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Group 38

Do Employee Training and Employee Productivity influence the relationship between R&D intensity and firm performance? - An empirical study of non-financial, publicly listed firms in the US

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Five Key Words: "Research & Development", "Return on Assets", "Market Capitalization", "Employee Training", "Employee Productivity"

Purpose: To investigate how Employee Training and Employee Productivity interact with R&D on firm performance measured by ROA and Market Capitalization.

Methodology: Hierarchical Pooled OLS Regression, Fixed Effects Regression

Theoretical Perspectives: Resource-Based View, Knowledge-Based View, Human Capital Theory, Efficient Market Hypothesis, R&D Accounting Treatment, Signaling, and Capital Structure

Empirical foundation: All non-financial firms listed in the S&P 1500 Composite Index were selected from the Bloomberg and CapitalIQ databases. The time period relevant for this research is 2016-2021.

Conclusion: In this study, R&D intensity shows a significant negative impact on firm performance, measured by one-year lagged ROA, and a positive effect of R&D on firm value, measured by Market Capitalization. The research further concluded that the interaction of Employee Training and R&D, and Employee Productivity and R&D, on firm performance, is significantly positive.

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Abbreviations

EMH	-	Efficient Market Hypothesis
EP	-	Employee Productivity
EPS	-	Earnings per Share
ET	-	Employee Training
FASB	-	Financial Accounting Standards Board
IASB	-	International Accounting Standards Board
IFRS	-	International Financial Reporting Standards
KBV	-	Knowledge-Based View
MBV	-	Market-Based View
MC	-	Market Capitalization
NPV	-	Net Present Value
OLS	-	Ordinary Least Squares
R&D	-	Research and Development
RBV	-	Resource Based View
RDI	-	Research and Development Intensity
ROA	-	Return on Assets
ROE	-	Return on Equity
ROI	-	Return on Investment
S&P	-	Standard and Poor's
SFAS	-	Statements of Financial Accounting Standards
SIC	-	Standard Industrial Classification
US	-	United States
US GAAP	-	United States Generally Accepted Accounting Principles
VIF	-	Variance Inflation Factor

1. Introduction and Motivation

1.1 Background

"Starving research and development is like eating the seed corn." - Mitt Romney

The above quotation is commonly used to demonstrate the importance of R&D. The quotation was chosen as a point of embarkment to illustrate the importance placed on innovative practices such as R&D.

Firm performance is an area of interest, especially in a research capacity in the field of corporate finance. This research agenda is due to its pivotal position when it comes to creating overall sustainable growth for the firm in the long run. Companies with consistently high-profit margins endorse innovation, value addition, staff training and recruitment, and tax payment, providing the firm with long-lasting benefits (Blättel-Mink, 1998).

R&D activities aid in developing new products and services, driving the attention of investors, and leading to valuable offerings, which helps the firm maintain its competitive advantage. Furthermore, a firm that has invested in R&D is highly adaptable; it can anticipate market trends and preferences, evolve and adjust to new regulatory requirements and generally stay ahead of the competition. In addition, R&D activities further enhance company value through patents, trademarks, and copywrites, enhancing the firm's product portfolio. The R&D investment of a company communicates the message of innovativeness that can appeal to the mindset of the firm's stakeholders and challenge competitors (Spence, 1973). While these are all attributes associated with R&D, it is not a fair representation of the complete outcome of R&D spending, as the effect of R&D performance on financial performance is not always clear-cut. Many factors contribute to the financial performance of the company, of which R&D is hypothesized to play a significant role. However, these internal factors, such as the quality of R&D investments, the availability of skilled personnel, and the effectiveness of project management, can affect the firm's capacity to invest in R&D and their choice. It can be argued that larger firms are more equipped to spend on R&D as they have access to sophisticated technologies and skilled staff, which would result in a better result on investment.

One key factor influencing the relationship between R&D and firm performance is the firm's ability to recruit and maintain a skilled workforce. A skilled workforce can comprise the existing firm-level 'knowledge asset' or be developed into knowledge assets through firm-specific 'training' (Thornhill, 2006). Thus, this thesis aims to examine the benefits of R&D investment in relation to the level of employee skills, which governs the firm's performance.

