-0.00)
ROA	**-0.12	-0.13	-0.13	-0.06	***0.493	***0.45	***1.07	***1.06	0.23	0.24	***0.81	*0.86	-0.04	-0.05
	(-2.05)	(-1.53)	(-0.75)	(-0.26)	(6.43)	(2.88)	(6.02)	(3.21)	(1.10)	(0.77)	(2.93)	(1.91)	(-0.74)	(-0.52)
Leverage	-0.008	-0.007	-0.04	-0.05	0.01	0.01	0.02	0.02	-0.04	-0.05	-0.02	-0.03	-0.002	-0.002
	(-0.43)	(-0.82)	(-0.79)	(-1.00)	(0.53)	(0.80)	(0.49)	(0.83)	(-0.60)	(-0.88)	(-0.29)	(-0.62)	(-0.16)	(-0.56)
Altman-Z	*-0.001	-0.001	***-0.008	***-0.008	***-0.004	***-0.005	**-0.006	***-0.008	***-0.01	***-0.01	***-0.01	***-0.01	***-0.01	***-0.01
	(-1.96)	(-1.38)	(-3.03)	(-3.73)	(-3.79)	(-6.32)	(-2.32)	(-4.63)	(-4.45)	(-4.64)	(-3.87)	(-4.76)	(-8.42)	(-4.88)
Board Size	***0.38	*0.19	0.40	0.30	0.15	-0.03	0.31	-0.03	***0.94	0.47	**1.09	0.47	**0.16	0.06
	(4.16)	(1.76)	(1.44)	(0.78)	(1.33)	(-0.26)	(1.14)	(-0.10)	(2.84)	(1.10)	(2.55)	(0.88)	(2.19)	(0.68)

Table 2.14 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation Input Choice**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**			
Model	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
	Model 1A	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
Board Independence	0.001	0.0005	-0.002	0.001	0.0005	-0.0002	-0.001	-0.001	-0.0009	0.001	-0.003	-0.0001	0.001	0.0004
	(0.63)	(0.34)	(-0.42)	(0.56)	(0.18)	(-0.15)	(-0.24)	(-0.55)	(-0.11)	(0.47)	(-0.29)	(-0.05)	(0.57)	(0.42)
CFO Turnover	0.02	0.04	*-0.17	-0.16	-0.001	0.02	-0.03	0.06	-0.15	-0.09	-0.18	-0.05	0.01	0.02
	(0.89)	(1.52)	(-1.85)	(-1.51)	(-0.05)	(0.49)	(-0.32)	(0.70)	(-1.33)	(-0.76)	(-1.22)	(-0.37)	(0.52)	(0.81)
CEO Turnover	**0.07	0.04	0.03	-0.002	-0.05	-0.03	-0.03	0.05	0.06	0.008	0.07	0.10	0.07**	0.04
	(2.07)	(1.15)	(0.31)	(-0.02)	(-1.04)	(-0.71)	(-0.32)	(0.47)	(0.47)	(0.06)	(0.44)	(0.55)	(2.41)	(1.39)
Duality	*0.06	-0.007	0.11	0.11	-0.07	*-0.09	-0.03	-0.03	0.10	0.01	0.14	0.07	-0.001	-0.06
	(1.70)	(-0.22)	(1.04)	(0.83)	(-1.63)	(-1.74)	(-0.30)	(-0.28)	(0.77)	(0.08)	(0.85)	(0.33)	(-0.04)	(-1.41)
Capital Intensity	0.36	***0.74	**-2.74	*-2.00	0.13	0.10	-0.12	-0.338	*-2.25	-1.15	-2.51	-1.59	0.34	***0.50

Table 2.14 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**				**Innovation Efficiency**				**Innovation Input Choice**	
	Make Strategy (R&D)		**Buy Strategy (TA)**		**Patent**		**Citation**		**PatentEff**		**CitationEff**			
Model	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
	Model 1A	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**	**Model 4B**	**Model 5A**	**Model 5B**	**Model 6A**	**Model 6B**	**Model 7A**	**Model 7B**
	(1.02)	(2.93)	(-2.55)	(-1.67)	(0.29)	(0.31)	(-0.12)	(-0.38)	(-1.76)	(-0.89)	(-1.51)	(-1.00)	(1.20)	(2.71)
ROE	0.0007	0.0007	0.002	0.001	-0.006	-0.004	-0.01	-0.01	-0.003	-0.002	-0.01	-0.009	0.0001	0.001
	(0.21)	(0.24)	(0.26)	(0.19)	(-1.51)	(-0.84)	(-1.40)	(-1.02)	(-0.26)	(-0.16)	(-0.68)	(-0.54)	(0.02)	(0.45)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	***-		***-		***-		***-		***-		***-		-0.13	
	1.45		9.12		1.88		4.16		12.47		14.75			
	(-4.74)		(-9.77)		(-4.75)		(-4.50)		(-11.24)		(-10.22)		(-0.43)	
No. of observations	1656	1490	1656	1490	1656	1490	1656	1490	1656	1490	1656	1490	1656	1490
Adjusted R^2	0.11	0.17	0.27	0.22	0.19	0.10	0.17	0.05	0.37	0.36	0.33	0.32	0.16	0.10

The table presents the results from OLS Fixed Effect (as in model 1A, 2A, 3A, 4A, 5A, 6A, 7A) and 2SLS Fixed Effect (as in model 1B, 2B, 3B, 4B, 5B, 6B, 7B) regression on the association between CFO Power, CEO Power and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1A, 1B and technology acquisition or 'buy' strategy – model 2A, 2B), innovation outcome (Patent – model 3A, 3B and Citation – model 4A, 4B)t, innovation efficiency (PatentEff – model 5A, 5B and CitationEff – model 6A, 6B) and innovation input choice (model 7A, 7B). t statistics (in parentheses); * $p<0.10$, ** $p<0.05$, *** $p<0.01$; All standard errors are subject to Huber/White adjustment.

To gain deeper insights into how CFO power is associated with innovation performance, two sources of CFO power were identified: *CFO Structural Power*, whose measure derives from the formal organisational structure denoting hierarchical authority, and *CFO Expert Power*, which measures their ability in dealing with environmental contingencies (Finkelstein, 1992) as example for CFO is the ability in overseeing financial activities of the entire firm and to influence operational and strategic decision-making in relation to financial matters including investment. Principal component factor analysis is used to construct these; they both are determined from an aggregation of *CFO Executive Director*, *Pay Status*, and *CFO-CEO Relative Pay* variables and *Outside Directors*, *Seniority,* and *Financial Expertise* variables (Florackis and Sainani, 2018; Garms and Engelen, 2019). CFOs with high structural power are perceived to have prescribed authority to exert their influence over their colleagues' actions and behaviour in managing uncertainty. Similarly, CFOs with high expert power are often individuals who have engaged contacts based on their specialism and strategically invested in relationship building with customers, suppliers, competitors or the government; they may have manipulated these networks to enhance their standing as an influencer in particular strategic decision making.

Table 2.15 shows the results for both CFO structural power and expert power on innovation input, outcome, efficiency and input choice, in Models 1A to 4A, respectively. The findings indicate that the coefficient for CFO Structural Power is positive and significant ($\beta = 0.02; p < 0.10$), ($\beta = 0.13; p < 0.10$) , ($\beta = 0.19; p < 0.05$) and ($\beta = 0.02; p < 0.1$) on 'Make' strategy, PatentEff, CitationEff and Innovation Input Choice in model 1A, model 3A, model 3B and model 4A, respectively. Conversely, CFO Structural Power has no significant effect on the 'Buy' strategy, Patent and Citation. The coefficient the coefficient estimate for *CFO Expert Power* is negative and significant ($\beta = -0.17; p < 0.10$) on 'Buy' strategy in model 1B, in contrast, is positive and significant ($\beta = 0.04; p < 0.10$) on Patent in Model 2A.

Table 2.15 The association between CFO structural power and CFO expert power on innovation performance from fixed-effect regression

Dependent Variable	**Innovation Input**		**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**
	Make Strategy (R&D)	**Buy Strategy (TA)**	**Patent**	**Citation**	**PatentEff**	**CitationEff**	
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**
CFO Structural Power	***0.02**	0.08	0.02	0.07	***0.13**	****0.19**	***0.02**
	(1.70)	(1.50)	(0.97)	(1.42)	(1.95)	(2.15)	(1.94)
CFO Expert Power	0.03	***-0.17**	***0.04**	0.05	-0.08	-0.08	0.01
	(1.18)	(-1.93)	(1.60)	(0.92)	(-0.89)	(-0.73)	(0.90)
CEO Power	-0.005	0.11	0.01	0.23	0.12	0.34	**0.07
	(-0.11)	(0.49)	(0.21)	(1.35)	(0.50)	(1.13)	(2.25)
Potential Slack	0.0009	0.0003	-0.0008	**-0.003	0.0004	-0.002	0.0002
	(1.22)	(0.18)	(-0.68)	(-2.03)	(0.21)	(-0.96)	(0.34)
Absorbed Slack	-0.02	0.01	-0.01	-0.03	-0.01	-0.03	-0.19
	(-0.79)	(0.19)	(-0.33)	(-0.38)	(-0.20)	(-0.33)	(-0.94)
ROA	*-0.12	-0.11	***0.49	***1.07	0.25	0.83	-0.04
	(-1.81)	(-0.36)	(2.80)	(2.91)	(0.64)	(1.62)	(-0.56)
Leverage	-0.005	-0.04	0.01	0.04	-0.02	-0.004	-0.0007

Table 2.15 (Continued)

Dependent Variable	Innovation Input		Innovation Outcome		Innovation Efficiency		Innovation Input Choice
	Make Strategy (R&D)	Buy Strategy (TA)	Patent	Citation	PatentEff	CitationEff	
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**
	(-0.38)	(-1.18)	(0.69)	(0.81)	(-0.58)	(-0.08)	(-0.10)
Altman-Z	-0.001	**-0.008	***-0.004	**-0.006	***-0.01	***-0.01	***-0.01
	(-0.77)	(-2.12)	(-2.92)	(-2.26)	(-2.75)	(-2.73)	(-3.45)
Board Size	*0.38	0.40	0.16	0.32	0.95	1.11	0.16
	(1.95)	(0.67)	(1.02)	(0.77)	(1.51)	(1.42)	(1.17)
Board Independence	***0.001	-0.002	0.0002	-0.001	-0.0008	-0.003	**0.0009
	(2.96)	(-1.22)	(0.38)	(-1.33)	(-0.37)	(-1.19)	(2.50)
CFO Turnover	0.03	***-0.29	0.01	-0.04	**-0.24	**-0.30	0.02
	(1.18)	(-3.17)	(0.31)	(-0.41)	(-2.25)	(-2.09)	(0.81)
CEO Turnover	0.07	0.05	-0.05	-0.04	0.07	0.08	0.07
	(1.19)	(0.46)	(-1.05)	(-0.29)	(0.49)	(0.43)	(1.43)
Duality	0.06	0.11	-0.07	-0.01	0.11	0.16	0.0006

Table 2.15 (Continued)

Dependent Variable	**Innovation Input**		**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**
	Make Strategy (R&D)	**Buy Strategy (TA)**	**Patent**	**Citation**	**PatentEff**	**CitationEff**	
Model	**Model 1A**	**Model 1B**	**Model 2A**	**Model 2B**	**Model 3A**	**Model 3B**	**Model 4A**
	(1.06)	(0.64)	(-0.74)	(-0.09)	(0.46)	(0.48)	(0.02)
Capital Intensity	0.41	**-2.73	0.21	0.04	-2.10	-2.27	0.37
	(1.08)	(-2.10)	(0.46)	(0.04)	(-1.39)	(-1.21)	(1.36)
ROE	0.0008	0.002	-0.006	-0.01	-0.004	-0.01	0.00009
	(0.27)	(0.15)	(-1.03)	(-1.15)	(-0.24)	(-0.57)	(0.03)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	*-1.47	***-9.43	**-1.90	***-4.30	***-12.82	***-15.22	-0.15
	(-1.88)	(-3.45)	(-2.47)	(-2.66)	(-4.45)	(-4.52)	(-0.23)
No. of observations	1656	1656	1656	1656	1656	1656	1656
Adjusted R^2	0.19	0.34	0.17	0.14	0.42	0.38	0.14

The table presents the results from OLS Fixed Effect regression on the association between CFO Structural Power, CEO Expert Power and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1A and technology acquisition or 'buy' strategy – model 1B), innovation outcome (Patent –

model 2A and Citation – model 2B), innovation efficiency (PatentEff – model 3A CitationEff – model 3B) and innovation input choice (model 4A). t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

2.5 Conclusion

2.5.1 Theoretical and research-related implications

This paper has several theoretical and research-related implications for further investigations into CFO power and innovation management theory as well as for the broader management literature. First, the findings have helped fill a void in the literature regarding the role of CFO power in innovation management by identifying the association between CFO power and the firm's commitment to R&D innovation using a range of innovation performance measures. The study establishes that an assertive CFO has a major role in driving internal innovation strategy initiatives through the pursuit of 'Make' strategy and a preference of 'Make' over 'Buy' strategy. Furthermore, a powerful CFO is seen to play a major role in driving both innovation outcomes and efficiency. A CFO's expert power and structural power are found to be associated with decisions leaning towards a 'Buy' and 'Make' strategy, respectively. In a similar manner to Chief Technology Officers (CTOs), CFOs may engage in hierarchical power struggles in influencing a firm to support a 'Make' strategy (Garms and Engelen, 2019). Although acquiring external technologies may reduce the time required to bring products to market (Ford and Probert, 2010; Mortara and Ford, 2012), it often involves a considerable one-off payment. In this case, the CFO's financial expertise is crucial in evaluating the efficacy for returns of such ready-made solutions against investing in an internal 'Make' strategy. A benefit of the 'Make' strategy is allowing for R&D expenditure to be spread across several years, which may be particularly helpful when such budgets are limited.

Conclusions can also be drawn from our results on the roles of financial slack and TMT power struggles. We find that the financial position of the firm can moderate the CFO's assertiveness. Notably, when the financial slack of a firm is high, it reinforces the CFO's power to invest in both 'Make' and 'Buy' strategies. Consequently, the firm is capable of not only producing more patents and citations but it can also do so more efficiently. This suggests that with greater firepower from the financial slack, a CFO is much more open to pursue large, risky and disruptive innovation projects (Dane, 2010). However, excessive power struggles between the CFO and CEO are likely to be detrimental to a firm in achieving its innovation agenda. Interference from a powerful CEO can result in lower R&D expenditure on both 'Make' and 'Buy' strategies. The findings show that when both the CFO and CEO are powerful, there is lost innovation efficiency and fewer patents and citations are produced.

Second, by applying the upper echelons theory in explaining the association between CFOs power and innovation performance, and how the link is affected by firms' financial slack and conflict of power, the study makes a valuable contribution to the theory. The upper echelons theory explains that organisational outcome is a reflection of top executive's characteristics (Hambrick and Mason, 1984; Cannella et al., 2009). In this study, an extension of upper echelons theoretical framework is made as shown in the study's research model to address the research questions by integrating internal corporate governance mechanism namely the financial slack as well as conflict of power to the theoretical framework. Through the extension of the theoretical framework of upper echelons, this study provides valuable insights on how the financial slack fosters the relationship between a highly powerful CFO and innovation, and how a power struggle between CFO and CEO affects the association.

Thus, this research in terms of strategic decision making where resource allocation is handled by career-oriented, assertive executives who pursue their self-interests and believe in the decisions they make (Finkelstein, 1992; Patel and Cooper, 2014). Felekoglu and Moultrie (2014) identify the CFO as an "innovation steward" behind the innovation wheel, who has the appropriate assertiveness to drive the innovation agenda favourably "front and centre" in the TMT. The insights from this study add to the literature examining the role of the TMT as an entity in deriving innovation-related outcomes. The arguments and findings also reveal that the relationship between CFO power and innovation can be more nuanced and complex; financial slack and CEO power can either strengthen or weaken the association with the desired innovation performance. Specifically, a dysfunctional power-related conflict between the CFO and CEO can result in fewer patents and citations and lower innovation efficiency. Therefore, we conclude that future studies should consider how power struggles among individual TMT members might affect a firm's commitment to R&D activity and innovation performance.

2.5.2 Policy and managerial Implications

Our findings have important implications for firm's policy- and decision-makers such as search committees responsible for appointing Chief-level individuals for the TMT.

The appointment of unsuitable candidates can result in a lack of commitment to the innovation agenda of a firm. Hence, the firm may lose competitiveness, revenue or even market share. Our research delivers three important messages to decision-makers who wish to avoid the costs of poor recruitment for senior roles in this regard (Garms and Engelen, 2019).

First, they should design compensation packages tailored to attract suitable and capable individuals, such as being tied to innovation performance. This could be an effective way to attract potential CFOs with clear strategic competencies, a commitment to innovation, passion, relevant experience and fruitful networks. A well-designed compensation scheme could link CEO and CFO jointly to avoid potential power clashes and minimise conflict. It should be designed around boosting conditions for cohesion in decision making. For example, their bonuses could be tied jointly to meeting or exceeding a specific threshold of patents produced or citations generated within an agreed timeframe. This may incentivise their interests to align more properly in delivering the firm's innovation agenda.

Second, CFO structural power and expert power could be appropriately deployed when pursuing specific innovation strategies. For instance, a CFO could focus on influencing their TMT peers when pursuing the internal 'Make' strategy by asserting or deferring to authority within the hierarchy. Likewise, they could focus on leveraging and foregrounding the acumen gained from years in industry and finance, as part of their expert power when evaluating external technology options. Decision-makers on compensation committees could recommend that the CFO is appointed as an executive member of the board of directors as an explicit move in seeking to drive the internal innovation performance. Our results also imply that rewarding the CFO for prioritising cost-effectiveness in external technology acquisition appraisals is sensible. Such decision-makers could also usefully narrow the pay gap between CEOs and CFOs in the medium and longer terms as a strategy to increase CFO commitment to the firm's R&D agenda.

Third, appointing a suitable CFO would require the alignment of a preferred input R&D strategy the firm may have with that likely of the CFO. Search committee decision makers need to be clear on this, either developing internal capability through a 'Make' strategy or acquiring external technology through a 'Buy' strategy to help ensure innovation success (Lind and Barner, 2017). Our research indicates that assertive and career-minded CFOs prefer to grow their internal capabilities over acquiring external technologies. Therefore, search committees should seek clarification from CFO candidates during interviews on their input strategy preferences as a route to achieving the firm's R&D agenda. A mismatch between the firm's and CFO's strategic approaches could result in a misallocation of resources. It may also cause friction among TMT members; poor strategic decisions could result, acting as an obstacle to the firm achieving its R&D agenda.

2.5.3 Limitations and further research

The present research has limitations that present potentially useful avenues for future research. Firstly, while the impact of CFO power on innovation performance is examined, there are other TMT members who must also play an influential role in securing it. Exploring this would be illuminating, for example, the role of CMO or CTO power in influencing innovation performance (Garms and Engelen, 2019).

Secondly, the post-hoc analysis failed to fully reveal and measure the sources of CFO power. Perhaps extending the conceptualisation of structural power and expert power by disentangling the sources further to include the dimensions of power depth and power breadth, we might understand it more comprehensively (Daily and Johnson, 1997; Finkelstein, 1992; Garms and Engelen, 2019).

Thirdly, financial slack and CEO power have been identified as playing an important moderation role on CFO power impacting the innovation performance of firms. However, other TMT characteristics should also be considered. Board diversity in TMTs, for instance, could play a pivotal role in moderating CFO power; the literature has demonstrated the impact of gender representation in both boards and R&D teams in affecting innovation efficiency (Xie et al., 2020).

Fourthly, innovation is inherently risky. It is crucial to examine the role of shareholder risk preferences and attitudes. Failure rates from innovation are relatively high; thus, shareholders may instinctively lean towards acquiring tried and tested external technology rather than invest in internally developed, riskier R&D activities. To explore this subject, secondary data are unlikely to be available, so a survey could be undertaken to gauge the risk preferences and tolerances of shareholders.

Chapter 3 Does CEO compensation drive innovation performance? The role of industry regulation

Abstract

Despite considerable works have shown that CEO compensation could be a key determinant of innovative performance, less is known on the impact of external governance mechanism such as industry's regulation on the association. The present study seeks to determine the direct and indirect links CEO compensation has on innovation performance by input strategy, outcome, efficiency and input choice. The investigation found support for both the main effect of CEO compensation and indirect effects via government Regulation on innovation performance. Finally, the study provides several theoretical implications and managerial policy for innovation management theory building and committees who are responsible for recruitment and executive compensation.

Keywords: Innovation, CEO compensation, Regulation

3.1 Introduction

Motivated by the mounting ongoing debate about the association between CEO compensation and innovation performance, this chapter seeks to extend the discussion by investigating whether industry's unique characteristic such as regulation is beneficial in nurturing the compensation-innovation link. The empirical analysis, therefore, aims to investigate the association between CEO compensation and innovation performance, and how the industry's regulation impacts the relationship by taking the U.S. pharmaceutical industry from 1998 to 2018 as an illustration. By doing so, the present study extends compensation-innovation research to the role of industry's regulation.

The U.S. pharmaceutical industry provides a great platform to accomplish the aim of the present study. In relation to its feature, the pharmaceutical industry is a highly regulated industry. Hence, it is feasible to inspect the impact of regulation on compensation-innovation association by taking this industry as an example. Furthermore, regulatory environment is a top concern of many firms nowadays, with three-quarters of CEOs reporting that they spend more time working with regulators or government officials. Specifically, to the pharmaceutical industry, the regulatory environment affects nearly all aspects of pharmaceutical companies' operations, including the processes and outcomes of R&D (Oliver, 2017), the approval of products and drugs, manufacturing and labelling, marketing communications as well as patent protection and enforcement. Thus, keeping up with regulation and procedures in this industry can consume 25% of a pharma firms' budget (Martin et al., 2018). Thus, in the process of driving innovation agendas for their firms, CEOs in this industry face many challenges from external governance mechanism, such as the introduction or amendment of Regulation in particular pertaining to drug products. Yet, it is less known whether regulation is beneficial for the association between CEO and innovation performance.

Apart from being a highly regulated industry, CEOs in the U.S. pharmaceutical firms are highly rewarded. The CEO compensation is indeed a critical factor in the industry. USA Today (2016) reports that CEO compensation for pharmaceutical companies in 2015 was 71% higher than that of other industries within the Standard and Poor 500. In 2018, the pharmaceutical CEOs of leading companies were the most well-paid executives in the US (Business Insider, 2018). It is believed that compensation is an economic incentive and an important element for greater innovation performance (Zhou et al. 2021). This is at the same time, however, that the industry is struggling with rising costs of scientific innovation, which can be seen in the rising prices of drugs (DiMasi et al., 2016). However, Mendoza (2019) argues that increasing innovation costs is only a fraction of the innovation issue and that innovation in pharmaceuticals depends very much on economic incentives, specifically on 'fat cat' CEO compensation.

This chapter is important as it offers a better understanding not only on the direct CEO compensation-innovation association but also the indirect impact. Designing compensation packages for top executives as a reward or motivation for achieving a greater firm's innovation performance is not straightforward. In the first instance, capping CEO compensation simply to restrain rising innovation costs will have unfavourable effects on innovation (Fossett and Wunnava, 2017). Second, while setting high compensation for CEOs can motivate them to succeed (Zajac, 1990), sustaining high compensation can also deprive the firm of the financial resources it needs to invest in R&D and hinder the firm's ability to innovate. Third, top executives, on the other hand, are not necessarily motivated by economic incentives. Finkelstein and Hambrick (1988) argue that executives are motivated to perform beyond expectations regardless of financial incentives. In light of all this, it is essential to develop deeper insight into the direct relationship between compensation and innovation. Therefore, this study aims to answer the question of '*How does CEO compensation associate with innovation performance at the firm's level in the US pharmaceutical industry*?'.

Early research highlights that legislation discourages innovation. Food, Drug and Cosmetics Act 1962 discourages innovation by increasing the economic cost of R&D and extending the time required to obtain approval for experimental drugs (Virts and Weston, 1980). However, CEOs with high levels of compensation have high structural power (Finkelstein, 1992), and the assertive CEOs can influence their firms' strategic decision-making, regardless of any internal and external opposition they may face (Adams et al., 2005), make unilateral decisions without consensus from any other senior executives and have a higher authority to make the most critical decisions (Harris and Helfat, 1998). In short, they 'can get things done' (Gupta et al., 2018). However, to the author's best knowledge it is unknown as to how the industry's Regulation would affect the role of a highly compensated CEO on innovation activities at the firm's level. Thus, this study also seeks to answer the question of '*To what extent* *does the regulation in the US pharmaceutical industry influence the association between CEO compensation and innovation performance*?'

The chapter relies on upper echelons theory and economy theory of agency in answering the research questions. Based on the upper echelon theory, the organisational outcome is a reflection of the top executive's characteristics, such as his compensation (Hambrick and Mason, 1984; Cannella et al., 2009). The separation of principal and agent is the central component of the economy theory of agency, which creates conflicting interests between the two parties and, therefore, defines the governance mechanisms, such as laws and Regulation that limit the acting agent's self-serving behaviour (Eisenhardt, 1989; Thomsen and Conyon, 2012).

Therefore, the present study suggests an extension of the upper echelons theory in a research model to address the research question by integrating external corporate governance mechanism vis the industry's regulation to the theoretical framework. In essence, the study extends the research framework concerning strategic leadership characteristics and innovation performance by investigating external governance mechanisms through the integration of upper echelons theory and the economy theory of agency. Thus, this study designs CEO compensation as the main independent variable, while the pharmaceutical industry's regulation is a moderating variable and examines the impact on various innovation performance indicators. A multisource secondary panel data set consisting of 843 firm-year observations from 75 firms between 1999 to 2018 is used to validate the research framework empirically.

The results show that there are positive associations between CEO compensation and innovation input both for 'make' and 'buy' strategies. The findings suggest that CEOs are motivated by higher compensation to engage in more innovation-related activities. In contrast, the study finds that CEO compensation has insignificant association with innovation outcome and efficiency. Subsequently, the highly compensated CEOs tend to prefer internal R&D rather than external technology procurement. The present study finds that the pharmaceutical industry's regulation has mixed impact on CEO compensation and innovation. In particular, the industry's regulation weakened the association between CEO compensation and innovation input 'make' (R&D) and 'buy' (technology acquisition) strategy. On the other hand, it reinforces the links between CEO compensation and innovation outcome (Patent). In the event of introduction of new or amendment to the industry's regulation, the highly paid CEOs' prefer to invest more in 'buy' strategy.

