INTERNATIONAL JOURNAL OF SOCIAL SCIENCES BULLETIN
ISSN: (E) 3007-1917 (P) 3007-1909
Volume 3, Issue 1, 2025

THE EFFECT OF CORPORATE GOVERNANCE MECHANISMS ON RESEARCH & DEVELOPMENT INVESTMENT IN PAKISTAN

Haris Khan[1], Syed Hamid Ali Shah[*2], Ilyas Shareef [3], Hamid Ullah[4]

*[1,*2,3]Quaid-e-Azam College of Commerce, University of Peshawar, Pakistan.*
[4]Islamia College Peshawar, Pakistan

[1]hariskhan206432@gmail.com, [*2]hamidqcc@uop.edu.pk, [3]ilyasqacc@uop.edu.pk ,
[4]Hamidullah@icp.edu.pk

[*2]0000-0003-2078-6824

Corresponding Author: *
DOI: https://doi.org/10.5281/zenodo.14759907

Received	Revised	Accepted	Published
06 November, 2024	06 December, 2024	21 January, 2025	28 January, 2025

ABSTRACT

The study investigates the effect of corporate governance mechanisms (CGMs) on research and development (R&D) investment in a sample of Pakistani stock exchange listed non-financial firms through panel data regression analysis. Unbalanced panel-data for the period of twelve years from 2011-2022 is analyzed. The findings from fixed effect regression reveal that board size, independent directors, board gender diversity, director's ownership, independent audit committee and audit quality have a significant effect on R&D investment. Whereas, a significant inverse effect of ownership concentration on R&D spending is documented. However, CEO duality, institutional ownership, and size of audit committee do not have any significant association with R&D spending in the sample firms. These results are valuable for investors and others seeking CGMs that effectively drive R&D investment. The study provides policy maker's with valuable insights to design corporate governance frameworks that promote R&D spending.

Keywords: *Corporate Governance Mechanisms, R&D investment, Board Structure, Ownership Structure, Audit Committee, Pakistan.*

INTRODUCTION

In order to thrive in today competitive business environment, firm must make significant investment research and development (R&D) as it enables the introduction of new products and processes (Ghaffar & Khan, 2014; Jermias, 2007). R&D demand has grown as customer needs and industry dynamics continue to evolve. Industry dynamics encompass a range of factors such as production patterns, market competitiveness, and innovation (Yousaf et al., 2019). According to Septiandendi & Ramadhan (2021) R&D is a procedure or activity used to create goods that are better than existing goods and can also enhance the quality of existing goods. Whereas, Kutlu & Gerekan (2021) explain that R&D means the action undertaken to increase sales and lower production-related costs, as well as to adopt the latest manufacturing techniques. Both the definitions highlight that R&D is a means of increasing and/or maintaining the level of revenues. According to Cherensky & LJ (1994) the reason behind investment in R&D is to maximize shareholders wealth. Moreover, they believe that shareholders favor R&D spending because share prices reflect the current earnings of the firm as well as future earnings, and the latter is significantly influenced by a company's R&D initiatives. As Kiraci et al. (2016) documented, that long-term profitability can be significantly improved through R&D investment. In this connection, Jermias (2007) argues that R&D investment drives innovation, providing businesses with a

competitive advantage by launching new products and processes and is essential for the growth and success of businesses. An investment in R&D also boosts a company's ability to meet future customer demand and compete more efficiently. However, such investments are riskier, offering long-term and unpredictable returns compared to other investments (Scott, 2014), potentially reducing short-term performance (Muhammad et al., 2022). Due to this unpredictability, risk-averse managers often avoid these risky and career detrimental projects (Mezghanni, 2008).

However, agency theory states that managers exhibit risk-aversion and are incapable of diversifying their human capital risks being firm-specific (Jensen & Meckling, 1976). On the contrary, shareholders are perceived as risk-takers due to their ability to diversify investments across various alternatives (AlHares, 2020). Consequently, managers refrain from investing in R&D due to their conflicting interests as shareholders may be more willing to take on risk in pursuit of higher returns, while managers may prioritize minimizing risk to ensure their own job security (Fama & Jensen, 1983). Therefore, it is believed that relative to shareholders, career-conscious managers will favor short-term profits and will avoid risky and long-term investments like R&D (Mezghanni, 2008). Corporate governance theories suggest that various CGMs including the board of directors, ownership structure and audit committee can mitigate the adverse effects of agency problems. Corporate governance is a system that directs and controls the behavior of companies. Good governance is crucial as it enhances oversight, prevents scandals, ensures efficient resource allocation, and develops stronger stakeholder relationships (Wang et al., 2019). Corporate governance makes firms more accountable and transparent, which is essential for firm growth. Ensuring an effective governance system that protects shareholders' interests is the responsibility of the board of directors (Cadbury, 1992). Muhammad et al. (2022) demonstrate that the board of directors plays a crucial role in controlling agency issues. Similarly, Jensen & Meckling (1976) argue that ownership structure act as a supervisory tool in reducing conflicts of interest. Ozcan (2021) adds that audit committees oversee financial reporting, enabling firms to produce reliable accounting figures while also reducing information asymmetry between internal and external stakeholders.

Corporate governance is thus a means of fostering firms' long-term success and driving economic growth. Convincing shareholders to support companies that take risk and pursue long-term projects requires trust and sound corporate governance is essential to create that trust (Bolkestein, 2004). Yang et al. (2009) stated that corporate governance quality positively influences R&D in U.S. manufacturing firms. This suggests that firms in the U.S., with a developed capital market and strong regulatory framework, benefit from robust governance mechanisms that drive R&D investment.

Various studies have analyzed the effect of CGMs on firm R&D investment but their results are inconsistent. For instance, AlHares (2020) found a positive association between board independence and R&D investment, which is consistent with the results of (Chou & Johennesse, 2021; Kutlu & Gerekan, 2021). Further, the findings reveal that board size, board diversity and institutional ownership are negatively associated with R&D spending. On the contrary, Baysinger et al. (1991) and Septiandendi & Ramadhan (2021) concluded that R&D spending is positively affected by institutional ownership. In their assertion Song et al. (2022), reported that the board size, number of board meetings and CEO duality do not significantly affect R&D intensity. Moreover, Mezghanni (2008) provides evidence that CEO duality and ownership concentration do not impact R&D intensity, whereas board size and the ratio of inside directors have a positive effect on R&D investment. Meanwhile, Baysinger et al. (1991) and Hill & Snell (1988) found a positive correlation between ownership concentration and R&D expenditures.

Based On The Aforementioned Studies, It Is Evident That Empirical Evidence On The Association Between Corporate Governance And R&D Spending Are Inconsistent. Further, The Audit Committee, An Important Aspect Of Internal Cgm Is Given Little Importance In The Existing Empirical Studies. In Addition, We Argue That Cgms Are Context Dependent, And May Differ In Their Influence On R&D Investments Across

Various Countries Due To Varying Economic Conditions, Culture, Capital Market Development And Ownership Structures. Consequently, The Findings Of One Context Cannot Be Deemed Suitable For Any Other Context, Hence Emphasizing The Need For Context-Specific Investigation.