The importance of R&D activities and the impact of 'knowledge assets' and 'training' to create a skilled workforce to maintain long-term financial growth in a firm will be addressed through this thesis while providing an overview of how R&D dominant investments can provide a firm with a long-lasting competitive advantage.

1.2 Problematization

The conception that R&D investment directly impacts firm performance can be roughly traced back to the knowledge production function concept brought by Pakes and Griliches (1984). The concept describes the relationship between R&D and productivity, and innovation has been a critical factor in firms' performance and has become a 'mantra' in well-developed countries (Legros and Galia, 2011). Since then, studies have evaluated the relationship between innovation and short-run versus long-run firm performances (Vithessonthi and Racela, 2016; Cooper, 2008; Shin, Kraemer, and Dedrick, 2016). Previous research has shown a connection between a skilled workforce, as measured by training and knowledge assets, and a company's performance (Thornhill, 2006; Thang and Buyens, 2008; Freixanet and Federo, 2022). However, using recent data, there has been less research on the relationship between innovation and short-term versus long-term company performance. Studies by Vithessonthi and Racela (2016); and Shin et al. (2016) have explored this topic using data up until 2013-2015.

Moreover, limited studies have explored the impact of a skilled workforce on the relationship between R&D spending and short-term versus long-term company performance. According to the Resource-Based view of the firm (Barney, 1991) and the Human Capital theory (Becker, 1964), efficient human capital can help convert R&D information into innovation while ensuring that R&D projects are executed efficiently. Skilled employees can identify and solve problems quickly, thus reducing the time and cost of R&D projects, which invariably improves the firm's competitiveness in the market. Incidentally, the Knowledge-Based View (Grant, 1996) supports this, as a skilled workforce will be equipped with the knowledge and can transfer expertise and tacit knowledge generated through R&D activities to achieve the organization's goals. Furthermore, skilled employees can provide valuable and relevant feedback on R&D projects, ensuring they are focused on the right areas and more likely to deliver positive results. The Market-Based View suggests that a skilled workforce can help ensure the successful commercialization of R&D projects by identifying potential markets and customers for new products and services.

As evident from the discussion, the quality of the staff in a firm heavily influences the firm's ability to conduct firm-specific R&D that would aid in the upkeep of firm performance. Therefore, the purpose of this paper is to research the moderating effect of Employee Training and Productivity on the relationship between R&D and short-run and long-run firm performance using the data after the year 2015, which would contribute to existing literature by providing insights into how employee skill (which is a major factor in organizational culture) moderate the relationship between R&D investments and firm performance. The Signaling Theory (Spence, 1973) and Efficient Market Hypothesis (Fama, 1970) are used as foundational theories to motivate the inclusion of market capitalization as a measure for firm performance.

1.3 Research Question

The objective of this paper is to examine how Employee Training and Employee Productivity interact with RDI on firm's short-run and long-run financial performances. The following research questions will be used to achieve the objective of the study.

Q1: Is there a relationship between RDI and firm performance?

Q2: Does Employee Productivity and Training moderate the relationship between RDI and firm performance?

1.4 Methodology

The statistically methods employed in this study are a hierarchical Pooled OLS logistic regression functions and a deeper analysis of marginal effects based on this regression model. The results are supported by an additional Fixed Effects regression model, as this considers the panel structure of the data used in this study. Furthermore, various statistical tests are conducted to ensure the validity of the models and to further justify the use of the Fixed Effects model, rather than Random Effects.

1.5 Findings

This paper finds that there is a statistically significant negative impact of RDI on short-run firm performance, as measured by ROA and statistically significant positive impact of RDI on long-run firm performance as market capitalization. The relationship between RDI and ROA is confirmed with the use of a Fixed Effects model, however, the Fixed Effects model attributed an insignificant relationship of RDI to market capitalization.

Furthermore, it is found that the presence of training program for employees positively moderates the relationship between RDI and firm performance (both ROA and market capitalization), this is supported by the Fixed Effects model. Next, Employee Productivity is found to have a significant moderating impact on the RDI-ROA relationship, which is also supported by the Fixed Effects model. However, while the Pooled OLS model finds a statistically significant moderating effect of EP on the RDI – Market Capitalization relationship, this isn't consistent with the findings of the Fixed Effects model, which casts doubt on the classification of EP as a true-moderator.

