R&D Expenditures and Firm Performance:

An Analysis of PSX-Listed Firms

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CERTIFICATE

This is to certify that this thesis entitled: **"R&D Expenditures and Firm Performance: An Analysis of PSX-Listed Firms."** submitted by **Ms. Amna** is accepted in its present form by the PIDE School of Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfilment of the degree in Master of Philosophy in Economics and Finance.

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Author's Declaration

I **Amna** hereby state that my MPhil thesis titled **"R&D Expenditures And Firm Performance: An Analysis of PSX-Listed Firms"** is my work and has not been submitted previously by me for taking any degree from the Pakistan Institute of Development Economics or anywhere else in the country/world.

At any time if my statement is found to be incorrect even after my Graduation the university has the right to withdraw my MPhil degree.

Date: 07-11-2024

Amna

Amna

DEDICATION

This Effort is Dedicated to My Parents

ACKNOWLEDGEMENTS

"I begin with the name of "ALLAH", the most compassionate and merciful". I offer my countless salutations upon my beloved Holy Prophet MUHAMMAD (P.B.U.H) the entire source of guidance for humanity as a whole forever.

First of all, I would like to convey my sincere and deep sense of gratitude to my respected supervisor, Mr. Shahid Mehmood, Research Fellow at Pakistan Institute of Development Economics (PIDE) Islamabad—Pakistan, and also my respected Internal Examiner, Dr. Ahmad Fraz, Research Economist at PIDE for their unwavering guidance, constant supervision and precious advice for the completion of my thesis.

I would also like to extend my heartfelt gratitude to my extended family members, with a special mention to my parents and friends, including All my Five Brothers who supported me on every step of completing this Research Additionally, I would like to acknowledge all my teachers who have played a significant role in my education. Their teachings and guidance have been invaluable, and I am thankful for their contributions.

Finally, I must acknowledge that I cannot list all the well-wishers and supporters who played a role in completing my final thesis due to space constraints. However, I sincerely appreciate and wish them even greater blessings.

Abstract

Purpose: This research investigates the impact of Research and Development (R&D) and Intangible Assets expenditure on the performance of firms listed on the Pakistan Stock Exchange (PSX) from 2010 to 2022, using Return on Assets (ROA) as a primary measure of performance.

Design/Methodology/Approach: The study employs panel data analysis, utilizing both Fixed Effects and Random Effects models to test the relationship between R&D and Intangible Assets expenditure and firm performance. Data were collected from firm annual reports (2010-2022), focusing on both R&D investment and intangible assets.

Findings: The empirical analysis confirms a positive and significant relationship between R&D spending and firm performance, the study also confirms that all results are robust and free from outliers and multicollinearity issues with firms investing more in R&D showing higher returns on assets and competitiveness. Notably, the fertilizer, food, chemical, and manufacturing (this industry is the main driving force of economic growth) sectors exhibit the highest levels of R&D as well as Intangible Assets investment, indicating sector-specific strategies for innovation and growth.

Research Limitations/Implications: This study is limited by incomplete data on R&D and intangible assets in the firm's financial statements, which constrains the accuracy and scope of the analysis. The research focuses on PSX-listed firms within a specific period, limiting its generalizability. Future research could expand to other markets and incorporate additional performance metrics like Market Performance (Tobin's Q), Including qualitative methods, such as interviews or case studies, can provide deeper insights into the contextual factors influencing the relationship between R&D expenditures and firm performance. Additionally, considering macroeconomic variables like economic policy changes and industry-specific regulations.

Practical Implications: The outcomes of this study enable the firms, particularly in high-impact sectors like fertilizer, food, chemical, and manufacturing, sectors, should prioritize R&D to foster growth and innovation. Policymakers are advised to implement supportive measures such as tax incentives, grants, and subsidies for R&D activities, as well as policies that enhance intellectual property protection and streamline regulatory processes. Additionally,

establishing partnerships between industry and research institutions, and investing in infrastructure and skilled workforce development, can create a more conducive environment for R&D investment and innovation.

Originality/Value: This research contributes to the existing literature by providing empirical evidence from an emerging economy, specifically Pakistan. It underscores the critical role of R&D and intangible assets in driving firm performance, aligning with theory, such as the resource-based view theory (RBV), and providing actionable insights for businesses and policymakers to foster innovation and economic development.

Keywords: R&D expenditure, firm performance, Intangible Assets, PSX, Panel data analysis, Pakistan.

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Abbreviations

ROA	Return On Assets
R&D	Research and Development
IA	Intangible Assets
FS	Firm Size
FA	Firm Age
SG	Sale Growth
LE	Leverage
CE	Capital Employed
IR	Interest Rate

Chapter 1

Introduction

1. Background of the Study

Organizations need to invest in Research and Development because it facilitates technological, product, and process innovations. Thus, companies need to spend money on R&D to create new products and stay relevant on the market. R&D activities help in the generation of new ideas, product line expansion, and increase the value of the firm and its products, which in turn contributes to economic growth. Research has shown that R&D expenditures are crucial for improving productivity and financial performance (Hall et al, 2010, Bloom et al, 2019), thus R&D expenses are vital in improving the technological and developmental paradigms, enhancing productivity, and boosting the economy. This study investigates the relationship between R&D spending and the performance of firms in Pakistan, an emerging economy.

R&D operations often require substantial resources including time, energy, and money. These investments are crucial for innovation and enhancement of products and services; they create employment and enhance the world's economic performance. At the micro-economic level, R&D helps firms to come up with new products thus ensuring that they are abreast with the market, minimize the cost of production, increase output, and come up with ways of protecting their inventions and ideas making them stand out in the market.

R&D is a critical factor that influences the performance of any organization. However, R&D effectiveness differs across industries and firms due to differences in the firm's capacity to absorb and exploit new knowledge. Cohen and Levinthal (1990) introduced the concept of absorptive capacity, emphasizing the importance of a firm's ability to recognize assimilate, and apply external knowledge for innovation. furthermore, the Resource-Based View (RBV), (Wernerfelt, 1984; Barney, 1991) posists that R&D serves as a strategic resource, enabling firms to achive competitive advantage by developing rare, valuable, inimitable, and non substitutable capabilities. While developed countries enjoy massive R&D spending boosted by strong economies and sound policies, emerging economies like Pakistan struggle with issues concerning insufficient funding, poor infrastructure, and unfriendly regulatory environment which hamper the efficient use of R&D.

This study seeks to fill a void in the literature regarding the link between R&D expenditure and firm performance in Pakistan. Nonetheless, R&D is considered as one of the most important factors and its investment in Pakistan is relatively low; its effect on firm's performance has also not been explored to a greater extent. Mansfield (1981) showed that firms that are deeply involved in R&D activities generate better results, which can be a significant field of study for emerging countries.

Technological enhancement is one of the most critical factors in today's business environment and the world economy, and R&D is at the core of this process. Besides enhancing performance and cutting expenses, it also helps create new goods and services. Griliches (1998) observed that the returns on R&D investments are more than those of other forms of capital investments, hence underlining the role of R&D in business.

The research has two main analyses; the first one looks at the impact of intangible assets on the performance of the firm while the second one looks at the impact of R&D investment only. These analyses are important as they fill the research gap that exists in the current literature concerning the role of intangible assets and R&D spending in developing countries such as Pakistan. The distinction between intangible assets and R&D is substantial as all the R&D investments fall under intangible assets but not all intangible assets are from R&D. They can be defined as any asset that does not have a physical form, including corporate brand and reputation, ideas, inventions, and copyrights. These assets are vital in today's knowledge-based economy as they usually form a large part of a company's value and are the main determinants of the company's competitiveness. Knowing the relationship between them and the performance of the firm will assist companies and policymakers to allocate resources and define business tactics accordingly. R&D expenditure, however, is a subset of the overall capital expenditure; it entails the investments a firm makes in the R&D function to enhance innovation. This expenditure constitutes a direct indicator of the firm's intention to invest in the generation of new products, processes, or technologies that can increase competition, profitability, and market share.

This paper seeks to offer ideas and suggestions to serve business managers and policymakers in Pakistan to call for a conducive environment for R&D spending. This may involve providing tax exemptions, enhancing the availability of capital, and enhancing the link between firms and universities. By increasing the R&D activities, Pakistan can increase competition in the global business environment and attain the sustainable economic growth.

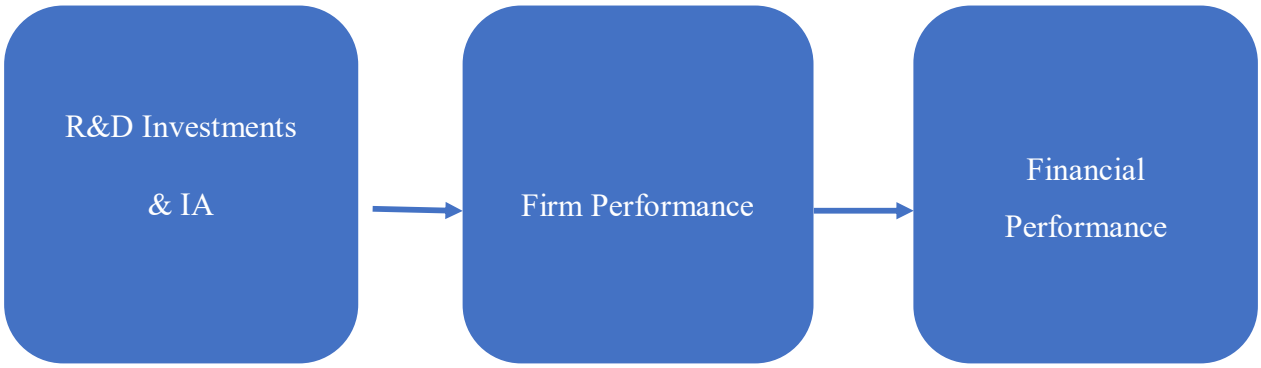
This study is grounded in the Resource-Based View (RBV) that suggests that firms can achieve a sustained competitive advantage through the strategic management of internal resources like R&D. These theories frame the research's focus on understanding how R&D investments drive firm performance in emerging markets like Pakistan. A more detailed discussion of these theories and their implications for the empirical analysis is provided in Chapter 3 (Data and Methodology).

Barney (1991) defines the concept of the VRIN framework.

- **Valuable:** R&D activities should help to produce a competitive advantage allowing better product market penetration or operational efficiency.
- **Rare:** R&D innovations must be hard for competitors to copy.
- **Inimitable:** R&D processes and innovations must be difficult to replicate for the firm to enjoy a competitive advantage over time.
- **Non-substitutable:** What results from R&D are abilities that have no excellent alternatives for which competitors might turn easily.

Firms investing in R&D and intangible assets, such as patents and brand value, gain a competitive edge by developing unique, hard-to-imitate resources, as emphasized by the Resource-Based View (RBV). The Knowledge-Based View (KBV) builds on this by highlighting how R&D enhances a firm's knowledge base, fostering innovation and improving profitability.

Figure 1.1: Theoretical Foundation

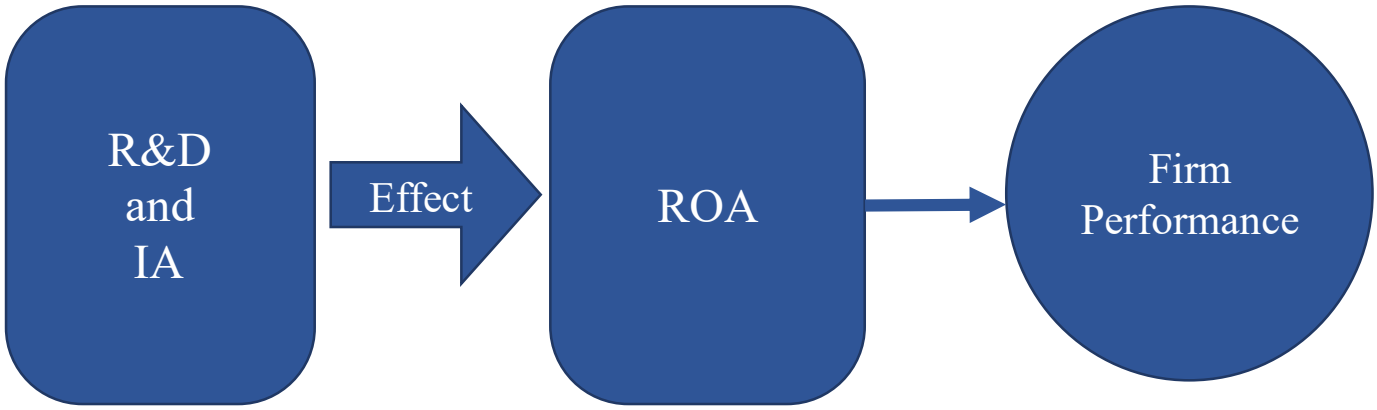


Source: *Pantagakisa, Terzakisb, and Arvanitis (2014).*

Many research studies have tried to link R&D spending to company performance using R&D intensity (Hirsch-Kreinsen, 2008). They often use annual metrics like ROA to measure how

well firms are doing (Griliches, 1998). These metrics, including market-based ones, help determine a company's performance (Hall, 2000). It's also important to consider other factors like the size of the firm (total assets), how old the firm is (years since it started), and its sales growth (Zahra & Covin, 1993). These factors help ensure that the performance measurement is accurate and not affected by other variables.

Figure 1.2. : Theoretical Foundation



Source: *Razaq, Freihat, and Kanakriyah (2017).*

Some common tools used when assessing a company's performance include effectiveness, efficiency, quality, timeliness, productivity, and financial success (Kaplan & Norton, 1992). Effectiveness ensures that a company is doing the right things that need to be done according to the set requirements, whereas efficiency focuses on doing things right with optimum resources (Drucker, 1954). Quality measurement is concerned with the extent to which customers' needs and expectations are met, while timeliness measures the efficiency of business processes in terms of time (Meredith & Shafer, 2016). A key aspect of performance, productivity, measures the efficiency of a process in terms of its contribution to the creation of economic value relative to the inputs of labor and capital (Meredith & Shafer, 2016).

Financial ratios such as ROA are significant in the evaluation of organizational performance. ROA evaluates the efficiency of asset usage to produce profits, while ROE gauges the efficiency of equity shareholders' investments (Brealey, Myers, & Allen, 2017). This paper aims to establish that R&D plays a crucial role in the achievement of corporate goals through innovation and sustainability (Cohen & Levinthal, 1990). The combination of the financial metrics ROA with the R&D activities of the firms generates a complex context to measure the

total performance of the companies (Cohen & Levinthal, 1990; Brealey et al., 2017). Altogether, such an analysis of factors allows for developing a comprehensive view of a company's performance and identifying ways to improve it.

1.1 Problem Statement

Low investment has been made in R&D in Pakistan and this has limited innovation and the introduction of new products hence the competitiveness of the country has been affected. This research aims to explore if current R&D expenditures enhance the firm's performance in terms of ROA and the involvement of intangible assets. By analyzing the current state of R&D investment, this study seeks to provide strategic recommendations to increase innovation and promote economic growth in Pakistan.

1.2 Literature Gap

This research purpose is to fill the gap in the literature by looking into the possibility of the divergence between R&D investments and ROA. The importance of technology, innovation, and competitiveness, which depends on R&D expenditure, is not very much questioned, but the effect of these expenditures on company performance is still questionable. Some of the issues include matters concerning the economic growth of Pakistan and the conditions for innovation. Still, there is a lack of proper and efficient utilization of these assets in the strategic context, which negatively affects organizational performance.

There are no studies in the Pakistan that have explored the linkage between R&D expenditures and the firm performance even the linkage between intangible assets and the firm performance is missing. This research therefore seeks to address this gap by examining the R&D spending and firm performance as well as the effect of intangible assets on the R&D spending and firm performance. This research aims to identify the possible areas of imbalance in the application of R&D spending by Pakistani firms to enhance their performance. Furthermore, the study will provide information concerning the policy and regulatory framework of R&D and business performance.

Thus, the research aims to suggest how Pakistani businesses and policymakers can overcome the identified shortcomings and bridge the gap between R&D investment and firm performance.

1.3 Significance of the Study

The implications of this study are significant for firms listed on the PSX as the study provides information on how R&D investments affect the firm's performance in this particular setting. Since the study is based on publicly traded firms, the findings of this study are quite practical and managerial in nature and can guide such firms to make appropriate decisions about their R&D investments. Thus, the study defines the conditions under which firms can manage R&D expenditures to improve financial performance and ensure that they remain profitable in the future. This is very important, especially to firms that are determined to sustain their market leadership.

The findings of this study are useful for large corporations listed on the PSX to refine their innovation strategies so that R&D spending is relevant to the corporation's objectives and customer wants. Such corporations with vast resources and large R&D programs can use the research results to adjust their investment decisions and direct their efforts toward the most promising projects that are likely to bring the maximum market effect and return on investment. On the other hand, small firms listed on the PSX that might be resource-scarce can use the study's findings to identify R&D projects with the best ROI. Thus, such firms can match large competitors and participate in the development of their industries' innovation potential.

Moreover, the study has several policy implications for Pakistan's policymakers and the regulatory authorities dealing with innovation and economic laws affecting the PSX-listed firms. Some of the relevant bodies include the Ministry of Industry and Production (MOIP), PSX, and Intellectual Property Organization (IPO). The findings of the research can be used to design specific policies such as tax cuts for R&D expenditure, funding schemes for PSX-listed companies to encourage innovations, and collaborative schemes between PSX-listed companies and academic institutions. Thus, the study reveals the effects of R&D investments on firm performance and contributes to the development of policies that can enhance innovation and productivity in the Pakistani market.