Indeed, the present study makes several contributions. First, the research makes a theoretical contribution through the integration of the upper echelon theory and the economy theory of agency. Second, the study contributes to the literature on strategic leadership. There is less focus on the study of strategic leadership concerning pharmaceutical innovation performance (Hill and Hansen, 1991; Finkle, 1998; Cardinal, 2001; Sloan and Hsieh, 2007; Hess and Rothaermel, 2011; Grabowski, 2011; Houston et al., 2013). In filling the void, the present research extends the literature by presenting evidence and analysing how strategic leadership's characteristics are necessary for innovation success in the pharmaceutical industry. Third, the study also contributes to the literature on corporate governance. Research into the external mechanisms of corporate governance (Thomsen and Conyon, 2012) are limited, such as the impact of industry regulation in fostering a relationship between a strategic leader and innovation. The contribution thus comes through new insights into how the industry's regulation can strengthen or weaken the association. Fourth, the study adds to the innovation literature by introducing a self-formulated measurement that reflects CEO preferences for innovation input strategies, specifically whether they want to 'make' or 'buy'. Thus, the research extends the literature of innovation beyond commonly used innovation indicators, such as R&D, patents and efficiency, to include a preference for innovation strategic choices as well.

The paper is organised as follows: The next section initially reviews the relevant literature and then a set of hypotheses is developed arguing for a relationship between CEO compensation, regulation and innovation performance. A report of the empirical results is given followed by a discussion of the implications for research and practice.

3.2 Literature review

3.2.1 Theoretical background

This section examines the elements of the research model and how the variables relate to each other. The dependent variables are innovation input 'make' (R&D) and 'buy' (technology acquisition) strategies, innovation outcome, efficiency and innovation input choice. The independent variable is the CEO's total compensation. According to the upper echelon theory, the organisational outcome reflects the characteristics of top executives (Hambrick and Mason, 1984). The CEO is among the most influential people in the TMT. The CEO can influence innovation performance through the channel of strategic decision-making concerning formulating innovation strategy, allocating resources and monitoring the process (Damanpour, 2020). Furthermore, they have tremendous discretion over firms' strategic orientation (Jensen and Meckling, 1976; Finkelstein, 1992), e.g. discretion over critical strategic decisions regarding particular R&D project expenditure that impacts innovation performance. Accordingly, this study is based on the assumption in line with the Upper echelon theory that a highly paid CEO leads to high innovation performance.

CEO compensation is a crucial yet controversial issue in corporate governance. Performance-based pay may reflect the severity of the agency problem, but at the same time, it is an attempt to align motivations so as to improve firm performance (Mishra et al., 2000; Thomsen and Conyon, 2012). There are two broad categories of CEO compensation: short-term cash and long-term incentives (Van Essen et al., 2015). The short-term compensation consists of salary and bonuses, which are tied to annual performance, while the long-term compensation is based on performance over a period of three to five years (Balkin et al., 2000). Currently, a study holds that both salary and equity compensation are important incentives for corporate executives to engage in more innovation (Zhou et al., 2021).

Furthermore, the study identifies one interaction effect, namely the amendment of industry regulation. This variable can mitigate the impact of CEO compensation on innovation performance, particularly on the production of new drugs in terms of costs and timeliness. Figure 3.1 shows the study’s conceptual framework.

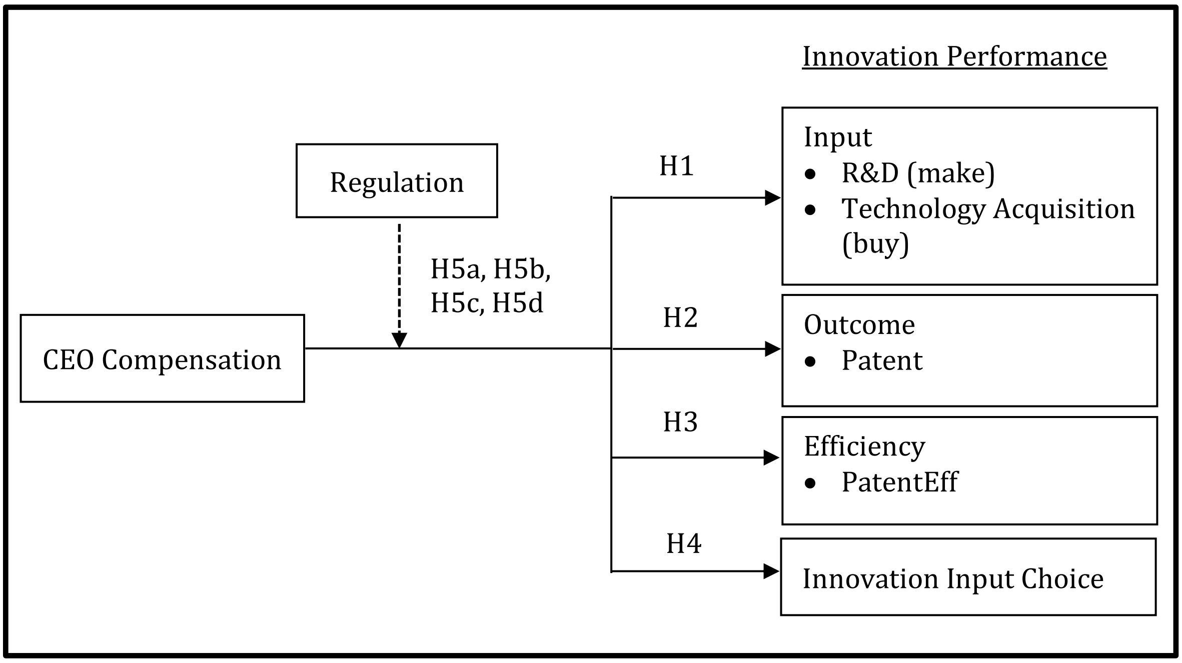


Figure 3-1 Conceptual framework on the association between CEO compensation, regulation and innovation performance

3.2.2 Direct effects of CEO compensation on innovation input strategy

There is mixed evidence on the association between CEO compensation (short and long-term compensation) and innovation performance in the existing literature. There are two components of CEO compensation, namely CEO Cash which includes salary and bonus, and another component is the CEO long-term compensation (LTIP) which is equity or stock-based compensation. Principally, in general, the two components of compensation are believed to associate with innovation performance differently. As such, by taking into consideration the measures of short-term compensation like salary and bonus are for a one-year settlement time, thus it is tied to a shorter-term of organization performance. Whereas the settlement time for equity or stock-based compensation can nest for multiple years, thus, it involves pursuing long-term organization performance such as innovation (Nguyen, 2018; Zhou et al., 2021). However, the empirical evidence presents mixed finding.

Surprisingly, an earlier study by Balkin et al. (2000) finds that short-term CEO compensation is indeed positively associated with innovation performance through R&D investments. Contrary, Tien and Chen (2012) argue otherwise, and assert that CEO short-term compensation do not encourage CEO behaviour to innovate. However, a more recent study highlights similar finding to Balkin et al. (2000) that an increased in short-term compensation indeed can significantly increase the R&D expenditure (Zhou et al. 2021). As for stock-based compensation, several studies have documented that the long-term compensation appears to encourage managers to implement risky policies, including high R&D spending (Xue, 2007; Barker and Mueller, 2002; Mazouz and Zhou, 2019) and all types of innovation measures, such as patents and citations (Sheikh, 2012). Still, the effect of long-term compensation on innovation is subjected to the level of firm risk (Nguyen, 2018).

In short both short- and long-term compensation presents mixed finding, thus, there is not much difference between the association of short- and long-term compensation and innovation performance. As previous studies emphasise more on the two types of compensation, the present study applies total compensation which consists of the two components in main analysis. As such, based on previous evidence that there is a positive association established between compensation and innovation performance regardless of short- or long-term compensation. Hence, this present study posits that there is a positive association between CEO compensation and innovation considering that both types of compensation can to some extent encourage top executives to pursue greater innovation performance. Therefore, the first hypothesis is as follows:

H1: CEO Compensation is positively associated with innovation input (spending on R&D and technology acquisition).

3.2.3 Direct effects of CEO compensation on innovation outcome

Researchers have discovered mixed evidence concerning the relationship between CEO compensation and innovation outcomes. Based on Balkin et al. (2000), CEO compensation, particularly short-term CEO compensation, appears to be positively related to innovation outcomes such as the number of patents. In other studies, long-term CEO compensation is associated with more patents granted and citations (Lerner and Wulf, 2007; Bulan and Sanyal, 2011; Nguyen, 2018). The short-term CEO incentives, however, are not related to innovation (Lerner and Wulf, 2007). A recent study has demonstrated that long-term compensation is positively correlated with higher levels of drug development within the biopharmaceutical industry (Ramaswamy and Banta, 2017). This evidence, however, is based on a single firm study. Nevertheless, based on single firm evidence, the present study suggests that CEO compensation in pharmaceutical firms is positively associated with innovation outcomes. Thus, the next hypothesis is as follows:

H2: CEO compensation is positively associated with the innovation outcome (number of patents granted).

3.2.4 Direct effects of CEO compensation on innovation efficiency

Innovation efficiency is a measure of innovation output in relation to the quantity of inputs (Cruz-Cázares et al., 2013). This can be described as the number of patents applied for or granted per amount invested in R&D. Indeed, innovation efficiency reflects a firm's ability to generate patents per dollar spent on R&D. However, research tends to primarily focus on executive compensation and innovation inputs, particularly R&D spending, and innovation outcome such as patents (Balkin et al., 2000; Nguyen, 2018), but there is less evidence on the efficiency of innovation. In spite of this, one study reveals that other CEO characteristics, such as tenure, is associated with innovation inefficiency (Peng, 2017). This study suggests there is a positive association between CEO compensation and innovation efficiency based on the role of the CEO in strategic decision making (Finkelstein 1992), championing innovation (Castellion, 2010), and providing a competitive advantage to firm (Balkin et al., 2000). On top of that, the organisation's outcome is a reflection of the firm's top managers (Hambrick and Mason, 1984). Accordingly, this study assumes that innovation efficiency is a reflection of an assertive CEO with high compensation. Hence, the next hypothesis is as follows:

H3: CEO compensation is positively related with innovation efficiency.

3.2.5 Direct effects of CEO compensation on innovation input choice

An innovative pharmaceutical firm can pursue two input strategies namely 'Make' and 'Buy'. 'Make' strategy relies on the firm's internal R&D investment, to innovate within the firm, while the 'Buy' strategy is the acquisition of ready-made technology external to the firm. In the "Make" strategy, there is an increase in risk, uncertainty, and a longer period of time to complete the process (Grabowski, 2011). Alternatively, the 'Buy' strategy seems more certain because the acquired technology is relatively more fully developed (Xue, 2007). It is noteworthy that the 'Buy' strategy or technology acquisition is, therefore, a better strategy since it reduces the time for products to reach the market (Ford and Probert, 2010; Mortara and Ford, 2012). Currently, most innovation studies focus on innovation performance, such as R&D investment and patenting, but rather little research has been conducted in order to gain insight into innovation input 'buy' strategy or technology acquisition. The present study, therefore, represents the first attempt at revealing CEO compensation preferences in pursuing a firm's innovation agenda. Contextually, the pharmaceutical industry, industry, where nature of the industry relies largely on R&D, their highly paid CEOs are predicted to prefer internal R&D strategies of 'Make' rather than 'Buy,' given the advantages that it provides in the long run. Therefore, the next hypothesis is as follows:

H4: CEO compensation is positively related to the 'Make' strategy as the preferred innovation input choice.

3.2.6 Interaction between CEO compensation and regulation and the effects on innovation performance

The pharmaceutical industry is a highly regulated industry, which is a reflection of its importance and concern for corporate governance. The main institutional regulator related to drugs and health care in the US is the US Food & Drug Administration (FDA). As an external corporate governance mechanism, laws and legislation are intended to align the interests of agents with those of principals, but it has not received the same amount of attention in research compared to internal corporate governance mechanisms (Thomsen and Conyon, 2012, Chen, 2015).

According to recent studies, the effectiveness of the industry's regulation as corporate governance is mixed, when it comes to various innovation performance measurements. Earlier research on the post amendment of the Federal Food, Drug, and Cosmetic Act 1962 indicates an increase in innovation investment, yet this has not been reflected in an increase of new medicines introduced or an improvement in the innovation outcomes (Schnee, 1979; Laubach, 1980). Indeed, regulation changes can delay approval and raise the cost of producing a new product (Virts and Weston, 1980; Grabowski, 2011) and may affect pharmaceutical companies' operations and drug production (Oliver, 2017; Martin et al., 2018). Separately, Grabowski (2011) points out that the changing Regulation of the Food and Drug Administration (FDA) since the 1962 Act have had a negative impact on innovation activities, in terms of the length of the R&D process, clinical trials, and other main processes of the drug development process. In addition, there are also some government Regulation, such as the USFDA's pharmaceutical regulation, which may cause firms to pay closer attention to stakeholder concerns. Where around three-quarters of CEOs report that they are spending more time working with regulators or government officials, also keeping up with regulation and procedures in this industry can consume 25% of a pharma firms' budget (Martin et al., 2018).

Based on the development of previous decades' research, this present study suggests that regulatory amendments in long run can align the interest and preference of an assertive highly rewarded CEO with the stakeholders' innovation goal. This is because the nature of R&D in pharmaceutical industry is unique as it takes longer time to produce a result (Grabowski, 2011). Thus, a rational CEO will be able to recognise current and potential challenges in the industry, relate it to maximising the value of the company, and they will de facto integrate these into the value-maximising process (Thomsen and Conyon, 2012). In other word, the time spent by the CEOs in dealing with regulation matters indeed encourage the CEOs to be more selective on innovation projects. Besides, higher compensated CEOs have greater managerial discretion (Finkelstein and Boyd, 1998) and those CEOs are also in a unique position to influence a company's strategic orientation (Jensen and Meckling, 1976) as well as a great deal of influence by virtue of preferences and attributes on its innovative activities (Balsmeier and Buchwald, 2015). Thus, the level of R&D expenditure does not really reflect innovative success. Based on this argument, the present study suggests that the industry's regulation can weaken the association between CEO compensation and innovation, but in a very positive way. This argument indeed parallel with the situation where pharmaceutical firms that invest heavily in R&D not necessarily mean higher innovative success. For instance, some of world's largest R&D investors particularly the pharmaceutical gigantic firms namely Roche, Novartis and Johnson & Johnson fails to place on the technology-dominated innovation list (Iqbal, 2017). Therefore, the study in the next hypothesis as the following:

H5a: The relationship between CEO compensation and innovation input 'make' strategy (R&D and TA) is weakened by pharmaceutical industry's regulation.

However, any amendments to Regulation would cause the production of new products to take longer, as a result, fewer patents would be granted. The result is that even though there has been a huge amount of investment allocated to R&D, the process-time in producing new drug products has increased and this has a negative impact on the number of patents produced and innovation efficiency in the industry. The next hypotheses are as below:

H5b: The relationship between CEO compensation and innovation outcome (number of patents granted) is negatively moderated by regulation amendment.

H5c: The relationship between CEO compensation and innovation efficiency is negatively moderated by regulation amendment.

Notably, regulation changes can delay new drug approval and raise the cost of producing the new product (Virts and Weston, 1980; Grabowski, 2011). In addition, it also can prolong the R&D process, adding more clinical trials and other drug development process (Grabowski, 2011), therefore, to expedite producing new drug, an assertive highly compensated CEO may prefer purchasing external technology to internal R&D investment. Hence, our next hypothesis is as below:

H5d: The relationship between CEO compensation and innovation input choice is weakened by regulation amendment.

3.3 Data and methodology

3.3.1 Sample and data

A secondary panel data study was designed to validate the research model empirically. As a sampling frame, US Pharmaceutical and biotechnology firms was drawn from Standard and Poor's Compustat database using SIC code 28 from 2002 to 2018. Focusing on publicly listed firms ensures that available public company filings, capital market performance data such as financial data, CEO compensations are comparable. Focusing on US firms provides the basis for the predictions of innovation performance based on upper echelon theory as CEOs operate within a high degree of managerial discretion (Hambrick, 2007; Talke et al., 2011; Garms and Engelen, 2019).

The study used five databases to construct the sample, which consists of pharmaceutical and biotechnology firms drawn from Standard and Poor's Compustat database using SIC code 28 from 2002 to 2018. The compensation information, R&D expenditure, and other financial information, along with patent data are all available from 1992 through ExecuComp, Compustat North America, and the United States

Patent and Trademark Office (USPTO) database, respectively. In addition, the study also exploits Google Patents for patent data (Kogan et al., 2017). The search resulted in 89 firms, which collectively had 2,581 firm-year observations.

The study accessed the legislation information from the US FDA website, and governance information, such as outside CEO, and other data like board independence, CEO replacement, education, age, gender and board size, which is obtainable from the year 1999 from Boardex. As a result, the sample was reduced to 75 firms with 899 firm-year observations. Also available in Datastream are data on university partnerships and product delays, which can be accessed from 2002 onwards. To construct the sample, this paper merged all the data from the various databases, including only those firms with complete data on R&D expenditures, finance and the compensation of CEOs. In the final sample, there are 75 firms with 843 firm-year observations.

3.3.2 Variable description and measurement

Dependent variables

The firms' innovation activities are commonly proxied by their innovation input, outcome and efficiency measures (Satta et al., 2016; Xie et al., 2020). As for innovation input strategy, the 'Make' strategy is measured as the natural logarithm of R&D investment expenditure (Chen et al., 2018), and the 'Buy' strategy is measured as the natural logarithm of intangible assets and goodwill (Xue, 2007), respectively, using the annual financial data available in Compustat. The innovation outcome was measured by the natural logarithm of the number of patents that were applied for by a firm during a year and eventually granted (Satta et al., 2016; Shen and Zhang, 2018). The US Patent data was collected from Google Patents (Kogan et al., 2017). There is an average delay of two years between applying for a patent and receiving a grant, so this has led to a truncation bias in the number of patents towards the end of the sample period. To deal with this issue, the study included year-fixed effects in the regression models (Hall, Jaffe and Trajtenberg, 2001).

The study also measured innovation efficiency, which means how many patents were granted given a certain quantity of R&D input (Cruz-Cázares et al., 2013). This measure shows how many patents the firm generated per dollar invested in R&D. In short, R&D expenditure gauges input against innovation. In addition, the study measured innovation input choice which indicates between 'Make' or 'Buy' strategies by the ratio of R&D investment expenditure ('Make' strategy) to TA expenditure ('Buy' strategy).

Independent variables

The main independent variable in the study is the compensation of the CEO. The short-term compensation comprises of the annual salary and bonus amount, while the CEO LTIP covers the CEO's annual stock options, restricted stock and other long-term compensation (Van Essen et al., 2015). Briefly, firms that want to promote fast change tend to emphasize on short-term incentive. While the long-term compensation is paid based on the year goal achieved or deferred or paid for several years (Groysberg et al., 2021). This present study applies the total amount of compensation (short- and long-term compensation) similar to the approach taken by Mishel and Kandra (2021) for two main reasons. Firstly, this is taking into consideration that the two components of compensation present mixed findings and on top of that there is not much difference effect between the two components of compensations on innovation performance (Balkin et al., 2000; Tien and Chen, 2012; Zhou et al., 2021). In addition, this present study aims are also to investigate the indirect effect of highly paid CEO as a total pay on innovation performance in the event of new industry's regulation or amendment. Therefore, there is a need to combine the short- and long-term compensation as a total amount of compensation. Nevertheless, the effect of short- and long-term compensation is analysed in additional analysis to gain deeper understanding on direct association between different compensation components and innovation performance.

Moderating variable

The pharmaceutical industry in the United States is heavily regulated. Therefore, the study considers new or amended Regulation related to the industry as an interaction variable. The term 'regulation' refers to the rules established by the United States Food and Drug Administration (US FDA) for the Food, Drug, and Cosmetic Act in the US.

Control variables

In order to limit the possibility of omitted variables bias in the analysis, the research employed an extensive set of control variables. The first category is CEO characteristics: age (Cummings and Knott, 2018) and gender (Quintana-García and Benavides-Velasco, 2016). As stated in the literature, CEO age is an important aspect because as CEOs grow older, they tend to reduce their investment in R&D. The gender of CEOs is also important; more specifically, women tend to invest more in innovation (Chen et al., 2018). Second, board and firm characteristics include board independence and size of the board (Van Essen et al., 2015).

Third, this study-controlled R&D collaboration such as mergers and acquisitions (Munos, 2009; Grabowski, 2011), and university partnering (Gassmann et al., 2008). Research and development collaboration not only helps firms to reduce risk in R&D investment but also helps to reduce the risk of a lack of access to needed substances in the drug development pipeline (Gassmann et al., 2008). The two main reasons for controlling R&D collaboration are as follows. Scholarly researchers in the pharmaceutical and biotech industries have placed relatively high importance on this element of the research process, believing that it is capable of influencing innovation in a positive way. In practice, pharmaceutical and biotechnology firms frequently pursue various types of R&D collaboration as it helps tap new technology and reduce costs and risk via sharing mechanisms (Grabowski and Vernon, 1994; Gassmann et al., 2008; Munos, 2009; Grabowski, 2011).

The fourth category is financial indicators, such as return on equity, leverage, firm risk and Altman-Z score which reflects the firm's financial distress. It is also important to control market competition in the study since firms provide stronger incentives when industry competition is greater (Karuna, 2007). Finally, the paper controls for CEO replacement as one crucial factor influencing innovation. In this relation, previous studies show that a new CEO has a positive impact on innovation performance in the first three years (Sunder et al., 2017). Apart from that, the study also controls for product delays. The reason is that any delay in product development that occurs after the filing of its patent application will effectively shorten the patent term and thereby reduce the time between product launch and the arrival of the generic product (Schuhmacher et al., 2016). Table 3.1 summarises all the dependent, independent, interaction, control variables and variables used to construct the Altman-Z score.

Table 3.1 Summary of variables and measures

Variable	Description	Source
Panel A: Dependent Variables		
ln(1+R&D)	Natural logarithm of *R&D* expenditure as a measure of innovation input where *R&D* is the Research and Development Expenditure in USD million.	Compustat
ln(1+TA)	Natural logarithm of *TA* expenditure as a measure of 'buy' input strategy where *TA* is the technology acquisition in million USD dollars. *TA* is calculated as: *Intangibles + Amortisation of Intangibles + Change in Goodwill + Amortisation of Goodwill where Intangibles, Amortisation of Intangibles*, *Change in Goodwill* and *Amortisation of Goodwill* are in USD million.	Compustat
ln(1+Patent)	Natural logarithm of *Patent* where *Patent* as a measure of innovation output where *Patent* is the number of patents applied and were eventually granted.	Google Patent
PatentEff	Measure of innovation of efficiency using the number of patents granted scaled by *R&D* expenditure. PatentEff is measured as: $\frac{\ln(1+Patent)}{\ln(1+R\&D)}$	Compustat, Google Patent

Table 3.1 (Continued)

Variable	**Description**	**Source**
Innovation Input Choice	Ratio of natural logarithm of R&D expenditure to natural logarithm of TA expenditure as a measure to indicate choice of innovation input strategy. Choice is calculated as: $\frac{\ln(1+R\&D)}{\ln(1+TA)}$	Compustat
Panel B: Independent Variables		
CEO Compensation	Natural logarithm of *CEO compensation* as a measure of CEO's annual short-term and long-term equity-based compensation where CEO Pay are cash, bonus, stock option, restricted stock and other long-term compensation in USD thousand. *CEO compensation* is measured as: $[\ln(1+Cash)+\ln(1+LTIP)]$	ExecuComp
CEO LTIP	Natural logarithm of *CEO LTIP* as a measure of CEO's annual long-term equity-based compensation where *CEO LTIP* are *stock option, restricted stock and other long-term compensation* in USD thousand. *CEO LTIP* is measured as: $\ln(1+LTIP)$	ExecuComp
CEO Cash	Natural logarithm of *CEO Cash* as a measure of CEO's annual short-term compensation where *CEO Cash* is *cash* and *bonus* in USD thousand. *CEO Cash* is measured as: $\ln(1+Cash)$	ExecuComp

Table 3.1 (Continued)

Variable	**Description**	**Source**
Panel C: Moderating Variables		
Regulation	Regulation is significant amendment to pharmaceutical Regulation made by the United States Food and Drug Administration (US FDA). Regulation is measured by dummy variable coded 1 if the US FDA makes an amendment to the pharmaceutical Regulation and 0 otherwise.	US Food & Drug Administration Website
Panel D: Control Variables		
University partnership	*University Partnership* as measure of firm's partnership with university in research. It is measured by dummy variable coded 1 if the firm has partnership with university and 0 otherwise.	Datastream
Product Delay	*Product delay* as measure of firm's delay in producing new product. It is measured by dummy variable coded 1 if firm has a product delay or 0 otherwise.	Datastream
CEO Age	*CEO Age* as measure of the CEO age in natural logarithm. It is measured as: $\ln(1+Age)$	Boardex
CEO Gender	*CEO Gender* is measure gender. It is measured by dummy variable coded 1 if the CEO is female and 0 otherwise.	Boardex
CEO Replacement	*CEO Replacement* is measure of CEO being replaced. It is measured by dummy variable coded 1 if the CEO is replaced and 0 otherwise.	Boardex
Board size	Number of individuals sitting on the board of directors in the firm by natural logarithm. It is measured as: $\ln(1+BoardSize)$	Boardex

Table 3.1 (Continued)

Variable	**Description**	**Source**
Board independence	Measure the number of independent directors on board and it is calculated as ratio of the number of independent directors to the total number of board members.	Boardex
Merger & Acquisition (M&A)	M&A as a measure of firm involve in merger and acquisition. It is measured by dummy variable coded 1 if the firm makes expenses for merger and acquisitions of business and 0 otherwise.	Compustat
Return on equity	Measure of return on equity of the firm. It is calculated as the ratio of *Net Income* divided by the *Total Common Equity where Total Common Equity is in USD million.*	Compustat
Leverage	Measure of leverage of firms. It is calculated as the ratio of *Total Liabilities* to *Total Equity* where *Total Liabilities* is in USD million.	Compustat
Altman-Z	Measures the probability of the firm going to bankruptcy using the Altman's Z-score. It is measured as: $1.2\,T_1 + 1.4\,T_2 + 3.3\,T_3 + 0.6\,T_4 + 1.0\,T_5$. The T_1 to T_5 variables are listed in Panel E	Compustat
Firm Risk	Measure of risk faced by firm. It is measured as beta of a stock.	Compustat
Sales	Measure of sales of the firm. It is measured as natural logarithm of sales (in USD million).	Compustat

Table 3.1 (Continued)

Panel E: Altman Z-Score

Variable	Description	Source
	Measured as $T_1 = \frac{Working\ Capital}{Total\ Assets}$ where *Working Capital* is in USD million	Compustat
	Measured as $T_2 = \frac{Retained\ Earnings}{Total\ Assets}$ where *Retained Earnings* are in USD million	Compustat
	Measured as $T_3 = \frac{Earnings\ before\ Interests\ and\ Taxes}{Total\ Assets}$ where *Earnings before Interests and Taxes* are in USD million	Compustat
	Measured as $T_4 = \frac{Total\ Common\ Equity}{Total\ Liabilities}$ where *Total Common Equity* is in USD million	Compustat
	Measured as $T_5 = \frac{Sales}{Total\ Assets}$ where *Sales* is in USD million	Compustat

3.3.3 Empirical model

This study used a multiple-year observation dataset, which may have led to several potential issues in the panel data, including autocorrelation, heteroskedasticity and multicollinearity. Some specification tests were carried out to select the most appropriate panel model. The tests are the Hausman test[3], Testparm[4] testing, Breusch-Pagan/Cook-Weisberg, White's test and VIF test.