Relevant statistics offer yet another stronger reason to investigate this association between CGMs and R&D investment in Pakistan where overall R&D spending is minimal. According to World Development Indicators (WDI)[1], Pakistan spent 0.32% of its GDP on R&D in 2011. In 2013, the spending was 0.29% and further dropped to 0.25% in 2015. The spending on R&D continued to decline in the subsequent years. The country overall expenditures stood at 0.21% and 0.17% in 2017 and 2019, respectively. Hence, if overall spending is too minimal, it implies that the portion of R&D spending by firms would be significantly smaller. Moreover, the ratio of R&D to GDP is one of the lowest relative to other developing countries i.e., India and China. Over the past decade, India has an average R&D expenditure of 0.70% of its GDP, while China spent an average of 2.08% during the same period. Research scholars therefore should take the initiative to examine this phenomenon. On the contrary, theory suggests that CGMs could enable firms to make risky investments, such as those in R&D. As mentioned above, Pakistan's spending on R&D is minimal, and corporate governance codes have also been developing over time during the period. Therefore, it is important to investigate whether these developments play any role in promoting R&D investment. Thus, this study seeks to explore whether corporate governance mechanisms (CGMs) affect R&D spending in non-financial stock exchange listed firms of Pakistan. This study considers three distinct and major CGMs i.e., board structure, ownership structure and audit committee. Further, to the best of our knowledge, this is however, so far not investigated in Pakistan. More specifically, the study aims to achieve the following objectives: (i) to measure the effect of board size, board independence, CEO duality and gender diversity on R&D investment (ii) to measure the effect of ownership concentration, institutional ownership and director's ownership on R&D investment (iii) to measure the influence of audit committee size, audit committee independence and audit quality and (iv) to measure if changes in corporate governance code have an effect on R&D investment in non-financial firms listed on Pakistan Stock Exchange (PSX).

The rest of the paper is organized as follows. Section 2 presents the relevant literature and hypotheses. Population and sample, data collection, variables and research model are explained in Section 3. Section 4 describes the empirical analysis and discussion. The conclusion is presented in the last section.

2. Literature Review & Hypotheses Development

2.1 Research and Development Investment

Research is the process of investigating to discover new knowledge, while development involves utilizing scientific and technical knowledge to enhance the quality of products, processes, and overall outcomes. Consequently, it can be inferred that research often leads to development, as the new knowledge gained can be employed to improve products, services, or processes (Yousaf et al., 2019). According to Jermias (2007), to stay competitive in today's robust business environment firms must engage in innovative activities which requires investment in R&D (Block, 2012). Similarly, Song et al. (2022) asserts that high R&D investment can help businesses to gain a competitive edge in the face of accelerated technology development. Promoting innovation through R&D is crucial in enhancing economic development for businesses. It leads to inventions and successful launch of new products, ultimately fortifying a company's competitive advantage, ensuring its survival, and strengthening its market position. In addition, investment in R&D helps the firms in cost reduction, enhancing performance and selling new products (Shanwari et al., 2021). In the study by Ghaffar & Khan (2014), it is emphasized that the performance of firms is subject to R&D which serves as a mechanism for improving overall performance. Furthermore, Mezghanni (2008) suggests that firms that invest more in R&D are likely to achieve

[1] https://databank.worldbank.org/source/world-development-indicators

higher long-term profits, highlighting R&D as a pivotal factor in value creation.

In contrast, Block (2012) draws attention to the distinctive characteristics of R&D spending, which sets it apart from other types of investments. This includes its time-consuming nature and failure to achieve desired objectives. Furthermore, Scott (2014) emphasizes that R&D investments entail high risk and a greater likelihood of failure, as the anticipated benefits are considerably more uncertain. Moreover, R&D expenditures contribute to a reduction in current cash flows and profits (Mezghanni, 2008). To boost R&D investment, firms should develop better CGMs. Effective governance mechanisms are expected to curb manager's opportunistic behavior and nurture R&D investment (Muhammad et al., 2022).

2.2 Corporate Governance and R&D

Corporate governance encompasses a set of mechanisms, both internal and external, that are designed to manage conflicts of interest between managers and shareholders stemming from the ownership-control separation within a company (Shleifer & Vishny, 1997). Given the divergent objectives, shareholders typically strive to maximize the long-term profitability and value of their investments while managers are driven by personal wealth, job security, and prestige (Baysinger et al., 1991). This inherent misalignment of interests between managers and shareholders significantly influences investment decisions, especially those pertaining to R&D activities (Mezghanni, 2008).

Honoré et al. (2015) argue that shareholders are commonly perceived as risk-takers owing to their capacity to diversify investments across portfolios. Conversely, managers are often regarded as risk-averse since their risk exposure is specific to the firm and cannot be easily diversified. Consequently, managers are expected to place a greater emphasis on short-term profits, which may have a dampening effect on long-term returns. According to Zeng & Lin (2011), managers may exhibit a greater inclination to invest in projects with shorter-term returns in order to enhance their reputations and advance their careers swiftly, while owners, on the contrary, may prioritize long-term investments. These conflicting objectives between managers and shareholders lead to agency problems. As a result, may significantly influences R&D investment decisions, as highlighted by Honoré et al. (2015) and managers may devote fewer resources to riskier assets like R&D than shareholders would prefer (Rodrigues et al., 2020). Therefore, it is suggested that good corporate governance practices should seek to align the conflicting interests of managers and shareholders, in order to have a favorable effect on R&D investment (Honoré et al., 2015).

2.3 Board Size

The ultimate responsibility of the board is to ensure smooth operation of the firm, improves the decision making process and effect management efficiency (Jensen, 1993). Board size is considers as crucial aspect of board characteristics that might influence a company's investment in R&D. Small boards lack the skills and expertise required for effective control and evaluation of initiatives, particularly those related to innovation (Zahra et al., 2000). Conversely, larger boards have broader knowledge, experiences and skills that can assist in evaluation of innovative opportunities. It also enables the board to prioritize long-term objectives, resulting in an increased focus on R&D investment (Gonzales-Bustos et al., 2017). This viewpoint is supported by Mezghanni (2008), who asserts that board size has a positive effect on R&D investment. Based on the reviewed literature, it is hypothesized that.

H_1. Board size has a positive effect on R&D investment.

2.4 Board Independence

Composition is another significant feature of a board. An increase in the proportion of independent directors results in a decrease in agency costs, resulting in a greater allocation of funds towards R&D initiatives. Independent directors, being detached from operational activities, provide independent and unbiased judgments on corporate matters. Their effective oversight and control can limit managers' short-term priorities and promote long-term R&D spending (Song et al., 2022). Further, Chen & Hsu (2009) emphasize that due to lower risk-aversion, independent directors are more prone to nurture and uphold innovative capabilities. The findings of Song et al. (2022) indicate

that higher independent director's ratio has a positive association with R&D investment, improving the board professionalism and independence. This enhances the board's commitment to objectivity and fairness, boosts its monitoring abilities and results in increased funding for R&D. Similarly, Chou & Johennesse (2021) also found a positive association between independent directors and R&D investment. In the light of above discussion, the following hypothesis is developed.

H_2. Board independence has a positive effect on R&D investment.