Thus, this study also contributes to the body of knowledge through filling the research gap on the link between R&D investments, intangible assets, and firm performance focusing on firms listed at PSX. This study offers a systematic literature review and main findings to set a base for future researches and to contribute to the formation of strategies for improving the innovation system in Pakistan's emerging economy.

1.4 Research Questions

1. Does R&D investment impact the financial performance among firms listed on the PSX?
2. Does intangible assets investment impact the financial performance of firms listed on the PSX?

1.5 Objectives

1. To assess the relationship between intangible assets and firm performance among companies listed on the PSX.
2. To analyze the relationship between R&D investment and firm performance among companies listed on the PSX.

1.6 Plan of the Study

Chapter 1 provides the Background and Introduction, outlining the research question, objectives, and significance of the study. Chapter 2 offers a brief literature review, summarizing the relevant theoretical and empirical findings. Chapter 3 details the data and methodology, including the empirical model, techniques, and conceptual framework used in the research. Chapter 4 presents the results of the study, analyzing the findings of the research questions and objectives. Finally, Chapter 5 provides the conclusion and recommendations, summarizing the key insights and suggesting implications for policy and practice.

Chapter 2

Literature Review

This part contains a brief literature review of theoretical and empirical works done in the past on the subject of interest studies. The literature was reviewed not only to provide the framework for the study but to also give a background of the study for the historical perspectives on the relationship between R&D, and Intangible Assets investment and the performance of the firm.

2.1 R&D and Firms Performance

The expenditure in the R&D function is a critical determinant of the strength of technical innovation and competitiveness. Guo, Wang, Wei and He (2018) examined the Chinese firms in the period 2009 to 2016 concerning R&D expenditures, strategic posture, and company performance. They employ empirical analysis and regression tests for the examination of the variables which include the R&D expenditure, strategic posture of the firm (Differentiating between the product differentiation strategy and the cost leadership strategy), and Business performance of the manufacturing firms based on Chinese-listed enterprises. Thus, the survey shows that companies that follow a product differentiation strategy invest more in R&D than the companies that follow a cost leadership strategy. Also, R&D spending has a positive relationship with future performance for firms that have adopted the product differentiation strategy. However, in the case of organizations that have chosen to be cost leaders, the relationship between R&D expenditures and organizational performance is a U-shaped one. As seen above, only Non-State Owned Enterprises (Non-SOE) have a positive effect on the future performance but the expenditure on R&D has a negative effect if it is too much. To identify the most profitable areas for R&D resource allocation, it is crucial to comprehend strategic positions.

This paper sought to understand the role of R&D in volatile competitive markets especially the pharmaceutical industries between the years 2015 and 2020. Pharmaceuticals can lead the way in countries such as Bangladesh that have institutional voids and high economic growth rates. Through these measures, Bangladesh has created and improved its regulatory environment and has also been able to attract foreign direct investment while having to deal with health care and governance problems. Still, there is no sufficient research on the moderating effect of the institutions on R&D spending for business value and performance. To this end, Rahman et al.

(2022) seek to determine the relationship between R&D spending and business performance and value in the pharmaceutical sector in Bangladesh. The paper presents valuable and relevant information on the ways and means of R&D investment positively impacting business growth, and the development of the emerging market economy in Bangladesh, that useful to researchers, industrious individuals, and policymakers who wish to learn more about the subject.

Examining the moderating effect of R&D expenditure on firm performance in Vietnam, a developing country with immense potential and rapid economic and social transformation is Tung and Binh (2022). Their study analyzes a unique panel data set of 343 listed businesses from 2010 to 2018 using two different techniques: In this paper, we shall use a fixed effect model and a two-stage least squares (2SLS) model. Thus, the research identifies the positive impact of spending on R&D on sales, profit, ROA, and ROE. The regression findings also indicate that firms that have high R&D expenditure yield high profit, revenue, as well as ROA as compared to firms with low R&D expenditure. Thus, this research can be considered as the first attempt to analyze the effects of R&D on business performance in the Vietnamese country. The findings suggest that Vietnamese enterprises should increase their investment in R&D activities including basic and applied research to improve performance and improve competitiveness in the future.

The study by Freihat, Kanakriyah, et al. (2017) seeks to establish the effect of R&D spending on pharmaceutical firms listed on the Amman Stock Exchange in Jordan. Filling the void of the specific research in this area for Jordan, the study adds to the scarce literature in developing countries. This paper employs a quantitative design to analyze data gathered from six firms for five years, starting from 2006. The R&D data were gathered in the period 2006-2010 and performance data were gathered from 2011 to 2015. In simple linear regression analyses, R&D is examined as the independent variable, while company performance is the dependent variable with ROA, ROE, and EPS as its measures. The analysis suggests that the level of R&D expenditure is positively related to company performance, therefore, the a need for a reconsideration of policies about R&D spending.

In their study conducted in 2019, Abbas, Fazal, et al. also highlighted the function of R&D in assisting the investors' decision-making processes. A significant portion of a firm's value lies in its fixed assets, and International Accounting Standard (IAS) 16 offers two accounting treatments for these assets: Historical value and fair market value are the two most important

factors that determine the amount of a price of an item. The present research workers the effect of revaluation of fixed assets on future firm performance with special reference to the cement industry of Pakistan. From the study findings, it was revealed that the revaluation of fixed assets in cement companies negatively affects future firm's performance meaning investors may consider this accounting treatment as unfair. This paper should be useful for researchers who wish to apply the results and consider the corresponding relations in the context of the general analysis of accounting practices.

Goodwill and R&D as intangible assets play a critical part in companies and their operating performance and market value. In line with the market-based and resource-based theories, Tahat et al. (2017) analyze the data from the UK FTSE 150 non-financial firms over the period of 1995-2015 and state that intangible assets are the long-term investments for the firm's value creation. A company's goodwill affects its current and expected stock value, whereas R&D affects the company's future value. This is why the above intangibles should be included in the financial statements to provide a true and fair view of the business's worth. The results also show that the attempts to find and create intangible assets can help to enhance the investment appraisal, despite accountants' inability to provide proper benchmarks for such investments. This study contributes to the existing literature by advocating for improved techniques of recognizing and measuring the aspects of goodwill that are linked to intangible assets to improve the assessment of their worth to the financial performance of firms.

Bøler, Moxnes, et al. (2015) look at how R&D cost shock, R&D expenses, imported input and firm efficiency are connected. The approach includes imported inputs into the R&D model in which R&D and foreign souring are two related operations. The study focuses on a Norwegian R&D tax credit that was introduced in 2002 and acts as a natural experiment; the findings show that a decrease in R&D costs affects not only R&D spending but also the import of intermediate goods. Availability of imported inputs is hence important in promoting R&D spending and technological advancement. Ghaffar, Khan, et al. (2014) extend this work by focusing on the relationship between R&D budgets and firm performance while underlining the rising importance of R&D in today's world. This paper aims at exploring the link between R&D and business performance through the use of ROA, return on equity, and earnings per share ratios. The findings of the study reveal a positive correlation between the variables, with the help of statistical tool SPSS. The limitations are time factor and concentration on only one sector, hence, future research should incorporate other sectors in order to establish the effect of R&D on their performance.

In contrast to the earlier works that adopted a unidirectional approach to the link between R&D investment and corporate performance, Lin, Ge et al. (2011) explore the possibility of curvilinear relationships. In this study, data from 1923 IT firms in the hardware, computer chip, and software industries are analyzed and a positive U-shaped relationship between R&D investment and the firm's performance is established in all sectors. Interestingly, the impact of R&D expenditure on business performance is higher in software firms than in hardware and computer chip firms. The implications of these findings are theoretical and managerial.

Pantagakis, Terzakis, et al. (2012) focus on parameters such as R&D, the market value of the company's stock, and operational effectiveness. The research questions are geared towards understanding the existence of a correlation between R&D expenditure and the market value of a company. In this research, financial data from 39 European software and hardware computer companies from the years 2006 to 2010 were employed in the data analysis, which involved the use of panel data analysis and feasible generalized least squares (FGLS). The data show a positive relationship between R&D expenditure and firms' performance in the market. However, it is essential to note that the relationship between R&D expenditure and a firm's market capitalization is not proportional. In this way, the research contributes to the literature by establishing the existence of this non-linear relationship.

The trends in corporate investments have changed over the last two decades, especially with an increase in intangible investments which have difficulties in assessment. As strategic and effective tools, R&D expenditures are instrumental in defining a company's direction and identifying its strategies. Decision-making related to knowledge acquisition and rights in R&D is irreversible and can lead to the transformation of firms and sometimes, risks. Controlling R&D activities is difficult because of the escalating intricacy of technological projects, thus they require higher control expenditures to counter information asymmetry. This paper aims to examine the effects of integration strategies on the financial performance of firms; particularly on the adoptions of the IAS 38 standard in the European Union among publicly traded companies. Even though, earlier researches point to the fact that high levels of R&D expenditures are beneficial to the market, the effects on income and financial performance are still a subject of debate and research.

Saima Bangash (2020) claims that institutions are the key determinants of economic development and firm performance especially in developing countries where the low firm performance is attributed to institutional environments. This research focuses on Pakistan and

seeks to establish the relationship between institutional quality and firms' performance and whether these firms can develop any measures to work around poor institutions. Based on the "World Bank Enterprise Survey 2013" which contains information on private firms in the manufacturing and service sectors, the findings of the study show that institutional quality does not have a positive effect on firm performance. However, the study identifies positive outcomes from the senior management efforts and informal payments and, therefore, provides possibilities of other ways through which firms can experience improvements in their performance despite the challenges in the institutional environment. However, this study finds that senior management's proactive involvement seems to mitigate the negative impact of a suboptimal institutional environment on firm performance.

Romaisa Batool (2020) focuses on the relationship between exports, financial conditions, and R&D investment at the firm level. Using the data of 258 exporting firms listed at the PSE from 2009 to 2018, the empirical model utilizes Seemingly Unrelated Regression (SUR) to estimate the multiple relationships between variables. Thus, the study establishes a positive and strong relationship between exports and R&D investment suggesting that the two variables are interdependent. On the other hand, the link between financial problems and exports is found to be negative in sign. In the same way, in the case of the impact of R&D investment on financial constraint, it is observed to have a negative effect.

R&D expenditure has been a popular topic of research regarding its effects on future company performance; however, the literature is rather complex. The literature review on R&D expenditure shows that there is a positive relationship between R&D spending and future profitability, market value, and stock returns, based on the studies of Branch (1974), Sougiannis (1994), and Eberhart et al. (2004); however, the critics have pointed out that R&D costs are escalating, and there is a risk that is associated with the investment in R&D (Shi, 2003; Chan et al., 2001). Further, dissimilarities in the effects viewed in different industries raise even more questions on the issue. The literature has identified that high-technology organizations can generate higher returns from investment in R&D than low-technology organizations (Chan et al., 1990; Garner et al., 2002). This means that there is an indirect linkage between R & D expenditure and company performance and that other industry factors can influence this relationship.

Most of the prior research is hence based on industry-level analysis while it is important to analyze the impact at the firm level. This research gap led to this study that seeks to establish

the moderating effect of business strategy on the relationship between R&D activities performed and their results. We categorize the firms based on Porter's (1980) generic strategies of cost leadership and differentiation to analyze the impact of R&D spending on firm performance.

Thus, Wang and Wei (2018) examine the future performance of Chinese manufacturing firms based on strategic orientations. They then discover that firms following the product differentiation strategy have a higher spending on R&D which results in enhanced performance. In the case of cost leadership, the R&D expenditure performance also shares an inverse U-shape, where returns start to decline after a certain level, especially among non-state-owned enterprises.

Consistent with the literature, Pourkarimi and Kam's (2022) empirical analysis of marketing strategies in the U. S. Information and Communications Technology industry shows that innovation is significant while advertising has little effect on market share and revenue. Thus, their research shows the importance of keeping up the innovation for continued excellence in high-tech firms.

Brynjolfsson and Yang (1997) and Lev and Sougiannis (1996) in their studies on US and UK data have employed market value as an independent variable that could be used to predict a firm's expected R&D outcome. Nevertheless, there is a sparse analysis of the continent of European countries as data is not easily accessible. This lack of evidence is remedied by Hall and Oriani (2004) who carry out their analysis on recently assembled panel data on publicly traded firms in France, Germany, and Italy. They establish that the relative shadow cost of R&D in France and Germany is quite similar to the one in the United States and the United Kingdom during the same period. On the other hand, R&D in publicly listed Italian enterprises is under-recognized by the financial markets in general. In addition, this study establishes that the R&D valuation of French and Italian companies is high where nobody holds more than one-third of the company, while in the other cases R&D is not valued.

McGrath and Nerkar (2004) has highlighted that the factors such as the scope of opportunity, prior experience and competitive effects affect the firm's tendency to invest in new R&D opportunities. Regards this, this study is to link R&D activity to the firm's internal operations and managers' decision-making through capturing feedback loop between current R&D activity and future performance.

In their study conducted on manufacturing firms listed in China and not subjected to deterministic assumptions of the industry, Xin and Essen (2019) seek to explain the process of investing in R&D. They concentrate on the aspect of having to invest in R&D as a way of coming up with new ideas that will yield sustainable results. Therefore, analyzing the connection between performance feedback and the R&D expenditure frequency using the frequency of ROI data enhances the knowledge of the future direction of strategic changes in companies in China's growing economy. In addition, the study reveals that performance feedback affects the relationship between R&D investment and state-owned enterprises (SOEs) and privately-owned enterprises (POEs) thus helping the decision-makers to encourage R&D investment to the maximum.

Wang et al. (2020) examine quantitatively the degree of the linkage between various R&D tactics and business performance; they use 107 ICT firms listed in China from the CSMAR database and China SIPO. The research findings show that R&D depth enhances business performance using OLS regression analysis. Also, it reveals the moderate positive relationship between R&D depth and breadth activities and all three kinds of R&D on the performance of the firm. Thus, the paper calls for ICT firms to embrace all three dimensions of R&D intensity, breadth, and depth as the recipe for success.

As opined by Wadhwa (2016), the chapter explicates the relationship between R&D investment and commitment as an indication of an organization's stewardship towards the advancement of technology through the creation of new and enhancement of existing products and services. Extant literature has suggested that R&D expenses are vital in the innovation process of firms and enhanced organizational performance. However, the shifting environment that characterizes knowledge distribution and the consequences of generating revenues from new products and services make it necessary for firms to seek other sources of innovation. This shift therefore means that firms are now seeking to integrate external linkages to support the internal R&D processes as well as the dynamics of technologies.

In the early theoretical literature, the link between innovation and exports was mainly examined through the product life cycle model which stated that innovation or product differentiation lead to the establishment of competitive advantages in the international market (Vernon, 1966). The Schumpeterian theory also comes in handy in explaining the dynamics of the aspect by noting that new technology replaces old technology in the market, thus improving the quality of products. According to this theory, growth is attributed to the international strategies by firms

that are involved in R&D activities (Jones, 2013). Therefore, innovation leads to the improvement of firms' efficiency, and thus, raises exportations (Melitz, 2003).

Nooteboom (1995) looks into the empirical findings of the Schumpeterian approach that aims to establish the relationship between innovation, firm size, and market structure. In this context, R& D has been modeled as a probabilistic contest where the winners gain substantial advantages. This research also uses industry effects based on Pavitt's taxonomy suggested in 1984. The study that uses Dutch and American industries' surveys reveals that among the total Pavitt classes, small firms are more effective in terms of R&D spending except for the Science-Based class. This finding depicts innovation and firm characteristics across the different industries.

Banji Samuel Godadaw Ayinaddis (2023) sought to establish the extent of the effect of innovation on the performance of micro and small manufacturing enterprises in some towns of Awi Zone, Amhara, Ethiopia. As applied to 247 firms, it was established that product, process, marketing, and organizational innovations affect performance, with the highest impact from product deployment.

Previous research has recently paid much attention to the role of R&D investment in firms' performance especially in emerging economies. In the same vein, Del Monte and Papagni (2003) posit that the investment in R&D has a positive impact on the growth rate of sales in the firms; Ulku (2007) and Mowery (1983) also opine that enhancement of R&D intensity enhances the growth rates and survival chances. Nevertheless, there are firm characteristics that affect the innovation – firm growth link such as the age and size of the firm. Coad and Tamvada (2013) reveal that the proportionate returns from R&D investment are higher in young firms than in old firms. The productivity of R&D investments is likely to differ between developed and emerging markets because of the differences in the economy, markets, and governments. According to Lundvall et al. (2013), R&D can have a positive impact on the growth of firms but emerging economies are characterized by less efficient national innovation systems. The research by Manogna and Mishra (2021) reveals the specific problems of the Indian food and agricultural production manufacturing industry, including the slowly increasing R&D indicators in the recent period.

Food and agricultural sector is one of the key sectors in India that contributes a large part to the GDP and employment (Sharma et al. , 2019; FAO, 2017). Although this sector is considered as crucial in the society, its R&D intensity has not been high. In a recent work, Manogna and

Mishra (2021) confirm that R&I investments enhance firm growth, especially in the early stages of the firm's life cycle. However, the positive impact of R&D is generally realized in the future and, hence is likely to have a lagged effect on the performance of the firm. Several challenges have been identified in the literature regarding firms in emerging economies in terms of R&D investment. The risks that include uncertainty of returns, the non-tangible nature of outcomes from the R&D investments as well as absence of essential factors such as skilled personnel and the right levels of competition are constraints (Pray and Nagarajan, 2012; Alam et al., 2019). These challenges can thus prevent R&D investments from being a source of firm growth. The findings from India reveal that government policies should strive to encourage R&D activities through taxation and subsidies. Such policies can assist in reducing the risks of R&D investments and support innovation-based development, which is crucial in the modern world (Manogna and Mishra, 2021).