The specified model may suffer from endogeneity; prior upper echelons studies that draw from Compustat have shown that heteroskedasticity and autocorrelation are expected to be present in the observations (Garms and Engelen, 2019). The Wooldridge test for autocorrelation and Breusch-Pagan/Cook-Weisberg and White's test for heteroscedasticity. The results of both tests show $(p < 0.05)$, indicating there are autocorrelation and heteroskedasticity issues in the dataset. Due to these concerns, this study applies a robust standard error estimation when performing this panel data regression. Moreover, before regressing non-linear association and interaction effects, we use a centring on the mean technique to address the multicollinearity problem (Aiken and West, 1991) and perform the Variance Inflation Factor (VIF) test. All variables have a VIF between 1.02 being the lowest and 1.83 is the highest, which means multicollinearity is not an issue (Hair et al., 1995).

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[3] **Hausman Test**

The Hausman test is calculated as follows:

$H = (\beta_c - \beta_e)' (V_c - V_e)^{-1} (\beta_c - \beta_e)$

Where:

β_c is the coefficient vector from the consistent estimator
β_e is the coefficient vector from the efficient estimator
V_c is the covariance matrix of the consistent estimator
V_e is the covariance matrix of the efficient estimator

The null hypothesis is that the preferred model is random effects; The alternate hypothesis is that the model is fixed effects. If H is significant (equal or less than 0.05), the null hypothesis is rejected, and *Fixed Effects Model* should be used.

[4] **Testing for Time-Fixed Effects (Testparm)**

Testparm is conducted to see if time fixed effects are needed. A joint test is conducted to check whether the time dummies for all years are equal to zero or not (Torres-Reyna, 2007). If the Prob>F is equal or less than 0.05, the null hypothesis is rejected, which means that the coefficients for all years are not jointly equal to zero. Therefore, time fixed effects are needed.

Subsequently, a Hausman test, to determine which advanced panel data method is suitable for our dataset. The result is $(p < 0.05)$, suggesting the adoption of the fixed-effect model. The year-dummy variable is also included to capture the year-fixed effect, after the relevant Testparm test showed $(p < 0.05)$. The inclusion of firm and year-fixed effects can control the time-invariant unobservable firm characteristics, the economy-wide shocks, respectively. In addition, the application of firm-fixed effects helps to mitigate the endogeneity issue caused by omitted variables if the unobservable firm characteristics correlated with both CEO compensation and innovation output are constant over time. On top of that, the study clustered standard errors at the firm level. The study of executive incentives is empirically challenging due to potential endogeneity problems (Nguyen, 2018). Therefore, this study employed various methods to address the endogeneity concerns.

The research applies OLS fixed effects model that capture firm-year effects, and robust standard errors are clustered at firm level and also the two-stage least squares (2SLS) firm-year fixed effects model with instrumental variables (Schaffer, 2010; Wooldridge, 2016):

$$\begin{aligned} IP_{i,t} = \; & \beta_1 \text{CEO Compensation}_{i,t} + \beta_2 \text{Regulation}_{i,t} + \\ & \beta_3 (\text{CEO Compensation x Regulation})_{i,t} + \beta_4 Z_{i,t} + \alpha_i + U_{i,t} \quad \ldots\ldots\ldots\ldots (1) \end{aligned}$$

Where $IP_{i,t}$ represents firm I's innovation performance at time t with several proxies, namely innovation input strategies (R&D expenditure and technology acquisition), innovation output performance (Patent) and innovative efficiency, and innovation input choice. β_0 is the intercept term, β_1 and β_2 are regression coefficient for independent variables, β_3 is regression for control variables, CEO $\text{Compensation}_{i,t}$ is the main independent variables. $\text{Regulation}_{i,t}$ is the interaction variable, $Z_{i,t}$ is the control variables, which also include year and firm fixed effects, α_i is constant and finally, $U_{i,t}$ represents the model error term.

3.4 Data analysis and discussion

3.4.1 Descriptive statistics

The descriptive statistics for the untransformed variables are reported in Table 3.2. The maximum amount of R&D investment of US pharmaceutical firms in the sample is USD 12.18 billion, while the mean amount is USD 0.97 billion. Comparatively, the maximum technology acquisition investment is USD 223.78 billion, and the average is USD 9.27 billion. This implies the pharmaceutical firms in the US spent more cost in acquiring external technologies compared to the cost of internal innovation activities.

On average, CEOs are paid USD 11.08 million annually. The minimum and maximum values for CEO compensation are USD 0.28 million and USD 75.12 million, respectively. The maximum CEO cash is USD 6.65 million, the minimum is USD 63,000, and the average is USD 1.2 million CEO LTIP can reach USD 73.88 million and the average is USD 8.9 million. For both CEO compensation and LTIP, the standard deviation is greater than the mean, indicating high variation between values and abnormal distributions. In contrast, the standard deviation for CEO cash is less than the mean, suggesting that there is no significant difference between the CEO salary and bonus.

Table 3.3, 3.4 and 3.5 reports the pairwise Pearson correlation coefficients. R&D expenditures are positively correlated with technology acquisitions, the number of patents granted, innovation efficiency, innovation input choice, and CEO cash and long-term incentive plans. All of the innovation performance measures are positively correlated with independent variables such as CEO compensation, CEO total cash, and CEO LTIP. Furthermore, CEO cash and CEO LTIP do not have a high correlation. In comparison with Finkelstein and Boyd (1998), the logarithms of cash and long-term compensation are moderately correlated, indicating that cash and long-term compensation are sufficiently distinct concepts. Overall, the correlations among all variables are low to medium, suggesting that multi-collinearity is not an issue.

Table 3.2 Summary statistics among unstandardised regression variables

Variable	**Mean**	**Standard Deviation**	**Minimum**	**P25**	**P50**	**P75**	**Maximum**
R&D	978.599	2101.66	0	1	105.774	10962	12183
Technology Acquisition	9273.24	27893.78	0	0	467.54	208414	223782
Patent	3.55	6.72	0	0	0	41	48
PatentEff	1.14	.189	1	1	1	2	2.4
Input Choice	2.33	.52	.71	.83	2.44	3.11	3.11
CEO Compensation	11083.49	12168.98	283.135	2402.168	6063.273	56312.36	75123.04
CEO Cash	1212.21	909.35	63.462	600	957.3	5309.615	6650.1
CEO LTIP	8935.942	11421.48	0	872.683	4017.315	13028.95	73881.04
Regulation	.631	.483	0	0	1	1	1
University Partnership	.215	.411	0	0	0	1	1
Product Delay	.004	.0687	0	0	0	1	1
CEO Replacement	.090	.286	0	0	0	1	1
CEO Age	55.308	7.3847	36	38	60	68	85
CEO Gender	.143	.350	0	0	0	1	1
Board Size	9.17	2.52	4	5	9	11	16

Table 3.2 (Continued)

Variable	**Mean**	**Standard Deviation**	**Minimum**	**P25**	**P50**	**P75**	**Maximum**
Board Independence	.7766	.1484	.25	.27	.833	.88	1
Merger & Acquisition	.455	.4983	0	0	1	1	1
Return on Equity (ROE)	.0820	.9880	-16.17	-3.045	.124	2.572	16.81
Leverage	.4586	.2946	0	0	.459	2.015	3.016
Altman-Z	8.971	11.884	-6.534	-2.569	5.228	9.645	65.74
Firm Risk	.8700	.3301	-.1144	.0554	.8085	1.9737	2.0758
Sales	9041.20	22332.03	0	.209	656.98	179045	208357

N = 843 firm-year observations from 75 companies. *Statistically significant at 5% level.

Table 3.3 Pairwise correlation analysis (panel A)

Panel A

Variables	R&D	TA	Patent	PatentEff	Input Choice	CEO Compensation	CEO Cash	CEO LTIP	Regulation	University Partnership	Product Delay	CEO Replacement	CEO Age	CEO Gender
R&D	1													
TA	*0.66	1												
Patent	*0.63	*0.35	1											
PatentEff	*0.29	*0.11	*0.82	1										
Input Choice	*0.80	*0.93	*0.44	*0.15	1									
CEO Compensation	*0.63	*0.59	*0.48	*0.23	*0.64	1								
CEO Cash	*0.65	*0.50	*0.39	*0.18	*0.59	*0.53	1							
CEO LTIP	*0.27	*0.33	*0.26	*0.16	*0.32	*0.81	*0.16	1						
Regulation	0.01	0.03	*0.10	*0.08	0.01	*0.09	-0.05	*0.15	1					
University Partnership	*0.63	*0.49	*0.55	*0.30	*0.51	*0.51	*0.38	*0.31	*0.09	1				
Product Delay	*0.09	*0.10	0.03	0.02	*0.09	0.07	0.06	0.05	0.02	*0.13	1			
CEO Replacement	0.02	0.04	0.02	-0.02	0.02	0.00	*-0.10	0.03	*-0.08	0.02	-0.02	1		

Table 3.3 (Continued)

Panel A														
Variables	**R&D**	**TA**	**Patent**	**PatentEff**	**Input Choice**	**CEO Compensation**	**CEO Cash**	**CEO LTIP**	**Regulation**	**University Partnership**	**Product Delay**	**CEO Replacement**	**CEO Age**	**CEO Gender**
CEO Age	***0.07**	0.05	***0.15**	***0.19**	0.07	0.06	***0.08**	0.02	-0.01	***0.17**	0.02	***-0.19**	1	
CEO Gender	***0.10**	0.06	***-0.11**	-0.03	0.04	0.01	0.06	***0.09**	0.01	0.02	0.02	-0.05	***0.10**	1

N = 843 firm-year observations from 75 companies. *Statistically significant at 5% level.

Table 3.4 Pairwise correlation analysis (panel B)

Panel B

Variables	**R&D**	**TA**	**Patent**	**PatentEff**	**Input Choice**	**CEO Compensation**	**CEO Cash**	**CEO LTIP**	**Regulation**	**University Partnership**	**Product Delay**	**CEO Replacement**	**CEO Age**	**CEO Gender**
Board Size	***0.68**	***0.53**	***0.45**	***0.16**	***0.59**	***0.49**	***0.56**	***0.26**	-0.02	***0.40**	***0.10**	0.06	0.03	0.01
Board Independence	***0.33**	***0.29**	***0.30**	***0.18**	***0.32**	***0.46**	***0.19**	***0.43**	***0.09**	***0.21**	0.05	0.01	0.03	-0.06
Merger & Acquisition	***0.28**	***0.38**	***0.17**	0.05	***0.38**	***0.30**	***0.20**	***0.19**	0.06	***0.28**	***0.08**	0.03	-0.04	***0.07**
ROE	0.02	0.06	0.02	0.005	0.04	0.01	0.05	-0.01	0.01	***0.09**	0.00	-0.04	-0.004	-0.01
Leverage	***0.19**	***0.13**	***0.11**	0.02	***0.15**	***0.17**	0.02	***0.10**	0.01	0.01	0.00	0.03	***-0.21**	***-0.25**
Altman-Z	***0.17**	-0.22	***-0.10**	-0.04	***-0.21**	***-0.20**	***-0.08**	***-0.19**	-0.04	***-0.08**	-0.03	-0.06	***0.19**	0.04
Firm Risk	***0.22**	-0.28	***-0.15**	-0.04	***-0.23**	***-0.28**	***-0.13**	***-0.21**	-0.05	***-0.30**	-0.03	-0.06	-0.06	***0.07**
Sales	***0.43**	***0.48**	***0.33**	***0.18**	***0.42**	***0.45**	***0.38**	***0.43**	-0.002	***0.47**	***0.15**	0.03	0.01	***0.25**

N = 843 firm-year observations from 75 companies. *Statistically significant at 5% level.

Table 3.5 Pairwise correlation analysis (panel C)

Panel C								
Variables	**Board Size**	**Board Independence**	**Merger & Acquisition**	**ROE**	**Leverage**	**Altman-Z**	**Firm Risk**	**Sales**
Board Size	1							
Board Independence	***0.33**	1						
Merger & Acquisition	***0.53**	***0.23**	1					
ROE	***0.30**	***0.19**	***0.13**	1				
Leverage	0.04	***-0.02**	0.06	0.05	1			
Altman-Z	***0.16**	***0.18**	***0.13**	0.01	-0.01	1		
Firm Risk	***-0.20**	***-0.21**	***-0.10**	***-0.11**	0.02	***-0.42**	1	
Sales	***-0.20**	***-0.10**	***-0.22**	***-0.17**	-0.05	0.04	0.01	1

3.4.2 Main analysis, results and discussion

Baseline model results

Table 3.6 provides the baseline results from the OLS fixed-effect regression analyses with the input performance innovation input 'make' (R&D) and 'buy' (Technology Acquisition – TA) strategies as the dependent variables. The coefficient estimates for CEO compensation are significant and positive for the 'Make' without and with control variables in model 1 and model 2, $(\beta = 0.20; p < .01)$ and $(\beta = 0.16; p < .01)$, respectively. Similarly, for 'Buy' strategy in model 3 $(\beta = 0.21; p < .10)$ without control variables and $(\beta = 0.19; p < .10)$ with the control variable in model 4.

While, Table 3.7 provides the baseline results from the fixed-effect regression analyses with innovation output and innovation efficiency as the dependent variables. However, the coefficient estimates for CEO compensation has no significant effect on innovation outcome in model 1 and model 2, and innovation efficiency in model 3 and model 4.

Table 3.6 The association between CEO Compensation and innovation (input)

Dependent Variable	Innovation Input			
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
CEO Compensation	*****0.20**	*****0.16**	***0.21**	***0.19**
	(3.96)	(3.94)	(1.88)	(1.89)
University Partnership		**0.23		0.23
		(2.02)		(0.75)
Product Delay		-0.03		-0.04
		(-0.24)		(-0.14)
CEO Age		0.02		0.21
		(0.08)		(0.25)
CEO Gender		0.07		-0.33
		(0.26)		(-0.77)

Table 3.6 (Continued)

Dependent Variable	**Innovation Input**			
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Board Size		*0.67		0.62
		(1.76)		(0.86)
Board Independence		0.24		0.02
		(0.65)		(0.02)
Merger & Acquisition		***0.19		***0.79
		(3.55)		(4.80)
ROE		*-0.02		0.02
		(-1.77)		(0.62)
Leverage		0.18		***1.02
		(0.74)		(3.25)
Altman-Z		0.0004		-0.005
		(0.14)		(-0.79)
Firm Risk		*-0.53		0.46
		(-1.92)		(0.90)
Firm Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
Constant	***1.96	1.03	1.34	-1.60
	(4.80)	(0.75)	(1.38)	(-0.39)
No. of observations	843	843	843	843
Adjusted R2	0.39	0.450	0.386	0.451

The table presents the results from OLS regression on the association between CEO Compensation and Innovation Input (R&D or 'make' strategy – model 1,2) and (technology acquisition or 'buy' strategy – model 3,4). In model 1 and 3, we add CEO Compensation without control variables. In model 3 and 4, we add CEO Compensation and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 3.7 The Association between CEO compensation and innovation (outcome and efficiency)

Dependent Variable	Innovation Outcome		Innovation Efficiency	
	Patent		PatentEff	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
CEO Compensation	0.03	0.02	-0.01	-0.005
	(0.52)	(0.36)	(-0.83)	(-0.44)
University Partnership		***0.46		0.03
		(3.67)		(1.38)
Product Delay		-0.64		-0.04
		(-0.83)		(-0.36)
CEO Age		***1.47		***0.31
		(3.28)		(3.35)
CEO Gender		-0.23		-0.004
		(-1.00)		(-0.08)
Board Size		0.04		-0.12
		(0.17)		(-1.30)
Board Independence		0.54		0.04
		(1.03)		(0.51)
Merger & Acquisition		0.01		-0.003
		(0.15)		(-0.20)
ROE		0.003		0.002
		(0.28)		(0.90)
Leverage		0.001		-0.02
		(0.01)		(-0.74)
Altman-Z		-0.001		*-0.002
		(-0.59)		(-1.72)
Firm Risk		0.04		-0.0001
		(0.21)		(-0.00)
Firm Effect	Yes	Yes	Yes	Yes

Table 3.7 (Continued)

Dependent Variable	Innovation Outcome		Innovation Efficiency	
	Patent		PatentEff	
Model	Model 1	Model 2	Model 3	Model 4
Year Effect	Yes	Yes	Yes	Yes
Constant	-0.59	***-6.74	***1.05	0.05
	(-1.17)	(-3.39)	(9.24)	(0.13)
No. of observation	843	843	843	843
Adjusted R^2	0.22	0.28	0.10	0.15

The table presents the results from OLS regression on the association between CEO Compensation and Innovation Outcome (Patent – model 1, 2) and Innovation Efficiency (PatentEff – model 3,4). In model 1 and 3, we add CEO Compensation without control variables. In model 3 and 4, we add CEO Compensation and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 3.8 shows the baseline results from the fixed-effect regression analyses with innovation input choice as the dependent variables. The coefficient estimates for CEO compensation are significant and positive for without and with control variables in model 2 and model 3, $(\beta = 0.06; p < .01)$ and $(\beta = 0.05; p < .01)$, respectively.

Table 3.8 The association between CEO compensation and innovation input choice

Dependent Variable	Innovation Input Choice	
Model	Model 1	Model 2
CEO Compensation	***0.06**	***0.05**
	(4.38)	(3.68)
University Partnership		0.004
		(0.10)
Product Delay		-0.03
		(-0.75)

Table 3.8 (Continued)

Dependent Variable	**Innovation Input Choice**	
Model	**Model 1**	**Model 2**
CEO Age		0.08
		(0.66)
CEO Gender		-0.08
		(-1.38)
Board Size		0.14
		(1.38)
Board Independence		-0.01
		(-0.13)
Merger & Acquisition		***0.10
		(4.35)
ROE		0.002
		(0.51)
Leverage		**0.10
		(2.16)
Altman-Z		-0.0007
		(-0.82)
Firm Risk		0.001
		(0.02)
Firm Effect	Yes	Yes
Year Effect	Yes	Yes
Constant	***1.45	0.81
	(11.76)	(1.44)
No. of observations	843	843
Adjusted R^2	0.37	0.42

The table presents the results from OLS regression on the association between CEO Compensation and Innovation Input Choice (model 1, 2). In model 1, we add CEO Compensation without control variables. In model 2, we add CEO Compensation and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 3.9 provides the results from the OLS Fixed-Effect regression analyses with input performance innovation (input ‘make’ and ‘buy’ strategies, outcome, efficiency, and choice) as the dependent variables and Regulation as moderating variables. The coefficient estimate for CEO compensation is significant and positive for the ‘Make’ strategy model ($\beta = 0.20; p < .01$) in model 1. Similarly, for the ‘Buy’ strategy, the coefficient estimate for CEO compensation is significant and positive ($\beta = 3.69; p < .01$) in model 2. The coefficient estimate for CEO compensation has no significant link with the innovation outcome (Patent) and innovation efficiency (PatentEff) as in model 3 and model 4, respectively. In model 5, the coefficient estimates for CEO compensation is positive and significant for innovation input choice ($\beta = 0.05; p < .01$).

Table 3.9 The association between CEO compensation, regulations and innovation performance

Dependent Variable	**Innovation Input**		**Innovation Outcome**	**Innovation Efficiency**	**Innovation Input Choice**
	'Make' Strategy (R&D)	**'Buy' Strategy (TA)**	**Patent**	**PatentEff**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
CEO Compensation	***0.20***	***3.69***	-0.03	-0.02	***0.05***
	(3.93)	(5.50)	(-0.67)	(-1.43)	(3.08)
Regulation	***1.16	0.11	***1.02	***0.22	***0.466
	(4.48)	(0.95)	(2.78)	(3.09)	(5.02)
CEO Compensation X Regulation	***-0.06**	*****-1.80**	****0.09**	0.02	*****-0.101**
	(-1.88)	(-3.64)	(2.21)	(1.61)	(-2.96)
University Partnership	**0.26	0.19	***0.42	0.024	0.004
	(2.22)	(0.59)	(3.34)	(1.04)	(0.11)
Product Delay	-0.04	-0.0113	-0.62	-0.04	-0.038
	(-0.29)	(-0.03)	(-0.77)	(-0.30)	(-0.75)
CEO Age	0.01	0.23	***1.49	***0.32	0.088
	(0.04)	(0.28)	(3.27)	(3.36)	(0.66)

Table 3.9 (Continued)

Dependent Variable	**Innovation Input**		**Innovation Outcome**	**Innovation Efficiency**	**Innovation Input Choice**
	'Make' Strategy (R&D)	**'Buy' Strategy (TA)**	**Patent**	**PatentEff**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
CEO Gender	0.08	-0.34	-0.24	-0.006	-0.087
	(0.28)	(-0.80)	(-1.05)	(-0.12)	(-1.37)
Board Size	*0.65	0.66	0.07	-0.12	0.145
	(1.72)	(0.91)	(0.26)	(-1.26)	(1.37)
Board Independence	0.264	-0.02	0.50	0.03	-0.019
	(0.72)	(-0.02)	(0.98)	(0.41)	(-0.12)
Merger & Acquisition	***0.19	***0.79	0.009	-0.004	***0.100
	(3.56)	(4.80)	(0.12)	(-0.24)	(4.33)
ROE	*-0.02	0.02	0.004	0.003	0.002
	(-1.88)	(0.66)	(0.33)	(0.95)	(0.51)
Leverage	0.17	***1.04	0.01	-0.02	**0.103
	(0.70)	(3.27)	(0.10)	(-0.65)	(2.14)

Table 3.9 (Continued)

Dependent Variable	**Innovation Input**		**Innovation Outcome**	**Innovation Efficiency**	**Innovation Input Choice**
	'Make' Strategy (R&D)	**'Buy' Strategy (TA)**	**Patent**	**PatentEff**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Altman-Z	0.0003	-0.005	-0.001	*-0.002	-0.0007
	(0.12)	(-0.76)	(-0.54)	(-1.69)	(-0.82)
Firm Risk	*-0.53	0.45	0.035	-0.001	0.001
	(-1.93)	(0.88)	(0.18)	(-0.03)	(0.02)
Firm Effect	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes
Constant	0.815	-1.148	***-6.399	0.137	0.814
	(0.59)	(-0.29)	(-3.25)	(0.33)	(1.47)
No. of observations	843	843	843	843	843
Adjusted R^2	0.452	0.452	0.285	0.165	0.419

The table presents the results from OLS regression on the association between CEO Compensation, Regulations and Innovation Performance as measured by Input (R&D or 'make' strategy – model 1 and Techhnology Acquisition or 'buy' strategy – model 2), innovation outcome (Patent – model 3), innovation efficiency (PatentEff – model 4) and innovation input choice (model 5). t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment

Direct effects

In order to address endogeneity concerns, this study employs Two-stage Least Squares (2SLS) Fixed-effect regression (Schaffer, 2010) with the CEO experience (Liu et al., 2021), CEO replacement and one-year lag of CEO compensation as instrumental variables (Campbell and Minguez-Vera, 2008). The use of lag variables is to avoid simultaneity (Reed, 2015). Table 3.10 provides the results from the 2SLS FE regression analysis in Models 2, 4, 6, 8 and 10, with dependent variables (input 'make' (R&D) and 'buy' (TA) strategies, outcome, efficiency and choice) and regulation as moderator.

Hypothesis 1 posits that CEO compensation is positively associated with innovation input. The coefficient estimates for CEO compensation is significant and positive for the 'Make' strategy model ($\beta = 0.57; p < .01$) in model 2. As for 'Buy' strategy the coefficient estimate for CEO compensation is significant and positive ($\beta = 0.99; p < .01$) in model 4. In both the make and buy strategies, the results support Hypothesis 1.

Hypothesis 2 provides that CEO compensation is positively associated with innovation outcome. The coefficient estimate for CEO compensation has no significant link with the innovation outcome (Patent) as in model 6. The result does not provide support to Hypothesis 2. Hypothesis 3 suggests that CEO compensation is positively associated with innovation efficiency. The coefficient estimate for CEO compensation has no significant link with the innovation efficiency (PatentEff) as in model 8. The result does not provide support to Hypothesis 3. The direction for both coefficient estimates are similar, negative.

Hypothesis 4 states that CEO compensation is positively related to 'Make' strategy being the preferred input choice. In model 10, the coefficient estimates for CEO compensation is positive and significant for innovation input choice ($\beta = 0.20; p < .01$). The result provides support to Hypothesis 4.