2.5 CEO Duality

According to Fama & Jensen (1983), CEO duality reduces both effectiveness and the board ability to supervise the CEO's performance. When the CEO is also the board chairman, decision-making and supervisory functions are concentrated in the hands of the same person. Consequently, this consolidation grants the CEO considerable control over the board, potentially hinders their independence and capacity to efficiently monitor and hold management accountable (Mezghanni, 2010). Hence, due to the CEO's dominant position, managers often prioritize projects that may serve their own interests, potentially neglecting shareholder interests. This viewpoint indicates that distinct roles of the CEO and chairman can enhance board independence, reduce managerial opportunism, and promote greater investment in R&D (Yong-hai, 2010). Numerous studies provide evidence that supports the above arguments. For instance, Chou & Johennesse (2021) found that CEO duality negatively impacts R&D spending. Likewise, Yong-hai (2010) demonstrated that the dual role prompts CEOs to prioritize personal interests, thereby negatively affecting R&D investment. Hence the following hypothesis is proposed.

H_3. CEO Duality has a negative effect on R&D investment.

2.6 Board Gender Diversity

The presence of female director on the board can lead to better monitoring Suman & Singh (2021) as they think independently (Azzam, 2022). Female directors ensure better problem solving by reducing the issue of group-think (Suman & Singh, 2021). Women tend to display lower tolerance for opportunistic behavior, showing greater sensitivity to ethical considerations and adherence to established practices. They avoid self-interest, and expedience (Azzam, 2022). Furthermore, Harymawan & Nismara (2022) asserts that compared to the male counterparts, women on the board can bring new perspectives, knowledge, working styles, experiences and expertise which can aid in the identification of new innovative opportunities. Studies further suggest that women have a deeper understanding of customer needs, providing firms with innovative ways to effectively respond to and fulfill those needs (Gonzales-Bustos et al., 2017; Azzam, 2022). The study by Rossi et al. (2017) indicates that firms with greater gender diversity on their boards invest more in R&D. These findings support the argument that diverse boards, having various perspectives, enhance problem-solving capabilities. In another empirical study in UK, Azzam (2022) found that R&D intensity is positively affected by board gender diversity. This aligns with the argument that female directors play a crucial role in protecting shareholders' interests. Considering the literature review, the following hypothesis is suggested.

H_4: There is a positive relationship between Board Gender Diversity and R&D investment.

2.7 Ownership Concentration

In accordance with the agency theory perspective, Zeng & Lin (2011) argue that ownership concentration cause conflicts of interest between the controlling and minority shareholders. This conflict stems from the controlling shareholders' ability to divert company resources in ways that may undermine the interests of minority shareholders, particularly when minority shareholder rights lack proper protection. Such self-serving actions can negatively impact a firm's R&D investments. Lee (2012) further suggests that major shareholders, due to their large equity stakes, may adopt a more conservative stance and avoid risky investments like R&D to protect their own investment. They may have incentive to collude with the managers at the expense of minority shareholders. Yangfan (2015) documented that firms with concentrated ownership tend to invest less in R&D. Additionally, Javid & Iqbal (2008)

reported that ownership concentration is a prominent feature in Pakistan, with a significant proportion of firms being closely held by family investors. Consequently, this concentration may impose constraints on the allocation of funds towards R&D initiatives. On the basis of literature following hypothesis is developed.

H_5. Ownership concentration has a negative effect on R&D investment.

2.8 Institutional Ownership

Institutional investors actively engage in the firm operations and monitor managerial activities, allowing them to develop a closer relationship with management and gain insights into the firm's future plans and hence serve as an effective means to minimize agency conflicts (Septiandendi & Ramadhan, 2021). Institutional investors favor short-term earnings and hinder managers from undertaking long-term investments like R&D (Mishra, 2022). Further, Gupta (2019) suggests that institutional investors exhibit myopic behavior and prefer immediate returns on their investments. Unlike R&D, they prefer safe or less risky projects. Moreover, in the peculiar settings of Pakistan and the continued poor economic prospects the institutional investors may be shy of relatively riskier investments like R&D. Empirically, Gupta (2019) found that R&D investment is negatively affected by institutional ownership. In accordance with the aforementioned arguments, the subsequent hypothesis is framed:

H_6. Institutional ownership has a negative effect on R&D investment.

2.9 Directors Ownership

Boards are pivotal in monitoring managerial activities and harmonizing their objectives with those of shareholders through shareholdings will help mitigate agency issues (AlHares, 2021; AlHares et al., 2019). Directors with significant ownership stakes are more inclined to support R&D investments due to their focus on long-term value creation (Teng & Yi, 2017). This alignment often motivates directors to invest in R&D, which enhances the long-term value of the firm's. Directors with significant ownership stakes tend to advocate for R&D investments, driving innovation and long-term growth for the company. Hill & Snell (1988), Baysinger et al. (1991), and Zhu & Wang (2012) show that a higher shareholding proportion among board members positively influence R&D spending. These findings demonstrate that shareholding of the board members encourages the firm to prioritize R&D spending. Thus, the following hypothesis is developed.

H_7. Directors Ownership has a positive effect on R&D investment.

2.10 Audit Committee Size

The audit committee plays a key role in prompting agents to make decisions that ultimately serves the interests of shareholders (Ananda et al., 2022). The effectiveness of corporate governance is often influenced by the size of the audit committee (Buallay & Al-Ajmi, 2020). Agency theory proponents suggest that larger committees may face conflicts and coordination challenges, leading to poor corporate governance. Similarly, Ioana (2014) emphasizes that maintaining a reasonable committee size is essential to prevent responsibility dispersal and ensure effective oversight. Yermack (1996) and Jensen (1993) support the idea that smaller audit committees are more efficient and effective in fulfilling its crucial role of supervision and accountability. A smaller committee is better equipped to monitor financial reporting and ensure compliance with regulations and best practices (Hassan Bazhair, 2022). The literature investigating the effect of audit committee size is sparse. An empirical study by Ali & Amir (2018) conducted in Pakistan shows that the audit committee size is negatively associated with financial performance, potentially leading to budget cuts and reduced funding for R&D. This could curtail the firm's ability to pursue innovative projects and research initiatives. Additionally, management and investors may become more cautious, prioritizing short-term financial stability over long-term R&D investment. Therefore, it is hypothesized that:

H_8. Audit Committee Size is negatively associated with R&D investment.

2.11 Audit Committee Independence

A key indicator of audit committee independence is the lack of relationships between its members and management. Audit committee independence enhances the credibility of financial information which

could enhance investors' confidence in financial reports (Al-Hadrami et al., 2020). Being free from management influence, independent audit committee provides more effective oversight and prevents financial reporting manipulation, thereby improving the overall quality of financial reporting (Chariri & Januarti, 2017). Chen &Chen (2012) support the view that a fully independent audit committee significantly influences efficient investment allocation, highlighting the vital role of independent directors in ensuring optimal allocation and utilization of funds within the company. According to Nekhili et al. (2016), R&D activities create asymmetric information between managers and shareholders, resulting in an agency problem. The audit committee acts as a monitoring mechanism, enhancing financial disclosure and reducing the agency problem. It also oversees the utilization of funds by managers (Suman & Singh, 2021), which may prevents managers from underinvesting in R&D projects. The findings of Ahmad & Kowalewski (2021) suggest that an independent audit committee leads to higher R&D investment. In line with the extant literature, the following hypothesis is formulated:

H_9: AC independence has a positive effect on R&D investment.