From a theoretical point of view, at least two scenarios can be distinguished about the influence of financial constraints on exports. The first pattern shows that the level of financial constraints affects exports through high sunk cost thresholds that inhibit firms from engaging in international trade (Manova et al., 2011). The second pattern indicates that exporters are allowed to gain market access easily and this enhances their ability to increase their credit supply and hence their liquidity status (Greenaway et al., 2007). Also, there is a circular relation between exports and financial constraints in which export-oriented firms have lower probabilities of credit application rejection and firms that are not credit-constrained are more likely to export (Altomonte et al., 2015).

Theoretically, the R&D investment and financial constraints have inverse relationships, for instance, the Pecking order theory that explains that managers and external investors have different information during the assessment of investment projects (Myers & Majluf, 1984). The fact that information asymmetries are particularly severe at the beginning of projects means that external financing is more costly. Thus, as the innovative project evolves, these discrepancies are reduced, which leads to the increased interest of outside investors. Speculative factors that are derived from imperfections and asymmetry of information can also act as a barrier to R&D investment (García-Quevedo et al., 2018). Therefore, firms mostly use internal financing for R&D especially small firms that are more vulnerable to external conditions (Czarnitzki & Hottenrott, 2009).

R&D investment does not have a significant direct impact on firms' probability of being financially constrained, but financial constraints can still affect R&D activities indirectly. In periods of economic downturns, it becomes hard to get external funding to support R&D and the constraints placed on the use of internal funds may also hamper R&D spending, especially in the emerging markets (Sasidharan et al., 2015). Losses in R&D projects due to financial market failure are high and the financial resources factor plays a very important role in not neglecting innovative projects (García-Quevedo et al., 2018). It is argued that internal sources of funds are more important in R&D investment than capital investment, especially for small firms that are more vulnerable to external constraints (Czarnitzki & Hottenrott, 2009).

Firm performance in emerging economies is largely determined by R&D investment, which is an essential part of the firm's strategy, but it does not operate in isolation. Other factors unique to these economies, for instance, the enhancement of national innovation systems and government support, can help to intensify the beneficial relationship between R&D and firm growth. In this regard, this perspective is consistent with the existing literature on the subject. For instance, Chan, Martin, and Kensinger (1990) revealed that R&D expenditure is positively associated with firm value, while Knecht (2013) stated that the returns from R&D investment are uncertain and could be a function of the firm's capabilities to market innovations. Cefis and Orietta (2004) also pointed out that innovation, irrespective of the characteristics of the firm such as size, age, and so on can increase the period of the firm and its probability of survival.

This paper will show that there is a co-interdependence of R&D and exports. The literature review reveals that there is a link between the R&D activities carried out by companies and their entry into international markets. This paper supports the hypothesis that firms participating in R&D are more likely to export (Carboni & Medda, 2018). A study carried out in Portugal suggested that firms that participate in exports are more likely to carry out R&D and vice versa thus supporting the idea that exports and R&D are substitute activities (Neves et al., 2016).

Similar problems and prospects are also seen in the case of Pakistan. The nature of the economy, market system, and the government's policies and strategies regarding R&D expenditures also affect the efficiency of such spending. Few resources of skilled manpower, poor infrastructure, and lack of support from the government are the factors that negate the influence of R&D on firm performance. Nevertheless, examples and practices reveal that R&D can greatly contribute to the firm growth if properly supported. This paper has identified several

challenges in the context of Pakistan that hinder the contribution of R&D to economic development and firm performance.

Research in the last few years has paid much attention to the effect of R&D investment on firms' performance with emphasis on emerging markets. In the article by Yang et al. (2020), the authors describe the role of R&D investments in the process of economic development and underline the significant increase in R&D spending across the world. Firms that have invested a large amount in R&D activities are considered high-growth firms and are rated highly by investors. For instance, Liao and Lin, (2017) and Banker et al., (2019) have noted that firms with high R&D expenditure have high growth prospects. These are firms that have many investors' interests because of their growth potential and innovation strategy.

Kim et al. (2021) also explain the balance between the R&D expenditure and dividends distribution. They observe that although dividend payout hampers a company's liquidity, which results in underfunding of R&D projects that enhance value, it is important that firms strike a balance between the two to achieve long-term gains. This is backed by Fama and French (2001) and Bates et al. (2009) who affirm from the US that companies that invest in R&D pay lower dividends. Thus, the given hypothesis that higher R&D investments can lead to lower dividend payments is also supported by the result. Gugler (2003) also finds the same results using the Australian data, whereby he establishes that R&D investment is negatively correlated with dividend payment. These works indicate that companies with larger R&D expenditures do not distribute dividends to shareholders since they need the money for expansion.

Mitton (2004) focuses on the function of corporate governance in dividend policy whereby the study is done in emerging markets. The research establishes that if corporate governance is to be enhanced then this would result in higher dividends as outside shareholders prefer dividends rather than retained earnings to avoid the risk of expropriation by managers. This can be explained by La Porta et al. (2000) stating that in countries where there is good investor protection, then minority shareholders can demand higher dividends. This finding is quite important, especially in the emerging economies which have different levels of investors' protection.

According to Clarke (2015), the business models and governance systems of BRICS economies are different from the Anglo-American model. Thus, the study implies that BRICS countries need to create their own governance structures based on the ethical systems and values that are specific to these countries. According to Wang and Zhang (2020), the economies of BRICS

countries have been steadily growing in the last 30 years averaging at 5. 42 percent and an addition to global GDP of more than 22 percent. Nevertheless, the effective R&D investment in GDP has not shown substantial growth, indicating that the institutions should pay more attention to innovation.

Wang et al. (2021) conduct a study to assess the effect of institutional quality on technological innovation in BRICS countries and discover that weak institutional quality is unfavorable to innovation. They have proposed enhancing institutions to foster an environment for R&D and innovation. Pinkowitz et al. (2006) have identified that investor protection is made up of both legal rights and enforcement. Investor protection has been seen to influence dividend payments positively since shareholders can influence management. According to Easterbrook (1984), and Jensen (1986), dividend payments lessen the amount of free cash flow available to managers and thus decrease the likelihood of managers' opportunistic behavior. This mechanism is a control instrument that ensures the managers' goals coincide with those of the shareholders.

Mitton (2004) also reveals that country-level governance indicators are more useful in explaining dividends compared to firm-level governance indicators. The findings of this paper show that better country-level governance can increase dividend payouts in emerging markets with poor investor protection. Seifert and Gonenc (2018) hold that good governance minimizes the occurrence of embezzlement and increases the chances of cash being returned to shareholders. Enhanced political institutions enhance investors' rights and property rights protection, which in turn raise dividend payouts (Roe, 2006; Roe and Siegel, 2011).

According to Sawicki (2009), the roles of both firm and country-level governance in enhancing investor protection and dividends are stressed. Thus, good governance at both levels can support each other to improve the performance of the firms and the value of the shareholders.

A number of empirical researches have shed light on the positive effects of R&D spending on firms' performance especially in the emerging economies. Czarnitzki and Toole (2011, 2013) have identified that market uncertainty tends to decrease R&D investment; nevertheless the effect depends on firm size. Due to their financial strength, large firms are in a more position to bear the risks that are related to the R&D expenses. Small firms that usually have limited capital are more vulnerable to market risks as compared to large firms. Ghosal and Loungani (2000) noted that small firms are more react to profit uncertainty and this in turn affects investment greatly. This is because, they have limited options of going for external funding and

this makes them more sensitive to market conditions. On the other hand, bigger firms can continue with R&D expenses even in times of risk owing to their big cash or financial muscle.

Chevalier-Roignant and Trigeorgis (2011) and Smit and Trigeorgis (2001) are also related to our paper as they discuss the strategic issues of the firms under conditions of uncertainty. This research proves that the SC shaped the R&D investment decisions through competitive rivalry and market conditions. This view is essential for explaining how companies manage risks through investment in innovation. Furthermore, it has been established in earlier research that R&D expenditures lead to the growth of the knowledge capital that is needed for more innovation and firm expansion. This is important to small firms in developing countries where technology transfer from large firms can greatly improve innovation performance.

The literature also shows that firms with high R&D investments are regarded as those that are likely to grow at a fast rate and thus gain favor among investors. Nevertheless, there is the major issue of the balance between R&D spending and dividend payout. Kim et al. (2021) state that although dividend payout reduces a firm's liquidity and hence its ability to make value-creating R&D investments, both must be managed for the long-term value creation. This view is supported by Fama and French (2001) and Bates et al. (2009) who show, from evidence based on the US, that companies that invest more in R&D offer lower dividends. Gugler (2003) arrives at similar results and uses Australian data to demonstrate a negative link between R&D spending and dividend payouts. From these studies, it can be argued that firms with high R&D expenditure do not distribute their earnings to shareholders in the form of dividends.

In the emerging economies, it often happens that the dynamics are quite different as the financial factors enhance the impact of market conditions on R&D investment. According to Hasan et al. (2021), firms operating in these regions face several problems arising from the underdevelopment of financial markets and, consequently, limited access to credit. Such financial constraints are common in companies and often act as a stumbling block to invest in R&D. Many studies show that government subsidies and supportive R&D policies help to reduce the impact of uncertainty. For instance, the Korea Small and Medium Business Innovation Research (KOSMBIR) supplies financial support and a less competitive market for small companies, increasing the probability of R&D spending.

Therefore it can be said that market uncertainty affects R&D investment and firm performance as well as other factors moderate this effect like firm size, firm age, sale growth, and government policies. Newly industrialized countries have several constraints which may limit

the efficiency of the R&D spending. However, when there is adequate government intervention and positive capital budgeting decisions, firms can manage the uncertainty and exploit R&D for long-term development and profit.

The effect of interest rates on firm performance in EMs is an important research area due to the uncertainty that characterizes many of these markets. These works, including Bernanke and Gertler (1995) note that fluctuations in the rate of interest can have a noticeable effect on the investment plans of firms especially in those industries that involve capital-intensive technologies. In emerging markets where credit is a major constraint, higher interest rates lead to higher costs of borrowing which lowers down funds that can be used in more useful activities such as R&D. According to Fama (1981), high interest rates are coupled with low stock returns, given that high interest rates affect the discount rate which in turn affects the value of cash flows expected in the future, which could hurt the performance of a firm. In addition, it has been argued that emerging markets are often associated with higher levels of economic risk and therefore firms are more responsive to changes in interest rates (Demirgüç-Kunt & Maksimovic, 1998). This sensitivity is especially so in small firms, as these firms are usually least likely to be able to obtain external funds and rely heavily on bank loans. As pointed out by Booth, Aivazian, Demirgüç-Kunt, and Maksimovic (2001), interest rates may also affect the overall development of the financial systems in a particular country moderating the effects on the firm performance. In markets with well-developed financial systems, firms may be able to secure other sources of finance which acts as a cushion to the biting of high interest rates. This body of research points to the fact that interest rates are a key factor that affects the performance of firms in emerging markets although the effects are augmented by other financial and economic factors.

2.2 Intangible Assets and Firms Performance

The importance of intangible assets as an important source for the development and sustainment of competitive advantage has been discussed in the literature. Porter (1985) stressed that companies' intangible assets like patents and brands are the key to competitive advantage. Many subsequent researches have also stressed the role of these assets in enhancing innovation, customer relations, and operational efficiency (Lev, 2001; Corrado, Hulten, & Sichel, 2009). Therefore, the general conclusion is that the recognition of intangible assets as an important asset can contribute to the achievement of competitive advantage and profitability.

For example, Medved, Peštović, and Saković (2023) conducted a study to establish the effect of intangible assets on firms' performance in Serbia. Thus, their research contributed significant data from the Serbian environment that supported the global validity of the link between intangible assets and firm performance. They recommended that managers should extend their concentration on intangible assets to sustain the organization's profitability and growth. There is a need for future research to expand on the long-term impacts of such investments and the outcomes by industry, to emphasize the significance of intangible capital for both the small and big firms.

Trimi and Berbegal (2012) were interested in human capital acquired by job training and organizational improvements; they explained that these factors helped new entrepreneurs by allowing them to make good decisions and thus be more likely to succeed. Chesbrough (2007, 2010) also stressed the importance of innovation and creativity especially in starting new projects and new companies, where he associated these resources with strategic management and value generation through R&D and marketing.

The use of digital technologies affects the characteristics of intangible assets in a very profound manner. Nambisan (2017), Fossen and Sorgner (2021), and Jafari-Sadeghi (2021) explained how DT reduces entry and operational barriers and changes the entrepreneurial risk. These advancements help in setting up new ventures, expanding the market, and reducing the time and efforts devoted to bureaucratic procedures, thus encouraging entrepreneurial culture. Thus, educational support through ICT also helps in the enhancement of other entrepreneurial skills like creativity and critical thinking to equip the students for entrepreneurship (Alvarez-Sousa, 2019).

Technological advancement and enhancement of the transportation and communication system has enabled start-ups to find new markets. Kraus et al., (2018, 2021) note that global business operation is supported by digital platforms that enhance market reach and the management of the business by entrepreneurs. Digital technologies also help in collaboration and cooperation, which leads to the generation of new business ideas and their growth (Elia et al., 2020; Youssef et al., 2021).

Finding more and more applications in today's knowledge-based economy are intangible assets, including intellectual property, software, and organizational capital, which are critical for improving the firm's performance. Bavdaž et al. (2022) presented the development of the intangible assets' definition and their influence on economic performance where they pointed

out that intangible assets have been considered since the 1960s and 1970s. Machlup (1962) found that more than a third of the American working population was involved in occupations related to the creation and processing of information goods and services, which can be seen as the early stage of intangible assets.

Service-based economies and the digital production process also support the role of intangible assets. Corrado et al. (2018) indicated that the compound annual average growth rates of investments in intangibles between 2000 and 2013 were higher than those in tangible investments in the main European Union countries and the United States. Haskel and Westlake (2018) noted that the process of the rise of intangible investment is at the heart of issues that are facing today's world, including innovation, growth, inequality, and financial and policy transformation.

In particular, in emerging markets, the economies' effectiveness is based on intangible capital. Over the last 30 years, the emerging markets have expanded mostly in the countries of Central and Eastern Europe and the Balkans where the intangible capital is still less developed than in the developed countries. For example, Slovenia, Slovakia, Hungary, and the Czech Republic have lower Intangible/Tangible assets ratios than the EU-14 (Corrado et al., 2018). This research shows that the companies, that invest in intangible assets, get higher profitability and market value, thus underlining the importance of intangible assets for the firms' performance (Bistrova et al., 2017).

Nonetheless, several difficulties exist in the management and valuation of intangible assets. The identification, valuation, and reporting of intangible assets in the financial statements are the main issues. More often than not, the existing accounting standards used in the company are unable to depict the intangible investments made by the company, which causes a lack of information for management and investors. These are the characteristics that are unique to intangible assets and therefore their management needs to be done in a way that considers these features; for instance, scalability, spillovers, and synergies to gain a competitive advantage in the market (Haskel & Westlake, 2018).

Bavdaž et al. (2022) noted that in the 21st century, more so than in the past, intangible assets have gained significance with investments made in intangibles often surpassing those in tangibles, particularly in the developed economies. The authors of the paper described the problems of measuring intangible assets and indicated that conventional accounting might not be effective in valuing such assets. They advocated for more extensive consideration of how

intangible assets are valued and reported as part of companies' balance sheets, and the various forms of intangibles, including IP, branding, and people.

Marr (2008) stressed that organizations should work on creating methods to measure their intangible value drivers. As such, intangible assets may be core determinants of future performance and sustainable competitive advantage and thus their management is of great significance to organizations. Managing intangible assets includes the following activities; identifying and categorizing the assets, assigning value to the assets, and incorporating the assets into the strategic planning process.

Steenkamp and Kashyap (2010) have provided a study on the role of intangible assets in SMEs. The authors claimed that the main reason why SMEs face the challenge of identification and management of intangible assets is the lack of resources and knowledge. They indicated that SMEs must establish certain strategies for controlling intangibles, for example, spending the money on the employees' training and development, as well as defending the intellectual property, and taking advantage of the brand.

Also, the management of intangible assets is not only about their valuation but also about providing conditions for their development and usage. Haskel and Westlake (2018) recommended that depending on the extent to which organizations apply or create intangible assets, they ought to select the appropriate organizational structure. In this case, newly established companies that are engaged in the production of intangible goods, for instance, software developers may require a more fluid structure that can facilitate innovation and teamwork. On the other hand, those firms that mainly utilize intangibles such as retail chains, might benefit from a more centralized structure to increase organizational effectiveness.

Intangible assets that cannot be touched can improve the ability of a company to withstand economic changes and thus, insulate it from the adverse effects of high interest rates on the performance of the company (Hall, 1993). Nonetheless, the financial constraints that are characteristic of emerging markets can hamstring the firm's ability to exploit their intangible assets fully, especially when the interest rates are high, and this in turn influences the overall performance of the firms. According to Brown, Fazzari, and Petersen (2009) in their empirical study, the link between interest rates and intangible assets is therefore important, because even firms with valuable intangibles may struggle to get cheap credit in high-rate environments, which may hamper their growth and innovation. Consequently, while intangible assets are an important factor that determines a company's performance, their efficiency depends on the

interest rate situation in the market, especially in the emerging markets with the not fully developed financial systems that support intangible asset financing.

Similarly, the literature also focuses on the leadership in the management of intangible assets. This paper has identified that leadership is critical to the development of an organizational culture that recognizes and enhances intangibles. Therefore, leaders have to encourage people, create interest, and stimulate learning and cooperation to effectively manage and exploit intangible assets. This is especially the case in industries where the competitive advantage lies in the exploitation of knowledge assets including human capital and intellectual property, which are more a function of personnel's skills and innovation.