Moderation effects

It is interesting to examine how regulation amendments in the industry affect the relation between CEO compensation and innovation. Table 3.10 model 2, 4, 6, 8 and 10 present results for the interaction effects of regulation on CEO compensation and innovation performance measures based on 2SLS FE regression analysis. Hypothesis 5a argues that the association between CEO compensation and innovation input is positively moderated by regulation. Based on the 2SLS FE regression analysis, the coefficient estimate for the interaction term is negative and significant for 'Make' strategy, ($\beta = -0.24; p < .01$) in model 2. The coefficient estimate for interaction term is also negative and significant for 'Buy' strategy ($\beta = -0.36; p < .05$) in model 4. The results both offer support to Hypothesis 5a through the 'Make' and 'Buy' strategy. In Figure 3.2, the presence of regulation amendment decreases the 'Make' input expenditure. On the contrary, the presence of Regulation amendment increases the 'Buy' input expenditure as shown in Figure 3.3.

While hypothesis 5b and 5c posit that the association between CEO compensation and innovation outcome and efficiency is negatively moderated by regulation, respectively. In model 6 and model 8, the coefficient estimates for interaction term is positive and significant for innovation outcome ($\beta = .10; p < .1$) and likewise for innovation efficiency ($\beta = .04; p < .05$). Thus, the study is unable to find support to Hypothesis 5b and 5c. From Figure 3-4, the amendment to regulation increases the innovation outcome. Similarly, the innovation efficiency also increases as shown in Figure 3-5. Finally, hypothesis 5d proposes that the association between CEO compensation and innovation input choice is positively moderated by regulation. The interaction term between CEO compensation and regulation on innovation input choice is positive and significant ($\beta = .08; p < .01$) as in model 10. Therefore, the study offers support to Hypothesis 5d.

Table 3.10 The association between CEO compensation, regulations and innovation performance

Dependent Variable	Innovation Input				Innovation Outcome		Innovation Efficiency		Innovation Input Choice	
	'Make' Strategy		'Buy' Strategy		Patent		PatentEff			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
CEO Compensation	*****0.20**	*****0.57**	*****3.69**	*****0.99**	-0.03	-0.02	-0.02	-0.03	*****0.05**	**0.20*****
	(3.93)	(5.32)	(5.50)	(3.65)	(-0.67)	(-0.24)	(-1.43)	(-1.36)	(3.08)	(5.38)
Regulation	***1.16	***0.19	0.11	0.17	***1.02	0.07	***0.22	0.01	***0.46	0.06*
	(4.48)	(3.70)	(0.95)	(0.55)	(2.78)	(0.42)	(3.09)	(0.37)	(5.02)	(1.47)
CEO Compensation X Regulation	***-0.06**	*****-0.24**	*****-1.80**	****-0.36**	****0.09**	***0.08**	0.02	0.03	*****-0.10**	**-0.08*****
	(-1.88)	(-4.20)	(-3.64)	(-2.34)	(2.21)	(1.21)	(1.61)	(1.67)	(-2.96)	(-3.76)
University Partnership	**0.26	***0.38	0.19	**0.51	***0.42	***0.33	0.02	0.008	0.004	***0.07
	(2.22)	(4.35)	(0.59)	(2.43)	(3.34)	(2.63)	(1.04)	(0.36)	(0.11)	(2.65)
Product Delay	-0.04	0.04	-0.01	0.14	-0.62	-0.68	-0.04	-0.06	-0.03	-0.004
	(-0.29)	(0.20)	(-0.03)	(0.32)	(-0.77)	(-1.03)	(-0.30)	(-0.56)	(-0.75)	(-0.06)
CEO Age	0.01	0.009	0.23	0.15	***1.49	***1.59	***0.32	***0.32	0.08	0.09

Table 3.10 (Continued)

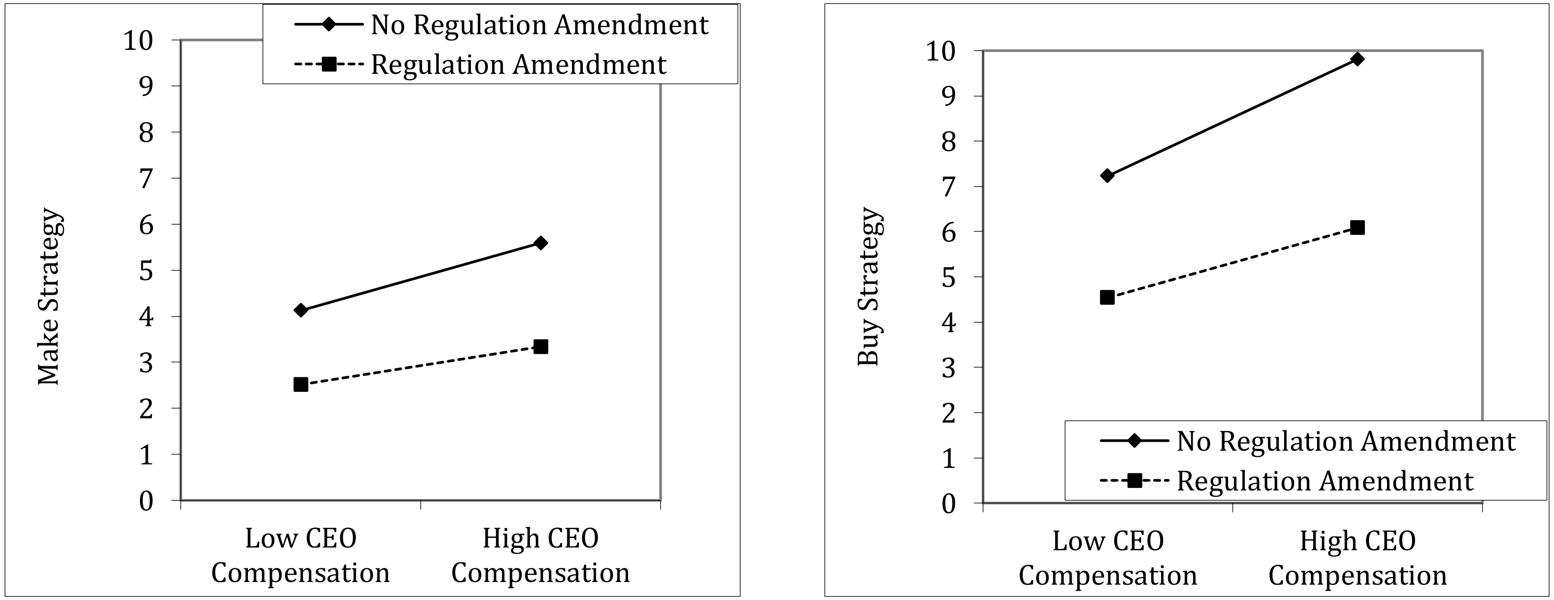
Dependent Variable	**Innovation Input**				**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**	
	'Make' Strategy		**'Buy' Strategy**		**Patent**		**PatentEff**			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
	(0.04)	(0.04)	(0.28)	(0.26)	(3.27)	(5.15)	(3.36)	(3.82)	(0.66)	(0.94)
CEO Gender	0.08	0.32	-0.34	-0.03	-0.24	0.06	-0.006	0.05	-0.08	-0.008
	(0.28)	(1.06)	(-0.80)	(-0.06)	(-1.05)	(0.44)	(-0.12)	(1.29)	(-1.37)	(-0.15)
Board Size	*0.65	**0.53	0.66	0.006	0.07	0.13	-0.12	**-0.12	0.14	0.03
	(1.72)	(2.54)	(0.91)	(0.01)	(0.26)	(0.65)	(-1.26)	(-2.04)	(1.37)	(0.51)
Board Independence	0.26	0.24	-0.02	0.02	0.50	0.21	0.03	-0.05	-0.01	-0.002
	(0.72)	(0.99)	(-0.02)	(0.03)	(0.98)	(0.74)	(0.41)	(-0.82)	(-0.12)	(-0.03)
Merger & Acquisition	***0.19	*0.12	***0.79	***0.80	0.009	0.005	-0.004	-0.003	***0.10	***0.09
	(3.56)	(1.82)	(4.80)	(5.80)	(0.12)	(0.08)	(-0.24)	(-0.25)	(4.33)	(4.84)
ROE	*-0.02	-0.02	0.02	0.01	0.004	0.005	0.003	0.002	0.002	0.0008
	(-1.88)	(-1.15)	(0.66)	(0.55)	(0.33)	(0.30)	(0.95)	(0.86)	(0.51)	(0.22)
Leverage	0.17	0.04	***1.04	***1.02	0.01	-0.01	-0.02	-0.03	**0.10	0.07

Table 3.10 (Continued)

Dependent Variable	**Innovation Input**				**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**	
	'Make' Strategy		**'Buy' Strategy**		**Patent**		**PatentEff**			
	OLS FE	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**	**OLS FE**	**2SLS FE**
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
	(0.70)	(0.22)	(3.27)	(2.74)	(0.10)	(-0.09)	(-0.65)	(-0.94)	(2.14)	(1.52)
Altman-Z	0.0003	-0.002	-0.005	**-0.01	-0.001	-0.001	*-0.002	-0.002**	-0.0007	**-0.002
	(0.12)	(-1.02)	(-0.76)	(-2.34)	(-0.54)	(-0.54)	(-1.69)	(-2.04)	(-0.82)	(-2.29)
Firm Risk	*-0.53	***-0.47	0.45	0.83*	0.03	-0.02	-0.001	-0.01	0.001	0.07
	(-1.93)	(-2.85)	(0.88)	(1.77)	(0.18)	(-0.14)	(-0.03)	(-0.42)	(0.02)	(1.10)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.81		-1.14		***-6.39		0.13		0.81	
	(0.59)		(-0.29)		(-3.25)		(0.33)		(1.47)	
No. of observations	843	759	843	759	843	759	843	759	843	759
Adjusted R^2	0.45	0.25	0.45	0.27	0.28	0.12	0.16	0.01	0.41	0.13

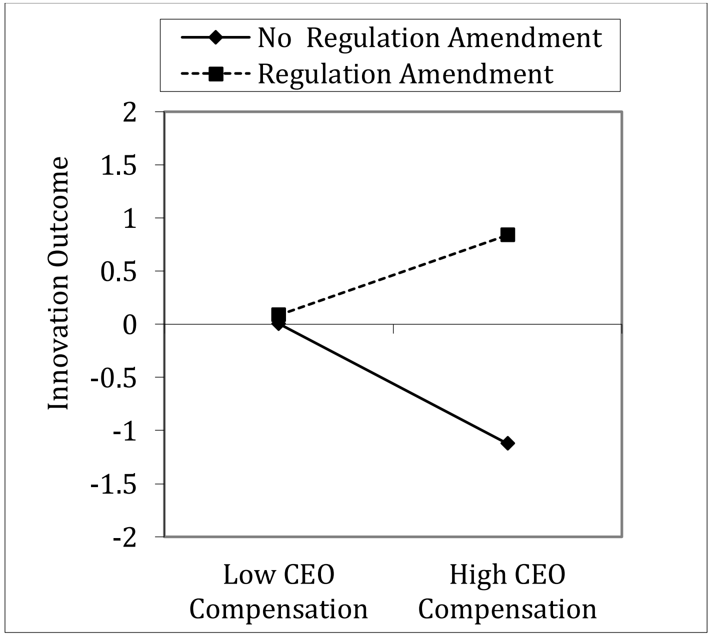
The table presents the results from OLS (as in model 1, 3, 5, 7, 9) and 2SLS (as in model 2,4,6,8,10) regression on the association between CEO Compensation, Regulations and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1,2 and technology acquisition or 'buy' strategy –

model 3,4) and innovation outcome (Patent – model 5,6) and innovation input choice (model 9,10). t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment. In the 2SLS FE regression analysis, we apply CEO experience, CEO replacement and one-year lag of CEO compensation as instrumental variables as in Model 2, 4, 6, 8 and 10.

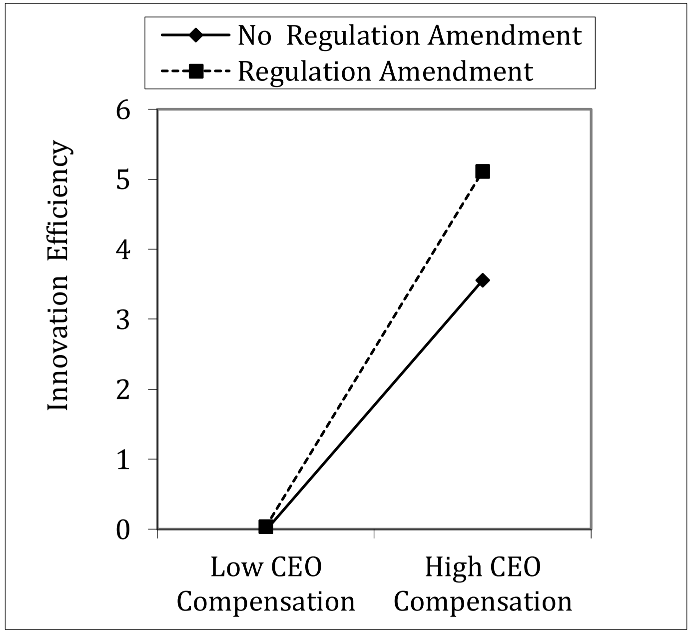


(Based Table 3.10 Model 2) (Based on Table 3.10 Model 4)

Figure 3-2 The interaction effects of CEO compensation and regulations on innovation performance (input)



(Based on Table 3.10 Model 6)



(Based on Table 3.10 Model 8)

Figure 3-3 The interaction effects of CEO compensation and regulations on innovation performance (outcome and efficiency)

Discussion

This chapter aims to examine the association between CEO compensation and innovation performance in the pharmaceutical industry, and to what extent the industry's regulation influences the link. First, this research addresses the question concerning how CEO compensation is associated with innovation various activities such as input strategies, outcome, efficiency and choice at the firm's level. The results show that CEO compensation is positively associated with innovation input strategies both 'make' and 'buy' strategy. The finding indicates that higher compensation motivates CEOs to engage in more innovation input strategies, as reflected in the amount of investment both in internal R&D and external technology acquisition. Indeed, the finding is consistent with previous studies (Balkin et al., 2000; Xue, 2007; Ramaswamy and Banta, 2017; Nguyen, 2018; Zulfiqar and Hussain, 2020). The findings also uphold the early views that assertive highly paid CEOs have higher managerial discretion that enables them to make the strategic choice of investment in innovation (Finkelstein and Boyd, 1998), thus making them the drivers for greater innovative success (Castellion, 2010).

In terms of innovation outcome, the association between CEO compensation and the number of patents granted is insignificant. Unlike other studies using U.S. data showing that a significant amount of R&D investment can lead to greater patents and citations (Sheikh, 2012), but the previous study is based on cross-industries. Similar results showing that higher CEO compensation has insignificant association with innovation efficiency. The finding, however, is not surprising in light of the previous studies. This may be due to a variety of reasons, mainly the nature of the industry in which these findings originated and the fact that the R&D development process lasted for a very long period of time with uncertain outcomes. A typical research and development project in the industry takes the industry 15 to 20 years (Grabowski, 2011). In this regard, it does not really reflect the company's ability to generate significant outcome and patents per dollar spent on R&D.

Balsmeier and Buchwald (2015) point out that CEOs influence innovation projects in accordance with the attributes and preferences they have. It is worth mentioning that this thesis takes a different approach from previous research and introduces an indicator by which one can measure the CEO's preference for innovation input strategies: to make (invest in R&D) or to buy (acquire technology from a third party).

The findings of this thesis suggest that a highly rewarded CEO shows greater interest in internal innovations, thus preferring to invest in the firm's research and development activities to encourage the production of patents in the future. In line with this, it has been observed that increasing competition in a number of industries has encouraged firms to develop strategic approaches to strengthen their positions on the market (Huang and Jacob, 2014).

Second, the study is to provide insight into the impact of an external governance mechanism such as regulation has on CEO compensation and innovation association. Indeed, pharmaceutical industry provides great platform for this analysis because the industry is widely recognised as heavily regulated industry. According to the upper echelon theory, CEO compensation is one characteristic of the executive, and the organisation's performance is essentially a reflection of the characteristics of its top executives. As such, the study provides meaningful insight into how a change in the industry's regulation will affect the relationship between CEO compensation and innovation. Based on the results, it appears that the amendment of the industry's regulation has a mixed effect on the links. The study concluded that regulation weakened the link between CEO compensation and the ‘make’ strategy (R&D expenditures), and between CEO compensation and the ‘buy’ strategy (TA). Conversely, the industry’s regulation strengthened the link between CEO compensation and innovation outcome (Patent). On top of that, a highly paid CEO would prefer to invest more in purchasing external technologies in the event of a change to industry regulation. According to the current literature, at the moment there is no previous evidence related to how regulation amendments or legislative environments can affect the link between a highly paid CEO and innovation performance. The discussion has been built around the direct effects of regulation or regulatory institution on innovation and the finding is mixed. As an example, there have been studies that present empirical evidence that regulation has a direct impact on the level of R&D investment and innovation behaviour. In a recent study conducted by Yi et al. (2020), it was found that regulatory institutions have an important role to play in strengthening the innovation R&D intensity in manufacturing firms in China. In addition, from an environmental perspective, there is empirical evidence that regulation promotes green innovation behaviour (Peng et.al., 2021). In particular, early studies show the evolving Food, Drug and Cosmetics Act 1962, the FDA Regulation has a mixed impact on innovation activities. As discussed in Schnee (1979), regulation has led to a fivefold increase in investment in the pharmaceutical industry, but the number of new pharmaceutical products produced every year has fallen by half. The evolving act has also discouraged innovation by delaying approval and the costs associated with producing a new product (Virts and Weston, 1980; Grabowski, 2011).

3.4.3 Additional analysis

Robustness check and endogeneity test

The 2SLS Fixed-effects regression analyses were repeated with the firm's 1-year lag of sales variable. The variable of sales is added as it is a proxy for firm size and to control for potential resource scale and market power effects on innovation performance. In Table 3.11, the firm's 1-year lag of sales variable is added in models 2, 4, 6, 8 and 10. The table reports the robustness result for CEO compensation and the interaction term for CEO compensation and Regulation on innovation input strategies, outcomes, efficiency and input choice from Models 1 to 10. The results from the additional analyses suggest the robustness of our main results.

Table 3.11 The association between CEO compensation, regulations and innovation performance (robustness – add sales)

Dependent Variables	**Innovation Input**				**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**	
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**		**Patent**		**PatentEff**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
CEO Compensation	***0.57**	***0.69**	***0.99**	***0.97**	-0.02	-0.04	-0.03	-0.03	***0.20**	***0.21**
	(5.32)	(5.70)	(3.65)	(3.24)	(-0.24)	(-0.32)	(-1.36)	(-1.27)	(5.38)	(5.17)
Regulation	***0.19	0.11	0.17	0.27	0.07	0.09	0.01	0.04	0.06*	0.06
	(3.70)	(0.71)	(0.55)	(0.78)	(0.42)	(0.46)	(0.37)	(0.93)	(1.47)	(1.47)
CEO Compensation X Regulation	***-0.24**	***-0.27**	**-0.36**	*-0.30**	0.08	0.09	0.03	0.01	***-0.08**	***-0.07**
	(-4.20)	(-4.11)	(-2.34)	(-1.77)	(1.21)	(1.23)	(1.67)	(1.13)	(-3.76)	(-3.24)
University Partnership	***0.38	***0.35	**0.51	**0.44	***0.33	**0.35	0.008	0.02	***0.07	**0.06
	(4.35)	(3.59)	(2.43)	(2.20)	(2.63)	(2.57)	(0.36)	(1.05)	(2.65)	(2.16)
Product Delay	0.04	0.38	0.14	0.30	-0.68	-0.56	-0.06	-0.01	-0.004	0.06
	(0.20)	(1.63)	(0.32)	(0.34)	(-1.03)	(-0.48)	(-0.56)	(-0.07)	(-0.06)	(0.41)
CEO Age	0.009	0.17	0.15	0.13	***1.59	***1.69	***0.32	***0.36	0.09	0.08

Table 3.11 (Continued)

Dependent Variables	**Innovation Input**				**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**	
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**		**Patent**		**PatentEff**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
	(0.04)	(0.62)	(0.26)	(0.20)	(5.15)	(4.68)	(3.82)	(3.58)	(0.94)	(0.80)
CEO Gender	0.32	0.19	-0.03	-0.31	0.06	0.07	0.05	0.02	-0.008	-0.03
	(1.06)	(0.71)	(-0.06)	(-0.55)	(0.44)	(0.50)	(1.29)	(0.62)	(-0.15)	(-0.61)
Board Independence	0.24	-0.009	0.02	-0.10	0.21	0.09	-0.05	-0.02	-0.002	-0.03
	(0.99)	(-0.04)	(0.03)	(-0.14)	(0.74)	(0.30)	(-0.82)	(-0.33)	(-0.03)	(-0.30)
Merger & Acquisition	*0.12	***0.17	***0.80	***0.77	0.005	0.03	-0.003	-0.0005	***0.09	***0.09
	(1.82)	(2.80)	(5.80)	(5.16)	(0.08)	(0.54)	(-0.25)	(-0.03)	(4.84)	(4.19)
ROE	-0.02	-0.01	0.01	-0.004	0.005	***0.03	0.002	**0.007	0.0008	-0.002
	(-1.15)	(-0.49)	(0.55)	(-0.11)	(0.30)	(2.75)	(0.86)	(2.10)	(0.22)	(-0.49)
Leverage	0.04	0.11	***1.02	***1.45	-0.01	0.02	-0.03	-0.01	0.07	***0.14
	(0.22)	(0.55)	(2.74)	(3.34)	(-0.09)	(0.20)	(-0.94)	(-0.42)	(1.52)	(2.82)
Altman-Z	-0.002	-0.002	**-0.01	-**0.02	-0.001	0.0003	**-0.002	-0.0008	**-0.002	*-0.001

Table 3.11 (Continued)

Dependent Variables	**Innovation Input**				**Innovation Outcome**		**Innovation Efficiency**		**Innovation Input Choice**	
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**		**Patent**		**PatentEff**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
	(-1.02)	(-0.85)	(-2.34)	(-2.39)	(-0.54)	(0.08)	(-2.04)	(-0.64)	(-2.29)	(-1.82)
Firm Risk	***-0.47	**-0.42	*0.83	0.81	-0.02	-0.05	-0.01	-0.01	0.07	0.05
	(-2.85)	(-2.27)	(1.77)	(1.53)	(-0.14)	(-0.36)	(-0.42)	(-0.34)	(1.10)	(0.83)
Board Size	**0.53		0.006		0.13		**-0.12		0.03	
	(2.54)		(0.01)		(0.65)		(-2.04)		(0.51)	
Sales		-0.008		**0.12		-0.0002		-0.005		*0.01
		(-0.25)		(2.10)		(-0.01)		(-1.17)		(1.93)
Firm Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	759	759	759	759	759	759	759	759	759	759
Adjusted R^2	0.25	0.19	0.27	0.29	0.12	0.11	0.07	0.04	0.13	0.14

The table presents the results from 2SLS fixed-effect regression on the association between CEO Compensation, Regulations and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1,2 and technology acquisition or 'buy' strategy – model 3,4), innovation outcome (Patent – model

5,6), innovation efficiency (PatentEff – model 7,8) and innovation input choice (model 9,10). In model 2,4,6,8 and 10, we add firm's 1-year lag of sales to test the robustness of the results. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

To address the endogeneity concerns, the study employs several approaches to mitigate the potential problems. To start with, this study included an extensive set of control variables in the regression analysis (Nguyen, 2018). Secondly, this is a longitudinal study and the panel data structure itself in the fixed-effect panel data regression model used can correct for the endogeneity problem to some extent (Wooldridge, 2016). The insertion of the firm and year fixed effects in the panel data regression model would capture the unobserved firm and time-specific effects arising from the omitted variables problem especially when unobservable variables are correlated with CEO compensation and innovation performance measures that are constant over time (Ebbes et al., 2017; Nguyen, 2018). In addition to this, the final analysis uses a two-stage instrumental variable approach with fixed effect regression (Schaffer, 2010). Through the use of these approaches, this study addresses the concerns regarding endogeneity.

The results for the endogeneity test for the regression analysis using different innovation performance measures, namely, the innovation input 'Make' strategy (R&D), 'Buy' strategy (Technology Acquistion – TA), innovation outcome (Patent), innovation efficiency (PatentEFF) and the input choice models showing $(p<.05)$. The results, therefore, are unable to reject the null hypothesis of exogeneous. The results from Kleibergen-Paap rk LM underidentification test of instrumental variables for all models (innovation input, outcome, efficiency and input choice) reject the null hypothesis of underidentification $(p<.05)$. Furthermore, the Kleibergen-Paap rk Wald *F*-statistic values are all higher than the rule of thumb value of 10 (Staiger and Stock, 1997). The results, thus, imply that the instrumental variables used in the study are not weak. To test for overidentification, the Hansen *J* test is used. The Hansen J test results show $(p<.05)$, therefore, the results are able to reject the null hypothesis of overidentification for all regression models using various innovation performance measures, implying valid instrumental variables.

Additional analysis (CEO Cash and CEO LTIP)

To gain deeper insights into how CEO compensation is associated with innovation performance, two types of CEO compensation were analysed, namely CEO cash (short-term) and CEO LTIP (long-term) compensation using 2SLS Fixed-effects model and applies new CEO replacement variable, lag of CEO Cash and CEO LTIP as the instrumental variables, respectively. The use of lag variables is to avoid simultaneity (Reed, 2015). To some degree, the type of compensation can become a motivating factor for executives in aiming for higher firm value (Mehran, 1995).

Table 3.12 reports the results for CEO cash, CEO LTIP, regulation and innovation performance (innovation input). Model 1 presents result for the association between CEO cash, regulation and innovation input ('make' strategy). The coefficient estimate for CEO cash is positive and significant ($\beta = 0.58; p < .01$) on 'make' strategy. Conversely, the coefficient estimate for CEO cash and regulation on 'make' strategy is significant albeit negative ($\beta = -0.30; p < .05$). Model 2 presents result for the association between CEO LTIP, regulation and innovation input ('make' strategy). The coefficient estimate for CEO LTIP is significantly positive ($\beta = 0.07; p < .10$) with 'make' strategy. The coefficient estimate for the interaction terms between CEO LTIP and regulation on 'make' strategy is significant and negative ($\beta = -0.06; p < .05$). Model 3 presents result for the association between CEO cash, regulation and innovation input ('buy' strategy). The results show that the coefficient estimate for CEO cash and 'buy' strategy is in positive direction and insignificant. Likewise, the coefficient estimate for the interaction term between CEO cash and regulation with 'buy' strategy is positive but insignificant. Model 4 presents result for the association between CEO LTIP, regulation and innovation input ('buy' strategy). The coefficient estimate for CEO LTIP and 'buy' strategy is positive and significant ($\beta = 0.10; p < .10$). However, the coefficient estimate for the interaction term between CEO LTIP and regulation with 'buy' strategy is negative and insignificant.