2.12 Audit Quality (BIG 4)

According to (Suman & Singh, 2021), an audit by big firms shows a company devotion to accurate financial reporting as well as a high degree of scrutiny. Big audit firms, equipped with better-trained staff and superior financial & technological resources, offer higher-quality audit services compared to smaller firms (Al et al., 2015). Enhanced financial reporting quality (FRQ) boosts investment efficiency by reducing information asymmetry between firm and investors. Thus, due to reduced information asymmetry, making appropriate investment decision becomes easier (Park et al. 2017). Empirically, studies by Wijaya (2020), Wang & Huang (2014) found that audit quality positively affects firm value, due to the commitment of Big 4 audit firms to ensure reliable and credible financial information, which is further confirmed by Afza and Nazir (2014) in Pakistan. Further, the results of Johnson & Pazderka (1993) indicate that R&D expenditures have a positive effect on firm value, as concluded by Yousaf et al. (2019) in their investigation within the Pakistani industry. Hence, Big 4 audit firms are expected to foster enhanced audit quality, thereby mitigating the possibility of under investment in R&D which will contribute to high firm value. Keeping in view the preceding arguments, it is proposed that:

H_{10}: There is a positive relationship between Audit Quality and R&D investment.

2.13 Control Variables

R&D investment is not solely determined by characteristics related to board structure, ownership structure, and audit committee; some firm-specific elements also play a role in determining a firm's investment in R&D. Based on existing literature, these factors include firm size, leverage, firm performance, firm age, and growth opportunities, which are controlled in this study.

According to Lai et al. (2015), larger firms allocate more resources to R&D due to their larger capital and enhanced managerial skills. Leverage can limit a firm's investments, especially in R&D, as debt holders may dissuade highly risky investments due to payment asymmetries (Suman & Singh, 2021). Additionally, when a company is financially underperforming, it may lack the capacity to increase R&D spending, as these costs are often cut to boost short-term performance (Daellenbach et al., 1999).

Furthermore, the association between a firm's age and its ability to innovate is influenced by the knowledge acquired over time; younger firms, facing a higher fear of failure, may be more conservative with R&D spending (Chen, 2014). Finally, firms with significant growth opportunities are likely to allocate more resources toward R&D activities to unlock the potential of future markets (Mezghanni, 2008)

3. Research Methodology

3.1 Sample of the Study

Initially, we aimed to include all non-financial firms listed on PSX that reported R&D data during the study period from 2011-2022. However, we found that only 51 firms reported R&D data for the chosen period.

3.2 Data Collection

The study utilized secondary data from the annual reports of the sample non-financial firms listed on Pakistan Stock Exchange (PSX). These reports were available on the respective company's website and PSX data portal as well. An unbalanced panel data from 2011 to 2022 is analyzed due to the non-availability of R&D data for some years. This timeframe captures the latest corporate governance codes in Pakistan and their revisions. The period prior to 2011 is excluded due to limited R&D reporting.

Table: Variables Defintion

Variables	Symbols
Dependent Variable	
Research & Development Investment	R&D
Independent Variables	
Board Characteristics	
Board Size	BSIZE
Board Independence	BIND
CEO Duality	DUALITY
Board Gender Diversity	BG
Ownership Structure	
Ownership Concentration	OWNC
Institutional Ownership	INSOWN
Directors Ownership	DOWN
Audit Committee	
Audit Committee Size	ACS
Audit Committee Independence	ACI
Audit Quality	BIG4
Corporate Governance Code	CG
Control Variables	
Firm Size	FSIZE
Leverage	LEV
Firm Performance	FP
Firm Age	FAGE
Growth Opportunities	MBR

3.3 Model Specification

To determine the effect of CGMs on R&D investment, this study employed the following multiple regression panel data model (Suman & Singh, 2021; Mezghanni, 2008; Song et al., 2022). Further, to choose pooled OLS, random or fixed effect estimation techniques, Breusch-Pagan LM test and Hausman's test are performed.

$$R\&D_{it} = \alpha_0 + \beta_1 BSIZE_{it} + \beta_2 BIND_{it} + \beta_4 DUALITY_{it} + \beta_3 BG_{it} + \beta_5 OWNC_{it} + \beta_6 iINSOWN_{it} + \beta_7 DOWN_{it} + \beta_8 ACS_{it} + \beta_9 ACI_{it} + \beta_{10} BIG4_{it} + \beta_{11} FSIZE_{it} + \beta_{12} LEV_{it} + \beta_{13} FP_{it} + \beta_{14} FAGE_{it} + \beta_{15} MBR_{it} + \varepsilon_{it}$$

4. RESULTS AND DISCUSSIONS

4.1 DESCRIPTIVE STATISTICS

Table 4.1 displays the summary statistics of all the key variables of this study. The table indicates that the average R&D spending as a proportion of total assets is 0.2%, with a variation of 0.7%. For board structure, the average board size is 8 members, with independent directors averaging 18.5%. CEO duality, where the CEO is also the board chairman, is observed in 7.7% of the sampled firms. Further, it is revealed that 9.2% of board members are female. In respect of ownership structure, the ownership concentration is relatively high, with an average of 62.8%. Institutional investors hold 11.3% of the total outstanding shares. Additionally, director ownership averages 22% of the total outstanding shares. Audit committee has 3 members on average, with 26.4% of these members being independent. Moreover, approximately 55.6% of the firms are audited by one of the Big 4 auditing firms.

Table 4.1: Descriptive Statistics

Variables	N	Mean	SD	p25	Median	p75
R&D	612	0.002	0.007	0	0	0.001
BSIZE	612	8.135	1.681	7	7	9
BIND	612	0.185	0.141	0.111	0.143	0.286
DUALITY	612	0.077	0.266	0	0	0
BG	612	0.092	0.118	0	0	0.143
OWNC	612	0.628	0.196	0.47	0.645	0.79
INSOWN	612	0.113	0.145	.023	0.067	0.148
DOWN	612	0.22	0.231	0.004	0.122	0.389
ACS	612	3.44	0.707	3	3	4
ACI	612	0.264	0.204	0	0.333	0.333
BIG4	612	0.556	0.497	0	1	1
FSIZE	612	7.055	0.904	6.65	7.01	7.46
LEV	612	0.514	0.239	0.341	0.503	0.650
FP	612	0.049	0.11	0.179	4.8	13.741
FAGE	612	43.208	20.503	29	38	55
MBR	612	1.543	1.424	0.775	1.02	1.65

4.2 CORRELATION MATRIX

Table 4.2 reveals that the explanatory variable OWNC has a negative correlation with R&D investment, implying that large shareholders tend to avoid spending on R&D. Conversely, BIND, DUALITY and BG exhibit positive correlations with R&D investment. Additionally, ACS and BIG4 are negatively correlated with R&D spending, whereas ACI is positively correlated with R&D investment, indicating that having independent members on the audit committee encourages R&D investment. Among the control variables, FSIZE and FAGE represent a negative correlation with R&D investment.