Therefore, this paper has sought to establish that intangible assets are vital in improving the performance of firms especially in emerging economies. As for the issues relevant to these economies, including the lack of financial inclusion and inadequate policies, it is possible to build on the positive impact of these investments on firm growth and overall development. Thus, it is necessary to identify the specific features of intangible assets, to work out the efficient ways of their valuation, and to include them in the strategic management process. It is for this reason that if adequate support and strategic orientation are given to firms, the latter can harness intangible assets in their quest for long-term growth and competitive advantage.

Table 2.1: Summary of Reviewed Literature

Reference	Region of Analysis	Period	Variables	Methodology	Conclusion
Zhang (2017)	China	2014-2016	Intangible assets ratio, ROA	Fixed Effects Model (FEM), Panel data analysis	Intangible assets positively impact ROA. Intangible assets contribute more to corporate performance than tangible assets.
Guo et al. (2018)	China	2009-2016	R&D spending, strategic position, firm performance	Random Effects Model (REM), Panel data analysis	Companies that focus on R&D and differentiation tend to perform better. Wasted R&D investment can harm future results.
Pantagakis et al. (2012)	Europe	2006-2010	R&D, Market value, Firm performance	Panel data analysis, Feasible Generalized Least Squares (FGLS)	Positive connection between R&D expenditure and market success. Non-linear relationship between R&D and firm market value.
Tahat, Ahmed, & Alhadab (2017)	UK	1995-2015	Goodwill, R&D, Firm performance	Empirical analysis using financial data from UK FTSE firms	Goodwill positively influences both current and future performance. R&D impacts future performance. Intangibles drive long-term success.
Batool (2020)	Pakistan	2009-2018	Exports, Financial constraints, R&D	Seemingly Unrelated Regression (SUR)	Significant positive association between exports and R&D. Negative impact of financial constraints on R&D investment.
Tung & Binh (2022)	Vietnam	2010-2018	R&D investment, Revenues, Profits, ROA, ROE	Fixed Effects Model (FEM), Two-Stage Least Squares (2SLS)	R&D investment positively impacts revenues, profits, ROA, and ROE. Firms investing heavily in R&D outperform others.
Aimen Ghaffar (2014)	Pakistan	2007-2012	R&D budget, ROA, ROE, EPS	Panel data analysis, Random Effects Model (REM)	Positive relationship between R&D budget and firm performance. Firms should increase awareness and spending on R&D activities.

Freihat et al. (2017)	Jordan	2006-2015	R&D spending, ROA, ROE, EPS	Simple linear regression analysis	Significant positive impact of R&D expenditure on firm performance.
Rahman & Howlader (2021)	Bangladesh	2015-2020	R&D expenditure, firm performance, Tobin's Q	Quantitative analysis with panel data	R&D expenditure positively impacts firm performance and value. Suggests policy reforms to encourage R&D investment.
Hall & Oriani (2006)	Europe	1995-2002	R&D expenditure, market value, productivity	Econometric analysis, Panel data (FEM, REM)	R&D positively impacts market value and productivity. Cross-country differences in R&D efficiency were observed.
Wang & Zhang (2018)	China	2005-2015	R&D intensity, financial performance	Regression analysis, Generalized Method of Moments (GMM)	R&D intensity positively affects financial performance. Government subsidies enhance the positive effect of R&D on performance.
Salinger et al. (2020)	USA	2010-2018	R&D expenditure, firm performance	Empirical analysis using panel data	Positive relationship between R&D and firm performance, leading to greater innovation and competitive advantage.
Brynjolfsson et al. (2021)	Global	2005-2020	Digital assets, firm productivity, market value	Panel data regression analysis	Digital assets contribute significantly to firm productivity and market value. Firms investing in digital assets outperform others.
Li & Hall (2020)	China	2008-2018	R&D expenditure, firm performance	Panel data regression analysis (FEM, REM)	R&D expenditure positively affects firm performance. Stronger effects seen in high-tech industries.
Corrado et al. (2016)	OECD countries	1990-2015	Intangible capital, firm performance	Cross-country comparative analysis	Intangible capital has a substantial impact on firm performance and economic growth. Differences observed across countries.

Haskel & Westlake (2018)	UK, USA	1995-2015	Intangible investment, productivity, economic growth	Macro-level analysis using national and firm data	Intangible investment drives productivity and economic growth. Policy recommendations for supporting intangible investments.
Ewens et al. (2020)	USA	2000-2018	Intangible assets, firm valuation, innovation	Structural equation modeling (SEM)	Positive relationship between R&D expenditure and firm market value. Importance of integrating R&D with business strategy.
Peters & Taylor (2017)	USA	1970-2010	Intangible assets, firm value, Q-ratio	Firm-level analysis using enhanced accounting models	Intangible assets play a crucial role in explaining firm value and investment efficiency.
Corrado et al. (2009)	USA	1973-2003	Intangible capital, economic growth, productivity	Macro-level analysis using national accounts and firm data	Intangible capital significantly contributes to economic growth and productivity. Intangibles are as important as tangibles in modern economies.
Lev (2001)	USA	Various	Intangible assets, firm value, profitability	Empirical analysis using financial and market data	Intangible assets are critical for competitive advantage. Firms with higher intangible assets have better profitability and market value.
Brynjolfsson & Yang (1997)	USA	1987-1994	IT investment, intangible assets, firm performance	Regression analysis using firm-level data	Intangible assets, particularly IT, significantly improve firm performance. Positive effect on market value.
Lev & Sougiannis (1996)	USA	1975-1991	R&D capitalization, earnings, stock returns	Longitudinal analysis with firm-level data	Capitalizing R&D expenditures provides better information about future earnings. The strong link between R&D and stock returns.
Griffith et al. (2004)	OECD countries	1980-2000	R&D intensity, productivity	Panel data regression analysis	R&D intensity is positively associated with productivity growth. International spillovers enhance domestic productivity.

Abebe Zelalem et al. (2022)	Ethiopia	2017-2020	Intangible assets, ROA, ROE, Debt, Asset Size, Liquidity Ratio	Random Effects Model (REM) for panel data	Intangible assets positively impact financial performance in Ethiopia. Strong impact from asset size and liquidity ratio.

In conclusion, the reviewed literature highlights the crucial role of intangible assets, such as human capital, innovation, digitalization, and intellectual property, in enhancing firm performance and fostering regional economic development. These assets are instrumental in improving business models, encouraging proactive entrepreneurial behavior, and facilitating innovation by providing entrepreneurs with essential skills and knowledge. Investment studies identify that intangible capital influences performance by entertaining economic gain and resource portraits for small and large firms. Thus, new opportunities and shifts in consumer behavior are brought by digital technologies, which help decrease barriers to entry and operational costs and alter the entrepreneurial processes. Also, information and capital technology (ICT) integration in education improves the aspects of entrepreneurial education and enables the development of skills for modern entrepreneurship. Evaluation of technological transformations and upgrades in the infrastructure empowers start-ups to revolutionize and diversify the market. In general, intangible assets lead to new developments and risky minimization and support the constant and long-term business activities speaking about their value in today's knowledge-based digitalized economy. Subsequent analysis should try to build upon the current understanding of the link that intangible assets have on firm performance to grasp more about the advancements that are taking place due to the development of digital services and the interconnected world.

Chapter 3

Data and Methodology

This chapter discusses the theoretical framework, empirical model, data, and methodology used in the research.

3.1 Theoretical Foundations

3.1.1 Resource-Based View (RBV) Theory

The Resource-Based View (RBV) theory, pioneered by Wernerfelt (1984) and later refined by Barney (1991), provides a framework for understanding how companies achieve lasting competitive advantages by strategically managing unique resources and capabilities. In the context of the impact of R&D spending on financial performance in Pakistani companies, the RBV notes that R&D acts as a strategic resource, contributing to the development of distinctive capabilities (Barney, 1991). This perspective emphasizes internal resources as key drivers of competitive advantage, countering the traditional economics of industrial organization (Wernerfelt, 1984). Empirical studies, exemplified by Peteraf's (1993) work, support the ideas of the RBV, highlighting the importance of strategic resources, including those cultivated through R&D, in gaining and maintaining competitive advantage. Hence, this paper seeks to contribute to the literature by applying the RBV to analyze the R&D expenditure of Pakistani firms to establish how these expenditures influence the firms's resource-based advantages and financial performance (Madhani and Practices, 2010).

A firm's unique resources and capabilities are the main determinants of its competitive advantage and performance, as stated by Radhika and Hartono (2003). According to RBV, companies can sustain a competitive advantage in the market if they have rare resources that are not widely available to competitors, valuable meant that contributing positively to the company's performance, inimitable which cannot be easily replicated by competitors, and non-substitutable means that with no equivalent alternatives (Barney, 1991). Additionally, managerial expertise, organizational culture, and operational processes are significant RBV components that must be considered (Grant, 1991). These elements are crucial as they contribute to the effective utilization and management of R&D resources, enhancing the firm's overall performance and competitive edge (Teece, Pisano, & Shuen, 1997).

The conceptual model is illustrated both graphically and in textual form, representing the complex relationship between R&D expenditures and firm performance in various industries and regions geographic areas, or markets. It shows the multiple interconnections described in the literature review, as well as the non-tangible intangible assets such as intellectual property and human capital and non-linear non-proportional or unpredictable effects of R&D and sectorial differences variations between different industry sectors (Cohen & Levinthal, 1990). It also includes the effects of other environmental factors like the economic situation like, overall economic conditions such as recession or growth periods and changes in policies which alterations in government regulations or corporate policies in the results of R&D investments (Pantagakis, Terzakis, & Arvanitis, 2014).

3.1.2 Knowledge-Based View (KBV)

The Knowledge-Based View (KBV) extends the RBV by emphasizing that knowledge is the most strategically important resource for firms (Grant, 1996). R&D activities and intangible assets contribute to building a firm's knowledge base, enabling it to develop new products, processes, and services that enhance performance. In this study, KBV explains how investments in R&D generate valuable knowledge and skills, leading to better innovation and competitive advantage, thereby improving profitability. This theory supports the idea that firms with a strong knowledge base—developed through R&D and intangible assets—are more likely to achieve higher profitability, as they create unique capabilities that competitors cannot easily replicate (Nonaka & Takeuchi, 1995

3.2 Methodological Framework

The current paper aims to test the relationship between R&D spending and firm performance in the PSX market from 2010 to 2022. The third chapter of the paper is dedicated to the detailed description of data and methods used to examine this relationship. First, it describes the process of data collection, the sources and period of the data, and the criteria for choosing firms listed on the PSX. The chapter outlines the variables that were used in the analysis such as R&D investment and firm performance measures and also explicates the criteria used in identifying the firms to include in the study. This way of working makes it easier to clearly state the dataset and its parameters.

The chapter also describes the research method used in this study, including the data collection and analysis method, with a specific focus on panel data and regression analysis to examine the R&D expenditure and its effects on the performance of the firm. It also contains the analysis of the impact of intangible assets on the assessment with the reasons for their consideration and the ways for their valuation. Through the identification of possible sources of bias, constraints, and methods applied in the research, this chapter affirms the credibility of the study.

3.3 Data And Methodology

This study employs a mixed research approach, integrating both quantitative and qualitative techniques to explore the impact of R&D and intangible asset investments on firm performance in the PSX. The study first examines the effect of intangible assets, used as a proxy for innovation, with data drawn from 544 firms of PSX only 144 firms were identified that invest in Intangible Assets. These firms are distributed across various sectors, including Food & Beverages, Pharmaceuticals, Chemicals, Automobiles, Oil & Gas, Cement, Electronics & Electrical Appliances, Steel, Packaging, Paper & Board, Banking & Finance, and Others.

The second component investigates R&D expenditures. From the 544 firms listed on the PSX, 46 firms were identified as actively investing in R&D. These firms are categorized into sectors such as Pharmaceuticals, Chemicals, Food, Fertilizer, Technology and Communication, Industrial & Manufacturing, Energy, Services, and Others.

The dataset covers the period from 2010 to 2022. This methodology ensures transparency and rigor, validating the study and providing a robust framework for understanding how R&D and intangible assets affect firm performance on the PSX.

3.4 Sample of Study

The study uses a proper method of sample selection to enhance the validity of the collected data.

The sample consisted of data from all 544 firms that were listed on the PSX from 2010 to 2022. The sample of the research consists of 144 companies that are recognized as investing in intangible assets, and there are also 46 companies with R&D expenditures. The analysis also differentiates between firms that invest in intangible assets and the ones that invest in R&D. Table 3.1 presents the companies' investments in intangible assets by industry. This segmentation enables the researchers to look at the effects of various types of investments on

the performance of firms in detail. This detailed approach helps to avoid ambiguity and omissions in the study's analysis and forms a strong foundation for evaluating the effects of R&D and intangible assets on the performance of firms.

The following are the sectorial distributions:

Table 3.1 Intangible Assets Sectors and their Firms Number

No	Sector	Number of Companies
1	Textile	25
2	Food & Beverages	20
3	Pharmaceuticals	12
4	Chemicals	17
5	Automobiles	13
6	Oil & Gas	12
7	Cement	6
8	Electronics & Electrical Appliances	6
9	Steel	9
10	Packaging	5
11	Paper & Board	6
12	Banking & Finance	4
13	Others	9
	Total	144

Table 3.2 R&D Expenses Sectors and their Firm Number

No	Sector	Number of Companies
1	Pharmaceutical	7
2	Chemicals	4
3	Food	6
4	Fertilizer	6
5	Technology and Communication	3
6	Industrail & Manufacturing	9
7	Energy	2
8	Services	4
9	Others	5
	Total	46

3.5 Econometric Techniques

To select the appropriate econometric technique, it is essential to first examine the nature of the data. Descriptive statistics are used to understand the central tendency, dispersion, and shape of the data distribution. Given that this study is based on a panel dataset analysis as in the study by Parisi & Sembenelli (2003), panel data analysis techniques examine For estimating the relationship between R&D expenditure and firm performance, random effects models and fixed effects models are most suited. The Hausman test is used to compare random and fixed effects models. Use the variance inflation factor test to check for multicollinearity. The explanations for the econometric methodologies utilized in this study are given below.

3.5.1. Descriptive Statistics

Descriptive statistics tries to give detailed information about the dataset, such as measures of central tendency Mean, Median, measures of dispersion (Standard deviation, Variance), measures of distribution shape Skewness, and Kurtosis (Gujarati & Porter, 2009). These statistics help to establish the basic characteristics of the data, including the identification of trends, the detection of outliers, and the evaluation of the data's quality. It is vital for the initial examination and graphical representation of the data which forms the basis of other analyses (Field, 2013).

3.5.2 Correlation

Correlation methods help to determine the connection between the variables through correlation coefficients, which indicate the degree and direction of relationships between variables (Pearson, 1896). Thus, this analysis assesses both the presence and the intensity of the connections between two variables which are critical for identifying the patterns within the data and for further econometric analysis (Cohen et al., 2003).

3.5.3 Variance Inflation Factor (VIF)

The VIF identifies multicollinearity in multiple regression models by estimating the degree to which the variance of an estimated regression coefficient increases as a result of collinearity with other predictors (O'Brien, 2007). If the VIF is greater than 5, it indicates moderate multicollinearity and if it is above 10, it shows that there is evidence of multicollinearity. If the

values of VIF exceed these thresholds, then action shall be taken concerning multicollinearity, for instance, elimination of variables or their aggregation (Hair et al., 2010).

3.5.4. Panel Regression Analysis

Panel data consists of observations on multiple entities (e.g., firms) over multiple periods, allowing for more complex analysis than cross-sectional or time-series data alone (Baltagi, 2008).

3.5.4.1. Fixed Effect Model

This model controls for time-invariant characteristics of the entities that could bias the results if not accounted for. It estimates the effect of predictors within each entity by removing the influence of entity-specific, constant factors (Wooldridge, 2010).

Applied to filter out unobserved heterogeneity that does not vary over time, enhancing the accuracy of the results (Greene, 2018).

3.5.4.2. Random Effects Model

The random effects model assumes that the unobserved effects are uncorrelated with the explanatory variables. It is used when variability across entities is assumed to be random and not fixed (Cameron & Trivedi, 2005).

This model allows for variability in effects and controls for potential time-varying confounders without assuming homogeneity (Greene, 2018).

3.5.4.3. Hausman Test

This test determines whether the fixed effects model or the random effects model is more appropriate for the data (Hausman, 1978).

The Hausman test compares the estimated coefficients from both models. The null hypothesis (H0) posits that the random effects model is suitable, while the alternative hypothesis (H1) suggests that the fixed effects model is more appropriate. A significant test result indicates that the fixed effects model should be used (Hausman, 1978).

H0=Random effect model is appropriate.

H1= Fixed effect model is appropriate.

3.6 Variables List

Symbol	Variables	Proxies	Description Measures	Source
Independent Variable				
R&D	Research and Development	Annual R&D expenditures	R&D activities contribute to generating intangible assets, representing knowledge and technology accumulation, which plays a pivotal role in enhancing firm performance and innovation.	(Firms Financial Reports)
IA	Intangible Assets	Annual Intangible Assets expenditures	Intangible assets comprise innovative breakthroughs, legal protections, and brand resonance, constituting invaluable non-physical resources that drive competitive advantage and business market differentiation.	(Firms Financial Reports)
Control Variables				
FA	Firm Age	Overall years of firm-establishment	Firm Age (FA) denotes the length of time a company has been in operation since its establishment or incorporation.	(Firms Financial Reports)
CE	Capital Employed	Total amount of capital used	Capital employed is the total investment required for a company to operate,	(Firms Financial Reports)
FS	Firm Size	Total assets of Firm	Firm size refers to the scale of a business	(Firms Financial Reports)

SG	Sale Growth	% Change in Sales Growth	Sales growth measures the percentage increase or decrease in a company's revenue over a specific period. It reflects the company's ability to increase market share, expand its customer base, and effectively execute its sales and marketing strategies. Sales growth is an indicator of business vitality and competitiveness, with higher growth rates generally considered favorable for firm performance.	(Firms Financial Reports)
LE	Leverage	Total funds borrowed	Total external funds of the firms	(Firms Financial Reports)
IR	Interest Rate	Country Intrest Rate	Interest rate refers to the rate set by the country's central bank or prevailing in financial markets, affecting the cost of borrowing and influencing the firm's financing decisions and performance.	World Bank
Dependent Variables				
ROA	Return on Assets	Firm Performance	ROA measures a company's efficiency in generating earnings from its assets, which is crucial for evaluating firm performance.	(Firms Financial Reports)

Dependent Variable: ROA.