Table 3.13 presents the results on the association between CEO Cash, CEO LTIP, regulation and innovation outcome (Patent) and efficiency (PatentEff). Model 1 and model 3 present results for CEO cash, regulation and innovation outcome (Patent) and innovation efficiency (PatentEff), respectively. The coefficient estimates for CEO cash with innovation outcome and efficiency are negative and insignificant. The coefficient estimate for the interaction term between industry's regulation and CEO cash on innovation outcome is significant and positive ($\beta = 0.29; p < .10$) in model 1 and also significant and positive ($\beta = 0.04; p < .10$) in model 3 with innovation efficiency. The coefficient estimate for CEO LTIP and innovation outcome and efficiency is negative and insignificant as in model 2 and model 4 respectively.

Table 3.14 presents result for the association between CEO cash, CEO LTIP, regulations, and innovation input choice. Model 1 reports result for CEO cash, regulation and innovation input choice. The coefficient estimate for CEO cash is significant and positive with innovation input choice ($\beta = 0.18; p < .05$). However, the coefficient estimate for CEO cash and regulation on innovation input choice is insignificant albeit negative direction. Model 2 reports result for CEO LTIP, regulation and innovation input choice. The coefficient estimate for CEO LTIP is significant and positive ($\beta = 0.02; p < .05$) with innovation input choice. Whereas, the coefficient estimate for regulation on CEO LTIP and innovation input choice is significant albeit negative ($\beta = -0.01; p < .10$).

Zhou et al. (2021) highlight that executives' short-term incentive has a positive association with R&D, while executives' long-term incentive has an insignificant link based on China-listed firms' study. Similarly, findings from this thesis show that CEO short-term compensation is positively associated with R&D. This recent study, provides deeper insight to the literature by adding that the association is to some extent is affected by regulations introduced or amendment made by the government. Under these circumstances, other industries such as nuclear, manufacturing, finance and banking and transportation industry may have similar impact. On the other hand, this study shows that regulations positively influence the association between CEO cash and innovation outcome and efficiency, respectively. On top of that, regulation also influences highly paid CEOs (cash) to change their preference for innovation input strategy from a 'make' to a 'buy' strategy. Findings of this study extend the previous research insight by explaining how external corporate governance mechanisms influence the link between different types of compensation such as CEO short-term and long-term compensation and innovation performance.

Table 3.12 The association between CEO compensation (cash and LTIP), regulations and innovation performance (input)

Dependent Variables	**Innovation Input**			
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
CEO Cash	***__0.58__	***__0.52__	0.22	0.26
	(2.93)	(3.44)	(0.39)	(0.60)
CEO LTIP	*__0.04__	*__0.07__	**__0.09__	*__0.10__
	(1.91)	(1.92)	(2.05)	(1.35)
Regulation	-0.18	-0.05	-0.22	-0.19
	(-1.21)	(-0.35)	(-0.86)	(-0.68)
CEO Cash X Regulation	**__-0.30__		0.02	
	(-2.26)		(0.08)	
CEO LTIP X Regulation		**__-0.06__		-0.01
		(-2.19)		(-0.28)
University Partnership	***0.37	***0.35	0.33	*0.35
	(4.08)	(4.02)	(1.60)	(1.85)
Product Delay	-0.01	-0.05	-0.04	-0.04

Table 2.12 (Continued)

Dependent Variables	**Innovation Input**			
	'Make' Strategy (R&D)			**'Buy' Strategy (TA)**
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	(-0.12)	(-0.28)	(-0.14)	(-0.16)
CEO Age	0.15	0.16	0.56	0.54
	(0.60)	(0.61)	(0.97)	(0.95)
CEO Gender	0.37	0.40	-0.24	-0.23
	(1.17)	(1.22)	(-0.43)	(-0.41)
Board Size	***0.53	**0.49	0.32	0.30
	(2.68)	(2.40)	(0.63)	(0.60)
Board Independence	0.17	-0.0002	-0.08	-0.08
	(0.77)	(-0.00)	(-0.14)	(-0.12)
Merger & Acquisition	***0.26	***0.24	***0.87	***0.87
	(4.94)	(4.66)	(6.13)	(6.56)
ROE	**-0.03	**-0.03	0.01	0.008
	(-2.11)	(-2.04)	(0.27)	(0.25)

Table 2.12 (Continued)

Dependent Variables	**Innovation Input**			
	'Make' Strategy (R&D)		**'Buy' Strategy (TA)**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Leverage	0.119	0.12	***1.15	***1.14
	(0.66)	(0.68)	(3.10)	(3.06)
Altman-Z	0.002	*0.003	-0.005	-0.005
	(1.38)	(1.85)	(-1.03)	(-1.06)
Firm Risk	***-0.531	***-0.55	0.64	0.65
	(-3.17)	(-3.34)	(1.44)	(1.45)
Firm Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
No. of observations	759	759	759	759
Adjusted R^2	0.29	0.27	0.35	0.35

The table presents the results from OLS regression on the association between CEO Compensation (Cash and LTIP), Regulations and Innovation Performance as measured by innovation input (R&D or 'make' strategy – model 1,2 and technology acquisition or 'buy' strategy – model 3,4). In model 1 and 3, we add CEO Cash, CEO LTIP, Regulations, interaction term between CEO Cash and Regulations and all control variables. In model 2 and 4, we add CEO Cash, CEO LTIP, Regulations, interaction term between CEO LTIP and Regulations and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 3.13 The association between CEO compensation (cash and LTIP), regulations and innovation performance (outcome and efficiency)

Dependent Variable	**Innovation Outcome**		**Innovation Efficiency**	
	Patent		**PatentEff**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
CEO Cash	-0.20	-0.002	-0.04	-0.01
	(-0.93)	(-0.01)	(-1.00)	(-0.52)
CEO LTIP	-0.02	-0.04	-0.004	-0.009
	(-0.86)	(-1.11)	(-0.77)	(-1.09)
Regulation	0.13	0.02	0.04	0.02
	(0.80)	(0.17)	(1.06)	(0.51)
CEO Cash x Regulation	***0.29**		***0.04**	
	(1.95)		(1.69)	
CEO LTIP x Regulation		0.04		0.01
		(1.47)		(1.55)

Table 3.13 (Continued)

Dependent Variable	**Innovation Outcome**		**Innovation Efficiency**	
	Patent		**PatentEff**	
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
University Partnership	**0.29	***0.34	0.009	0.01
	(2.14)	(2.63)	(0.42)	(0.66)
Product Delay	-0.74	-0.71	-0.06	-0.0
	(-1.19)	(-1.12)	(-0.62)	(-0.54)
CEO Age	***1.61	***1.58	***0.32	***0.317
	(5.04)	(5.15)	(3.70)	(3.71)
CEO Gender	-0.08	-0.04	0.03	0.03
	(-0.51)	(-0.27)	(0.76)	(0.83)
Board Size	0.26	0.21	**-0.12	**-0.12
	(1.20)	(0.98)	(-1.97)	(-2.00)
Board Independence	0.11	0.22	-0.05	-0.04
	(0.41)	(0.78)	(-0.90)	(-0.63)
Merger & Acquisition	-0.01	0.006	-0.009	-0.005

Table 3.13 (Continued)

Dependent Variable	Innovation Outcome		Innovation Efficiency	
	Patent		PatentEff	
Model	Model 1	Model 2	Model 3	Model 4
	(-0.29)	(0.10)	(-0.62)	(-0.39)
ROE	0.009	0.005	0.003	0.003
	(0.50)	(0.30)	(1.17)	(1.01)
Leverage	-0.02	-0.03	-0.04	-0.04
	(-0.26)	(-0.29)	(-1.30)	(-1.32)
Altman-Z	-0.0008	-0.001	**-0.002	**-0.002
	(-0.31)	(-0.60)	(-2.19)	(-2.33)
Firm Risk	-0.07	-0.04	-0.01	-0.01
	(-0.48)	(-0.27)	(-0.42)	(-0.32)
Firm Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
No. of observations	759	759	759	759
Adjusted R^2	0.11	0.12	0.01	0.01

The table presents the results from OLS regression on the association between CEO Compensation (Cash and LTIP), Regulations and Innovation Performance as measured by innovation outcome (Patent – model 1,2) and innovation efficiency (PatentEff – model 3,4). In model 1 and 3, we add CEO Cash, CEO LTIP, Regulations, interaction term between CEO Cash and Regulations and all control variables. In model 2 and 4, we add CEO Cash, CEO LTIP, Regulations, interaction term between CEO LTIP and Regulations and all control variables. t statistics (in parentheses); * $p<0.10$, ** $p<0.05$, *** $p<0.01$; All standard errors are subject to Huber/White adjustment.

Table 3.14 The association between CEO compensation (cash and LTIP), regulation and innovation input choice

Dependent Variable	Innovation Input Choice	
Model	**Model 1**	**Model 2**
CEO Cash	****0.18**	*****0.17**
	(2.31)	(2.86)
CEO LTIP	*****0.02**	****0.02**
	(3.08)	(2.44)
Regulation	-0.04	-0.006
	(-1.05)	(-0.14)
CEO Cash x Regulation	-0.07	
	(-1.41)	
CEO LTIP x Regulation		***-0.01**
		(-1.83)
	(2.41)	(2.34)
Product Delay	-0.03	-0.03
	(-0.86)	(-1.21)
CEO Age	0.16*	*0.16
	(1.75)	(1.73)
CEO Gender	0.01	0.01
	(0.14)	(0.27)
Board Size	0.02	0.01
	(0.40)	(0.26)
Board Independence	-0.03	-0.07
	(-0.35)	(-0.79)
Merger & Acquisition	***0.12	***0.11
	(6.00)	(5.92)
ROE	-0.002	-0.002
	(-0.80)	(-0.80)

Table 3.14 (Continued)

	Innovation Input Choice	
	Model 1	Model 2
Leverage	**0.10	**0.10
	(2.12)	(2.14)
Altman-Z	-0.00005	0.0002
	(-0.07)	(0.28)
Firm Risk	0.04	0.04
	(0.79)	(0.69)
Firm Effect	Yes	Yes
Year Effect	Yes	Yes
No. of observations	759	759
Adjusted R^2	0.23	0.20

The table presents the results from OLS regression on the association between CEO Compensation (Cash and LTIP), Regulations and Innovation Performance as measured by innovation input choice (model 1,2). In model 1, we add CEO Cash, CEO LTIP, Regulations, interaction term between CEO Cash and Regulations and all control variables. In model 2, we add CEO Cash, CEO LTIP, Regulations, interaction term between CEO LTIP and Regulations and all control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

3.5 Conclusion

3.5.1 Theoretical and research-related implications

Indeed, this chapter has several theoretical and research-related implications. At present, very few studies have examined the relationship between CEO compensation and regulation and innovation. Moreover, scholarly research pays little attention to strategic leadership characteristics and governance mechanisms in relation to innovation performance in the pharmaceutical industry. Therefore, this thesis focuses on CEO compensation and regulation, and further investigates how these two evident characteristics of the pharmaceutical industry influence innovation performance. In doing so, the thesis fills gap in the literature by providing new insights and makes several significant contributions to theory, literature and management practices.

This research contributes to the notion of the upper echelon theory in one significant way. In following the previous studies (Sheikh, 2012; You et al., 2020), the theoretical lens for this thesis is the upper echelon theory that supports the explanation of the proposed relationship between CEO compensation and innovation. However, a crucial part of this present study is the expansion of the upper echelons theory by integrating an industry-specific regulation as part of an external corporate governance mechanism in the research model. The present study contributes to a better understanding of the association by quantifying the importance of macro-environmental factors, specifically the industry's regulation, in shaping the role of CEO compensation on innovation performance. Thus, this study adds to the theoretical development by integrating upper echelons theory with industry regulation and showing how it fosters the relationship between CEO compensation and innovation.

This thesis contributes to the literature related to strategic leadership, corporate governance and innovation. Second, this study adds to the literature on strategic leadership by providing insights on how top executives' characteristics, specifically CEO compensation, and individually the short- and long-term incentives influence innovation investment, outcome, efficiency and strategic input choices. Specifically, to the pharmaceutical industry, there is little attention paid to the study of strategic leadership in relation to innovation performance (Hill and Hansen, 1991; Finkle, 1998; Cardinal, 2001; Sloan and Hsieh, 2007; Hess and Rothaermel, 2011; Grabowski, 2011; Houston et al., 2013). Nevertheless, the available literature suggests that a team leader plays an important role in the success of R&D projects in the pharmaceutical industry (Hara, 2003). This thesis moves the literature by providing empirical evidence that a strategic leader such as the CEO is also important for the innovative success of the industry through the mechanism of strategic decision making (Castellion, 2010).

Furthermore, this research contributes to the literature by adding evidence and insights from the pharmaceutical industry. Research outside of the pharmaceutical industry has noted that executives' incentives play a significant role in innovation processes, but little research looks at the relationship between innovation inputs and 'Make' and 'Buy' strategies (Xue, 2007). The present study contributes to the literature by arguing that the total CEO compensation drives internal innovation strategy initiatives through the pursuit of both a 'Make' and a 'Buy' strategy, with more preference for the 'Make' strategy. Looking into further fractionation based on the components of compensation, it was found that both cash (short-term) and long-term compensation are associated with higher investment in R&D innovation activities as well as preferring the 'Make' strategy over the 'Buy' strategy. Overall, CEOs with higher levels of total, short- and long-term compensation make more investment in R&D and are more likely to rely on internal innovation. It is indeed a surprise because innovation input 'buy' strategy such as technology acquisition can reduce the time to market drug products, however, due to the purchases often involve an enormous one-off imbursement and, therefore, this may explain behind the preference for R&D investment (Ford and Probert, 2010; Mortara and Ford, 2012).

The third contribution of this chapter is to the literature on corporate governance. The thesis contributes to the literature by explaining how external governance mechanisms such as the industry's regulation impact CEO compensation-innovation performance link. As one of the least studied facets of corporate governance, the study provides insight by illustrating that Regulation within the industry can moderate the association between CEO compensation and innovation performance. As an external corporate governance tool, the function of regulation is to align the interests of agents with the stakeholders in pursuing greater performance. However, to some extent changes in industry regulation weakened the driving power of highly paid CEOs in investing in internal R&D.

Virts and Weston (1980) highlight that the introduction of new or amendment of existing Regulation can be a challenge because it affects the timing of producing new products and returns to R&D activities of the firms. Findings of this research, however, provide the explanation that highly paid CEOs find an alternative for innovation input by undertaking a 'buy' or external technology acquisition strategy. Indeed, regulation changes can delay approval and raise the cost of producing a new product (Virts and Weston, 1980; Grabowski, 2011) and may affect pharmaceutical companies' operations and drug production (Oliver, 2017; Martin et al., 2018). CEOs with high compensation have greater managerial discretion (Finkelstein and Boyd, 1998). Therefore, they are able to influence organisational strategic decisions by investing more in external technologies acquisition to reduce the time to market products (Ford and Probert, 2010; Mortara and Ford, 2012). The study reveals further insights on the compensation component by showing that the industry's regulation strengthens the association between CEOs' long-term compensation and the level of innovation input, the number of patents granted and innovation efficiency. This implies that industry regulation plays a more effective role as a governance mechanism in aligning the interests of CEOs with stakeholders for greater innovation performance through long-term compensation.

Fourth, to the innovation literature, the contribution is in the form of innovation measurement and a valuable insight into governing innovation performance. This thesis includes a self-constructed variable to reflect CEOs' preference for innovation input as either 'make' or 'buy' strategies. Instead of focusing mainly on the commonly used innovation measures, such as R&D and the patents count, this study extends the literature by employing four innovation measures: innovation input strategies 'Make' and 'Buy', outcome, efficiency and introducing the strategic innovation input choice variable. In this respect, the findings of this study suggest that long-term compensation levels have a stronger relationship with innovation performance, as compared to short-term compensation levels.

More specifically, the long-term is associated with all innovation indicators, such as: making and buying things, number of patents granted, innovation efficiency, and choice of innovation input. Clearly, from these findings that CEOs with high long-term compensation have more influence and power in championing the firm's innovation agenda than CEOs who receive low long-term compensation. On top of that, regulation has proven to be an important monitoring instrument in strengthening the role of high paid CEOs in promoting innovation success, with the exception of the 'Make' strategy. The present research moves the literature of innovation from the basic perspective of compensation-innovation performance, that highly paid CEOs are assertive and have higher managerial discretion to influence the strategic decision (Finkelstein and Boyd, 1998) to the notion that the association is very much contingent upon the industry's regulation.

3.5.2 Managerial implications

The findings of the research have managerial implications and contributions to three important groups in organisation. Firstly, it is valuable for the firms' Compensation Committee. Obviously, innovation in the pharmaceutical industry is driven by economic incentives, in particular, by 'fat cat' CEO compensation (USA Today, 2016; Business Insider, 2018; Mendoza, 2019). Through the findings, the research provides a useful reference for the compensation committees to design a compensation package for top executives. Compensation packages that are thoughtful and properly designed could significantly motivate CEOs to perform better in innovation processes (Mousa and Chowdhury, 2014).

Secondly, the findings are beneficial for the firms' Search Committee. Hiring an unsuitable CEO and rewarding inappropriate compensation levels can hinder the firm's innovation goal, causing the firm to lose market share and competitiveness. On top of that, this study highlights not only the importance of the CEO compensation but also the industry's regulation. In this case, the Search Committee may consider recruiting someone for the CEO post who has some background dealing with the industry's regulation matters and regulatory authorities. A recent study highlights that the regulatory environment is a top concern of many firms nowadays, with three-quarters of CEOs reporting that they spend more time working with regulators or government officials. Specifically, to the pharmaceutical industry, among the factors that are governed by federal Regulation are product quality and quantity, R&D, packaging and labelling requirements and prices.

Thus, keeping up with Regulation and procedures in this industry can consume 25% of a pharma firms' budget (Martin et al. 2018). Given the challenging regulatory environment in which pharmaceutical companies operate, it is not surprising that regulation has a significant impact on the link between CEO compensation and innovation performance. This study recommends considering hiring CEO who has previous experience and knowledge in the pharmaceutical regulation, and who has a good network with government authorities, both of which are essential skills for this industry.

Thirdly, the findings from this research are important for those involved in strategic decision-making and policymaking, such as the board of directors. The importance of providing effective incentives for executives lies with the Board of Directors, as exemplified by Thomsen and Conyon (2012). Therefore, this research is important as a reference for board members because a suitable compensation package will also enable pharmaceutical firms to formulate strategy on how to handle the 'fat cat' CEO compensation, manage their limited resources more effectively, and reduce agency costs. In addition, this study suggests the Board of Directors to also observe the impact of external macro environmental factor such as the industry's regulation on the nexus of CEOs compensation and innovation performance. Moreover, through the findings of this research, it is made to understand that regulation is a crucial corporate governance tool to align the interest of CEOs with the stakeholders.

Taken together, this study helps the industry players particularly the pharmaceutical firms, by providing valuable reference to Search and Compensation Committees and Board of Directors, in deciding on a suitable candidate for the CEO post, offering suitable compensation packages to attract the best and most capable candidates for the CEO position. In addition, it is wise for the Board of Directors and stakeholders to be cautious when there is a regulation amendment because to some extent it weakens the association between highly paid CEOs and internal innovation strategy.

3.5.3 Limitations and further research

Our study focuses on CEOs as the most influential strategic leaders influencing company decision-making (Barker and Mueller, 2002), but the strategic direction is also dependent on the collective leadership of top managers and boards of directors (Cannella et al., 2009). Future research may wish to investigate how high compensation and other strategic leadership characteristics such as gender, experience, education and turnover affect innovation performance. Moreover, it is worthwhile to investigate other macroenvironmental factors or external corporate governance mechanisms as moderating or mediating variables. As this study is focusing on interaction term, thus future study may consider to examine the mediating effects.

Companies in the pharmaceutical industry are not the only ones that benefit from this research. The findings from this study can be generalised and applied to firms in other highly regulated industries as well such as banking and finance, nuclear, transportation and manufacturing. Therefore, future study may consider to conduct an investigation on these industries.

Finally, this study recommends that future studies on TMT individuals should consider how highly regulated versus less regulated industries affect their R&D commitments and include various innovation measurements such as 'make' and 'buy' strategies, and innovation input choice. Also, it is interesting to investigate CEOs' risk behaviour towards innovation performance in a highly regulated industry.

Chapter 4 Does political affiliation drive innovation input intensity? The role of board diversity

Abstract

This chapter aims to investigate the link between political affiliation and innovation input intensity in the listed firms related to the Malaysian palm oil industry from 2008 until 2018. The study also scrutinizes the role of corporate governance mechanisms, namely board diversity in mitigating the link. The present analysis reveals that firms with political affiliation have a lower intensity of innovation input. However, stronger association is found in firms with a higher proportion of female board members. Surprisingly, firms with more board nationality diversity further weakened the association. Additional investigation shows that different types of political affiliation have varying relationships with innovation input intensity. Specifically, firms that appoint politicians on board tend to produce lower innovation input intensity. In contrast, the present study does not find any evidence that suggests government officer on board has any impact of innovation input intensity. In short, political affiliation has a negative link with innovation while governance mechanisms such as board diversity in particular gender diversity aligns the interest of political affiliation with innovation goal, while nationality diversity is inadequate governance tool in pursuing innovation agenda. The evidence is fairly robust to alternative regression model, instrumental variables, various firm-level control variables and possible endogeneity. The present study contributes to the literature of innovation, strategic leadership and corporate governance by adding insights from Southeast Asia. Ultimately, the study extends upper-echelon theory that the link between strategic leaders' characteristics and organization outcome is contingent upon corporate governance mechanisms.

Keywords: Political affiliation, Board diversity, Innovation

4.1 Introduction

This chapter explores the association between political affiliation and innovation as well as examines the impact of board diversity on the association in Malaysia palm oil firms. Malaysia palm oil industry provides an interesting platform for the study due to its significance and unique characteristics. First, this industry is significant. Figure 4.1 shows that palm oil is the largest production of vegetable oils which accounts for 40% of global major vegetable oils throughout 2017-2022 (US Department of Agriculture USDA Foreign Agricultural Service, 2022). Malaysia is the world's second-largest producer and exporter of palm oil and is highly dependent on innovation activities such as the adoption of mechanization to remain competitive (Basiron, 2007; Craven, 2011).

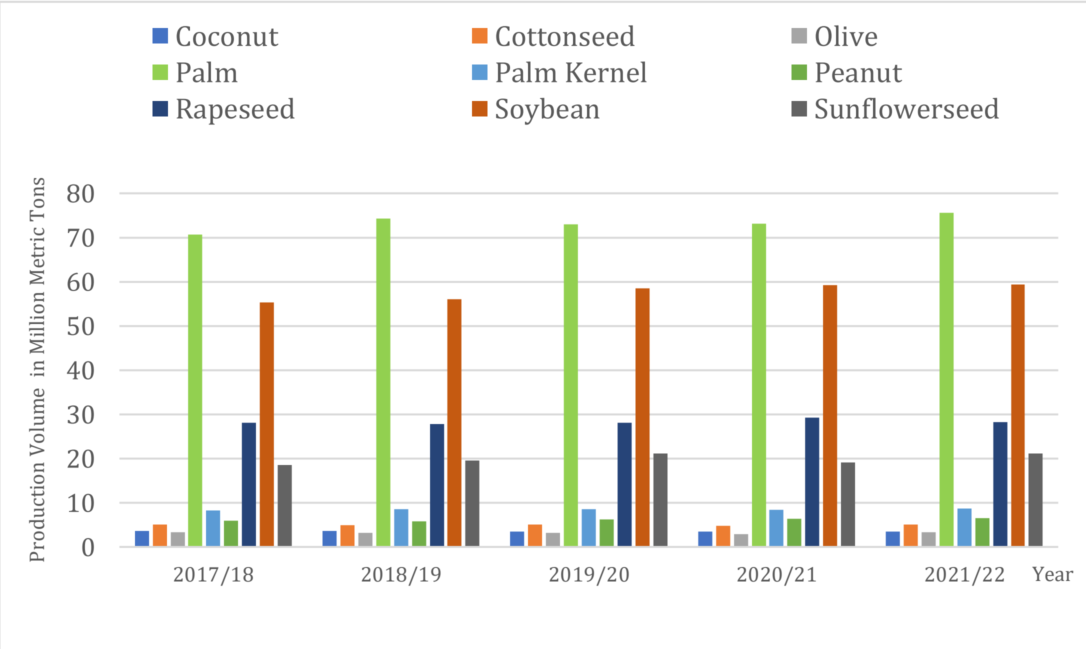


Figure 4-1 Production volume of major vegetable oils worldwide from 2017/18 to 2021/2022

Source. US department of agriculture; USDA foreign agricultural service April 2022

Second, the nature of innovation in the Malaysia palm oil industry is unique. For product-related innovations in this industry, in general, they are rarely firm-based, but rather emerge from an institutional framework and are shared by all the participating firms in the sector (Rasiah and Shahrin, 2005). Nevertheless, there are a few Malaysia palm oil firms involved in research and development at the corporate-level (Sime

Darby, 2017). Therefore, it is interesting to investigate how this whole industry that is rarely directly involved in R&D and patenting governs their innovation activities.

Third, the Malaysia palm oil industry is closely linked to government policies (Rasiah, 2006). According to Houston et al. (2014), firms that closely related to government policies tend to engage politically connected directors for greater corporate performance. Still, little is known on how political connection affects innovation performance. The literature on political affiliation and firm performance put less emphasis on other Asian perspectives. Most of the existing studies are based on China's perspective. As example, the impact of political connection on cornerstone investment in state owned firms (McGuinness, 2019), corporate social responsibility (Rauf et al., 2021), financial performance (Ling et al. 2016) and innovation performance (Lin et al., 2011; Song et al., 2015; Wu, 2011; Hou et al., 2017; Kwak et al., 2021). Interestingly, Zhang et al. (2019) explores the influence of political ties in China and India and discover the political ties increase institutional support and the effects of cognitive capital on product innovation performance is significantly stronger in India. Yet, little is known how political affiliation affects innovation performance in other Asian region, particularly from the Southeast Asia such as the Malaysian firms. Other Asian perspectives are needed because most of China listed firms are state-owned. Thus, the agency relationship within firms and approach of governance mechanisms might be different.