4.3 REGRESSION RESULTS

The fixed-effect regression results in Table 4.3 indicate that the board size has a positive effect on R&D investment, with a 0.085 unit increase in R&D for each unit increase in board size. The finding aligns with those of (Mezghanni, 2008; Gonzales-Bustos et al., 2017). Larger boards, with diverse knowledge, expertise and experience can make better decisions and guide firms toward growth-oriented investments like

R&D. They might be considered more resourceful and thus could aid in evaluating innovative opportunities just like R&D. Board independence significantly enhances R&D investment, with a 1% increase in board independence correlating to a 99.1% rise in R&D spending. This aligns with prior studies Song et al., (2022) and Chou & Johennesse, (2021), indicating that higher independent directors ratio boosts R&D spending. Agency theory posits that independent directors, being detached from the company, exhibit risk-averse behavior and effectively monitor management decisions, ensuring better decision-making regarding investment (Chen & Hsu, 2009; Song et al., 2022). Thus, by exercising oversight and control, they can deter managers from prioritizing short-term performance, thereby encouraging long-term R&D investments (Song et al., 2022). CEO duality has a positive but insignificant effect on R&D investment, indicating that the dual role of the CEO does not significantly influence R&D spending. The results show a positive effect of board gender diversity on R&D investment, with a 0.56 unit rise in R&D spending for each additional female director. Consistent with Rossi et al. (2017) and Azzam (2022), the findings suggest that female directors, through their diverse perspectives and experiences enhance board effectiveness, which can help in the identification of new innovative opportunities.

The results indicate a negative association between ownership concentration and R&D investment, supporting the notion that large shareholders, due to significant equity stakes, may adopt risk-averse behavior. Consequently, they avoid risky investments like R&D to safeguard their investment. Larger shareholders can also expropriate benefits through tunneling Ullah & Shah (2015) and may be hesitant to invest in relatively riskier investments like R&D. The studies by Yangfan (2015) and Ting et al. (2020) provide similar results, concluding that as ownership concentration increases, R&D investment tends to decrease. The results show a negative but insignificant association between institutional ownership and R&D investment, indicating that institutional ownership does not significantly influence R&D spending in the context of Pakistan. Similarly, Lee (2015) concluded that there is no significant effect of institutional investors on R&D investment in Korean firms. Director ownership has a positive association with R&D investment. It suggests that directors with significant ownership stakes in the firm are likely to support R&D investments, driven by their focus on long-term value creation (Teng & Yi, 2017). In their studies, Zhu & Wang (2012) and Song et al. (2022) also established a positive relationship between directors ownership and R&D investment.

Table 4.2: Correlation Matrix

	(1) R&D	(2) BSIZE	(3) BIND	(4) DUALITY	(5) BG	(6) OWNC	(7) INSOWN	(8) DOWN	(9) ACS	(10) ACI	(11) BIG4	(12) FSIZE	(13) LEV	(14) FP	(15) FAGE	(16) MBR
(1)R&D	1															
(2)BSIZE	-0.029	1														
(3)BIND	0.038	0.054	1													
(4)DUALITY	0.013	-0.062	-0.038	1												
(5)BG	0.0483	-0.195***	0.165***	0.176***	1											
(6)OWNC	-0.134**	-0.068	0.076	-0.083*	0.176**	1										
(7)INSOWN	-0.076	0.059	0.092*	-0.017	-0.097*	-0.169***	1									
(8)DOWN	-0.009	-0.206***	-0.08	0.101*	0.179**	-0.041	-0.251***	1								
(9)ACS	-0.090*	0.364***	0.068	-0.015	-0.08	0.097*	0.088*	-0.343***	1							
(10)ACI	0.126**	0.001	0.495***	-0.234***	0.125**	-0.006	-0.035	0.013	-0.047	1						
(11)BIG4	-0.118**	0.176***	0.082	-0.044	-0.018	0.079	0.165***	-0.377***	0.325***	0.035	1					
(12)FSIZE	-0.195***	0.332***	0.310***	-0.112**	-0.114**	0.107*	0.228***	-0.221***	0.337***	0.223***	0.232***	1				
(13)LEV	0.067	-0.005	0.058	-0.003	0.034	-0.094*	-0.029	-0.101*	-0.049	0.0913*	0.091*	-0.01	1			
(14)FP	-0.067	0.097*	0.021	0.067	-0.074	0.001	0.031	-0.118**	0.165***	-0.157***	0.229***	0.043	0.219**	1		
(15)FAGE	-0.098*	0.05	0.183***	-0.042	-0.072	0.0233	0.216***	-0.386***	0.254***	0.057	0.247***	0.286***	0.007	0.0517	1	
(16)MBR	-0.032	-0.00004	-0.019	-0.048	0.083*	0.241***	-0.093*	-0.227***	0.180***	-0.018	0.266***	0.02	0.051	0.462***	0.158***	1

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 4.3 highlights that audit committee size has a negative effect on R&D investment. However, the findings show that this negative association between audit committee size and R&D investment is insignificant. The table further reveals a positive and significant effect of audit committee independence on R&D spending. The evidence shows that an increase in audit committee independence leads to an increase in R&D investment. This emphasizes the importance of independent members in ensuring optimal fund allocation, preventing underinvestment in R&D, as suggested by Chen & Chen (2012). The finding is consistent to Ahmad & Kowalewski (2021), who also reported that independent audit committee boosts investment in R&D. The findings suggest a positive effect of Big 4 audit firms on R&D investment. Park et al. (2017) support this finding by suggesting that Big 4 audit firms result in greater financial reporting quality, which in turn improves investment efficiency and lessens information asymmetry between investors and managers. This reduction in information asymmetry increases the likelihood of making appropriate investments such as investment in R&D and prevents managers from underinvesting in R&D. Among the control variables, firm size and leverage show a negative but insignificant effect on R&D spending, indicating that neither firm size nor leverage significantly affects R&D investment. Additionally, firm performance and firm age exhibit a positive yet insignificant association with R&D spending. However, growth opportunities have a positive and significant association with R&D investment, indicating that firms with high growth potential are more likely to invest in R&D to unlock the future market.

The study also presents the results of OLS and random effects model for readers. Those interested can interpret and compare these results.