Independent Variable: R&D Investment and Intangible Assets

Control variables: Firm Age, Sales Growth, Capital Employed, Firm Size, Leverage, and Interest Rate.

Functional Form:

Firm Performance: f (IA, R&D, CE, SG, FA, FS, LE, IR) (1)

Firm Performance= ROA

IA= Intangible Assets

R&D = Research and Development

CE: Capital Employed

SG: Sales Growth

FA = Firm Age

FS = Firm Size

LE: Leverage

IR: Real Interest Rate

Many studies use a similar model to assess firm performance and R&D. The model's concept originates from M. Arif Khan et al. (2023) and Fakhrul Hassan et al. (2022), incorporating similar modifications.

Using an estimated growth equation, this study investigates the empirical relationship between firm performance and R&D for the sample firms in this analysis. The growth equation includes several standardized independent variables, such as firm size, firm age, sales growth, interest rate and capital employed, to control for external factors. Additionally, it integrates ROA as the dependent variable, alongside these standard variables, to assess the direct impact of R&D investments on firm performance. This approach helps isolate the effect of R&D activities from other influencing factors. Because of the simplicity of the preceding functional relationship, the preceding equation simplifies the form of equation 1.

Model 1

$$ROA_{it} = \alpha_{it} + \beta_1 R\&D_{it} + \beta_2 IR_{it} + \beta_3 CE_{it} + \beta_4 SG_{it} + \beta_5 FS_{it} + \beta_5 FA_{it} + \beta_6 LE_{it} + \varepsilon_{it} \quad (2)$$

Model 2

$$ROA_{it} = \alpha_{it} + \beta_1 IA_{it} + \beta_2 IR_{it} + \beta_3 CE_{it} + \beta_4 SG_{it} + \beta_5 FS_{it} + \beta_5 FA_{it} + \beta_6 LE_{it} + \varepsilon_{it} \quad (3)$$

In the above equations, α_{it} is the intercept term capturing unobservable factors, The R&D is for research and development, IA_{it} are intangible assets, LE_{it} is for Leavarage ROA_{it} is Return on Assets, i for the firm, FS is the firm size CE is the capital employed and FA is for Firm Age, SG_{it} for Sale Growth, IR is the Real Interest Rate and ε_{it} Error term. The chosen econometric methods aim to thoroughly analyze the relationship between R&D spending and financial performance, considering factors such as firm size, age, and capital employed. Panel data analysis is used to explore variations over time and across companies. The fixed-effects model controls for consistent, unobservable firm-specific characteristics within similar groups, enhancing precision. On the other hand, the random-effects model accommodates data heterogeneity. This integrated framework evolves into a comprehensive model to dissect the impact of R&D expenditure on the financial performance of firms in Pakistan, as outlined by a set of equations.

3.6.1 Independent Variable

3.6.1.1 Research and Development

R&D is described as the purposeful use of resources to develop new or better ways of acquiring and applying knowledge to beat competitors and increase the effectiveness of the business. According to Delanghe and Muldur (2016), this means that R&D performance enhances a company's output through technical change, which results in the development of new products, services, and processes that have the potential to increase efficiency, market position, and profits. It also produces employment and positive externality or social benefits through this investment. However, market failures often lead to under-optimal private sector R&D investments; thus, the right government intervention is required to enhance such outcomes. Lu et al. (2010) note that R&D expenses are closely associated with a firm's intangible assets; thus, increased R&D spending results in more valuable intangible assets, which result in higher future cash flows and increased firm value.

R&D= Log(R&D expenditure) ---------- (4)

3.6.1.2. Intangible Assets

These are assets that cannot be touched means non-physical assets and are very important in the performance of any company and its value; such are intellectual property, brands, and patents. These assets influence firms' competitiveness, innovation, and market positioning, thus enhancing such financial measures as ROA and firm value. To understand the true value of a company, it is crucial to measure and report intangible assets properly as they can define a substantial part of a business's value. Gamayuni and Rnku (2017) note that it is high time that accounting systems take into consideration to enhance accountability and encourage proper investment. Haji and Ghazali (2017) also establish that intangible assets and liabilities are key determinants of large firms' performance in Malaysia, with an extension of the resource-based view to include intangible liabilities. Ferdaous and Rahman (2019) investigate the relationship between intangible assets and the performance of firms in the manufacturing sector in Bangladesh; in this case, intangible assets positively influence the performance of the firms but firms fail to increase the shareholders' value which supports the idea that there is a need to effectively incorporate intangible assets in decision making.

IA= Log (Intangible Assets expenditures) ---------- (5)

3.6.2 Dependent Variables

3.6.2.1. Return on Assets

ROA is a key measure of a company's profitability and is calculated as the ratio of net income to total assets. This is arrived at by dividing the annual net income by the average total assets as put by Zutter and Gitman (2012). A higher ROA depicts a higher profitability and utilization of assets, hence the ratio is useful in comparing firms in the same industry. However, the trend of ROA over time as explained by Kabajeh et al. (2012) also proves to be another significant factor where an increasing ROA is an indication of bettering the financial performance while a decreasing ROA has the opposite implication. The relevance of ROA in assessing the performance of firms has been explicatively discussed in the financial literature according to Chao-Hung Wang (2011). It is useful in determining a company's capability to generate profits from a particular asset base, thus enhancing the evaluation of the overall performance.

The formula is:

ROA= Net Profit/ Total Assets ---------- (6)

3.6.3 Control Variables

Much research has been conducted in the area of the link between profitability and firm size. Although the size of the firm is still one of the most important issues in contemporary business theory, it is equally important to consider the growth of the enterprise. Business size and profitability relationship has been established to be an irregular relationship and may differ with industries. For instance, Becker-Blease and her colleagues (2010) established that this is the case where the profitability of firms grows as they expand in size, but at a decreasing rate in the general business environment. Likewise, Wang (2011) explained the different viewpoints that stemmed from the conflicting outcomes of these studies. Do (2013) has shown in his research that there is a strong correlation between the size of the firm and its profitability because bigger firms have better efficiency and a stronger market position. However, Rahman and Yilun (2021) noted that older firms perform better in terms of productivity and profitability than larger firms, thus underlining the role of the firm's age. On the other hand, Banchuenvijit (2012) found that the size of the firm may be positively or negatively related to the company's performance; the result further complicating the relationship. Besides the firm size, other studies have considered the effect of the firm age on profitability and the findings were not conclusive. According to Nakano and Nguyen (2011), older firms have better capital structure, more social capital, and experience that enable them to invest more in their R&D hence improving their competitiveness and value. However, young firms may be short of the required R&D personnel, financial capabilities, and market knowledge, and they therefore make inefficient investments that may compromise their strategic competitiveness and overall performance (Guo & Zhang, 2007). Leverage, another important control variable, is another variable that has an ambiguous effect on corporate performance. As pointed out by Alibabaee & Khanmohammadi (2016), it is argued that the effect of leverage on performance could be positive or negative depending on the firms' ability to manage the debts that it has taken. Leverage can increase the ROE of a company if the company is in a position to invest the borrowed funds to yield a return that is higher than the cost of the debt. Nevertheless, if the returns do not go beyond the fundraising cost, it means that leverage reduces the ROE. Didier et al., (2021) identified that high leverage comes with its drawbacks, particularly when the economy is not in the best shape, as firms may find themselves unable to meet their duties, thus

damaging the financial standing of the firm. In the same way, Ghardallou (2022) noted that high debt levels could be detrimental to the performance of the firm because the costs of debt could be higher than the gains. In line with this, Vithessonthi and Tonurai's (2015) study on Thai firms provides evidence of a negative relationship between the level of debt and the performance of the firms. Iqbal and Usman (2018) elaborated on the situation and stated that high interest rates and rising debt levels might erode the value of a company and thus affect the business performance in an adverse economic condition. Concerning Pakistan, interest rates have been found to have a strong effect on the performance of the firms. In the past, the State Bank of Pakistan (SBP) has played with the rates of interest to control inflation and fluctuation in the economy. High interest rates increase the cost of capital which, in turn, puts a strain on the financial position and thereby the profitability of the firm. For instance, when the interest rates go up, the firms have to pay more interest on the existing and new debts thus lowering their net income and may result in a decrease in ROE. This view is consistent with the experience in Pakistan. Javid and Iqbal (2012) in their study revealed that changes in interest rates influenced corporate profitability in Pakistan. In the high-rates environment, the cost of borrowing for companies with high levels of indebtedness reduced their profitability considerably.

3.6.3.1 Capital Employed

Capital employed, which is the total capital that has been put into a business and is defined as total assets less current liabilities or equity plus long-term debt affects the performance of the firm and R&D NGUYEN (2020). The management of capital employed in a business improves the operational efficiency and profitability of the firm as highlighted by ratios such as ROCE. Also, firms with high capital employed are in a better place to channel their resources towards R&D thus increasing the rate of innovation and growth. Thus, efficient capital management, besides influencing the current financial results, contributes to the company’s long-term competitiveness through ongoing innovation Smith, J. (2020). To account for differences in firm sizes and insure consistency across firms, Capital Employed logarithmically scalled. This transformation addresses potential non linear relationship and enables more meaningfull comparisons between firms, focusing on proportional rather than absolute changes in CE. The use of log scalling also helps manage large value ranges and improves the interpretability of the results, especially in Regression models where non linearity may affect outcomes.

Formula:

Log(Capital Employed = log(Total Assets - Current Liabilities) ---------- (7)

3.6.3.2. Firm Age

The age of a company is an important component in understanding its dynamics and features. It refers to how long a firm has been in operation since its inception. A firm's age can have a considerable impact on its behavior, tactics, and results. Tung and Binh (2022), Firm age represents the number of years since the firm was established.

3.6.3.3. Sales Growth

Sales growth is defined as the actual rate at which the revenue of a company increases in a given period, which is usually in a year or a quarter. It depicts changes in market share, customer base, or product line of a company, thus, its capacity to earn more revenue in the future. The concept of sales growth is utilized to analyze its effects on the performance of the firm concerning profitability and shareholder value in different governance structures where free cash flow is a factor.

Published in 2000, Brush's study aims to examine the link between sales growth and company performance based on agency theory. It seeks to establish whether there is lower sales growth in organizations with free cash flow especially where there is weak governance as compared to firms without free cash flow. Nevertheless, the government conditions affect the sales growth and success in sales differently. Thus, it is crucial to consider the governance structures while studying the link between sales growth and company performance.

Formula;

Sale Growth= (current year sales-previous year sales/ previous year sales)*100 ---------- (8)

3.6.3.4. Leverage

Leverage is defined as the Ratio of Total Debt to Total equity, which quantifies the extent to which a firm is utilizing debt to finance its operations. The study reveals that while leverage initially negatively affects firm performance, this impact lessens as firms grow, eventually becoming positive, especially for smaller firms. Ibhagui and Olokoyo (2018) discover that leverage's negative impact on firm performance is most significant in small-sized firms but diminishes as firms grow, eventually disappearing beyond a certain threshold size.

Formula;

Leverage = Total Debt / Total Equity ---------- (9)

3.6.3.5. Firm Size

Refers to the scale or magnitude of a business entity, often measured by indicators such as total assets, which encompass all the economic resources owned or controlled by the firm also According to financial literature, total assets are widely recognized as a fundamental metric in assessing firm size because they represent the cumulative value of tangible and intangible resources deployed by the company to conduct operations and generate revenues Hall, B. H. (1992).

Firm Size= Log (Total Assets) ---------- (10)

3.6.3.6 Real Intrest Rate

The Real interest rate in this thesis specifically refers to Pakistan and is defined as the nominal interest rate set by the State Bank of Pakistan minus the inflation rate. This adjustment gives a better implication of the actual cost of borrowing or the actual rate of return as it factors in for inflation. Real interest rate focuses on the real conditions that prevail in the economy this provides a clearer view of the environment that firms work in as opposed to the nominal interest rate. This measure is particularly significant in models of firm performance since it gives a more precise idea of the cost of capital. Higher real interest rates indicate that the cost of capital is going to be high which can be bad for the profitability of a firm due to high interest charges. Furthermore, high real interest rates may discourage firms from undertaking new ventures or may encourage them to reduce investment in new projects since the cost of capital is very high. Bernanke and Gertler (1995) and Fama (1981) have established that changes in real rates of interest which are brought about by alterations in monetary policy and inflation are capable of affecting investment decisions and results at the company level, which is why the real rate of interest is important in the analysis of the performance of firms.

Formula;

Real Interest Rate= Nomina Interest Rate- Inflation Rate ---------- (11)

Chapter 4

Results and Discussions

4.1 Graphical Representation

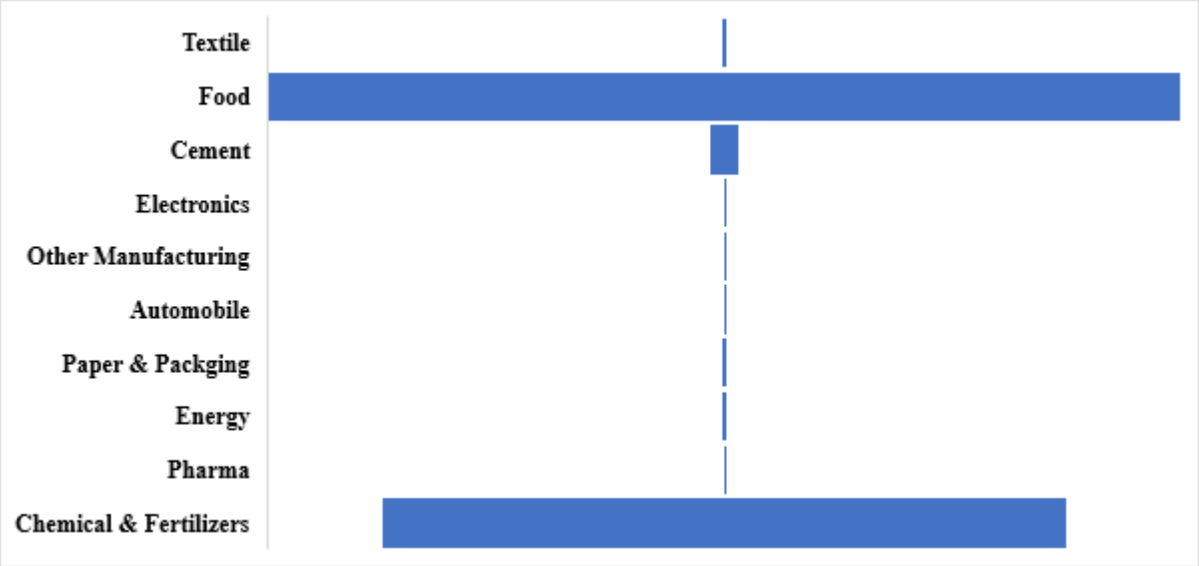
This chapter gives the findings from the analysis done in this research to arrive at the estimates that are presented here. The main focus of this chapter is to analyze the correlation between firm performance, R&D expenses, and IA in firms that are listed on PSX. The chapter starts by describing the pre-estimation tests, which include the tables of descriptive statistics and correlation, and which serve as a preliminary review of the data and their interconnections.

In the subsequent section, the chapter moves to the presentation and analysis of the estimation results to explain how R&D investments and intangible assets influence firm performance individually and combined. The findings are discussed in relation to the current literature, which aids in categorizing the specific contributions of R&D and intangible assets for firms in the emerging markets of Pakistan. The findings of the study are then related to both corporate strategy and policy-making to inform the reader about the factors that affect firm performance in this particular industry.

4.2. Empirical Analysis

This part is concerned with the panel data analysis of firms that have an interest in intangible assets. Thus, it is necessary to evaluate the effects of these investments on the performance of the firm. The last part of the study covers the panel data analysis of the companies from the above list that have R&D investments, using their annual reports. This research work is targeting at assessing the effect of R&D spending on the performance of firms.