Fourth, the palm oil industry is labelled as a gendered industry (Lai, 2011). The present study shows that board gender diversity in Malaysia palm oil listed firms is at an average of 10%. Despite being a male-dominated industry, these firms are gradually moving towards a more gender diverse, following the government requirement of 30% of female representatives (Ariff et al., 2017). Notably, a critical mass perspective suggests three or more females will allow a positive influence on innovation (Torchia et al., 2011). Thus, it is interesting to investigate if gender diversity at this level has any association with innovation performance in this industry, or female directors are just 'tokens' for the sake of fulfilling government requirements.

Fifth, the Malaysian palm oil industry went through a unique phase of development. This was from transnational to national in the early 1970s and, recently, decades to transnational (Pye and Bhattacharya, 2013). Previous studies highlight the important implication of nationality variable on transnational team performance (Earley and

Mosakowski, 2000). Yet, there is a limited corporate governance study focusing on nationality variable (Kaczmarek et al., 2012). This present study recognises nationality diversity is an important variable in a transnational firm and there is scarce evidence in the literature. Therefore, it is motivating to investigate how nationality diversity influences innovation strategy. Similar to gender diversity, nationality diversity brings dynamics to firms. For instance, nationality diversity in the top management team enhances corporate entrepreneurship by providing globally dispersed knowledge, emergent technologies, and specialised expertise and more innovative (Boone et al., 2018). Besides, board nationality diversity brings in various elements in terms of social, cultural, psychological and institutional characteristics, all of which exert positive association with firm's performance (Delis et al., 2017). In fact, the combination of various ideas, knowledge, and skills from different background greatly cultivate the potential for innovative creation (Swann et al., 2004).

Indeed, based on the unique characteristics of Malaysia palm oil industry, the present study is driven to provide answers based on Southeast Asia perspective to several questions such as '*How does political affiliation associate with innovation input intensity*?'. Little is known from the Southeast Asia on the role of board diversity as a governance mechanism in driving innovation agenda. Thus, the current study seeks to answer, '*To what extent does board diversity such as gender and nationality diversity influence the association between political affiliation and innovation input intensity*?'.

In sum, the chapter relies on the upper-echelon theory and agency theory in answering the research questions. Based on the theory, the organizational outcome is a reflection of the top executives' characteristics (Hambrick and Mason, 1984; Cannella et al., 2009). Whereas the central premise of agency theory is that the 'separation of ownership and control' creates an agency problem if the principal and agent have self-interest and when there is insufficient monitoring. Therefore, there is a need for governance mechanisms such as board of directors to limit the acting agent's self-serving behaviour (Eisenhardt, 1989; Thomsen and Conyon, 2012). Similar to the first two core chapters, this study suggests an extension of the upper-echelon's theoretical framework in a research model by integrating internal corporate governance mechanism namely the board diversity, particularly gender and nationality diversity, thus explaining the association between political affiliation, board diversity and innovation strategy.

The finding of this chapter reveals that firms with politically connected directors tend to have lower innovation input intensity. However, stronger association is found in firms with a higher proportion of female board members. Surprisingly, firms with more board nationality diversity further weakened the association. Subsequently, in additional examination, the political affiliation was divided into two types: politician on board and government officer on board. The investigation demonstrates that different types of political affiliation have varying relationships with innovation input intensity. Particularly, firms that appoint politicians on board tend to produce lower innovation input intensity. Contrariwise, the present study does not find any evidence that suggests government officer on board has any impact on innovation input intensity. In short, political affiliation has a negative link with innovation while governance mechanisms such as board diversity in particular gender diversity aligns the interest of political affiliation with innovation goal, while nationality diversity is an inadequate governance tool in pursuing innovation agenda. The finding holds after controlling various control variables and applying an alternative regression model namely the two-stage least square regression with the inclusion of instrumental variables, indicating the finding is fairly robust.

The present study offers a number of important contributions. First, it extends the upper-echelon theory by integrating governance mechanisms namely board diversity to the framework. Second, the study extends the largely Western-focused innovation, strategic leadership and corporate governance literature to an important and noticeably different context from Southeast Asia. Research on political affiliation, board gender and nationality diversity on Asian's innovation performance is under studied. Ariff et al. (2017) offer some information from Malaysia's perspective pertaining to just one reporting financial year, 2013, and the board diversity is represented by a diversity index. Furthermore, Kweh et al. (2019) suggest a point of data by highlighting only the role of board gender diversity in relation and limited to only firm performance (ROA, ROE). Third, unlike other research, the present study extends board diversity to include nationality diversity and contributes deeper insights on how board diversity can impact the association between political affiliation and innovation. Fourth, this chapter contributes empirically by applying industry-contextually relevant innovation measure namely the ratio of book value of plant, machinery and equipment to total asset to indicate innovation input intensity.

The finding provides significant managerial and policy implications to government and industry players. This chapter highlights the importance of board composition in achieving greater innovation strategy, specifically the appointment of political affiliated director, female directors, and nationality diverse directors as board members. Overall, the finding suggests the need for deep contemplation of the board composition, type of directors and governance for better innovation performance at the firm-level.

4.2 Literature review

4.2.1 Theoretical background

Figure 4.2 presents the conceptual framework of this core chapter. The study relies on the upper-echelon theory, which explains the relationship between a director's characteristics such as a politically connected director and innovation performance indicated by innovation input intensity. The framework also explains how the association is impacted by governance tool such as board diversity. The agency theory postulates the primary function of BoD is monitoring due to a conflict of interest antecedent from the separation of the organisation's ownership and control or aligning the interests of agents with those of the stakeholders (Fama and Jensen, 1983).

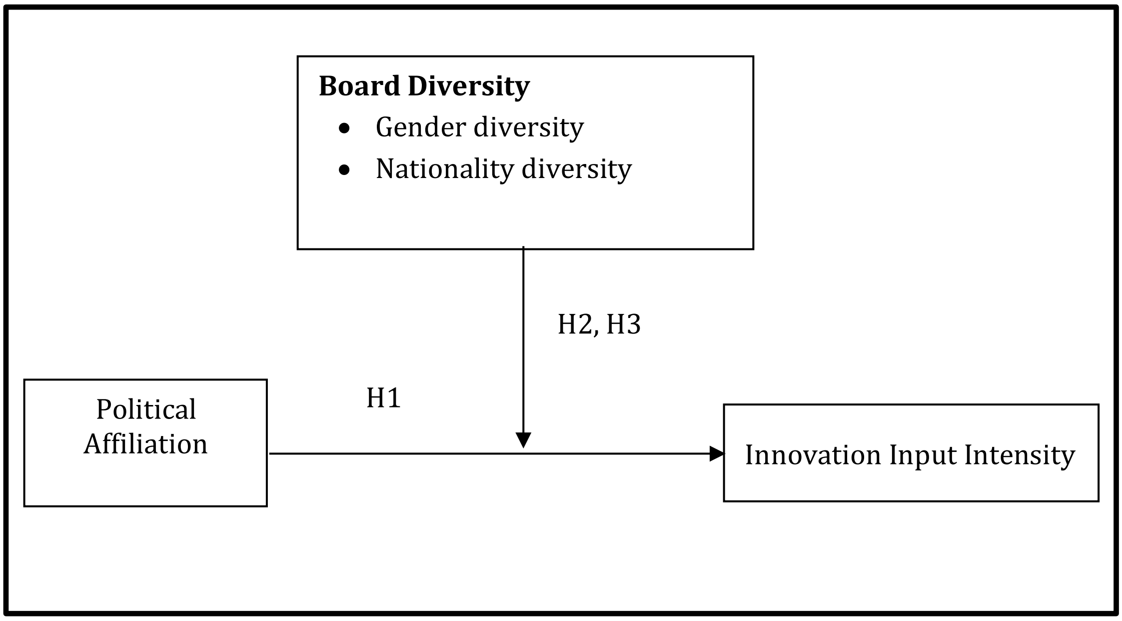


Figure 4-2 Conceptual framework on the association between political affiliation, board diversity and innovation strategy

4.2.2 Direct effects of political affiliation on innovation input intensity

Malaysia was ruled by a single long-dominant coalition party, the National Front (Barisan Nasional) from 1957 to 2018. Greene (2010) highlights that the political economy of consistent winning single-party dominance comprises a large state and a politically dormant public bureaucracy. Under such an environment, the dominant parties can transform public resources into patronage goods and unlawful funds for partisan campaigning and outspend the opposition at every turn. Apart from that, the dominant parties also engage mega projects like advantage-seeking politicians in all competitive systems through political appointees. However, the nation experienced the first change of the ruling party when the National Front lost to Alliance of Hope (Pakatan Harapan) in the 14th General Election in 2018. Ufen (2020) identifies, among others, a massive corruption scandal led to economic worries, thereby contributing to the defeat.

The innovation performance of the Malaysian palm oil industry is linked to national strategic economic growth policies such as the Eleventh Malaysia Plan 2016-2020 (Economic Planning Unit, 2015). This implies that the sector received considerable attention from the government. Rasiah (2006) highlights that this industry gains benefits from government policy instruments and government connections in assisting knowledge and information flows.

However, it is arguable that firms closely linked to the national strategic policies certainly benefit from politically connected directors. Politically affiliated directors are expected to provide critical resources to firms. As such, politically connected firms allow easier access to information, government funds, tax benefits (Al-dhamari and Ku Ismail, 2015), land, capital and licences (Ling et al., 2016) that enable firms to perform better. However, it is suggested that the presence of politically affiliated directors could cause more harm to performance as firms tend to have fewer professionals and may instead fulfil the political goals of politicians (Fan et al., 2007).

The existing research on political affiliations, financial performance and innovation present mixed arguments. Several previous studies established a positive link between political connection with firm value in particular market capitalisation, sales, assets, price and the equity ratio in the United States (Goldman et al., 2009), stock price, bank loans, tax preference and government subsidies in China (Cheng, 2018). The previous studies applied multivariate and OLS regression, respectively. In addition, firms with political connections experienced higher stock prices and a speedy recovery from the Asian financial crisis after the introduction of capital controls policy which is in favour of political cronies in Malaysia (Johnson and Mitton, 2003). Moreover, Shin et al. (2018) found a positive link between political affiliation and firm financial performance in large business conglomerates in South Korea. The study uses OLS and probit regression model and includes a wider scope of political affiliation definition, such as former journalists or social activities.

However, some studies argue that political connection negatively associated with financial performance. A study from Italy presents a negative impact of political affiliation in bank financial performance (Carretta et al., 2012). Separately, political connection also negatively affects firms' earning quality in the top 100 listed Malaysia firms (Al-dhamari and Ku Ismail, 2015). Notably, most of the previous studies are using OLS regression.

Specifically, on innovation performance, the literature also presents mixed evidence. A study based on China data finds a positive effect of political connection with innovation. However, the study focuses on the background of CEOs who are politically connected persons (Lin et al., 2011). Interestingly, Wu (2011) finds political connections have an inverted U-shaped with innovation in Chinese manufacturing firms. The study argues that positive effect diminishes as costs of political connection outweigh the benefits. Furthermore, Zhang et al. (2015) argue that the effects of political connection on innovation depend on innovation tasks. For instance, political ties are only beneficial for the exploratory type of innovation and counter-productive for exploitative innovation. This is because exploratory innovation activities facing higher institutional uncertainties and potential regulatory concerns and, therefore, large time investments in political ties benefit firm performance.

On the contrary, a study finds that while political connection lowers financing constraints, it also lowers Chinese private listed firms' innovation efficiency due to the improper use of capital (Song et al., 2015). Hou et al. (2017) also find a negative association between political connection and corporate innovation due to inappropriate resources allocation that hinders innovation the publicly listed non-state-owned firms in China. Similarly, political ties reduce R&D intensity of privately controlled listed Chinese firms (Wang et al., 2018).

There are similar approaches taken by existing studies. Most studies investigate the direct association of political affiliation on financial and innovation performance are using dummy indicator (Hou et al., 2017; Song et al., 2015). Except for Wang et al. (2018) which use both dummy and the percentage of politically affiliated directors on board. Other studies use the percentage of government ownership to measure political affiliation (Wu, 2011) and average time spends with government officers (Zhang et al., 2015). Most recent studies are based on Chinese cross-industries firms (Song et al., 2015; Hou et al., 2017; Wang et al., 2018) and manufacturing firms (Lin et al., 2011; Wu, 2011 and Zhang et al., 2015).

Using a single strategic industry from Southeast Asia, the present study proposes that firms in the palm oil industry will to some extent gain benefit from national policies via politically affiliated directors. These firms can gain easier access to critical resources essential for greater innovation success. Therefore, we propose:

Hypothesis 1. Political affiliation is positively associated with innovation input intensity

4.2.3 Interaction between political affiliation and gender diversity and the effects on innovation input intensity

A more diverse board brings positive dynamics to a firm. Blau (1977) suggests that greater diffusion of diversity within a group can weaken social barriers. Under this mechanism, positive forces of diversity will surface as enlightened by the value-in-diversity hypothesis. Apart from that, greater board diversity has a higher level of independence (Fama and Jensen, 1983), and higher board independence often means better monitoring and governance (Sena et al., 2018).

Many studies show that gender diversity has a positive force. An earlier study explains that boards with female representatives are more participative, and more participative boards lead to more progressive performance (Pearce and Zahra, 1991). Similarly, gender diversity is associated with better monitoring (Adams and Ferreira, 2009), driving socially-responsible investment (Cheah et al., 2011) and promoting transparency (McGuinness et al., 2017). In addition, gender diversity is also positively associated with risk management (Chen et al., 2016), accounting quality (García Lara et al., 2017), firm value (Carter et al., 2003; Campbell and Minguez-Vera, 2008), environmental performance (Elmagrhi et al., 2018) and innovation (Miller and Triana, 2009; Bernile et al., 2018; Chen et al., 2018; Bertrand and Mullainathan, 2003).

Nevertheless, several studies present the association between gender diversity and organisational outcome to be mixed. In a single-industry study, Lu and Baoteng (2018) find women on boards negatively influence credit risk in the UK Banking industry. The study is analysed using three statistical models, namely OLS, Fixed Effects and Random Effects. Interestingly, McGuinness et al. (2015) argue that there is not much difference between the effects of male and female directors on performance due to comparable risk aversion attitude. Surprisingly, some studies find an insignificant association between board gender diversity and firm performance (Chapple and Humphrey, 2014) and board performance (Kakabadse et al., 2015). The inconclusive findings denote that the association between gender diversity and organisational outcome is not straightforward.

The agency theorists often argue that agency problem occurs when agents are self-motivated. They focus on maximising their profits at the expense of principals. In several ways, board gender diversity can improve innovation via monitoring and mitigating agency problems. We rely upon theoretical views that board gender diversity offers good monitoring and suggest it as tool monitor the association between political affiliation and innovation performance. Thus, the next hypothesis follows:

Hypothesis 2. The association between political affiliation and innovation input intensity is contingent upon board gender diversity.

4.2.4 Interaction between political affiliation and board nationality diversity on innovation input intensity

Similar to gender diversity, nationality diversity brings further dynamics to firms. For instance, nationality diversity in the top management team enhances corporate entrepreneurship by providing globally dispersed knowledge, emergent technologies, specialised expertise, and more innovation (Boone et al., 2018). Moreover, board nationality diversity brings in various elements in terms of the social, cultural, psychological and institutional characteristics, all of which exert a positive association on the firm's performance (Delis et al., 2017). In fact, the combination of various ideas, knowledge and skills from a different background greatly cultivate the potential for innovative creation (Swann et al., 2004).

However, there is still scarce empirical evidence concerning board nationality diversity and innovation. An earlier study examines how directors' nationalities interact with the level of independence, the number of directorships, and demographics characteristics (Ruigrok et al., 2007). The study, however, does not investigate the association with innovation. Specifically, regarding the Malaysian case, Ariff et al. (2017) argue that board diversity is associated with innovation. The investigation uses the board diversity index and does not explicitly measure the association between nationality diversity and innovation. Nevertheless, Earley and Mosakowski (2002) suggest that the nationality variable in a transnational team is a significant feature that is associated with corporate performance. Therefore, this present study includes nationality diversity as a governance tool that can monitor or align the interest of politically affiliated directors with innovation input intensity. The study, hence, extend the view of previous study and propose the following hypothesis:

Hypothesis 3. The association between political affiliation and innovation input intensity is contingent upon board nationality diversity.

4.3 Data and methodology

4.3.1 Sample and data

The sample frame of this study is all the listed firms related to the palm oil industry in the primary market of Bursa Malaysia. The list of firms and their annual reports are accessed via Bursa Malaysia's website. The search resulted in 43 firms. In order to construct the sample, only firms with the complete financial and palm oil data from the period of 2008 and 2018 are included. Thus, resulting in 42 firms.

The firms' annual reports provide financial, board, firm and operational activities information. For instance, the book value of plant, machinery and equipment, directors' background, political affiliation, gender, nationality, tenure, board size, board independence and palm oil performance indicators such as oil extraction rate and MPOB ties (firms' board member who is also sitting as MPOB's board members). Information on MPOB ties is also accessed via MPOB's annual reports. Data concerning political affiliation was retrieved from the Malaysian Election Commission's website. The names of the representatives from the then ruling party in Parliament and the State were compared with the information in the firms' Annual Reports. The study also uses Boardex and Bloomberg database to complement any data related to the directors and board.

Financial information such as ROE, leverage, Altman-z score and firm risk were all gathered from the Bloomberg database. Information concerning the number of patents was collected via MyIPO website. The final dataset was derived from the merging of data from various data sources. Thus, totalling 446 firm-year observations over the 11-year sample period.

4.3.2 Variable description and measurement

Dependent variable

An innovative firm is a broad definition and may not be appropriate for all policy and research needs but depending on firm size, sectors, or countries (OECD, 2005), economic, social, political, cultural and educational systems. Innovation is to improve organisational efficiency and productivity, increase market shares and profitability as well as generate economic wealth for owners (Damanpour, 2020).

Innovation activities are divided into two categories: R&D and non-R&D. Based on OECD (2005), innovation activities that involve non-R&D are such as machinery and equipment investment. Non-R&D innovation activities are particularly important as the use of R&D investment is less frequent. Hence, innovative firms are those developing innovations on their own or in cooperation with others, and those that mainly adopt innovations. In sum, relevant investment in innovation activities includes the acquisition of fixed and intangible assets.

This study deviates from previous studies and focuses on the non-R&D type of innovation activities. This chapter applies innovation input intensity by taking the book value of plant and machinery and equipment (PME) divided by total asset as a proxy to innovation input intensity. Based on the OECD Oslo Manual 1997, the acquisition of machinery and equipment is a part of the main innovation input activities.

There are two reasons for using the variable of PME as indicator for innovation input intensity. Firstly, it is contextually appropriate in the Malaysian palm oil industry context. Innovation activities involve purchases of external knowledge and technology embodied in capital goods such as machinery and equipment or plant (OECD, 2005). OECD (2018) highlights the importance of investment in innovation inputs, such as mechanisation, equipment to innovate food and the agricultural sector.

Secondly, investment in machinery and equipment is a significant non-R&D innovation input (Evangelista et al., 1998; Pellegrinoa et al., 2012). In fact, machinery and equipment expenditure accounts for more innovation costs compare to R&D expenses (Mansfield, 1988; Brouwer and Kleinknecht, 1999). Therefore, this thesis applies the book value of plant, machinery and equipment divided by total asset to measure innovation input intensity.

Independent variables

Political affiliation is whether the director is a current or former federal or state's agency government officer, a member of parliament, a minister or state assembly member. It is operationalised by a dummy variable, where "1" symbolises the presence of a politically affiliated director on a board and "0" denotes otherwise (Al-dhamari and Ku Ismail, 2015; Houston et al., 2014). This proxy is similar with previous study, which refer political directors as those with 'prior employment in government or a political party' (Agrawal and Knoeber, 2001). Apart from that, as in the additional analysis, the study applies the percentage of current or former government officer on board as well as politician on board as operationalized by the percentage of current or former Member of Parliament, minister or state assemblyman as independent variables (Houston et al., 2014).

Moderating Variables

Following the corporate governance literature, the moderating variables are board diversity. For board diversity, this chapter includes gender and nationality diversity (Miller and Triana, 2009; Ariff et al., 2017) by using Blau's Diversity Index (1 - ∑P_i^2), where P is the proportion of individuals in a category, i is the number of categories. The range of index depends on the number of categories, where the number ranges from 0 to (i – 1)/i. There are two categories of gender: male and female. Thus, the gender diversity index ranges from '0', when only one gender is represented, to '0.5' when there is an equal number of male and female members on the board. The index ranges from '0' when only one nationality was represented and '0.875' when there are equal numbers of all eight nationalities represented on the board.

Control Variables

The study uses several types of control variables, namely, palm oil industry indicators, directors' characteristics, board characteristics and financial indicators. The palm oil indicators consist of oil extraction rate and MPOB ties. The oil extraction rate (OER) is one of important palm oil performance target for sustainable supply (Murphy, 2014), while the MPOB ties refer to firm's board member who also sit on the MPOB board). Commonly used internal governance variables are directors and board characteristics. The present study controls all the essential attributes such as directors' tenure on board and board size (Shaikh et al., 2018), board independence and the number of the board meeting (DeBoskey et al., 2019). Financial performance variables such as ROE and leverage (McGuinness et al., 2017), the Altman-z score which is a proxy for financial distress which resulted from a poor firm's management (Shaikh et al., 2018) and firm risk (Bernile et al., 2018) are also controlled. Table 4.1 summarises all the dependent and explanatory variables and variables used to construct the Altman-Z score.

Table 4.1 Summary of variables and measurements

Variable	**Description**	**Source**
Panel A: Dependent Variable		
Innovation Input Intensity	Innovation input intensity as a measure of the intensity of innovation input. It is calculated by dividing the Plant and Machinery/Equipment to book value of total asset, where PME is the book value of plant, machinery/equipment in RM million.	Annual Report
Panel B: Independent Variables		
Political Affiliation	*Political Affiliation* as measure of board member is or was a member of parliament, a minister, a head of state, a state assemblyman, or a person who is or was working under a government agency. It is measured by dummy variable coded 1 if the firm has *Political Affiliation* and 0 otherwise.	Annual Report Malaysian Election Commission's Website
Politician on Board	Politician on Board as measure of the percentage of board member who is or was a member of parliament, minister, head of state or state assembly member to board size.	
Government Officer on Board	Government Officer on Board as measure of the percentage of board member who is or was a government officer to board size.	

Table 4.1 (Continued)

Variable	Description	Source
Panel C: Moderating Variables		
Gender Diversity Nationality Diversity	Gender and Nationality Diversity as measure of board diversity. Gender Diversity and Nationality Diversity are operationalised by Blau's Index of Diversity as: $(1 - \sum P_i^2)$, where, p = proportion of individuals in a category, and i = number of categories.	Annual Report Boardex Bloomberg
Panel D: Control Variables		
MPOB	MPOB as measured of board member is a representative of Malaysian Palm Oil Board (MPOB). It is operationalised by a dummy variable with a value of '1' if firm's board member is also a member of Malaysian Palm Oil Board's board of directors, and '0' otherwise.	Annual Report
Oil Extraction Rate	OER as a measured of firm's achievement in producing oil extraction rate of crude palm oil comparison to the national average. OER is operationalised by a dummy variable with a value of '1' if firm achieved or above national average Oil Extraction Rate of Crude Palm Oil, and '0' otherwise.	Annual Report
Tenure	Tenure as a measure of the average number of years directors as board members by a natural logarithm.	Annual Report

Table 4.1 (Continued)

Variable	**Description**	**Source**
Meeting	Number as a measure of the number of firm's board meeting. It is calculated as the of board meeting by a natural logarithm.	Annual Report
Board Size	Number of individuals sitting on the board of directors in the firm. Board size as a measure of number of directors on board by natural logarithm.	Annual Report
Board Independence	Measure the number of independent directors on board and it is calculated as ratio of the number of independent directors to the total number of board members.	Annual Report Bloomberg
Return on Equity	Return on Equity or ROE as a measure of return on equity of the firm. ROE is calculated as the ratio of Net Income to Total Common Equity, where the Net Income and Total Common Equity are in RM million.	Annual Report Bloomberg
Leverage	Measure of leverage of firms. It is calculated as the ratio of Total Liabilities to Total Common Equity, where Total Liability is in RM million.	Annual Report Bloomberg
Altman-Z Score	Measure the probability of the firm going to bankruptcy using the Altman's Z-score. It is measured as: $1.2T_1 + 1.4T_2 + 3.3T_3 + 0.6T_4 + 1.0T_5$. The T_1 to T_5 variables are listed in Panel D	Annual Report Bloomberg

Table 4.1 (Continued)

Variable	Description	Source
Firm risk	Beta of a stock	Annual Report Bloomberg
Panel D: Altman-Z Score		
Measured as $T_1 = \frac{Working\ Capital}{Total\ Assets}$ where *Working Capital* is in RM million		Annual Report Bloomberg
Measured as $T_2 = \frac{Retained\ Earnings}{Total\ Assets}$ where *Retained Earnings* are in RM million		Annual Report Bloomberg
Measured as $T_3 = \frac{Earnings\ before\ Interests\ and\ Taxes}{Total\ Assets}$ where *Earnings before Interests and Taxes* are in RM million		Annual Report Bloomberg
Measured as $T_4 = \frac{Total\ Common\ Equity}{Total\ Liabilities}$ where *Total Common Equity* is in RM million		Annual Report Bloomberg
Measured as $T_5 = \frac{Sales}{Total\ Assets}$ where *Sales* is in RM million		Annual Report Bloomberg

4.3.3 Empirical model

This study used a multiple-year observation dataset, which may have led to several potential issues in the panel data, including autocorrelation, heteroskedasticity and multicollinearity. A number of specification tests were carried out to select the most appropriate panel model. The tests are the Hausman test[5], Testparm[6] testing, Breusch-Pagan/Cook-Weisberg, White's and VIF test.