1.6 Contribution

This study examines the thoroughly researched area of the effects of R&D spending on firm performance. However, it sheds light on important characteristics that influence effective R&D spending, which limited studies have attempted to examine. Furthermore, there is limited research on the effect of R&D on short- and long-term performance, and the studies that have ventured into the area have no evidence considering data beyond 2015. Hence, this research aims to address this gap in the literature by examining the effects of R&D on the firm's long and short-term performance with the latest available data from 2016-2021.

More importantly, this research aims to assess the effects of employee skill (proxied by productivity and training) on the firm's return on R&D investments. While this is an area of significant interest in the literature available, the vast majority of empirical studies investigate a direct impact between the variables, there is limited research that assesses the moderating effect of employee productivity and training and how it can impact the quality of R&D, which has a tremendous effect on the relationship between R&D and the long and short-term performance of a firm. This study attempts to address this gap, direct future research in this path while adding to the existing discourse.

2. Literature Review

2.1 Theoretical review

2.1.1 Theory of Economic Development

The theory of economic development refers to one formulated by Schumpeter (1942), which highlights innovation as one of the key drivers of economic development. Innovation is what breaks the chain of circular flow in the economy and allows for disruption, thereby inducing economic development. Schumpeter (1942) describes the role of the innovator and the motivations of the innovation. Great importance is placed on entrepreneurs who introduce innovation, take risks, and drive the process of creative destruction. Creative destruction refers to the consistent development of innovations which constantly disrupt existing economic cycles and existing markets by introducing more innovative products, and methods of production of services, thereby ushering further economic development. The motivations for the innovator can be simplified into, most importantly, the establishment of the innovator as a market leader, which leads to the generation of economic profits and commendation.

In summary, Schumpeter's (1942) growth theory highlights the role of innovation and innovators as key drivers of economic growth and development and states that there are monetary incentives for firms to innovate. Applying this theory to modern-day firms would imply that existing market leaders attained their position due to their emphasis on innovation. The effects of these innovations are reflected in the balance sheets by generating greater economic profits. Although this paper's focus is at the firm-level, this theory highlights the importance of innovation on a macro scale and puts into perspective the relevance of the topic being investigated.

2.1.2 The Resource-Based View, Market-Based View, and Knowledge-Based View

The RBV perspective points to different sources of competitive advantage for firms. The RBV is a managerial framework that argues that a firm's sustained competitive advantage is based on its resources which fit into four categories: valuable, rare, inimitable, and non-substitutable (Barney, 1991). According to the resource-based view, these resources determine a firm's competitive advantage and market position. If firms are able to generate and leverage these unique resources, they would be more capable to generate value, differentiating themselves, and effectively achieving a sustainable competitive advantage.

In the context of innovation and firm performance, the resource-based view can offer insight into how a firm can utilize its resources to maximize its innovation capabilities. The resources most relevant for this paper are a firm's human capital and a firm's knowledge management capabilities. RBV highlights the importance of these resources as they can be essential in determining the returns of a firm's R&D activities.

Human capital concerns the skills, expertise, and efficiency of a firm's employees and can play a critical role in the success or failure of R&D projects, as well as the dissemination of new knowledge which could improve the competitive advantage of a firm. Firms with higher levels of human capital or greater human capital efficiency could be more effective in actively converting R&D information into more concrete forms of innovation, which can help differentiate the firm. A more efficient workforce is more capable of effectively managing and implementing various R&D projects, thereby fostering a workplace culture of innovation and increasing the likelihood of the firm's success. Hitt, Bierman, Shimizu, and Kochhar (2001) found that human capital has a direct and significant positive impact on firm performance, and furthermore, human capital was found to have a moderating effect on the relationship between firm strategy and firm performance.

Thereby supporting the resource-based view of human capital on the relationship between innovation and firm performance.

In contrast, the MBV of the firm typically stresses the role of market conditions in developing a strategy for the firm. It argues that industry factors and external market orientation are the primary determinants of firm performance (Porter, 1980). They argue that the critical factors for the success of an organization are entry barriers, the number of players in the market, and the elasticity of demand. Sveiby (1997) declares that innovation and competitive advantage have deep roots in creating a product or service differently and collaboratively. According to Schumpeter (1942), innovation is essential to higher business performance, growth, and competitive advantage. As a result, there is a general agreement that innovation plays a crucial role in maintaining a competitive advantage.