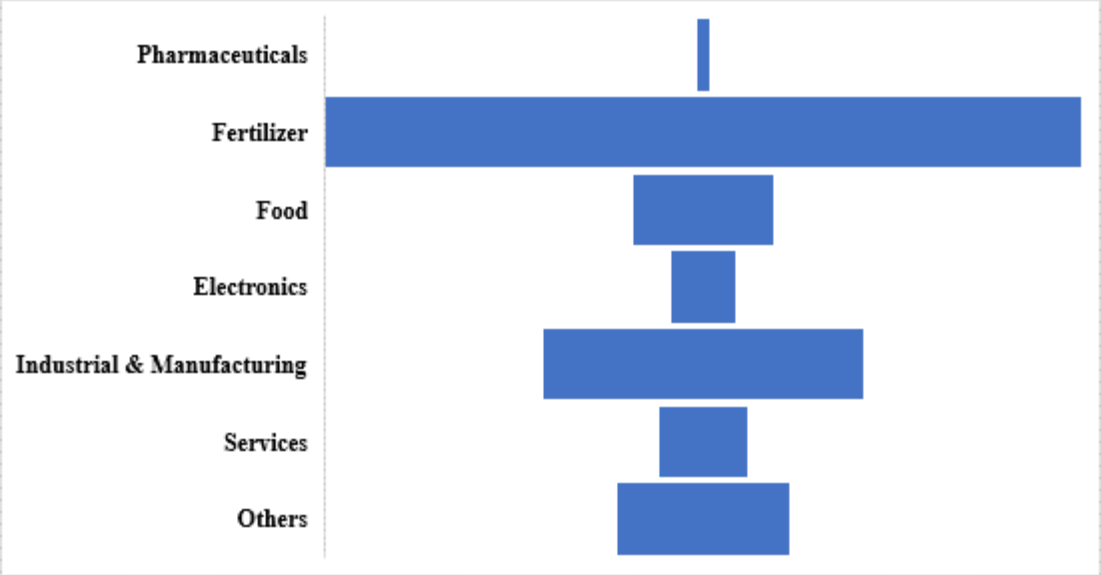
Figure 4.2.2 Intangible Assets Sectorial Investment



Source: *Authors own work*

The above Figure 4.2.2. This, consequently, depicts the significance of intangible assets in the enhancement of firm performance in different industries. The Food, Chemical, and Fertilizers sectors can be identified as having the longest bars, thus showing that these industries have the highest investment in the intangible assets especially patents, trademarks, and brand equity that greatly improve the performance of the firms in the economy. On the other hand, the Textile industry presents the shortest bar, which implies that the investment made in intangible assets and the effect on the performance of the firms is low. The Cement, Electronics, Other Manufacturing, Automobile, Paper & Packaging, Energy, and Pharma industries are presented with different levels of investment in intangible assets, where the shorter bar implies less contribution compared to the Food, Chemical, and Fertilizers industries. The chart indicates that the Food industry and the Chemical & Fertilizers industries have the highest value of the importance of intangible assets in firm performance while the other industries' values are moderate; thus, it is crucial to invest in intangible assets to enhance firm performance.

Figure 4.2.3 R&D Sectorial Investment



Source: *Authors own work*

The above Figure 4.2.3. depicts the proportions of the various industries in R&D and the impact on the performance of the firm. The Fertilizer industry has the longest bar, which indicates that this sector has the highest investments in intangible assets, such as intellectual property, patents, and brand value, that positively affect the firm's performance. Conversely, the pharmaceuticals industry which is known for its research has the shortest bar, this could imply that the R&D is either less documented or has the least effect on the firms' performance. In this case, the Food, Industrial & Manufacturing industries present reasonable outputs due to the steady investment made in R&D which in turn depicts steady improvement. The shorter bars for Electronics, Services, and Others indicate that they have relatively less investment in intangible assets, or the effects are realized within a shorter time on the firm's performance. Altogether, the chart shows the involvement of R&D in various industries, where the Fertilizer industry has the highest investment in those assets for the firm's performance enhancement, and the other sectors have different levels of R&D usage and impact.

4.3. Intangible Assets and Firm Performance

This section demonstrates the broad impact of intangible asset investments on firm performance. It contains subsections that include a descriptive analysis of intangible assets along with their dependent and control variables, followed by panel data analysis through fixed and random effects models, with Hausman testing to determine the appropriate model.

Table 4.3.1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Return on asset	8.506747	12.13279	-95.042	67.958
Firm leverage	0.2082173	0.2028408	0.0470914	1.202131
Firm size	16.17303	1.69753	11.59	22.43
Firm age	41.76857	16.96349	1	81
Capital Employed	19,800,000	46,300,000	-4,900,000	500,000,000
Intangibles Assets	12,164,000	18579,000	0	92,228,000
Sale growth	8.690017	30.33701	-99	222
Interest Rate	2.524743	3.215971	-4.45	7.7613

Skewness and kurtosis tests for normality

Variable	Pr(skewness)	Pr(kurtosis)	Adj chi2(2)	Prob>chi2
Residual	0	0	260.3	0

Table 4.3.1 presents the descriptive statistics for the variables used in the study. Return on Assets (ROA) has a mean value of 8.51, indicating moderate profitability across firms, but the standard deviation of 12.13 reflects significant variability in performance. The range of ROA, from -95.04 to 67.96, shows that while some firms are highly profitable, others experience substantial losses. This wide variation aligns with existing literature, which suggests that economic disruptions, such as the COVID-19 pandemic, can lead to fluctuations in profitability (Ding et al., 2020). Industries like agriculture and fertilizers have shown resilience, contributing to higher ROA in some cases (Gulzar et al., 2021).

Firm leverage has a mean of 0.208, with a standard deviation of 0.203, showing a diverse reliance on debt financing among firms. The leverage ratio ranges from 0.047 to a maximum of 1.202, indicating that some firms are heavily reliant on debt. These findings are consistent with studies that suggest capital structure decisions are influenced by factors such as industry type and market conditions (Frank & Goyal, 2009). Firm size, measured as the natural logarithm of total assets, has an average value of 16.17, with a standard deviation of 1.70, ranging from 11.59 to 22.43. This reflects substantial variability in firm scale, which can influence market power, resource allocation, and financial strategies, as suggested by Titman and Wessels (1988).

The average firm age is 41.77 years, with a standard deviation of 16.96 years, and ranges from 1 year to 81 years. This variation suggests a mix of both newly established and well-established

firms. Literature supports the notion that younger firms may face challenges such as innovation constraints while benefiting from fresh market positioning, whereas older firms may leverage experience and stability (Coad et al., 2018).

Capital employed shows a range from negative 4.9 million to 500 million, with an average value of 19.8 million and a high standard deviation of 46.3 million. The presence of negative values in capital employed may occur due to several valid reasons. Negative capital employed can result when a firm's liabilities exceed its total assets, often reflecting accumulated losses over time. For instance, Altman (1968) highlights that firms experiencing consistent financial distress often exhibit negative equity and impaired resource utilization, which can lead to negative capital employed. Another reason for negative capital employed is excessive reliance on short-term liabilities, where current liabilities surpass total assets. Myers (1984) discusses how firms with high debt-to-equity ratios may face liquidity constraints, sometimes resulting in negative financial indicators such as capital employed. Declines in asset valuations, such as through impairments or write-offs, also contribute to such negative figures. Lev (2001) explains that underperforming firms with asset impairments or operational inefficiencies are more likely to show skewed financial metrics, including negative capital employed. Certain industries or firms in distress might exhibit negative capital employed due to poor financial health or operational challenges. Damodaran (2001) notes that firms in high-risk industries or those facing market shocks often report negative working capital or capital employed as a signal of financial instability. Furthermore, accounting adjustments, such as revaluation of liabilities, deferred taxes, or large provisions, may temporarily skew the values.

Intangible assets have a mean value of 12.16 million, a standard deviation of 18.58 million, and a range from 0 to 92.23 million. This wide range illustrates diverse levels of investment in intangible resources like patents and brand value, which are influenced by industry type and innovation focus (Lev, 2001). Sales growth has an average value of 8.69, with a standard deviation of 30.34 and a range from -99 to 222. This indicates considerable dispersion, with some firms experiencing steep declines while others achieve substantial growth. Such variability is in line with studies that attribute sales performance to market conditions and firm-specific factors (Coad, 2007).

The interest rate shows a mean value of 2.52, with a standard deviation of 3.22, and ranges from -4.45 to 7.76. This variability reflects differences in borrowing costs faced by firms, influenced by factors such as creditworthiness, monetary policy, and macroeconomic

conditions. Firms with higher credit risk often encounter higher interest rates, whereas those with stronger financial standings benefit from more favorable borrowing terms. The observed range indicates that firms in the sample operate in diverse environments, with some accessing funding at lower costs, while others face significant borrowing expenses. The negative interest rates observed in the data may result from firms operating in economies that adopted unconventional monetary policies during periods of economic distress. For instance, during the COVID-19 pandemic, central banks in many regions implemented aggressive monetary easing policies, including lowering interest rates to near or below zero, to support economic recovery (Rogoff, 2016). This led to a reduction in borrowing costs for many firms, enabling them to sustain operations and investments during a period of heightened uncertainty. Bernanke and Gertler (1995) explain that fluctuations in interest rates, driven by monetary policy adjustments, have a significant impact on a firm's investment decisions, particularly in areas such as research and development, expansion, and liquidity management. During the pandemic, firms faced varied interest rate environments, depending on their geographic location and economic conditions. For example, firms in regions with robust stimulus measures experienced lower borrowing costs, while those in less economically supportive environments may have faced higher rates due to increased credit risk and financial instability. The observed range of interest rates also reflects how firms adjusted to the financial challenges posed by the pandemic. Some firms were able to secure favorable rates due to strong creditworthiness, while others faced heightened costs. Damodaran (2001) emphasizes that industry-specific dynamics, global economic conditions, and firm-specific characteristics all contribute to borrowing cost variations, which in turn influence a firm's financial strategies and resilience during crises like COVID-19.

Lastly, the skewness and kurtosis tests for normality show significant p-values (both 0), indicating that the data deviate significantly from a normal distribution. This non-normality, characterized by asymmetry and extreme values, is consistent with findings in financial data studies, which often exhibit skewness and heavy tails due to firm-specific variations (DeFond & Park, 1997). To address this, robust statistical methods were applied in the analysis to ensure accurate results, as recommended by Westfall and Young (1993).

Table 4.3.2. Correlation Matrix.

Variables	ROA	INT	SG	FS	FA	CE	LE	IR
ROA	1							
INT	0.061	1						
SG	0.01	0.04	1					
FS	0.05	0.30	0.00	1				
FA	-0.02	-0.01	-0.06	0.08	1			
CE	-0.0006	0.3207	0.0429	0.5221	0.1063	1		
LE	-0.3231	-0.0743	-0.0131	-0.1094	-0.1943	0.0688	1	
IR	0.1461	-0.668	-0.0101	-0.0710	-0.0981	-0.0363	-0.0101	1

Table 4.3.2 presents the multicollinearity table in the form of a correlation matrix, showing the relationships between the variables included in the study, such as Return on Assets (ROA), Intangible Assets (INT), Sales Growth (SG), Firm Size (FS), Firm Age (FA), Capital Employed (CE), Leverage (LE), and Interest Rate (IR). Multicollinearity arises when two or more independent variables in a regression model are highly correlated, leading to challenges in estimating the unique effect of each variable due to inflated standard errors and reduced reliability of coefficient estimates (Gujarati & Porter, 2009).

A significant finding is the positive correlation of 0.5221 between Firm Size and Capital Employed, suggesting that larger firms tend to utilize more capital. This relationship is consistent with the work of Graham (2000), who noted that larger firms inherently require greater financial resources to scale operations and sustain their activities, leading to a close relationship between firm size and capital deployed. Larger firms often have better access to funding due to their established market presence, enabling them to employ higher levels of capital for investment and growth.

Another notable observation is the strong negative correlation of -0.668 between Intangible Assets and Interest Rate. This indicates that firms with greater intangible assets typically secure lower interest rates, which can be attributed to their improved creditworthiness or reduced dependence on debt financing. Hall (1993) supports this, arguing that firms with substantial intangible assets—such as patents, trademarks, and proprietary technology—are perceived as

lower risk by creditors, as these assets signify innovation potential and future profitability. This lowers the cost of borrowing and enhances financial flexibility for such firms.

The positive correlation of 0.3207 between Intangible Assets and Capital Employed further highlights the interplay between these variables. Firms with significant intangible assets tend to invest heavily in capital to support their innovation-driven activities and sustain competitive advantages. Lev and Radhakrishnan (2005) emphasize that firms rich in intangible assets often align their capital investments with their innovation strategies, creating synergies that drive both growth and market leadership. The correlation between Sales Growth and ROA is very low at 0.01, suggesting minimal direct association between these variables. This implies that, in this sample, sales growth does not strongly influence overall profitability, which may reflect diverse industry conditions, firm characteristics, or varying market strategies. Similarly, other relationships, such as the negative correlations between Firm Age and Intangible Assets -0.01 and Firm Age and Interest Rate -0.0981, indicate weak associations, further reducing concerns about multicollinearity for these specific variables.

Table 4.3.3: Multicollinearity (VIF) test

Multicollinearity Testing		
Variable	**VIF**	**1/VIF**
Firm Size	1.51	0.66
Capital Employed	1.42	0.70
Intangibles Assets	1.22	0.81
Firm age	1.67	0.93
Leverage	1.05	0.94
Sale Growth	1.01	0.98
Interest Rate	1.02	0.99
Mean VIF	**1.19**	
Less than 5 indicates No multicollinearity		

In Table 4.3.3, the Variance Inflation Factor (VIF) test was conducted to assess the potential multicollinearity among the independent variables in the regression model. Multicollinearity occurs when independent variables are highly correlated, which can distort regression results by inflating standard errors and reducing the reliability of coefficient estimates. Gujarati and Porter (2009) noted that a VIF value exceeding 10 indicates a severe multicollinearity problem, while values below this threshold generally do not pose significant concerns.

The VIF values for the variables in this study firm age, firm size, sales growth, intangible assets, leverage, capital employed, and interest rate range from 1.01 to 1.67, with a mean VIF of 1.19. These values are well below the critical threshold, indicating that multicollinearity is not a significant issue in the dataset. Additionally, the inverse VIF values (1/VIF), or tolerance statistics, are all above 0.1, further supporting the absence of severe multicollinearity. The individual R-squared values also demonstrate that no variable is overly explained by other predictors, ensuring that each variable contributes unique information to the model.

This finding aligns with the work of Kennedy (2003) and Wooldridge (2015), who emphasized that low VIF values enhance the credibility of regression coefficients and support the robustness of the model's outcomes. The low multicollinearity in this study allows for a more precise interpretation of the relationships between firm characteristics and performance metrics, ensuring that each independent variable's effect is distinct and meaningful.

Moreover, these results are consistent with similar studies in both developed and developing economies, where low VIF values have been associated with reliable regression analyses (Kennedy, 2003). The non-significant correlations between predictor variables, as indicated by the VIF statistics, confirm that each variable adds unique explanatory power to the model. This strengthens the overall reliability of the analysis and its ability to provide insights into firm performance.

Table 4.3.4: Random effect

Dependent Variable is ROA			
Variables	**Coef.**	**p-value**	**t-value**
INT	0.017	0.1001	1.63
FA	-0.004	0.005	-2.81***
SG	0.011	0.826	0.22
CE	-0.027	0.006	-2.53**
FS	0.378	0.401	0.84
LE	-0.181	0	-14.09***
IR	0.272	0	4.74***
Constant	0.499	0.707	0.38
Mean dependent var	1.956	SD dependent var	1.065
R-squared	0.134	Number of obs	701
*** *p<.01*, ** *p<.05*, * *p<.1*			
Hausman Statistics			
Chi2	0.01		
Prob > Chi2	0.9274		

Table 4.3.4. presents the results of a random effects regression model, where the dependent variable is the firm's performance, measured by Return on Assets (ROA). Independent variables include Intangible Assets (INT), Firm Age (FA), Sales Growth (SG), Capital Employed (CE), Firm Size (FS), Leverage (LE), and Interest Rate (IR). The model examines how these variables affect firm performance, and the Hausman test confirms the suitability of the random effects model for this analysis.

The regression results show a positive coefficient of 0.017, statistically significant at the 10% level p-value of 0.1001. This indicates that intangible assets, such as patents, trademarks, and brand equity, positively influence firm performance. This finding aligns with the studies by Mohammed and Ani (2017) and Ferdous and Rahman (2019), who found a positive relationship between intangible assets and firm profitability. However, in Pakistan's context, the relatively weak significance may be due to regulatory challenges. The Pakistan Institute of Development Economics (PIDE) Sludge Audit (2022) highlighted that excessive bureaucracy and red tape, such as the requirement to obtain NOCs and licenses, hinder firm's ability to effectively capitalize on their intangible assets. Similar findings were reported by Villalonga (2004) and Eberhart, Maxwell, and Siddique (2004), who noted that regulatory constraints diminish the potential impact of intangible assets, limiting their role in driving profitability.

Interest rate is positively associated with ROA, with a coefficient of 0.272 and a p-value 0.000, suggesting that higher interest rates correlate with better firm performance. This counterintuitive result might indicate that firms enduring higher interest rates are financially stronger and better at managing credit risks. Bernanke and Gertler (1995) suggested that firms with superior financial health can perform well even in high-interest environments. This finding highlights the importance of financial management in mitigating borrowing costs and sustaining profitability despite external economic pressures.

The coefficient for firm age is -0.004 and a p-value 0.005, indicating a negative relationship with ROA. Older firms may struggle to maintain agility and innovation, leading to slightly diminished profitability over time. This result aligns with Coad, Segarra, and Teruel (2013), who found that older firms often face challenges in adapting to dynamic market environments, which impacts their performance.

Sales growth does not significantly affect ROA, with a coefficient of 0.011 and a p-value of 0.826. Hendriks and Singhal (2008) found that increased sales do not necessarily translate to higher profitability, particularly for trading companies where high sales volumes may not lead to efficient resource utilization or cost management.

Capital employed has a significant negative coefficient of -0.027 and a p-value of 0.006, suggesting that high capital employed does not always lead to improved performance. Poor capital management and inefficient allocation of resources could explain this finding. This supports the view that deploying capital effectively is critical for translating resources into profitability.

Firm size is not significantly related to ROA, with a coefficient of 0.378 and a p-value of 0.401. This indicates that larger firms do not necessarily achieve higher profitability, which is consistent with findings by other studies suggesting that size alone does not determine performance, as factors like efficiency and innovation play a critical role.

Leverage exhibits a strong negative relationship with ROA, with a coefficient of -0.181 and a p-value of 0.000. This underscores the dangers of excessive debt, as high leverage can lead to increased financial risk and reduced profitability. This finding aligns with Haji and Ghazali (2015), who also observed that firms with higher debt levels tend to underperform due to financial constraints and increased interest obligations.