The specified model may suffer from endogeneity; prior upper-echelon studies that draw from Compustat have shown that heteroskedasticity and autocorrelation are expected to be present in the observations (Garms and Engelen, 2019). To clarify the existence of the problem, the study performed the Wooldridge test for autocorrelation and Breusch-Pagan/Cook-Weisberg and White's test for heteroscedasticity. With $p<0.05$, the null hypothesis for no autocorrelation and heteroskedasticity was rejected, denoting autocorrelation and heteroskedasticity issues. Therefore, robust standard errors were used during the estimation of the panel data regression to address the issue. A second potential source of endogeneity may exist from the unobserved variables are correlated with the main independent variable and the dependent variables being constant over time. However, this concern to an extent was addressed by adding the year-fixed effects in the model (Ebbes et al., 2017).

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[5] **Hausman Test**

The Hausman test is calculated as follows:

$$H = (\beta_c - \beta_e)' (V_c - V_e)^{-1} (\beta_c - \beta_e)$$

Where:

β_c is the coefficient vector from the consistent estimator
β_e is the coefficient vector from the efficient estimator
V_c is the covariance matrix of the consistent estimator
V_e is the covariance matrix of the efficient estimator

The null hypothesis is that the preferred model is random effects; The alternate hypothesis is that the model is fixed effects. If H is significant (equal or less than 0.05), the null hypothesis is rejected, and *Fixed Effects Model* should be used.

[6] **Testing for Time-Fixed Effects (Testparm)**

Testparm is conducted to see if time fixed effects are needed. A joint test is conducted to check whether the time dummies for all years are equal to zero or not (Torres-Reyna, 2007). If the Prob>F is equal or less than 0.05, the null hypothesis is rejected, which means that the coefficients for all years are not jointly equal to zero. Therefore, time fixed effects are needed.

To address concerns about multicollinearity among the variables in the estimation, the variance inflation factor (VIF) was analysed. The VIF test results show that the range for all variables is from lowest at 1.24 to highest at 2.66 with mean VIF equal to 1.58. The results indicate no multicollinearity problem as the values are all below 4 (Hair et al., 1995). Apart from that, to further ensuring there is no multicollinearity problem, following Aiken and West (1991), the interaction variables were centred to their mean. The research applies OLS fixed effects model that capture firm-year effects, and robust standard errors are clustered at firm level (Schaffer, 2010; Wooldridge, 2016) as below:

$$IP_{i,t} = \beta_1 \text{Political Affiliation}_{i,t} + \beta_2 \text{Gender Diversity} + \beta_3 \text{Nationality Diversity} + \beta_4 (\text{Political Affiliation X Gender Diversity})_{i,t} + \beta_5 (\text{Political Affiliation X Nationality Diversity})_{i,t} + \beta_6 Z_{i,t} + \alpha_i + U_{i,t} \quad \ldots\ldots (1)$$

Where $IP_{i,t}$ represents firm I's innovation input intensity at time t as proxy of innovation performance. Political $Affiliation_{,t}$, Gender $Diversity_{i,t}$, and Nationality $Diversity_{it}$ as the main independent variables. The study also uses Political $Affiliation_{,t}$, as the interaction variable. $Z_{i,t}$ is the control variables, which includes year and firm fixed effects. Finally, α_i is constant and $U_{i,t}$ represents the model error term.

4.4 Data analysis and discussion

4.4.1 Descriptive statistics

Descriptive statistics

Table 4.2 presents the descriptive statistics. In particular, the standard deviation for all of the variables is relatively small, denoting, low spread out from the mean.

Table 4.2 Descriptive statistics

Variables	Mean	Standard Deviation	Min	P25	P50	P75	Max
Innovation Input Intensity	0.80	0.10	0.41	0.49	0.84	0.94	0.95
Political Affiliation	0.71	0.45	0	0	1	1	1
Gender diversity	0.104	0.14	0	0	0	0.21	0.49
Nationality diversity	0.103	0.18	0	0	0	0.19	0.67
Politician on Board (%)	0.24	0.07	0	0	0	0.33	0.33
Government Officer (%)	0.19	0.18	0	0	0.14	0.75	1
MPOB	0.07	0.26	0	0	0	0	1
Oil Extraction Rate	0.41	0.49	0	0	0	1	1
Tenure	10.8	5.07	1	7.37	10.6	13.66	26.42
Meeting	5.55	2.37	2	4	5	17	25
Board size	8	2	4	4	4	14	15
Board independence	0.48	0.16	0.22	0.37	0.44	0.57	1
ROE	0.06	0.09	-0.54	0.01	0.06	0.11	0.45
Leverage	0.30	0.36	0	0.03	18	50	352.40
Altman-Z	5.78	8.95	-1.65	1.48	2.95	5.56	51.74
Risk	0.45	0.32	0.09	0.23	0.35	0.55	2.65

Table 4.3 presents the pairwise correlation analysis. There is a number of significant correlations among the variables with Innovation Input Intensity at a 5% level of significance. In particular, Innovation Input Intensity is positively and significantly correlated with Political Affiliation, Government Officer on Board, Oil Extraction Rate, Board Size, Leverage and Risk. Conversely, Innovation Input Intensity is negatively and significantly correlated with Nationality Diversity, ROE and the Altman-Z score. In addition, firms with political affiliation tend to have a greater percentage of Government Officer on Board compared to Politician on Board, also have more directors who also sit in MPOB, produce higher Oil Extraction Rate, more frequent board meeting, have larger board size and in term of financial performance, have

higher level of ROE, and greater leverage and firm risk. Interestingly, firms with political affiliation on boards tend to have a lower Altman-Z score, indicating the firms are experiencing higher financial distress on their financial performance. Besides, firms with political affiliation have less nationality diversity and consist of directors with shorter tenure as board of directors suggesting there are more directors with lesser experience. In sum, the correlation level among all the variables is low, denoting no serious multi-collinearity problem.

Table 4.3 Pairwise correlation analysis

Variable	**Innovation Input Intensity**	**Political Affiliation**	**Political Member**	**Government Officer**	**Gender Diversity**	**Nationality Diversity**	**MPOB**	**Oil Extraction Rate**	**Tenure**	**Meeting**	**Board Size**	**Board Independence**
Innovation Input Intensity	1											
Political Affiliation	***0.27**	1										
Politician on Board	0.04	***0.27**	1									
Government Officer	***0.22**	***0.65**	***0.14**	1								
Gender Diversity	0.09	0.04	-0.08	-0.07	1							
Nationality Diversity	***-0.22**	***-0.29**	***-0.16**	***-0.21**	***-0.25**	1						
MPOB	0.01	***0.17**	0.02	***0.20**	***0.19**	***0.13**	1					
Oil Extraction Rate	***0.18**	***0.16**	***-0.10**	0.09	0.04	0.03	***0.19**	1				
Tenure	-0.05	***-0.17**	***-0.13**	***-0.37**	-0.08	***0.10**	***-0.30**	-0.04	1			
Meeting	0.02	***0.15**	***0.21**	***0.32**	0.03	0.03	***0.17**	0.0004	***-0.34**	1		
Board Size	***0.11**	***0.24**	0.04	-0.003	0.08	***0.13**	***0.20**	***0.19**	0.04	***0.12**	1	
Board Independence	-0.02	0.06	-0.09	***0.31**	***-0.12**	***0.10**	0.01	-0.03	0.05	0.07	***-0.43**	1

Table 4.3 (Continued)

Variable	**Innovation Input Intensity**	**Political Affiliation**	**Political Member**	**Government Officer**	**Gender Diversity**	**Nationality Diversity**	**MPOB**	**Oil Extraction Rate**	**Tenure**	**Meeting**	**Board Size**	**Board Independence**	**ROE**	**Leverage**	**Altman-Z**	**Risk**
ROE	***-0.12**	***0.10**	0.08	-0.06	***-0.09**	0.05	0.01	***0.26**	-0.02	-0.002	***0.21**	***-0.12**	1			
Leverage	***0.23**	***0.15**	***0.17**	***0.12**	0.05	***-0.33**	-0.07	0.07	-0.007	***0.11**	0.006	-0.05	***-0.17**	1		
Altman-Z	***-0.44**	***-0.23**	***-0.17**	***-0.14**	***-0.20**	***0.41**	-0.05	***-0.12**	***0.24**	-0.05	-0.02	***0.23**	***0.11**	***-0.37**	1	
Risk	***0.18**	***0.10**	0.08	***0.11**	***0.14**	***-0.20**	***0.22**	-0.02	***-0.20**	***0.16**	-0.008	-0.06	***-0.26**	***0.22**	***-0.23**	1

N = 446 firm-year observations from 42 companies. *Statistically significant at the 5% level.

4.4.2 Main analysis, results and discussion

Table 4.4 presents the main results on the association between political affiliation and innovation input intensity from the OLS fixed-effect regression analysis. Model 1 includes of independent variables without control variables, while model 2 excludes the independent variables, but with control variables. Finally, model 4 is similar with model 3, but consists of interaction variables.

The coefficient estimates for political affiliation is significant and negative $(\beta = -0.02; p < .01)$ as in model 1. The coefficient estimates for board diversity both gender and nationality are positive and significant $(\beta = 0.07; p < .01)$ and $(\beta = 0.09; p < .01)$, respectively.

Model 3 provides result for hypothesis 1. Hypothesis 1 posits that political affiliation is positively associated with innovation input intensity. The result shows that the association between political affiliation and innovation input intensity is significant albeit negative $(\beta = -0.01; p < .05)$. The result, therefore, is unable to support hypothesis 1.

Model 4 provides result for hypothesis 2 and hypothesis 3. Hypothesis 2 suggests that the association between political affiliation and innovation input intensity is contingent upon board gender diversity. The coefficient estimates for Political Affiliation and Gender Diversity is positive and significant $(\beta = 0.007; p < 0.1)$. The result, thus, provides support to hypothesis 2. Hypothesis 3 predicts that the association between political affiliation and innovation strategy is contingent upon board nationality diversity. The coefficient estimates for Political Affiliation and Nationality Diversity is negative and significant $(\beta = -0.18; p < .01)$. The result is in support of Hypothesis 3.

Table 4.4 The association between political affiliation, board diversity and innovation input intensity

Dependent Variable/ Model	**Innovation Input Intensity**			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Political Affiliation	**-0.02*** **		**-0.01** **	**-0.02*** **
	(-3.56)		(-2.10)	(-2.85)
Gender Diversity	**0.07*** **		**0.04*** **	**0.08** **
	(4.06)		(2.64)	(2.20)
Nationality Diversity	**0.09*** **		**0.07*** **	**0.15*** **
	(4.42)		(3.24)	(4.62)
Political Affiliation X Gender Diversity				**0.007* **
				(1.70)
Political Affiliation X Nationality Diversity				**-0.18*** **
				(-4.53)
MPOB		-0.0009	-0.004	-0.0007
		(-0.18)	(-0.77)	(-0.15)
Oil Extraction Rate		0.007*	0.008*	-0.04
		(1.78)	(1.86)	(-1.13)

Table 4.4 (Continued)

Dependent Variable/	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Tenure		0.01***	0.02***	0.02***
		(3.22)	(3.33)	(4.42)
Meeting		-0.004	-0.004	-0.004
		(-0.49)	(-0.45)	(-0.57)
Board Size		-0.003	0.002	0.002
		(-0.23)	(0.11)	(0.14)
Board Independence		0.009	0.01	0.01
		(0.50)	(0.51)	(0.57)
ROE		-0.06***	-0.05***	-0.04***
		(-3.04)	(-2.76)	(-2.59)
Leverage		0.01	0.009	0.01
		(1.56)	(1.49)	(1.53)
Altman-Z		-0.001***	-0.001***	-0.001***
		(-3.65)	(-3.23)	(-3.21)

Table 4.4 (Continued)

Dependent Variable/ Model	Innovation Input Intensity			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Risk		0.02***	0.02***	0.02***
		(4.55)	(3.94)	(4.06)
Firm Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
Constant	0.95***	0.91***	0.89***	0.88***
	(144.08)	(25.14)	(22.55)	(24.62)
No. of Observations	446	446	446	446
Adjusted R^2	0.40	0.51	0.52	0.54

The table presents the results from OLS regression on the association between Political Affiliation, Board Diversity and Innovation Input Intensity. In model 1, we add Political Affiliation, Gender Diversity and Nationality Diversity. In model 2, we add only control variables. In model 3, we add Political Affiliation, Gender Diversity, Nationality Diversity and Control Variables. In model 4, it is similar with model 3 but we also add the interaction terms between Political Affiliation and Gender Diversity, and Political Affiliation and Nationality Diversity. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

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Discussion

This core chapter examines the direct association between political affiliation and innovation input intensity and also investigate the impact of board diversity on the association. Firstly, the finding addresses the question concerning '*Does political affiliation associate with innovation input intensity*?' The results show that the association between political affiliation and innovation is significant, albeit negative. The result implies that firms with political affiliation via BoD appointment tend to have lower innovation input performance. Unlike previous study which establishes a positive link between political connection and innovation (Lin et al., 2011). The finding is somehow similar to Song et al. (2015) and Wang et al. (2018).

Finding of this chapter rebuts the assumption of engaging politically connected directors are beneficial for industry that is closely related to the national policies. Indeed, the finding suggests that the presence of political affiliation hinders innovation input intensity. Supposedly, firms with political affiliation should have easier access to various type of benefits such as access to information, government funds, tax benefits (Al-dhamari and Ku Ismail, 2015), land, capital and licences (Ling et al., 2016) that provide firms with great opportunity and resources to invest more intensively in innovation input. However, one plausible reason for this unfavourable organization outcome is that firms tend to have fewer professionals on board which is crucially needed in strategic decision making for greater innovation performance. Instead of pursuing innovation agenda, the firms might deviate from the goal and fulfil the political goals of the politicians. The finding adds to similar empirical evidence based on Malaysian data that political affiliation has a negative effect on organization outcome (Al-dhamari and Ku Ismail, 2015).

Notably, most of political affiliation research are based on China's perspective. In general, similarly, southeast Asia firms also have higher tendency to engage political connection compared to the Western. It is indeed interesting to discover more insights on the agency relationship and innovation performance within this environment. In term of direct association, the results imply that board diversity, both gender and nationality diversity have a positive and significant association with innovation input intensity, similar to Bernile et al. (2018). Despite being a gendered industry, the small number of female representatives on board has positive association with innovation activities in this industry. Interestingly, the finding counters critical mass perspective promoted by many studies (Torchia et al., 2011; Joecks et al., 2013). Similarly, nationality diversity is positively associated with innovation input intensity. This finding is in line with Boone et al. (2018) which is focusing on nationality diversity in top management team of Multinational Corporation.

However, it is less known if board diversity has any influence on the relationship between political affiliation and innovation performance. This chapter answers the question '*To what extent does board diversity such as gender and nationality diversity can align the interest of politically affiliated directors with firm's innovation performance?* The results show gender diversity has a positive impact on the association between political affiliation and innovation input intensity. Conversely, nationality diversity has a negative impact. These findings imply that board gender diversity is an effective governance tool. Pearce and Zahra (1991) argue that female directors are more participative, and less likely to involve in fraud (Cumming et al., 2015), thus, making them more effective as monitors and facilitators to innovation (Bertrand and Mullainathan, 2003). Surprisingly, board nationality diversity weakened the link between political affiliation and innovation input intensity. The involvement of other nationalities in a transnational industry is evidently beneficial as the industry expand investment to other countries (Earley and Mosakowski, 2000) by providing globally dispersed knowledge, emergent technologies, and specialised expertise and more innovative (Boone et al., 2018). This chapter extends the investigating by examining the impact of nationality diversity on political affiliation and innovation and finds nationality diversity is an insufficient governance tool to foster the association.

4.4.3 Additional analysis

Subsequently, in a deeper analysis, the political affiliations were divided into two categories: Politician on Board and Government Officer on board. Based on the result in Table 4.5 model 1 and model 2, Politician on Board has a negative link with innovation input intensity. Further, in Table 4.6 model 1 the presents research discovers that Gender Diversity nurtures the positive link between the Politician on Board and innovation input intensity. In contrast, Nationality Diversity deters the association between Politician on Board, Government Officer on Board and innovation input intensity as in model 2 and model 4, respectively. Surprisingly, model 3 suggests firms with more Gender Diversity has insignificant effect on the link between Government Officer on Board and innovation input intensity.

In summary, finding of this chapter suggests that firms with Political Affiliation presence, specifically Politician on Board as individual have a lower innovation input intensity. However, organizations that engage Political Affiliation have greater innovation input intensity when it upholds more female directors as board members. Conversely, a more diverse board nationality dampens innovation agenda when firms have political connection.

Table 4.5 The association between political affiliation (politician on board and government officer on board) and innovation input intensity

Dependent Variables	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Politician on Board	**-0.07****	**-0.07***		
	(-2.00)	(-1.94)		
Government Officer on Board			0.005	0.008
			(0.33)	(0.52)
Gender Diversity		**0.04*****		**0.04*****
		(2.79)		(2.98)
Nationality Diversity		**0.08*****		**0.08*****
		(3.29)		(3.29)
MPOB	-0.0002	-0.004	-0.0009	-0.004
	(-0.04)	(-0.62)	(-0.17)	(-0.76)
Oil Extraction Rate	0.007	0.008*	0.008*	0.009**
	(1.54)	(1.74)	(1.79)	(2.00)
Tenure	0.01***	0.02***	0.01***	0.02***

Table 4.5 (Continued)

Dependent Variables	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	(3.29)	(3.41)	(3.21)	(3.35)
Meeting	-0.005	-0.006	-0.004	-0.006
	(-0.71)	(-0.81)	(-0.54)	(-0.68)
Board Size	-0.005	-0.002	-0.003	0.00002
	(-0.39)	(-0.13)	(-0.22)	(0.00)
Board Independence	0.008	0.006	0.009	0.007
	(0.42)	(0.31)	(0.49)	(0.37)
ROE	-0.05***	-0.04**	-0.06***	-0.05***
	(-2.75)	(-2.51)	(-3.07)	(-2.86)
Leverage	0.009	0.009	0.009	0.009
	(1.53)	(1.46)	(1.52)	(1.43)
Altman-Z	-0.001***	-0.001***	-0.001***	-0.001***
	(-3.66)	(-3.34)	(-3.65)	(-3.33)
Risk	0.02***	0.02***	0.02***	0.02***

Table 4.5 (Continued)

Dependent Variables	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
	(4.37)	(3.69)	(4.50)	(3.88)
Firm Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
Constant	0.92***	0.90***	0.91***	0.89***
	(25.70)	(22.58)	(25.11)	(22.10)
Number of Observation	446	446	446	446
Adjusted R^2	0.51	0.52	0.51	0.52

The table presents the results from OLS regression on the association between Political Affiliation, Board Diversity (Gender and Nationality) and Innovation Input Intensity. In model 1, we add Politician on Board and control variables. In model 2, we add Politician on Board, Gender Diversity, Nationality Diversity and control variables. In model 3, we Government Member on Board and control variables. In model 4, we add Government Member, Gender Diversity, Nationality Diversity and control variables. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Table 4.6 The association between political affiliation (politician and government officer on board), board diversity and innovation input intensity

Dependent Variables	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Politician on Board	**-0.06***	**-0.13*****		
	(-1.89)	(-2.68)		
Government Officer on Board			0.008	-0.01
			(0.49)	(-1.08)
Gender Diversity	**0.03****	**0.04*****	**0.05****	**0.05*****
	(2.01)	(2.84)	(2.36)	(3.20)
Nationality Diversity	**0.07*****	**0.09*****	**0.08*****	**0.11*****
	(3.22)	(3.93)	(3.17)	(5.35)
Politician on Board X Gender Diversity	**0.37****			
	(2.15)			
Politician on Board X Nationality Diversity		**-0.70***		
		(-1.89)		
Government Officer on Board X Gender Diversity			-0.01	
			(-0.19)	

Table 4.6 (Continued)

Dependent Variables	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Government Officer on Board X Nationality Diversity				**-0.35*****
				(-3.86)
MPOB	-0.003	-0.003	-0.004	-0.002
	(-0.53)	(-0.50)	(-0.74)	(-0.36)
Oil Extraction Rate	0.008*	0.008*	0.008**	0.007*
	(1.88)	(1.74)	(1.99)	(1.78)
Tenure	0.02***	0.02***	0.02***	0.02***
	(3.60)	(3.86)	(3.32)	(4.43)
Meeting	-0.007	-0.006	-0.005	-0.006
	(-0.85)	(-0.74)	(-0.68)	(-0.79)
Board Size	-0.005	-0.002	-0.0002	0.002
	(-0.31)	(-0.17)	(-0.01)	(0.13)
Board Independence	0.005	0.007	0.007	0.003
	(0.28)	(0.37)	(0.37)	(0.18)

Table 4.6 (Continued)

Dependent Variables	**Innovation Input Intensity**			
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**
ROE	-0.051**	-0.04**	-0.05***	-0.05***
	(-2.56)	(-2.54)	(-2.86)	(-2.72)
Leverage	0.008	0.009	0.009	0.009
	(1.31)	(1.42)	(1.43)	(1.46)
Altman-Z	-0.001***	-0.001***	-0.001***	-0.001***
	(-3.35)	(-3.31)	(-3.33)	(-3.34)
Risk	0.021***	0.020***	0.02***	0.02***
	(3.71)	(3.53)	(3.88)	(4.15)
Firm Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
Constant	0.90***	0.89***	0.89***	0.88***
	(22.81)	(22.95)	(22.15)	(24.00)
Number of Observations	446	446	446	446
Adjusted R^2	0.53	0.53	0.52	0.53

The table presents the results from OLS regression on the association between Political Affiliation (Politician and Government Officer on Board), Board Diversity (Gender and Nationality) and Innovation Input Intensity. In model 1, we add Politician on Board, Gender Diversity, Nationality Diversity and control variables. In model 2, it is similar with model 1 but we also add the interaction term between Politician on Board and Gender Diversity. In model 3, we add Government Officer on Board, Gender Diversity, Nationality Diversity and control variables. Model 4 is similar with model 3, but we also include the interaction term between Government Officer on Board and Nationality Diversity. t statistics (in parentheses); * $p<0.10$, ** $p<0.05$, *** $p<0.01$; All standard errors are subject to Huber/White adjustment.

Apart from that, following other previous studies, this thesis also considers the two-stage least squares (2SLS) firm-year fixed effects model with instrumental variables as additional and robustness test (Aghion et al., 2013; Bernile et al., 2018; Kang et al., 2018), with the inclusion of instrumental variables (Campbell and Minguez-Vera, 2008; Baltagi et al., 2014) as in Table 4.7 (model 2). The instrumental variables are the lag of main predictor variables: lag Gender Diversity, lag Nationality Diversity and lag Political Affiliation. The use of lag variables is to avoid simultaneity (Reed, 2015). Apart from that, the study adds another instrumental variable namely, the distance in kilometres between the firms' headquarters with federal capital city (Putrajaya), following Houston et al. (2014).

Subsequently, the study proceeds with endogeneity test for the main independent variables, and underidentification and over-identifications test for the instrumental variables. The endogeneity test results show p-value = 0.2337. Since it is more than a 5% level of significance, therefore, the study is unable to reject the null hypothesis that the variable is exogeneous. Next, we examine for underidentification test for our instrumental variables. Result for Kleibergen-Paap rk LM test is p-value = 0.0033. It denotes less than a 5% level of significance. Therefore, the study is able to reject the null hypothesis for underidentification. This implies that the instrumental variables are not weak. Subsequently, the study performs overidentification test for the instrumental variables. The Hansen J statistics presents p-value = 0.6243, which is greater than a 5% level of significance. Hence, the research is unable to reject the null hypothesis for overidentification. This result suggests that the instrumental variables are valid. Table 4.7 below (model 2) presents the results of additional analysis and denote that our findings are fairly robust.

Table 4.7 The association between political affiliation, board diversity and innovation input intensity (robustness)

Dependent Variable/ Model	**Innovation Input Intensity**	
	OLS FE	**2SLS FE**
	Model 1	**Model 2**
Political Affiliation (dummy)	**-0.02*** **	**-0.04** **
	(-2.85)	(-2.15)
Gender Diversity	**0.08** **	**0.07* **
	(2.20)	(1.68)
Nationality Diversity	**0.15*** **	**0.15*** **
	(4.62)	(4.02)
Political Affiliation X Gender Diversity	**0.007* **	**0.006* **
	(1.70)	(1.90)
Political Affiliation X Nationality Diversity	**-0.18*** **	**-0.17*** **
	(-4.53)	(-3.29)
MPOB	-0.0007	0.0005
	(-0.15)	(0.11)
Oil Extraction Rate	-0.04	0.006
	(-1.13)	(1.30)
Tenure	0.02***	0.02***
	(4.42)	(4.55)
Meeting	-0.004	-0.003
	(-0.57)	(-0.45)
Board Size	0.002	-0.001
	(0.14)	(-0.09)
Board Independence	0.01	0.002
	(0.57)	(0.10)
ROE	-0.04***	-0.03**
	(-2.59)	(-2.02)
Leverage	0.01	0.006

Table 4.7 (Continued)

Dependent Variable/	Innovation Input Intensity	
Model	OLS FE	2SLS FE
	Model 1	Model 2
	(1.53)	(0.83)
Altman-Z	-0.001***	-0.001***
	(-3.21)	(-3.03)
Risk	0.02***	0.01***
	(4.06)	(3.43)
Firm Effect	Yes	Yes
Year Effect	Yes	Yes
Constant	0.88***	
	(24.62)	
Observations	446	403
Adjusted R^2	0.54	0.15

The table presents the results from OLS fixed-effect (model 1) and 2SLS fixed effect (model 2) regression on the association between Political Affiliation, Board Diversity (Gender and Nationality) and Innovation Input Intensity. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment.

Apart from that, the research also attempts to regress the predictor variables with another dependent variable, namely, number of the patent. As discussed earlier, the number of patents is not substantial in this study. Thus, the results are as expected, not significant, therefore, not reported in this paper. The result is attached in Appendix 1. In sum, finding from this chapter indicates the appropriateness of our proxy for non-R&D innovation activities.

4.5 Conclusion

This chapter aims to investigate the link between political affiliation and innovation input intensity and the role of board diversity in influencing the association by taking 42 Malaysian palm oil listed firms as an illustration from 2008 until 2018. This research is a longitudinal study and employs the OLS fixed effect model in analysing the panel data. The finding reveals that firms with political affiliation have a lower intensity of innovation input. However, a positive association is found in firms with a higher proportion of female board members. In contrast, nationality diversity weakened the association between political affiliation and innovation. In more detail, firms that appoint politicians on board tend to produce lower innovation input intensity, while government officers on board have an insignificant effect. Results of the study remain after controlling for endogeneity by applying the 2SLS fixed effect model with the inclusion of instrumental variables.