Table 4.3 Regression Results

Variables	(OLS)	(FE)	(RE)
	R&D	R&D	R&D
BSIZE	0.069**	0.085**	0.093***
	(.034)	(.035)	(.033)
BIND	0.52	0.991***	0.691***
	(.322)	(.233)	(.227)
DUALITY	0.02	0.016	0.026

	(.146)	(.1)	(.098)
BG	0.316**	0.56**	0.478
	(.132)	(.211)	(.298)
OWNC	-0.21	-0.64**	-0.531**
	(.225)	(.271)	(.254)
INSOWN	-0.078	-0.209	-0.189
	(.24)	(.16)	(.159)
DOWN	0.161*	0.07***	0.095*
	(.085)	(.027)	(.057)
ACS	-0.071	-0.018	0.001
	(.08)	(.065)	(.063)
ACI	0.732***	0.356**	0.27*
	(.255)	(.16)	(.158)
BIG4	0.61***	0.174*	0.285***
	(.105)	(.105)	(.1)
FSIZE	0.087	-0.041	-0.016
	(.066)	(.063)	(.06)
LEV	-0.252**	-0.036	-0.067
	(.103)	(.087)	(.085)
FP	1.769***	0.202	0.48
	(.455)	(.334)	(.326)
FAGE	1.187***	0.752	1.051**
	(.226)	(.597)	(.435)
MBR	0.119***	0.044**	-0.028
	(.029)	(.021)	(.021)
CONS	-1.888***	-0.161	-1.027
	(.568)	(.96)	(.769)
Observations	612	612	612

*** p<.01, ** p<.05, * p<.1

4.4. REGRESSION RESULTS BEFORE AND AFTER CHANGES IN CORPORATE GOVERNANCE CODES

In this section, the study focused on the effect of CGMs on R&D investment prior to and following changes in corporate governance codes. The period of the study with respect to data provide the opportunity to explore if changes in CG codes have any significant influence on R&D investment. Notably, the corporate governance codes were revised in 2017, introducing several key changes. The revised corporate governance code stipulated that a director shall not serve as an alternate director for more than five listed companies. It also made it mandatory that the minimum independent directors must not be less than two in number and one-third of total members became mandatory. Furthermore, a major addition to the CG code 2017 was the requirement that at least one director must be female. Thus, the study availed this opportunity and performed these additional analysis. Table 4.4 presents regression results before and after amendments to the corporate governance codes.

Table 4.4 presents that prior to the corporate governance code revision, board size had a positive but insignificant effect on R&D investment. After the amendments, the effect became significant, suggesting that larger boards have become more effective in promoting R&D investment following the amendments in corporate governance code. Initially, the association between board independence and R&D investment was not significant as shown in the Table 4.4. However, following the changes, the relationship became significant, indicating that the shift may be due to higher proportion of independent directors, which likely enhanced the board's monitoring capacity and encouraged managers to concentrate on long-term investment opportunities, such as R&D. It is evident from the Table 4.4 that CEO duality initially

exerts an insignificant negative effect on R&D spending before change in corporate governance code. After incorporation of changes the effect shifted to positive but remains insignificant. The data suggests that CEO duality persists despite the amendments, and its effect on R&D investment remains largely unaffected. Before the changes in corporate governance code, board gender diversity has a negative insignificant effect on R&D investment. Following the corporate governance code amendments, this effect transformed dramatically, became positive and significant. This transformation underscores the importance of gender diversity in driving innovation, suggesting that boards with female representation are better positioned to prioritize and invest in R&D.

Table 4.4 indicates that ownership concentration is negatively associated with R&D investment in both periods. Before the changes in corporate governance code, this negative relationship is insignificant, but after the amendments, it became significant. This shift implies that having more independent directors and a female director on the board may encourage major shareholders to be more resilient. The association between institutional ownership and R&D investment remains negative and statistically insignificant in both periods prior to and following the changes in corporate governance code. This insignificance suggests that institutional ownership does not influence R&D investment in both periods. Director's ownership has a negative and insignificant effect on R&D investment before the changes in corporate governance code. After amendments, this effect shifted to positive and significant. This change suggests that before the corporate governance code revision, directors were likely influenced by large and institutional shareholders. However, with the incorporation of more independent directors and the addition of a female director to the board after the corporate governance code revision, directors may have gained greater freedom in decision-making, which enabled them to prioritize investments in R&D.

According to Table 4.4, the audit committee size has an insignificant effect on R&D investment in both periods. This indicates that audit committee size does not affect R&D spending, highlighting its negligible effect in both periods. Before the changes in the corporate governance code, audit committee independence had an insignificant relationship with R&D investment. After the amendments, this lack of significance continued, indicating that audit committee independence does not influence R&D spending in both periods. Before changes in the corporate governance code, audit quality represented by Big 4 audit firms had a positive but insignificant effect on R&D spending. Following the amendments in corporate governance code, this effect became significant. This shift implies that having more independent directors and a female director on the board could strengthen the audit committee, making it more likely to hire a Big 4 audit firm to enhance audit quality.

Before the changes in corporate governance code, firm size had a negative but insignificant effect on R&D investment, which became significant after the amendments. Leverage showed a negative and insignificant effect throughout. Furthermore, firm performance positively influenced R&D spending before the changes but lost significance afterward. Firm age maintains a positive but insignificant association with R&D investment in both periods. Lastly, growth opportunities had a negative but insignificant effect on R&D investment before the changes in corporate governance codes, suggesting that growth opportunities do not influence R&D spending. Following the amendments, this negative effect became significant.

The R-squared values presented in Table 4.4 indicate the amount of variation in the dependent variable explained by the independent variables in the regression models. Before the corporate governance code changes, the R-squared value of 0.038 indicates that the model accounts for 3.8% of the variation in R&D investment. Following the amendments, the model's explanatory power slightly improves, explaining 4.4% of the variation in R&D investment.

Table 4.4 Fixed Effect Regression Analysis before and after Changes in the Corporate Governance Code

Variables	(Before Code) R&D	(After Code) R&D
BSIZE	0.112	0.045**
	(0.074)	(0.023)
BIND	0.632	0.408**
	(0.702)	(0.205)
DUALITY	-0.14	0.096
	(0.587)	(0.096)
BG	-0.789	0.74**
	(0.719)	(0.371)
OWNC	-0.898	-0.667**
	(0.614)	(0.286)
INSOWN	-0.124	-0.187
	(0.196)	(0.31)
DOWN	-0.044	0.685**
	(0.067)	(0.267)
ACS	-0.02	0.03
	(0.125)	(0.077)
ACI	0.109	-0.122
	(0.307)	(0.212)
BIG4	0.207	0.315**
	(0.213)	(0.149)
FSIZE	-0.118	0.747***
	(0.074)	(0.259)
LEV	-0.116	-0.067
	(0.13)	(0.255)
FP	0.985*	0.043
	(0.573)	(0.432)
FAGE	3.098	0.033
	(2.953)	(0.859)
MBR	-0.025	-0.076*
	(0.027)	(0.043)
CONS	-3.459	-4.251**
	(4.743)	(1.876)
Observations	612	612
R-squared	0.038	0.044

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

5. Conclusion

This study analyzed the effect of CGMs on R&D investment from an agency theory perspective. CGMs include board structure, ownership structure and audit committee features. Using a sample of 51 non-financial firms listed on the Pakistan Stock Exchange (PSX) over the period 2011–2022, the study found that board size, board independence, board gender diversity, director ownership, audit committee independence, and audit quality have a positive and significant effect on R&D investment. In contrast, ownership concentration exhibits a significant negative effect on R&D spending. However, CEO duality, institutional ownership, and audit committee size reveal an insignificant association with R&D investment. The study further concluded that, prior to the amendments in the corporate governance code, the effects of board size, board independence, board gender diversity, ownership concentration, director ownership, and audit quality on R&D spending were insignificant. However, following the corporate governance code amendments, these relationships became significant. On the contrary, the effect of CEO duality, institutional ownership, audit committee size, and audit committee independence remained insignificant across both periods.