Furthermore, knowledge management is an additional critical factor in determining the likelihood and success of innovation within firms. Relating to human capital, firms that effectively capture, accumulate and disseminate knowledge generated through, for example, R&D activities, should be able to reap greater value from their R&D investments. Grant's (1996) KBV of the firm suggests that knowledge is the most crucial resource in an organization. The knowledge-based view emphasizes the importance of developing and managing knowledge assets in order to eventually enhance firm performance. Theoretically, the generation of original knowledge, supplemented by an effective knowledge management process can facilitate the transfer of insights, expertise, and tacit knowledge generated through R&D activities, which is relevant to the current research topic. In other words, according to the Knowledge-Based View, firms that invest in R&D and also invest more in employee training and skill could have better capabilities to create and apply new knowledge.

These theories highlight the importance of understanding the organizational context when investigating the relationship between R&D and firm performance. They further highlight the relevance of employee abilities, skills and knowledge in this topic and motivate its identification as a potential moderating effect.

2.1.3 Efficient Market Hypothesis

The efficient market hypothesis was first proposed by Fama (1970) and it explains that all information which is currently available to the public is immediately reflected in the stock price of the firm. Since, according to the theory, financial markets are efficient, R&D intensity, employee culture, and firm performance should theoretically already be priced into the firm's stock value, assuming they are determined to be valuable and significant enough for the market. Since the market should promptly integrate all public information about a firm (including its R&D expenditure), R&D intensity should not yield abnormal market returns when using a market-based measure of firm performance, as the market should have already accounted for this information. Chan, Lakonishok & Sougiannis (2001), while investigating the stock markets' interpretation of firm R&D expenditure, find that the market may not perfectly value R&D expenditure due to uncertainty and information asymmetry, further implying that R&D can be seen as a form of risk. These findings align better with the semi-strong form of the efficient market hypothesis, which states that some information may not be immediately and accurately priced into the market prices.

Lastly, an important aspect to consider when viewing this topic from the efficient market hypothesis point of view is that there might not be uniform interpretation across the market. Some investors could perceive high employee skill or high R&D intensity as indicators of future growth, while others could view them as signs of excessive expenditure and risk-taking (Shiller, 1981). It is this diverse range of interpretations that could cause price movements, which is why further research is needed in this topic and how the EMH theoretical lens can help rationalize the conclusions.

2.1.4 Human Capital Theory

The Human Capital Theory, originally proposed by Becker (1964), suggests that investments in human capital can considerably increase individual and organizational productivity. Human capital is referred to as the knowledge, skills, and experience that individuals have, and is an intangible asset, which is incredibly tough to quantify. Applying this theoretical lens to the topic of this paper provides a relevant foundation on which to base the hypothesis on. Investments in human capital, such as training programs, not only enhance the employee's skill sets but also foster an environment that promotes innovation and creativity, which is a necessity for successful R&D outcomes (Schultz, 1961). This hypothesis is similar to the one which can be inferred from the Knowledge-Based View, mentioned previously. Subramaniam and Youndt (2005) found that firms which invest in their human capital are more likely to nurture a more innovative workplace culture, which facilitates effective implementation of R&D activities. This finding aligns with the theoretical position of the human capital theory (Becker, 1964) which postulates that continuous learning is a crucial determinant of the culture of an organization, and thereby also its innovative capability and performance.

Bartel (1994) found that firms that implement training programs for their employees experience an increase in productivity. Supplementally, Black and Lunch (1996) also found that employees who take part in a skill training program are able to yield higher productivity levels for their employer, a distinction is also made between what type of training is offered. As the positive benefit of training programs on innovation and firm performance has been established, this provides a foundation for the inclusion of employee skill level as a moderating variable when investigating the effect of R&D intensity on firm performance.

Lastly, a concept which is relevant to human capital theory and innovation is Organizational Ambidexterity (O'Reilly and Tushman, 2013) which highlights the process of exploitation and exploration in terms of managing day-to-day tasks, while also simultaneously pursuing innovative projects. Kenny (2019) states that more experienced employees have a more skills and tend to be more productive. Pairing this theory with innovative exploration, explained by Organizational Ambidexterity, can motivate the relevance of employee skill as a moderating factor when investigating innovation and firm performance.