4.5.1 Theoretical and research-related implications

The present study offers a number of contributions to theory and literature. This chapter contributes to the theory by integrating governance mechanisms namely board diversity to the theoretical framework of upper echelon. Through empirical evidence, the finding reveals that organization performance for instance the innovation input intensity is indeed a reflection of strategic leaders' characteristics, but it is also contingent upon governance tool such as board diversity namely gender and nationality diversity. Thus, provide deeper understanding on the association between political affiliation and innovation performance.

The study contributes to the literature of innovation, strategic leadership and corporate governance. Notably, over the past 60 years, research on innovation has been focusing on the aspect of technological, product and services. There is very less emphasis on management and marketing. This present study indeed enriched the literature of innovation through the standpoint of management discipline specifically on strategic leadership and corporate governance.

Additionally, the study extends the largely Western-focused innovation literature to an important and noticeably different context. Research on innovation from Asian's perspective is under studied. Ariff et al. (2017) offer some information from Malaysia's perspective pertaining to just one reporting financial year, 2013, and the BoD diversity is represented by a diversity index. Furthermore, Kweh et al. (2019) suggest a point of data by highlighting only the role of board gender diversity in relation and limited to only firm performance (ROA, ROE).

Besides, the present study contributes to the literature of strategic leadership by adding perspective that characteristics of strategic leaders is an important aspect to consider in pursuing organizational goal such as innovation performance. Apart from that, unlike many other research, the present study enlarges board diversity to include nationality diversity and contributes deeper insights on how board gender and nationality diversity can affect innovation.

4.5.2 Policy and managerial implications

The current study highlights relevant courses of action for the government. Notably, current updates on Malaysian Code on Corporate Governance (2021) issued by Securities Commission Malaysia addressed board gender diversity and appointment of politician as board member. Based on the latest code, the requirement for at least 30% of women directors on board is extended to senior management for greater participant of women in strategic decision-making position. Apart from that, the code highlights that politician on board is not encouraged. In this relation, findings of this thesis support the requirement made by the Securities Commission Malaysia by presenting empirical evidence that there is no critical need to appoint politically connected directors as board members if the firm's goal is to pursue more intensity in innovation. Indeed, this thesis highlights the appointment of politicians as board member should be discouraged and board diversity particularly greater number of women participations on board is important.

The current study highlights relevant managerial implications to the industry players. For instance, the finding highlights the importance of board composition for greater innovation strategy, in the Malaysian palm oil industry. The finding suggests the need for deep contemplation of the board composition particularly the board diversity and type of director's background for better innovation strategy governance at the firm-level.

4.5.3 Limitations and further research

The study acknowledges the limitations of this study. The first limitation of this research is the non-availability of a substantial number of patents and research and development information for additional analysis. This is due to the characteristics of the industry which determine the type of innovation activities the firms adopt. In fact, an innovative firm is a broad definition and may not be appropriate for all policy and research needs as it is very much depending on factors such as firm size, sectors or countries. In addition, innovative firms include those developing innovations on their own or in cooperating with other organisations as well as those that mainly adopt innovations (OECD, 2005). Despite what we may say regarding this being a limitation or debatable, our study provides high practical relevance and originality.

Second, the present study is limited to quantitative research and statistical data. Therefore, future research may extend the study by conducting mixed research, which is to include qualitative approach as example, conducting interview sessions with board members and distributing questionnaires to get more of primary insights. Studying the impact of strategic leaders on innovation agenda can be more effective and inclusive by also considering opinions, concerns and ideas directly from the companies' key leaders.

Third, future research is recommended to explore more on the impact of nationality diversity on organisation outcome such as innovation or financial performance. This recommendation is taking into account that research on this facet of board diversity is still very limited even though nationality diversity is also identified as a dynamic force that can contribute to companies' innovation performance via diverse skill, knowledge, ideas and expertise.

Fourth, this research investigates the link between political affiliation, board diversity and innovation based on upper-echelon theory. The study mainly scrutinizes the characteristics of the strategic leaders on innovation. Further study on strategic leaders and innovation can explore the impact of leadership style of the directors or top executives based on style theory of leadership.

Finally, this present research essentially investigates the moderation role of governance mechanism such as board diversity on innovation. It is proposed that new study to explore the mediation impact of board diversity. Besides, there are other governance mechanisms apart from board diversity such as board independence, capital structure, legislation, creditors, culture and compensation. It is worthwhile to investigate the extent of these governance tools in moderating or mediating the link between strategic leadership and innovation.

As a conclusion, the present study recognises limitation in this study, thus makes recommendations for future research. The suggestions as highlighted above will further enrich and extend the literature of innovation, strategic leadership and corporate governance.

Chapter 5 Conclusion

The main theme of this thesis is Strategic Leadership, Corporate Governance Mechanisms and Innovation Performance. The theme connects three core chapters in this thesis from the Western and Asian perspective by taking innovative listed firms in the US and Malaysia. The thesis examined the association between various strategic leadership's characteristics and innovation performance of 150 listed firms from US high-technology, 75 listed firms from pharmaceutical, both from 1998 to 2018, and 42 listed firms related to the Malaysian palm oil industry from 2008 to 2018.

This chapter recaps the research key findings of the three core chapters, highlights the contribution and implication of the thesis, underlines the limitations of the studies and finally recommends some areas for further research.

5.1 Research key findings

This section summarizes the findings of the three core chapters. This thesis presents profound findings on the associations between strategic leaders' characteristics and innovation performance, and how governance mechanisms influence links. In the **first core chapter**, this thesis is focusing on CFO power, financial slack, CEO power and innovation performance in the U.S high-technology industry. In line with expectations from the upper-echelon theory, the findings indicate that CFO power is associated with the CFO's commitment towards innovation performance. A powerful CFO is likely to commit to higher R&D expenditure, produce more patents and citations, yield higher outcomes per unit of input expenditure and prefer an internal growth strategy over acquiring external technologies.

In relation to the impact of financial slack on the association between CFO power and innovation, a powerful CFO would be able to pursue both 'Make' and 'Buy' strategies, resulting in greater efficiency in patents and citations outcomes when financial slack is high. The results also suggest that an assertive CFO would prefer to invest in an internal innovation strategy (rather than a 'Buy' strategy) when financial slack levels are high. Within the TMT, the CEOs are the highest rank executives, while the CFOs are second after the CEOs in most firms. The findings indicate that when the power of both the CFO and CEO is high, the firm will invest less in both internal ('Make') and external ('Buy') innovation strategies. Unsurprisingly, there were fewer patents and citations produced and the efficiency in patents and citations declined when both CFO and CEO are powerful. The main reason that is causing the negative effects on all innovation performance indicators is that there may be a dysfunctional power balance that could lead to struggles between the two top strategic leaders in the US high-technology firms. This situation is in line with the upper echelons theory that predicts that dysfunctional conflicts arising from the inherent power struggles between CEOs and CFOs can be detrimental to strategic decision-making on innovation strategy and performance (Garms and Engelen, 2019). The CFO's preference and acceptance of a certain level of risk may be different from the CEO's. For example, the CFOs may align R&D budget allocations and financial slack levels in accordance with analyses of short- and long-term debt and valuation of risky projects (Finkelstein, 1992; Pettigrew and McNulty, 1995; Garms and Engelen, 2019). Thus, any dysfunctional conflict arises between the two top executives especially when the CEO is highly powerful, he can make autonomous strategic decision-making. This, therefore, can hinder innovation performance through poor or even wrong decision making.

In term of preference to invest internally or buying more established technology externally, there was a preference to 'Buy' rather than 'Make' when both individuals exhibited high assertiveness. In the "Make" strategy, there is an increase in risk, uncertainty, and a longer period of time to complete the process (Grabowski, 2011). Alternatively, the 'Buy' strategy seems more certain because the acquired technology is relatively more fully developed (Xue, 2007). It is noteworthy that the 'Buy' strategy or technology acquisition is, therefore, a preference for innovation input choice when the top executives are both powerful as they may want to cut short the time frame, reduce hussles and risks for the whole R&D processes through a better or more assured strategy since acquiring more established technology can reduce the time for products to reach the market (Ford and Probert, 2010; Mortara and Ford, 2012).

In the **second core chapter**, this thesis aims to examine the association between CEO compensation and innovation performance in the pharmaceutical industry, and to what extent the industry's regulation influences the link. The findings suggest that higher compensation motivates CEOs to engage in more innovation input strategies, as reflected in the amount of investment both in internal R&D and external technology acquisition, which confirms early views that assertive highly paid CEOs have higher managerial discretion that enables them to make the strategic choice of investment in innovation (Finkelstein and Boyd, 1998), thus making them the drivers for greater innovative success (Castellion, 2010). Besides, a highly rewarded CEO shows greater interest in internal innovations, thus preferring to invest in the firm's research and development activities to encourage the production of patents in the future. This study, nevertheless, provides additional insights that actually regulation affect the links between CEO compensation and innovation performance. In specific, regulation weakened the link between CEO compensation and the 'make' strategy (R&D expenditures), and between CEO compensation and the 'buy' strategy (TA). Conversely, the industry's regulation strengthened the link between CEO compensation and innovation outcome. On top of that, a highly paid CEO would prefer to invest more in purchasing external technologies in the event of a change to industry regulation.

In more details, when we analysed compensation by its' category: short- and long-term, the findings from this thesis show that CEO short-term compensation is positively associated with innovation input, in particular the R&D expenditure. This recent study, provides deeper insight to the literature by adding that the association is to some extent is affected by regulations introduced or amendment made by the government. On the other hand, regulations positively influence the association between CEO cash and innovation outcome and efficiency, respectively, and also influences highly paid CEOs (cash) to change their preference for innovation input strategy from a 'make' to a 'buy' strategy. Findings of this study extend the previous research insight by explaining how external corporate governance mechanisms influence the link between different types of compensation such as CEO short-term and long-term compensation and innovation performance.

Finally, in the **third core chapter**, the thesis aims to investigate the link between political affiliation and innovation input intensity, and how board diversity influences the association. Finding of this chapter rebuts the assumption of engaging politically connected directors are beneficial for industry that is closely related to the national policies. Indeed, the finding suggests that the presence of political affiliation hinders innovation input performance. Supposedly, firms with political affiliation should have easier access to various type of benefits such as access to information, government funds, tax benefits (Al-dhamari and Ku Ismail, 2015), land, capital and licences (Ling et al., 2016) that provide firms with great opportunity and resources to invest more intensively in innovation input. However, one plausible reason for this unfavourable organization outcome is that firms tend to have fewer professionals on board which is crucially needed in strategic decision making for greater innovation performance. Instead of pursuing innovation agenda, the firms might deviate from the goal and fulfil the political goals of the politicians. The finding adds to similar empirical evidence based on Malaysian data that political affiliation has a negative effect on organization outcome (Al-dhamari and Ku Ismail, 2015).

The findings also suggest that gender diversity has a positive impact on the association between political affiliation and innovation input intensity. Conversely, nationality diversity has a negative impact. These findings imply that board gender diversity is an effective governance tool. Pearce and Zahra (1991) argue that female directors are more participative, and less likely to involve in fraud (Cumming et al., 2015), thus, making them more effective as monitors and facilitators to innovation (Bertrand and Mullainathan, 2003). Surprisingly, board nationality diversity weakened the link between political affiliation and innovation input intensity. The involvement of other nationalities in a transnational industry is evidently beneficial as the industry expand investment to other countries (Earley and Mosakowski, 2000) by providing globally dispersed knowledge, emergent technologies, and specialised expertise and more innovative (Boone et al., 2018). The study extends the investigating by examining the impact of nationality diversity on political affiliation and innovation and finds nationality diversity is an insufficient governance tool to foster the association.

In summary, this thesis is able to establish links between strategic leaders' characteristics and innovation performance, in specific CFO power, CEO compensation and political affiliation with innovation performance. The findings of this study also suggests that governance mechanisms both internal and external governance tools such as capital structure, regulation and board diversity play important roles in either fostering or hindering the link between strategic leaders' characteristics and innovation performance.

5.2 Research key contributions

In essence, this research complements other studies and contributes to upper echelons theory, and to the existing literature of innovation, strategic leadership and corporate governance in a number of ways. The first contribution is to the theory of upper echelons. The upper echelons theory suggests that organisational outcomes are reflective of top executive's characteristics (Hambrick and Mason, 1984; Cannella et al., 2009). This thesis extends the upper echelons theory by integrating internal and external corporate governance mechanisms, namely the capital structure - financial slack, the board of directors and regulation. In sum, this thesis extends the upper echelons theory by integrating internal and external corporate governance mechanisms, namely the capital structure - financial slack, the board of directors, and regulation by providing valuable insights into how financial slack, regulation, and board diversity can foster or hinder the relationship between a powerful CFO, highly paid CEO and politically connected director and innovation performance.

The second key contribution of this thesis is to the innovation literature. The findings fill the void in the literature over the role of strategic leadership in innovation management. The contribution is made by identifying and presenting valuable understandings on the association between CFO power, CFO-CEO power, CEO compensation and politically affiliated directors and the firm's commitment to innovation using a range of innovation performance measures. In relation to the measurement, the thesis's contribution is through the creation of measurement to indicate the preferences towards types of innovation input strategic choice, to 'make' or 'buy' technology. Unlike most other research focusing on innovation input, such as R&D investment, this thesis also includes technology acquisition investment (the 'buy' strategy) as one of the innovation inputs measures. In short, the thesis applies a more holistic dimension of innovation performance by employing four innovation measures, namely the innovation input strategies, innovation outcome, innovation efficiency and formulation of a new variable to indicate firms' preference of strategic innovation input choice, whether to 'make' their own technology through internal R&D or to 'buy' technology from outside.

The third key contribution is to the strategic leadership literature. The thesis, indeed, adds insights on the interaction effects of governance mechanisms such as capital structure – financial slack, industry's regulation and board diversity with the role of a powerful CFO, highly paid CEO and directors with a political affiliation background on innovation performance, respectively. This thesis is the first to investigate how CFO-CEO power conflict impacts the association between CFO and innovation performance.

Besides, the study highlights the importance of a power balance, which means, a 'power ideal' between the CFO and CEO to ensure that the firm meets its innovation agenda. Any dysfunctional power balance could lead to struggles between the two top strategic leaders. Thus, it can hinder innovation performance through poor or even wrong decision making.

The fourth key contribution is to the literature of corporate governance. The agency theory states the conflicting interest between the owner and manager due to the 'separation of ownership and control' creating agency problems and subsequently leading to agency cost if there is insufficient monitoring. Therefore, governance mechanisms are needed either to align the interests of managers with the owners or to monitor the managers (Jensen and Meckling, 1976; Eisenhardt, 1989). The findings provide insights on the effectiveness of governance tools in raising innovation performance. Explicitly, the internal governance tools, namely the capital structure and board diversity (gender diversity), play a dynamic role in fostering innovation performance by aligning the interests of a powerful CFO and politically affiliated directors, respectively, with firms' innovation agenda. Surprisingly, the industry's regulations imposed by the government seem to be unable to nurture the association between highly paid CEOs and innovation performance. It seems to be not as effective governance mechanism compared to capital structure and board gender diversity in fostering innovation.

As for the fifth key contribution, the thesis contributes to varieties of viewpoints other than the Western standpoint by adding perspective from a gigantic industry from the Southeast Asia region. Many scholarly researchers focus on the Western point of view when it comes to studies on innovation. Indeed, many emerging economy countries are now experiencing a change in policy and regulation where there is a possible adjustment to the agency relationship at the firm's level (Elston, 2019), including in terms of how they get things done. Therefore, this present study adds to innovation and corporate governance literature via contributing insights from Southeast Asia.

The sixth contribution, unlike other studies, this thesis extends board diversity by including nationality diversity. The existing literature on board diversity focuses more on gender diversity (Miller and Triana, 2009; Zona et al., 2013). To this date, research on nationality diversity is scarce. The present thesis, indeed, contributes to the literature on board diversity and it offers empirical evidence on the association between nationality diversity and innovation.

The seventh key contribution, the thesis serves as a valued reference for innovative industries which is not limited to the high-technology, pharmaceutical and palm oil industries. This study offers an overview of the best practices that stakeholders, top management and the board of directors can use to determine the level of compensation and power of executives, align the power between CFOs and CEOs as well as review the policy pertaining to the appointment of directors with political ties to the company. Besides, the findings propose capital structure and board gender diversity as an effective governing tools for stakeholders. External governance mechanism such as regulation seems to have mixed effects on CEO compensation and innovation performance. As a whole amount of compensation, regulations demote highly paid CEOs to further pursue innovation goals. Still, exclusively on the cash component, CEOs that receive high salaries and bonuses focused more on driving success in innovation in the event of regulation changes.

As for the eighth key contribution, the research presents relevant courses of action for government and industry players. Notably, the Malaysian government put into practise political appointments as board of directors. The finding reveals political affiliation hinders the innovation agenda. However, the interaction between politically affiliated directors and board gender diversity fosters firms' innovation performance. Therefore, if the government wishes to continue the practices of appointing politically affiliated directors as board members, thus, there is a need to increase board gender diversity, specifically to have more female directors as board members to drive innovation goals.

The ninth key contribution, the present research highlights relevant courses of action for the shareholders, firms' policymakers and the government. The findings provide valuable information to shareholders and firms' policymakers concerning the role of capital structure, in particular financial slack on various levels of innovation performance. The current literature indicates that financial slack adversely impacts firm performance in the US because of corporate governance structures, specifically, large-scale companies, dispersed ownership and short-term positioning (Lee 2012). Because of this, the agency costs are higher in the United States. Nevertheless, the findings of this thesis reveal the importance of financial slack in fostering the association between a powerful CFO and innovation. Shareholders and firms' policymakers may consider adjusting an appropriate level of CFO power and financial slack to nurture firms' innovation performance.

In addition, the study provides a course of action to the shareholders and firms' policymakers concerning compensation and regulation, in particular, and the findings help the Search and Compensation Committees and Board of Directors in deciding on a suitable candidate for the CEO post, offering suitable compensation packages to attract the best and most capable candidates for the CEO position. Furthermore, the study highlights the significant impact of the industry regulation by the USFDA on innovation input strategy. Board of Directors and stakeholders should be cautious when there is a regulation amendment because, to some extent, it dampens the motivation of highly paid CEOs to invest in internal innovation projects.

Finally, as the tenth key contribution, the study contributes to the construction of a more extensive dataset for three significant industries. In particular, the study manually collected a dataset for firms related to palm oil in Malaysia from 2008 to 2018. For the US pharmaceutical and high-technology industry, the study covered a wide range of data stretching from 1998 to 2018. Apart from commonly used data, such as financial, board and firm characteristics in the cross-industries study, the present study's dataset also includes the industries' evident characteristics.

In sum, this thesis is of significant value and provides practical implications for policymakers, shareholders and the executives of firms who desire to enhance firm innovation performance to adopt best corporate governance mechanisms in order to mitigate agency costs, and in turn achieve greater innovation performance and shareholders' wealth. Hence, this study suggests that policymakers and shareholders should draw on the findings of this thesis to review the composition of board of directors, level of compensation and type of capital structure that have not been associated with improved innovation performance.

5.3 Research limitations

Similar to any research, this study suffered from several limitations that need to be acknowledged for the recommendation of further research. Firstly, the focus of the study is on strategic leadership's characteristics such as CEO, CFO and board director on innovation performance, thus it does not include all the TMT members. However, the strategic direction is often an outcome of the collective resources of the top management team (TMT) and the board of directors.

Secondly, financial slack and CEO power have been identified as playing an important moderation role on CFO power impacting the innovation performance of firms. However, other TMT characteristics should also be considered. Board diversity in TMTs, for instance, could play a pivotal role in moderating CFO power; the literature has demonstrated the impact of gender representation in both boards and R&D teams in affecting innovation efficiency (Xie et al., 2020).

Thirdly, this study is limited to quantitative method. In fact, innovation is inherently risky and it is crucial to examine the role of shareholder risk preferences and attitudes. Failure rates from innovation are relatively high; thus, shareholders may instinctively lean towards acquiring tried and tested external technology rather than invest in internally developed, riskier R&D activities. To explore this subject, secondary data are unlikely to be available, so a survey or interview could be undertaken to gauge the risk preferences and tolerances of shareholders.

Apart from that, specifically in the third core chapter, the limitation is the non-availability of a substantial number of patents and research and development information for additional analysis. However, this is due to the characteristics of innovation activities of the Malaysian palm oil industry itself. Based on the OECD (2005), the definition for an innovative firm is a broad definition. The definition of innovative firms may not be appropriate for all policy and research needs as it is very much depending on factors such as firm size, sectors or countries. Innovative firms are not only those developing innovations on their own or in cooperating with other organisations, but also those that mainly adopting innovation technologies. Malaysian firms in the palm oil industry adopt innovations more via the application of technology, mechanisation and equipment, and only a few firms carry out their own R&D and patenting. Therefore, the commonly used proxy such as R&D and patents data is not substantially available.

5.4 Further research

This research suggests further research areas and possible extensions in which some justifications are included in the above limitations. Concerning the role of the board of directors, this study calls for further investigation into the impact of specific board characteristics uniquely relevant to a sector or country on innovation performance, for example culture, norm, political, economy, social and technology. Similarly, further research is suggested to identify the types of innovation activities relevant to a sector or country. This is because a different environment may have an influence on the board attributes and innovation activities that are unique to a sector or country. Hence, we recommend considering a similar approach by focusing on the industry’s characteristics for further research.

Apart from CFOs and CEOs, future research may wish to investigate how high compensation and other strategic leadership characteristics or TMT as a whole team of executives such as gender, experience, education and turnover affect innovation performance. Moreover, it is worthwhile to investigate other macro environmental factors or external corporate governance mechanisms as moderating or mediating variables. As this study is focusing on interaction term, thus future study may consider to examine the mediating effects.

Companies in the pharmaceutical industry are not the only ones that benefit from this research. Indeed, the findings from this study can be generalised and applied to firms in other highly regulated industries as well. Therefore, future study may consider to conduct an investigation on other highly regulated industries such as banking and finance, nuclear, transportation and manufacturing. Besides, this study recommends that future studies on TMT individuals should consider how highly regulated versus less regulated industries affect their R&D commitments and include various innovation measurements such as 'make' and 'buy' strategies, and innovation input choice. Also, it is interesting to investigate CEOs’ risk behaviour towards innovation performance in a highly regulated industry.

Besides, future research may extend the study by conducting mixed research, which is to include qualitative approach as example, conducting interview sessions with board members and distributing questionnaires to get more of primary insights. Studying the impact of strategic leaders on innovation agenda can be more effective and inclusive by also considering opinions, concerns and ideas directly from the companies' key leaders.

Finally, future research is recommended to explore more on the impact of nationality diversity on organisation outcome such as innovation or financial performance. This recommendation is taking into account that research on this facet of board diversity is still very limited even though nationality diversity is also identified as a dynamic force that can contribute to companies' innovation performance via diverse skill, knowledge, ideas and expertise.

Appendix A

The Association between Political Affiliation, Board Diversity and Innovation Performance (Number of Patents Granted)

Dependent Variable	Patent					
Model	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Political Affiliation		-0.02	-0.005	-0.05	0.11	0.08
		(-0.55)	(-0.09)	(-0.92)	(0.91)	(0.79)
Gender Diversity		-0.45	-0.49	0.08	-0.69	-0.48
		(-1.04)	(-1.06)	(0.21)	(-1.24)	(-1.04)
Nationality Diversity		0.57	1.62	1.76	0.76*	0.86*
		(0.77)	(1.62)	(1.67)	(1.69)	(1.78)
Political Aff. X Gen. Diversity				-0.93		-0.31
				(-1.28)		(-0.79)
Political Aff. X Nat. Diversity					2.00	1.87
					(1.60)	(1.57)
MPOB	0.21		0.20	0.21	0.18	0.18
	(1.17)		(1.54)	(1.62)	(1.61)	(1.62)
Oil Extraction Rate	0.005		-0.002	-0.01	0.0002	-0.005
	(0.20)		(-0.07)	(-0.45)	(0.01)	(-0.15)
Tenure	0.34		0.53	0.49	0.44	0.44
	(1.07)		(1.50)	(1.51)	(1.60)	(1.60)
Meeting	-0.16		-0.11	-0.10	-0.11	-0.11
	(-0.91)		(-0.77)	(-0.74)	(-0.76)	(-0.75)
Board Size	0.18		0.47	0.43	0.44	0.43
	(1.03)		(1.50)	(1.50)	(1.61)	(1.59)
Board Independence	-0.42		-0.37	-0.33	-0.37	-0.36
	(-0.91)		(-0.89)	(-0.83)	(-0.91)	(-0.89)
ROE	0.21		0.26	0.29	0.31	0.31
	(0.83)		(0.89)	(0.93)	(1.01)	(1.01)
Leverage	0.08		0.12	0.12	0.10	0.10
	(0.75)		(0.87)	(0.89)	(0.85)	(0.86)
Altman-Z	-0.001		0.0003	0.0001	0.0005	0.0005
	(-0.78)		(0.34)	(0.15)	(0.78)	(0.66)
Risk	-0.09		-0.16	-0.19	-0.21	-0.22
	(-0.89)		(-1.10)	(-1.20)	(-1.25)	(-1.27)
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.61	0.13***	-1.75	-1.67	-1.45*	-1.45*
	(-0.93)	(2.74)	(-1.63)	(-1.67)	(-1.82)	(-1.81)
No. of Observations	446	446	446	446	446	446
Adjusted R^2	0.03	0.01	0.08	0.09	0.10	0.10

The table presents the results from OLS regression on the association between Political Affiliation, Board Diversity (Gender and Nationality) and Innovation Performance (Patent). In model 1, we add all control variables. In model 2, we add Politician on Board, Gender Diversity and Nationality Diversity. Model 3 is similar to model 2, but we also include control variables. Model 4 is similar with model 3 but we also add the interaction term between Political Affiliation and Gender Diversity. In model 5, we add Political Affiliation, Gender Diversity, Nationality Diversity, interaction term between Political Affiliation and Nationality Diversity and control variables. Model 6 is similar to model 5, but we also include the interaction term between Political Affiliation and Gender Diversity. t statistics (in parentheses); * p<0.10, ** p<0.05, *** p<0.01; All standard errors are subject to Huber/White adjustment

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