The current study adds to the existing body of knowledge regarding the correlation between corporate governance and R&D investment. Previous studies (i.e., Mezghanni, 2008; Septiandendi & Ramadhan, 2021; AlHares, 2020) have primarily focused on two CGMs such as board structure and ownership structure, whereas this study broadens the scope by incorporating an additional CGM namely audit committee. Additionally, this study provides valuable empirical evidence on the influence of CGMs on R&D investment from the perspective of agency theory within the capital market of a bank-based developing country —a context that remained unexplored. The findings of the study may have some meaningful implications. To the policymakers, this

study provides guidelines to ensure such corporate governance mechanisms that result in a favorable effect on R&D spending. The study is also expected to offer shareholders a clear understanding of the type of board structure, ownership structure and audit committee features necessary for committing capital to firms engaged in R&D investment. Investors could easily investigate the desired characteristics needed for R&D promotion.

Despite the significance of the study, there are certain limitations as well. The foremost limitation is associated with the sample employed, which is relatively small owing to the limited availability of data concerning R&D investment in Pakistani non-financial listed companies. Second, the study excludes several relevant variables, such as board age, tenure, education, and family ownership, which may have an influence on R&D investment. Lastly, the study focused only on Pakistani listed firms. However, corporate governance mechanisms are context-dependent and may exhibit differences across countries. Hence, the findings of this study cannot be considered applicable to any other setting.

These limitations create avenues for future research studies. Future studies may enhance the scope by considering a larger sample size and undertaking a comparative analysis with other Asian countries such as India, Bangladesh, and China. To further enrich the analysis, there is an opportunity to integrate additional variables related to board and ownership structures.

REFERENCES

Afza, T., & Nazir, M. S. (2014). Audit quality and firm value: A case of Pakistan. Research Journal of Applied Sciences, Engineering and Technology, 7(9), 1803-1810.

Ahmad, M. F., & Kowalewski, O. (2021). Board reforms and innovation.

International Review of Financial Analysis, 88, 102707.

Al Ani, M. K., & Mohammed, Z. O. (2015). Auditor quality and firm performance: Omani experience. European Journal of Economics, Finance and Administrative Sciences, 74, 13-23.

AlHares, A. (2020). Corporate governance mechanismss and R&D intensity in OECD courtiers. Corporate Governance: The International Journal of Business in Society, 20(5), 863-885.

AlHares, A., Dominic, G., & Al Abed, R. J. T. E. L. (2019). The corporate governance practices: Evidence from MENA countries. 9(04), 999.

AlHares, A. J. I. J. o. C. G. (2021). Corporate governance mechanisms and R&D intensity in OECD countries. 12(1), 36-56.

Al-Hadrami, A., Rafiki, A., & Sarea, A. (2020). The impact of an audit committee's independence and competence on investment decision: a study in Bahrain. Asian Journal of Accounting Research.

Ali, K., & Amir, M. (2018). Impact of Audit Committee structure on firms' value in Pakistan: Evidence from the Cement Sector. Journal of Corporate Governance Research, 2(1), 42.

Ananda, A. S., Sumarta, N. H., Satriya, K. K. T., & Amidjaya, P. G. J. E. (2022). Determinants of Audit Quality: The Effect of Ownership Structure and Audit Committee Activities. 6(3), 333-350.

Azzam, A. a. (2022). Board gender diversity and innovation activities: Evidence from R&D investments in the UK. Cogent Business Management 9(1), 2154056.

Baysinger, B. D., Kosnik, R. D., & Turk, T. A. (1991). Effects of board and ownership structure on corporate R&D strategy. Academy of Management journal, 34(1), 205-214.

Block, J. H. (2012). R&D investments in family and founder firms: An agency perspective. Journal of business venturing, 27(2), 248-265.

Bolkestein, F. (2004, October). Corporate governance in the European Union. In European Corporate Governance Forum (Vol. 18).

Buallay, A., & Al-Ajmi, J. (2020). The role of audit committee attributes in corporate sustainability reporting: Evidence from banks in the Gulf Cooperation Council. Journal of Applied Accounting Research, 21(2), 249-264.

Cadbury, A. (1992). Report of the Committee on the Financial Aspect of Corporate Governance Gee & c/o , London.

Chariri, A., & Januarti, I. (2017). Audit committee characteristics and integrated reporting: Empirical study of companies listed on the Johannesburg stock exchange.

Chen, H.-L., & Hsu, W.-T. (2009). Family ownership, board independence, and R&D investment. Family business review, 22(4), 347-362.

Chen, H. L. (2014). Board capital, CEO power and R&D investment in electronics firms. Corporate Governance: An International Review, 22(5), 422-436.

Chen, S.-S., & Chen, I.-J. (2012). Corporate governance and capital allocations of diversified firms. Journal of Banking & Finance, 36(2), 395-409.

Cherensky, S. S. J. S. C. C., & LJ, H. T. (1994). Shareholders, managers, and corporate R&D spending: An agency cost model. 10, 299.

Chou, T., & Johennesse, L. (2021). Board characteristics, ownership structures and firm R&D intensity. Accounting, 7(3), 635-644.

Daellenbach, U. S., McCarthy, A. M., & Schoenecker, T. S. (1999). Commitment to innovation: The impact of top management team characteristics. R&d Management, 29(3), 199-208.

Eng, L. L., & Shackell, M. (2001). The implications of long-term performance plans and institutional ownership for firms' research and development (R&D) investments. Journal of Accounting, Auditing & Finance 16(2), 117-139.

Fama, E. F., & Jensen, M. C. (1983). Separation of ownership and control. The journal of law and Economics, 26(2), 301-325.

Ghaffar, A., & Khan, W. A. (2014). Impact of research and development on firm performance. International journal of accounk and financial reporting, 4(1), 357.44(2), 533-543.

Gonzales-Bustos, J. P., Hernández-Lara, A. B., & Li, X. (2017). Board composition in family and non-family innovative businesses. Corp. Ownersh. Control, 15(1), 459-466.

Gupta, A. (2019). Capital Structure, Ownership Structure and R&D Investments: Evidence from Indian Firms. IUP Journal of Applied Finance, 25(1).

Harymawan, I., & Nismara, K. (2022). Board Gender Diversity and Corporate Innovation: Evidence from Indonesian Family Firms. Journal of Accounting Strategic Finance 5(1), 22-39.

Hassan Bazhair, A. (2022). Audit committee attributes and financial performance of Saudi non-financial listed firms. Cogent Economics & Finance 10(1), 2127238.

Hill, C. W., & Snell, S. A. (1988). External control, corporate strategy, and firm performance in research-intensive industries. Strategic management journal, 9(6), 577-590

Honoré, F., Munari, F., & de La Potterie, B. (2015). practices and companies' R&D intensity: Evidence from European countries. Research policy, 44 (2), 533-543. Research policy, 44(2), 533-543.

Ioana, A. (2014). Study Regarding the Impact of the Audit Committee Characteristics on Company Performance. Studies in Business & Economics, 9(2).

Javid, A. Y., & Iqbal, R. (2008). Ownership concentration, corporate governance and firm performance: Evidence from Pakistan. The Pakistan Development Review, 643-659.

Jensen, M. C. (1993). The modern industrial revolution, exit, and the failure of internal control systems. The journal of finance, 48(3), 831-880.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure Corporate Governance (pp. 77-132): Gowe

Jermias, J. (2007). The effects of corporate governance on the relationship between innovative efforts and performance. European Accounting Review, 16(4), 827-854.