The model's R-squared value is 0.134, indicating that the independent variables explain 13.4% of the variance in ROA. While this value might seem low, it is typical in firm-level studies due to the complex nature of financial performance, which is influenced by numerous unobserved factors. Fama and French (1992) and Himmelberg, Hubbard, and Palia (1999) also documented similarly low R-squared values in studies examining firm-specific and market factors, reinforcing the multifaceted nature of firm performance.

The Hausman test yielded a Chi-squared statistic of 0.01 with a p-value of 0.9274, confirming that the random effects model is appropriate. This indicates that the unobserved individual-specific effects are uncorrelated with the observed variables, making the random effects model a more efficient and unbiased estimator. The regression analysis highlights several key factors influencing firm performance. Intangible assets positively contribute to profitability, but regulatory challenges in Pakistan limit their full potential. The unexpected positive relationship between interest rates and ROA underscores the importance of effective financial management in mitigating borrowing costs. On the other hand, the negative effects of leverage and capital employed emphasize the need for prudent debt management and efficient resource allocation. Additionally, the findings suggest that age and size are not guarantees of superior performance, pointing to the need for adaptability and innovation. These results collectively emphasize the importance of strategic financial management and regulatory reforms to enhance firm performance, especially in dynamic economic conditions such as those experienced during the COVID-19 pandemic. They provide actionable insights for policymakers and managers aiming to improve firm-level outcomes in developing economies like Pakistan.

4.4. R&D and Firm Performance

This section illustrates the extensive impact of R&D investments on firm performance. It encompasses subsections that offer a descriptive analysis of R&D along with their dependent and control variables, followed by panel data analysis employing fixed and random effects models, with Hausman testing to determine the appropriate model.

Table 4.4.1. Descriptive Statistics

Variable	Mean	Std. dev.	Min	Max
ROA	8.9845	12.0188	-53.59	67.958
Sale Growth	9.0385	29.3044	-99	165
Fim Size	16.6324	1.8304	11.586	22.429
Firm Age	41.9415	19.0139	1	75
Leverage	0.213	0.341	0.0000199	2.147161
Intrest rate	2.518462	3.224519	-4.45	7.76
R&D	48,200,000	209,000,000	5	2,510,000,000
Capital Employed	30,200,000	59,300,000	-3,764,382	501,000,000

Skewness and kurtosis tests for normality

Variable	Pr(skewness)	Pr(kurtosis)	Adj chi2(2)	Prob>chi2
Residual	0.0042	0.0191	11.99	0.0025

The statistical insights are presented in Table 4.4.1. offer a comprehensive understanding of the relationship between R&D investments and firm performance, highlighting significant variability across key firm attributes. The mean ROA of 8.985, coupled with a standard deviation of 12.019, underscores considerable differences in profitability among firms, reflecting variations in market conditions, management efficiency, and strategic approaches, as noted by Fama and French (1995). Similarly, the sales growth data, with an average of 9.038 and a high standard deviation of 29.304, indicate pronounced heterogeneity in revenue growth rates. This finding aligns with Jovanovic's (1982) theory, which emphasizes the unpredictability of growth, particularly among younger firms and those in volatile industries.

Firm Size, measured as the natural logarithm of total assets, shows a mean of 16.632 with a standard deviation of 1.83, representing a balanced distribution of small and large firms. This is consistent with Gibrat’s Law, which suggests that firm size follows a normal distribution. Firm Age further reflects this diversity, with an average of 41.941 years and a standard

deviation of 19.014, distinguishing younger, growth-focused firms from older, more stable organizations. This observation supports Huergo and Jaumandreu's (2004) view that firm age significantly influences stability and life expectancy.

Leverage, with a mean of 0.213 and a standard deviation of 0.341, highlights variations in debt usage among firms, consistent with Rajan and Zingales' (1995) assertion that leverage ratios differ due to industry standards, taxation policies, and firm-specific factors. Similarly, the mean interest rate of 2.518% and a standard deviation of 3.225% suggest variability in borrowing costs, reflecting differences in credit risk, market conditions, and firm-specific risk profiles. These findings are in line with the Modigliani and Miller (1958) theory, which attributes variations in capital costs to firm and market dynamics.

R&D investments show a mean value of 48.2 million PKR, with a substantial standard deviation of 209 million PKR, indicating significant disparities in innovation spending. Lev and Sougiannis (1996) observed similar trends, particularly in high-tech industries where R&D expenditures often exceed total assets, underscoring its strategic importance. Likewise, capital employed, with a mean of 30.2 million PKR and a standard deviation of 59.3 million PKR, exhibits high volatility, reflecting variations in industry factors, market conditions, and firm-specific commitments, as highlighted by Himmelberg, Hubbard, and Palia (1999).

The skewness and kurtosis tests reveal a significant departure from normality, with p-values of 0.0042 and 0.0191 respectively, indicating moderate skewness and heavy tails in the data. These deviations suggest asymmetry and the presence of outliers, likely influenced by external shocks such as the COVID-19 pandemic. This aligns with DeFond and Park's (1997) findings that financial data often deviate from normality due to firm-specific and macroeconomic factors. To address these challenges, robust analytical methods, as recommended by Westfall and Young (1993), were employed, ensuring the reliability of the relationship assessment between R&D investments and firm performance.

Table 4.4.2. Correlation Matrix.

Variables	ROA	R&D	INT	SG	FS	FA	CE	LE
ROA	1							
R&D	0.07	1						
Int Rate	0.196	0.065	1					
SG	-0.03	-0.000	-0.0586	1				
FS	0.01	0.27	-0.05	0.04	1			
FA	-0.09	0.012	-0.099	-0.011	0.046	1		
CE	-0.159	0.13	-0.234	-0.052	0.095	0.12	1	
LE	-0.017	0.062	0.1423	-0.04	0.06	-0.17	0.024	1

The correlation matrix in Table 4.4.2. provides insights into the relationships between various financial variables. Return on Assets (ROA) exhibits a weak negative correlation with leverage -0.017, supporting Myers (1977), who argued that high leverage increases financial risk, potentially reducing profitability. The positive, albeit low, correlation between ROA and R&D expenses 0.07 suggests that higher R&D investments may enhance profitability, though the effect is modest and context-dependent. Similarly, the positive correlation between ROA and interest rate of 0.196 implies that more profitable firms might pay higher borrowing costs, aligning with Modigliani and Miller's (1958) theory of capital cost. On the other hand, ROA's negative correlation with capital employed -0.159 suggests that increased capital investment could initially reduce ROA due to higher fixed costs.

R&D expenses show a positive and moderately significant correlation with firm size 0.27, consistent with Cohen and Levinthal's (1989) observation that larger firms possess greater resources to invest in innovation. Additionally, the weak positive correlation between R&D and interest rates of 0.065 suggests that firms investing heavily in R&D may face slightly higher borrowing costs due to the risks associated with R&D activities. This observation reflects the nuanced relationship between innovation financing and risk perception.

Interest rate correlations further reveal interesting dynamics. A weak positive correlation between interest rates and leverage 0.1423 suggests that firms with higher borrowing costs may also rely more on debt financing, as noted by Rajan and Zingales (1995). Conversely, the negative correlation between interest rates and capital employed -0.234 implies that firms with

substantial capital tend to enjoy lower borrowing costs, likely due to better collateral and lower risk assessments by lenders.

Sales growth exhibits a very weak positive correlation with firm size 0.04 and a weak negative correlation with capital employed -0.052. These findings align with Hendricks and Singhal (2008), who noted that sales growth does not necessarily correlate with firm size or capital investment, particularly in industries with fluctuating operational efficiency. Firm size shows a weak positive correlation with leverage 0.06, consistent with Hall's (1993) observation that larger firms often secure more favorable financing terms. However, firm age demonstrates a weak negative correlation with ROA -0.09, suggesting that older firms may experience lower profitability, potentially due to market saturation or outdated strategies. This aligns with Coad, Segarra, and Teruel (2013), who highlighted the complex and non-linear relationship between firm age and performance.

Capital employed shows a low positive correlation with R&D 0.13, indicating that firms with more capital may allocate resources toward innovation, reflecting a strategic emphasis on market exploration and new product development. Lastly, the correlation between leverage and firm size 0.06 and leverage and interest rate 0.1423 suggests that larger firms with high leverage may face higher borrowing costs due to their perceived riskiness by lenders.

Table 4.4.3. Multicollinearity Testing		
Variables	VIF	1/VIF
Intrast Rate	1.09	0.915775
R&D	1.02	0.983239
Firm Size	1.03	0.973249
Leverage	1.06	0.941095
Firm Age	1.06	0.945127
Capital Employed	1.09	0.917133
Sale Growth	1.01	0.987161
Mean VIF	1.05	
Less than 5 No multicollinearity		

The multicollinearity test results, summarized in Table 4.4.3. demonstrate that the variables included in the regression model, Interest Rate, R&D, Firm Size, Leverage, Firm Age, Capital Employed, and Sales Growth do not exhibit high multicollinearity. The Variance Inflation Factor (VIF) values for all variables are significantly below the conventional threshold of 5, with a mean VIF of 1.05. These results indicate that multicollinearity is not a concern in the dataset, allowing for accurate estimation of regression coefficients.

Low multicollinearity is critical for econometric modeling, as it enhances the reliability and precision of the regression analysis by ensuring that the influence of each predictor variable on the dependent variable can be appropriately isolated. This finding aligns with the observations of Kennedy (2003), who emphasized that low VIF values confirm reduced multicollinearity, thereby increasing the credibility of the model and the robustness of its coefficients. In the context of this study, the absence of multicollinearity supports the ability to discern the impact of predictors such as R&D, Interest Rate, and Firm Size on firm performance.

This property is especially significant in financial datasets, where correlations among variables can often be substantial due to interconnected economic factors. By maintaining low multicollinearity, the regression model ensures that the relationships between variables such as

R&D investments, capital employed, and firm performance are accurately represented. Gujarati and Porter (2009) also highlight the importance of careful testing and interpretation of multicollinearity in econometric analyses to ensure meaningful and credible results.

Table 4.4.4. Random Effect Model

Dependent Variable is ROA			
Variables	**Coef.**	**p-value**	**t-value**
R&D	0.023	0.046	2.00**
IR	0.349	0.00	5.23***
SG	-0.027	0.706	-0.38
FS	0.483	0.447	0.76
LE	-.033	0.324	-0.99
CE	-0.080	0.062	-1.87*
FA	-0.005	0.121	-1.55
Constant	1.33	0.443	0.77
Mean dependent var	2.011	SD dependent var	1.153
Overall r-squared	0.066	Number of obs	279
Chi-square	94.445	Prob > chi2	0.000
R-squared within	0.030	R-squared between	0.603
*** p<.01, ** p<.05, * p<.1			
Hausman Statistics			
Ch2	1.60		
Prob > Ch2	0.9527		

Table 4.4.4. the regression analysis using the random effects model provides crucial insights into the relationship between firm performance, measured by ROA, and several independent variables, including R&D spending, interest rates, sales growth, firm size, leverage, capital employed, and firm age. The findings highlight the significant role of R&D spending in enhancing firm performance, while other factors exhibit varying levels of influence.

The results indicate that R&D spending has a positive and statistically significant effect on ROA at the 5% significance level, with a coefficient of 0.023. This suggests that a one-unit increase in R&D expenditure leads to a 0.023 unit increase in ROA, emphasizing the critical role of innovation in driving firm profitability. This finding aligns with the work of Arif Khan et al. (2023), who observed that R&D investments significantly enhance firm performance by fostering innovation, improving efficiency, and creating competitive advantages. It supports the argument that firms that prioritize knowledge creation and technological advancements are better positioned to achieve sustained profitability and market leadership, particularly in dynamic and innovation-driven industries.

The interest rate (IR) variable is also positively associated with ROA and is highly significant at the 1% level, with a coefficient of 0.349. This finding implies that firms capable of managing higher borrowing costs tend to perform better. This supports the classical theory proposed by Modigliani and Miller (1958), which posits that leverage, when effectively managed, can amplify firm value by reducing the cost of capital and facilitating growth opportunities. Firms that can secure financing at competitive rates may demonstrate better financial performance, possibly due to their ability to leverage borrowed capital for high-return investments. Additionally, this may indicate that firms with higher profitability are perceived as lower-risk borrowers, enabling them to access funds even at slightly higher costs.

In contrast, SG and FS do not exhibit statistically significant relationships with ROA, with p-values of 0.706 and 0.447, respectively. These results suggest that neither the scale of operations nor revenue growth alone guarantees higher profitability. This aligns with Hendricks and Singhal (2008), who noted that sales growth does not always translate into improved financial performance, especially in industries characterized by volatile demand or inefficiencies in operational scaling. Similarly, firm size, which is often associated with economies of scale, does not appear to consistently affect ROA, suggesting that larger firms may encounter diminishing returns or increased inefficiencies as they grow.

LE and FA demonstrate significant relationships with ROA, with p-values of 0.324 and 0.121, respectively. The absence of a significant relationship for leverage contradicts traditional theories that emphasize the benefits of debt financing, potentially indicating that excessive reliance on debt increases financial risk without necessarily improving profitability. This finding aligns with Myers (1977), who highlighted the potential adverse effects of financial distress on firm performance. Similarly, the non-significant relationship between firm age and ROA supports the non-linear perspective suggested by Coad, Segarra, and Teruel (2013), who argued that older firms might face challenges such as market saturation, outdated strategies, or resistance to change, which can offset the benefits of accumulated experience and stability.

Finally, CE shows a negative and statistically significant relationship with ROA at the 10% level, with a coefficient of -0.080. This result suggests that higher levels of capital employed may be associated with lower profitability, likely due to inefficiencies in resource allocation or the underutilization of assets. Thanh and Huu (2020) also noted that excessive capital investments can sometimes lead to diminishing returns, especially when firms invest in low-performing or non-essential projects. Inefficient capital allocation may increase fixed costs and

reduce flexibility, thereby negatively impacting profitability. This finding highlights the importance of strategic capital management to ensure that investments contribute effectively to performance improvement.

The model fit, indicated by the Chi-square statistic of 94.445, $p < 0.001$, confirms the significance of the regression model, with an R-squared value of 0.603 between groups, demonstrating a good explanatory power for cross-sectional variations in the data. The Hausman test results in p 0.9527 validate the use of the random effects model, ensuring the robustness of the conclusions.

4.5. Results and Findings of Study

The analysis is divided into three main parts a graphical presentation and two panel tests of intangible capital and R&D expenditure on firm performance.

The graphical presentation depicts that the majority of the firms 144 have an investment in intangible assets while only 46 firms invest in R&D. This analysis also shows the pattern of sectoral investment in intangible assets, and it is clear that food, chemical, and fertilizer sectors are the most active in this regard while the industrial and manufacturing sectors are not very active in either intangible assets or R&D investments. Thus, the food sector, which is characterized by high investments, has lower levels of innovation due to the growing competition, as evidenced by the opinions of experts and the State Bank's report of 2017, according to which the food sector is rather competitive and calls for substantial R&D expenditures to ensure high quality.

The graphical analysis depicts that 144 out of the 544 companies listed on the PSX are actively investing in intangible assets. It also reveals from this graph that the food, chemical, and fertilizer industries have also budgeted heavily in intangible assets. Based on the further analysis of the sample, limiting it to the enterprises that already carry out R & D activities, we can identify that only 46 out of the initial 144 are involved in the R & D processes. Also, the fertilizer, industrial, and manufacturing industries spend a lot of money in the area of R&D.

The fertilizer and chemical sectors have also received their share of problems. According to PIDE literature and the interactions with the professionals, there were no explicit innovation policies in the fertilizer sector until 2017. The investors did not patent their products or do any R&D because the laws were not well defined and when it comes to the seed industry, they encounter a lot of difficulties in protecting their ideas.

The pharmaceutical sector shows significant R&D investment in our results, but the literature indicates regulatory burdens hinder this sector in Pakistan. According to PIDE's Sludge Audit (2023), registering new medicines takes more than 1.7 years, with inspections from four to five regulatory bodies, affecting pharmaceutical innovation.

Sectoral R&D investment has been growing in recent years compared to past years. Further information is detailed in Table 4.4.

Table 4.5.1 R&D Investing Sectors	**Key Outcomes**
Sector **Fertilizer**	• Record production of 2.3 million tonnes of urea (18.3% increase) • 20.3% rise in urea sales • 35% market share increase
Chemical	• Improved product quality and operational efficiency • Focus on energy transition and sustainable materials • Sustained growth despite currency devaluation and rising raw material costs
Pharmaceutical	• Development of innovative medications • Enhancement of existing formulations • Compliance with regulatory standards • Resilience and growth despite economic instability
Automobile	• Development of fuel-efficient and eco-friendly vehicles • Improvement in production technology • Integration of advanced manufacturing processes

Source: *Authors own*

The percentage of publicly investing firms is reduced when just 6 out of 144 companies are public and receive investments, as revealed by the contrast between private and public companies. These results are supported by experts, who say that our government agency is not spending much on R&D . The reason behind this is that, according to the literature, firms rely on government aid to fund their R&D investments. Lenders like banks and commercial lenders are less interested in companies with little collateral, which limits their capacity to spend in R&D. Results from the PIDE study show that nearly all businesses 95% are struggling to get the funding they need (Usman Qadir, 2023).

Intangible assets have a favorable and statistically significant effect on company performance, according to the panel assessments. After controlling for several factors, the study still shows a strong correlation between intangible asset growth and better business results. Consistent with previous research, these findings highlight the importance of intangible assets in propelling business success. Investment in R&D also has a favorable and statistically significant impact on company success, acc[1]according to panel study. The results show that a 3% boost in business performance is associated with a 3% rise in R&D spending. The importance of R&D investment in enhancing corporate results is shown by this conclusion, which is in line with the intangible asset analysis coefficient.