Johnson, L. D., & Pazderka, B. (1993). Firm value and investment in R&D. Managerial and Decision Economics, 14(1), 15-24.

Kiraci, M., Celikay, F., & Celikay, D. (2016). The effects of firms' R & D expenditures on profitability: An analysis with panel error correction model for Turkey. International Journal of Business and Social Science, 7(5), 233-240.

Kutlu, H. A., & Gerekan, B. (2021). Effect of Corporate Governance Practices on R&D and Innovation Costs: A Case Study on Borsa Istanbul. Journal of Accounting and Taxation Studies, 14(3), 967-994.

Lai, Y. L., Lin, F. J., & Lin, Y. H. (2015). Factors affecting firm's R&D investment decisions. Journal of Business Research, 68(4), 840-844.

Lee, M. (2015). Impact of Corporate Governance on Research and Development Investment in the Pharmaceutical Industry in South Korea. Osong Public Health Res Perspect, 6(4), 249-255. doi:10.1016/j.phrp.2015.07.003

Lee, S. (2012). The effect of ownership concentration on R&D decisions in Korean firms. Seoul Journal of Economics, 25(1), 89.

Lipton, M., & Lorsch, J. W. (1992). A modest proposal for improved corporate governance. The business lawyer, 59-77.

Mezghanni, B. S. (2008). Ownership structure, board of directors and R&D investments: evidence from France. Corporate Ownership & Control, 5(3-2), 250-262.

Mezghanni, B. S. (2010, May). How CEO attributes affect firm R&D spending? New evidence from a panel of French firms. In Crises et nouvelles problématiques de la Valeur (pp. CD-ROM).

Mishra, C. S. (2022). Does institutional ownership discourage investment in corporate R&D?. Technological Forecasting and Social Change, 182, 121837.

Muhammad, H., Migliori, S., & Consorti, A. (2022). Corporate governance and R&D investment: does firm size matter? Technology Analysis Strategic Management 1-15.

Muhammad, H., Migliori, S., & Mohsni, S. (2022). Corporate governance and R&D investment: the role of debt financing. Industrial and Corporate Change, 31(3), 628-653.

Nekhili, M., Hussainey, K., Cheffi, W., Chtioui, T., & Tchakoute-Tchuigoua, H. (2016). R&D narrative disclosure, corporate governance and market value: Evidence from France. Journal of Applied and Business Research, 32(1), 111-128.

Ozcan, A. (2021). Audit Committee and Firm Value: An Empirical Investigation. Muhasebe Bilim Dünyası Dergisi, 23(2), 204-221.

Park, S., Kim, I., & Kim, W. (2017). Investment efficiency between listed and unlisted firms, and big 4 audit firms' effect: Evidence from Korea. Journal of Applied Business Research (JABR), 33(6), 1095-1112.

Rodrigues, R., Samagaio, A., & Felicio, T. (2020). Corporate governance and R&D investment by European listed companies. Journal of Business Research, 115, 289-295.

Rossi, F., Hu, C., & Foley, M. (2017). Women in the boardroom and corporate decisions of Italian listed companies: Does the "critical mass" matter? Management Decision, 55(7), 1578-1595.

Scott, R. W. (2014). Do institutional investors influence R&D investment policy in firms with high information asymmetry? International Business Research, 7(10), 22.

Septiandendi, R., & Ramadhan, A. F. (2021). Impact of Corporate Governance on Research & Development Investment in The Pharmaceutical Industry in Indonesia. Indicators: Journal of Economic and Business, 3(2), 109-118.

Shanwari, S., Qazi, U., Khan, I., Rauf, A., & Said, B. (2021). Impact of Research & Development on the Performance of Pharmaceutical Firms: Evidence from Pakistan. Sarhad Journal of Management Sciences, 7(1), 137-156.

Shleifer, A., & Vishny, R. W. (1997). A survey of corporate governance. The journal of finance, 52(2), 737-783.

Song, Z.h., Kang, W.j., & Zhou, D. (2022). The Impact of Board Characteristics on R&D Intensity: The Case of Chinese Machinery Industry. The International Journal of Business Management and Technology, 6(1).

Suman, S., & Singh, S. (2021). Corporate governance mechanisms and corporate investments: evidence from India. International Journal of Productivity and Performance Management, 70(3), 635-656.

Teng, D., & Yi, J. J. F. o. B. R. i. C. (2017). Impact of ownership types on R&D intensity and innovation performance—evidence from transitional China. 11, 1-25.

Ting, I. W. K., Lo, H. C., & Kweh, Q. L. (2020). How do ownership concentration and family control affect R&D investments? New evidence from Taiwan. International Review of Finance, 20(1), 275-291.

Ullah, H., & Shah, A. (2015). Related party transactions and corporate governance mechanisms: evidence from firms listed on the Karachi stock exchange. Pakistan Business Review, 17(3), 663-680.

Wang, Y., Abbasi, K., Babajide, B., & Yekini, K. C. (2019). Corporate governance mechanismss and firm performance: evidence from the emerging market following the revised CG code. The international journal of business in society.

Wang, C.-J. (2012). Board size and firm risk-taking. Review of Quantitative Finance and Accounting, 38, 519-542.

Wang, Y. F., & Huang, Y. T. (2014). How do auditors increase substantially firm value. International Journal of Economics and Finance, 6(10), 76-82.

Wijaya, A. L. (2020). The effect of audit quality on firm value: A case in Indonesian manufacturing Firm.

Yang, Y., Fallah, M. H., & Chen, L. (2009, September). Does Corporate Governance Quality affect R&D Expenditures?. In 2009 International Conference on Management and Service Science (pp. 1-5). IEEE.

Yangfan, T. (2015). Ownership Concentration and Innovation: Empirical Examination from China. April 2015.

Yermack, D. (1996). Higher market valuation of companies with a small board of directors. Journal of financial economics, 40(2), 185-211.

Yong-hai, Y. (2010). Impact of CEO Characteristics on Enterprise R&D Expenditure: Empirical Evidence Coming from Small and Medium Listed Companies in China. Paper presented at the 2010 3rd International Conference on Information Management, Innovation Management and Industrial Engineering.

Yousaf, M. U., Khurshid, M. K., Ahmed, A., & Zulfiqar, M. (2019). Empirical investigation of relationship between research and development intensity and firm performance: The role of ownership structure and board structure. International Journal of Financial Engineering, 6(02), 1950016.

Zahra, S. A., Neubaum, D. O., & Huse, M. (2000). Entrepreneurship in medium-size companies: Exploring the effects of ownership and governance systems. Journal of management, 26(5), 947-976.

Zeng, T., & Lin, H. C. (2011). Ownership structure and R&D spending: evidence from China's listed firms. Chinese Management Studies, 5(1), 82-93. doi:10.1108/17506141111118471

Zhu, Z., & Wang, D. (2012). The Board Structure and R&D Investment—A Study on the Chinese Listed IT Companies. Paper presented at the Proceedings of the ISMOT 2012 International Symposium on Management of Technology (ISMOT), Hangzhou, China.