4.6. Limitations and Future Research of the Study

There is a limitation of data in this study which is a major concern. Because there was no directly indicated R&D data in yearly reports, some important information was missing that might have affected the analysis's completeness and correctness. Furthermore, one has to concede that the problem of using intangible assets as a substitute for R&D expenses arises. This technique is still rather disputed and there are certain problems with it because intangible assets do not always properly represent R&D efforts and investments.

A third issue is related to the choice of macroeconomic indicators. The results were not statistically significant when these variables were included which suggests that different techniques may be necessary to measure the true effects that macroeconomic factors have on the performance of the company. In addition, there were challenges in data collection, which was rather difficult. Data collection from the Ministry of Industries and Production (MOI&P) was also a challenge as there was no list available that could be used which sometimes was a source of error in the data.

The following limitations need to be considered in future studies in a bid to enhance the reliability and validity of the findings. Thus, the solution to the data availability problem, for example, by using more extensive databases or finding other ways to collect data, could have a significant positive impact on the study. Furthermore, improving the proxies for R&D expenditures and investigating new macroeconomic variables could produce more meaningful

[1] https://pide.org.pk/research/evaluation-of-seed-industry-way-forward/
https://pide.org.pk/research/pide-sludge-audit-vol-2/
https://www.sbp.org.pk/reports/quarterly/fy17/First/Special.pdf
https://www.sbp.org.pk/reports/quarterly/fy17/First/Special.pdf
https://www.brecorder.com/news/40289285

results. Applying this methodology to State-Owned Enterprises (SOEs) could also yield useful insights if the appropriate data is available. SOEs frequently have different operational dynamics and financial structures than private enterprises, and examining them may show distinct patterns and factors influencing their success. Further research in these areas could significantly contribute to our understanding of company behavior and performance drivers.

Chapter 5

Conclusion And Recommendations

5.1 Conclusion

This study provides a comprehensive analysis of the impact of R&D spending on firm performance using panel data from all listed firms on the PSX, covering the period from 2010 to 2022, with ROA as the primary metric of firm performance. By employing both Fixed and Random Effects models in the panel data analysis, the research offers robust empirical evidence regarding the relationship between R&D investment, intangible assets, and firm performance within the Pakistani business context.

The empirical findings indicate a positive and statistically significant impact of R&D spending on firm performance across PSX-listed firms. This result highlights the crucial role of R&D in driving profitability, enhancing market competitiveness, and ensuring long-term sustainability in the Pakistani corporate sector. The positive relationship between R&D investment and firm performance aligns with the RBV theory, which emphasizes that firms can achieve a competitive advantage by developing and leveraging unique resources such as R&D and intangible assets.

Similarly, the Chemical sector has seen improvements in product quality and operational efficiency, focusing on energy transition and sustainable materials, which have enabled it to sustain growth despite challenges like currency devaluation and rising raw material costs. The Pharmaceutical sector's R&D efforts have led to the development of innovative medications, the enhancement of existing formulations, and compliance with regulatory standards, contributing to its resilience and growth despite economic instability. The Automobile sector has also reaped the benefits of R&D, with advancements in fuel-efficient and eco-friendly vehicles, improved production technology, and the integration of advanced manufacturing processes.

These sector-specific outcomes underscore the importance of R&D in driving sectoral growth and innovation. The strategic investments made by these sectors have not only enhanced their performance but have also positioned them to better navigate economic challenges. This sectoral analysis highlights the critical role of R&D in shaping the competitive landscape, with significant implications for firm's long-term success and sustainability.

The regression results further underscore the strong and positive relationship between intangible assets and firm performance. Intangible assets, such as patents, trademarks, and proprietary technologies, are shown to significantly enhance ROA and overall company performance. This finding is consistent with existing literature and reinforces the strategic importance of intangible assets in driving firm profitability and market success. The study's results, therefore, underscore the significance of both R&D and intangible assets as critical drivers of firm performance, supporting the RBV theory's assertion that unique resources are key to achieving sustained competitive advantage.

While these findings are robust, the study also acknowledges certain constraints. The generalizability of the results to other contexts or sectors may be limited due to the specific economic and regulatory environment in Pakistan. Additionally, while the study identifies sectoral differences in R&D investment, further research is needed to explore the underlying reasons why sectors like Fertilizer and Manufacturing invest more in R&D and how these investments specifically enhance firm performance.

In conclusion, this research offers important recommendations for Pakistani businesses and policymakers. It advocates for increased R&D and intangible asset investments, particularly in the Fertilizer, Chemical, Pharmaceutical, and Automobile sectors, to sustain growth and foster innovation. Moreover, it calls for government and policymakers to introduce supportive measures, such as incentives and policies, to further encourage R&D and innovation across all sectors. By promoting these strategic investments, Pakistan can enhance its global competitiveness, drive economic growth, and better prepare its industries for future challenges and opportunities on the global stage.

This study contributes significantly to the literature on the effects of R&D and intangible assets on firm performance, offering new insights into the sectoral dynamics of R&D investment in Pakistan. By aligning the findings with established theoretical frameworks such as the RBV, the study not only deepens our understanding of the factors driving firm performance but also provides practical guidance for harnessing the potential of Pakistan's economy in the future.

5.2 Recommendations

1. The findings of this research demonstrate the significant positive impact of R&D on firm performance, highlighting its role in driving profitability and long-term growth. Both public and private sector organizations should prioritize investments in R&D and intangible assets, especially in innovative projects with high potential for future spillovers. For instance, industries like pharmaceuticals and technology can achieve sustained competitive advantage by channeling resources strategically toward innovation. Public policies should provide fiscal incentives, such as tax breaks or grants, to encourage firms to increase their R&D efforts, fostering a culture of innovation.
2. Policy reforms are crucial to removing barriers to R&D investments and accelerating innovation. In the pharmaceutical sector, the reallocation of the 1% gross sales contribution to the Central Research Fund (CRF) directly to firms for R&D can strengthen innovation capacity. Additionally, inefficiencies in intellectual property rights (IPR) and licensing processes, as highlighted by the PIDE *Sludge Series*, must be simplifying and expediting these procedures will reduce bureaucratic hurdles, lower costs, and enable timely commercialization of innovations, thereby maximizing the impact of R&D investments on firm performance.

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Annexure

Our research involved conducting qualitative interviews with stakeholders, including those from the Ministry of Industry and Production (MOI&P), Engineering Development Board (EDB), and other relevant entities such as the IPO office.

These interviews were crucial for confirming the sectors managed by the MOI&P. The analysis is somewhat controversial, as the companies were chosen from an existing sample after extensively reviewing the MOI&P website and consulting professionals. When companies register themselves on the PSX, they also obtain their manufacturing certificates from MOI&P. Therefore, the sectors under the influence of MOI&P and registered on the PSX are distinguished in the graphical representation. In the second part, panel data was created, incorporating a dummy variable for these companies.

Graphical Representation

This section provides a graphical representation of the list of companie;s shares registered on the PSX as well as those listed by the Ministry of Industries & Production (MOI&P). The comparison is made between PSX-listed companies and industries with R&D and intangible investing companies.

Out of a total of 144 companies actively investing in intangible assets, 88 companies are listed on the PSX. Of these, 56 companies are also listed on the PSX under the influence of the MOI&P. The graph indicates that more firms are exclusively listed on the PSX without any influence from the MOI&P. Further detailed comparisons are provided in Table 1.1 of the Annexure.

Only 46 companies are actively investing in R&D. Among these, 28 companies are listed on the PSX, while the remaining 18 companies are listed on both the PSX and under the influence of the MOI&P. This indicates that a greater number of firms are listed solely on the PSX without any active involvement from the MOI&P. Further comparisons can be found in Table 1.2 of the Annexure.

Panel Data Analysis

Based on this information, we created a dummy variable to categorize sectors those handled by MOI&P were coded as 1, while others were coded as 0. Additionally, you identified and listed intangible companies on the PSX.

Subsequently, we performed panel data analysis. This type of analysis allows for examining trends and relationships over time among the identified intangible companies. It provides insights into their performance and characteristics within Pakistan's economic landscape and stock market.

Table 1.1 Fixed Effect of Intangible Assets

Dependent Variable is ROA

Variables	**Coef.**	**St.Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
MOI&P Dummy	0.229	0.078	2.91	0.013	0.058	0.4	**
INT	0.023	0.008	2.89	0.013	0.006	0.04	**
FS	0.484	0.447	1.08	0.299	-0.488	1.457	
SG	0.045	0.048	0.94	0.367	-0.059	0.149	
CE	-0.032	0.008	-4.11	0.001	-0.048	-0.015	***
LE	-0.188	0.014	-13.74	0	-0.218	-0.158	***
FA	-0.004	0.001	-2.94	0.012	-0.007	-0.001	**
Constant	0.403	1.253	0.32	0.753	-2.328	3.133	
Mean dependent var	1.981	SD dependent var	1.066				
R-squared	0.127	Number of obs	984				
F-test	108.086	Prob > F	0				
Akaike crit. (AIC)	2756.04	Bayesian crit. (BIC)	2790.28				
*** $p<.01$, ** $p<.05$, * $p<.1$							
Hausman Statics							
Chi2	21.29						
Prob > Chi2	0.0034						

According to Table 1.1 results, a dummy variable technique was used to classify intangible-investing corporations listed on the PSX. In particular, companies categorized as 0 were compared to those linked with the Ministry of Industry and Production (MOI&P), which are

represented by 1. Panel data study showed that among the 56 companies studied, those associated with MOI&P had a notable and beneficial effect on ROA. Since the p-value is smaller than 0.05, which means that the null hypothesis may be rejected, the fixed effect model is suitable for this scenario.

The results show that ROA increases by more than 2% for every unit increment for MOI&P-linked companies. In addition, ROA is positively impacted by intangible assets. On the flip side, ROA is negatively impacted by capital employed, leverage, and the age of the firm. The effects of company size and sales growth are insignificant. Taken together, these results show that PSX-listed companies linked with MOI&P perform better, therefore it's clear that being a part of MOI&P and being listed on the stock exchange is helpful.

Table 1.2 Random Effect of Intangible Assets

Depedent Varaible is ROA							
Variables	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
DummyMOI&P	0.346	0.093	3.71	0	0.163	0.53	***
R&D	0.025	0.013	1.99	0.046	0	0.05	**
INT	-0.036	0.022	-1.58	0.114	-0.08	0.009	
SG	-0.049	0.033	-1.46	0.143	-0.113	0.016	
LE	-0.354	0.042	-8.45	0	-0.436	-0.272	***
FS	0.3	0.71	0.42	0.672	-1.091	1.692	
CE	-0.113	0.044	-2.58	0.01	-0.199	-0.027	***
Mean dependent var	1.981	SD dependent var	1.066				
R-squared	0.127	Number of obs	984				
F-test	108.086	Prob > F	0				
Akaike crit. (AIC)	2756.04	Bayesian crit. (BIC)	2790.28				
*** *p<.01*, ** *p<.05*, * *p<.1*							
Hausman Statics							
Chi2	2.74						
Prob > Chi2	0.9494						

The results from Table 1.2 indicate that firms associated with the MOI&P, as represented by the dummy variable, have a significant positive impact on firm performance, specifically on ROA. Increasing the dummy variable by 1 unit leads to a notable increase of more than 3% in ROA.

This model supports the random effect due to Hausman test results and a probability value greater than 0.05.

Furthermore, variables related to R&D have a slight but positive impact on firm performance. On the other hand, variables like capital employed and other intangible factors also demonstrate positive impacts on performance, underscoring that firms listed under MOI&P and on the PSX tend to perform better than those solely listed on the PSX.

These results suggest that being affiliated with MOI&P, along with being listed on the PSX, improves a company's performance metrics like ROA. This could be because being affiliated with MOI&P gives a company strategic advantages, access to resources, or a better reputation in the market.

Analysis of Companies under MOI&P and Listed on PSX

Intangible Assets Analysis

56 Companies: There are 56 companies listed on the Pakistan Stock Exchange (PSX) that operate under the influence of the Ministry of Industries & Production (MOI&P).

Regulations Impact: This highlights a significant number of companies working under the MOI&P's rules and regulations.

R&D Analysis

18 Companies: Out of 26 total companies analyzed, 18 companies are under the influence of MOI&P.

Panel Data Analysis Results

Intangible Assets Impact

Model: Fixed Effect Model

Findings: Companies under MOI&P have a significant and positive impact on their intangible assets.

R&D Impact

Model: Random Effect Model (determined by Hausman test)

Findings: The MOI&P dummy variable has a significant and positive impact on R&D activities.

Table 1.3 Regression Analysis of only R&D

Dependent Variable is ROA		
Variables	Coefficient	P-Value
R&D	0.0195806	0.106
SG	-0.0462412	0.25
FS	0.2951844	0.691
FA	-0.0035085	0.089
LE	-0.3402685	0
CE	-0.0955907	0.039
_cons	2.793539	0.156

The positive coefficient of R&D means that the enhancing the expenditure on R&D leads to an increase in ROA thus companies that embrace R&D as a strategic investment are likely to achieve good financial performance. This observation is consistent with the findings of other scholars like Griliches (1981) who established that R&D expenditure has a strong positive relationship with firm's productivity and profitability. Moreover, Cohen and Levinthal (1989) also pointed out that R&D not only results in immediate innovation but also improves the firm's capacity to assimilate external knowledge and convert it into commercial value and, therefore, increases its performance. The p-value of 0. 106, although not statistically different from zero at the 5% level, is different from zero at the 10% level, which implies that the R&D-ROA relation is quite strong. This is in agreement with Hall and Oriani (2006) who also revealed that the effect of R&D on firm's performance usually becomes significant at a less stringent level of confidence due to the fact that R&D investments are uncertain and long term.

Table 1. 4 Regression Analysis of only R&D with Macro Variables

Dependent Variable is ROA		
Variables	Coefficient	P-Value
R&D	0.0085551	0.606
SG	0.0234253	0.597
FS	-0.7964666	0.548
LE	-0.2954348	0.001
CE	-0.0341958	0.235
FA	-0.002279	0.256
INF	0.0047262	0.972
INR	0.3051158	0.011
Cons	4.306592	0.226

When including the macroeconomic variables Inflation and Interest Rate to the analysis of the firm performance through ROA, the results are quite noteworthy. The addition of these variables has led to the overall decrease in the coefficients' significance for most of the firm-specific variables and the appearance of negative associations with ROA.

With a coefficient very close to zero and a p-value of almost zero, inflation is highly significant. 972, implies that inflation does not affect ROA in this regard. In line with the previous research, Fama (1981) established that inflation can have a mixed and rather indirect impact on firm performance; hence, it may affect financial performance in a more nuanced manner.

The Interest Rate with a positive coefficient and a p-value of 0. The Pearson correlation coefficient of 011, is significant at the 5% level; this suggests that there may be a positive correlation with ROA. Nevertheless, this correlation should be discussed carefully, since higher rates for loans usually lead to increase of costs, which could affect the profitability of the company. The positive correlation that we have found in this study may be attributed to certain industry characteristics or the fact that the firms included in the sample might have limited their financing through debt hence getting higher interest income. This interpretation is consistent with the literature review, especially the study by Modigliani and Miller (1958) that pointed out the fact that interest rates have a differential impact on the value of a firm depending on its capital structure.

In conclusion, this paper shows that when incorporating the macroeconomic factors such as inflation and interest rate, the firm-specific characteristics such as R&D, SG, FS, and CE seem to lose some of their explanatory power as can be seen from the higher p-values and lower coefficients. This means that the external economic environment can moderate the relationship between corporate-level strategies and performance and produce paradoxical results. Schwert (1989) also underlines that while studying the performance of a company one should not overlook the macroeconomic indicators, since these may impose effects which may surpass the impact of the factors particular to the company.

Fixed Effect Model of non-R&D Investing Firms

Dependent Variable is ROA			
Variables	Coef.	p-value	t-value
R&D	0.035	0.005	2.79***
INT	-0.054	0.007	-2.72***
SG	-0.035	0.332	-0.97
FS	0.716	0.31	1.02
LE	-0.317	0	-7.66***
CE	-0.107	0.02	2.33**
FA	-0.004	0.051	-1.95*
Constant	2.203	0.23	1.2
Mean dependent var	2.026	SD dependent var	1.168
Overall r-squared	0.184	Number of obs	368
Chi-square	150.806	Prob > chi2	0
R-squared within	0.193	R-squared between	0.094
*** p<.01, ** p<.05, * p<.1			
Hausman Statistics			
Ch2			4.83
Prob > Ch2			0.6804

The results align with existing literature emphasizing the importance of R&D investment for sustaining firm profitability and competitiveness. Research by Cohen and Levinthal (1990) highlights that R&D enhances firms' absorptive capacity, enabling them to better utilize intangible assets and capital for innovation-driven gains. In contrast, firms without R&D struggle to derive similar benefits, as seen in the negative coefficient for intangible assets (INT, -0.054, p=0.007) and capital employed (CE, -0.107, p=0.02).

Leverage (LE, -0.317, p<0.001) negatively impacts ROA, consistent with findings by Modigliani and Miller (1958), which suggest that high debt levels can be particularly detrimental to firms lacking innovation, due to higher financial risk and limited growth opportunities. The insignificance of sales growth (SG, p=0.332) also supports prior studies (e.g., Penrose, 1959), which argue that sales growth without innovation may fail to translate into profitability.

Finally, the negative impact of firm age (FA, -0.004, p=0.051) aligns with Hannan and Freeman's (1984) organizational inertia theory, which posits that older firms often face difficulty adapting to market changes in the absence of innovation. These findings underscore the critical role of R&D in leveraging firm resources for profitability, highlighting the disadvantages faced by non-R&D-investing firms.