2.1.5 R&D Accounting Treatment

Although R&D investment is crucial since it may generate better corporate performance and higher firm value, the debate regarding the accounting treatment of R&D expenditures is not yet fully settled. Countries have followed two globally accepted standards. The first set of standards is US

GAAP issued by the Financial Accounting Standard Board in US. The second set of standards is IAS, issued by the International Standard Committee, which IFRS issued by IASB later supplemented.

According to SFAS N2 (FASB, 1974), R&D costs must be immediately expensed in the US. In contrast, International Accounting Standards N38 (IASB, 2004) prescribe capitalization of R&D costs if they meet specific criteria (Cazavan-Jeny, Jeanjean and Joos, 2011). The capitalization of R&D costs is a controversial accounting issue because of the contention that such capitalization is motivated by incentives to manipulate earnings, and whether the conditions for capitalization are satisfied is often left to the company's management (Markarian, Pozza and Prencipe, 2008). Theoretically, financial indicators such as ROA are reduced irrespective of whether R&D is expensed or capitalized however, how this impact to firm value depends on market reaction.

2.1.6 Signalling

Since market capitalization is being used as one of the dependent variables, the Signalling theory is a relevant theory to consider. Signalling theory suggests that in situations of information asymmetry, various actions by firms can serve as indicators to provide the market with information and reduce uncertainty (Spence, 1973). R&D investments can be considered a positive signal to the market as it could be interpreted by investors as the firm's commitment to innovation and confidence in its future growth (Bhattacharya and Ritter, 1983). An increase in R&D intensity could lead to increased investor confidence, thereby increasing the willingness to invest in the firm, causing a growth in the firm's share price and market capitalization. It is worth noting that these signals must be credible as easily imitable signals are easy to send and thus may not be as effective (Connelly, Certo, Ireland and Reutzel, 2011).

Similarly, employee skills can also serve as a positive signal to the market. A strong employee culture and a firm commitment to employee skills development can signal a firm’s investment in human capital, which can lead to a greater degree of productivity and competitiveness (Tsai, 2001). This theory, in collaboration with the RBV and EMH can be useful tools to develop the hypotheses which will be presented later.

2.1.7 Capital Structure

Capital structure or financial leverage decisions examine how debt and equity mix impact the firm’s profitability and market value.

Modigliani and Miller (1958), in their capital structure irrelevance theory illustrate that firm value is unaffected by the firm's capital structure, based on certain assumptions related to the behaviour of investors, the capital market and perfect information. Therefore, firms should not be concerned about the capital structure and can opt for any composition of debt to equity. Further, in proposition II they claim that an increase in financial leverage increases the risk of the firm due to higher financial distress cost and resulting higher cost of equity.

Lastly, a perspective brought by Baker and Wurgler (2002) is that firms issue new equity when their stock price is overrated, and they buy back shares when the price of stocks is underrated. They named this Market Timing Theory, where the fluctuation in the price of stocks affects the firm’s financing decisions and, thereby, the firm's capital structure. Further, they explain that market timing theory does not move to target leverage as equity transactions are completely time to stock market conditions and implies that changes in capital structure driven by market timing are long-lasting (Bessler and David, 2008). This proposition explains why gearing ratios negatively affect stock returns (Bessler, 2004).

2.2 Empirical Review

2.2.1 R&D Intensity and Accounting-Based Indicators

A company's financial performance depends on many characteristics that are often unique to the company, such as customer base, employee productivity, resources, and other defining attributes. Accounting-based or Market-based indicators are often used to measure firms' financial performances. This study section is dedicated to exploring the available literature on the effect of R&D on accounting-based indicators, predominantly ROA and ROE. Studies have shown interest in understanding the relationship between R&D and accounting-based performance, predominantly in corporate finance (Chen, Chan, Hung, Hsiang & Wu, 2015). Spending on R&D has often been considered a positive form of investment that promises to yield a competitive advantage in the long run (Freihat and Kanakriyah, 2017).

The available literature poses an interesting conundrum as it drifts off in various directions, creating an interesting debate on how different factors can determine the outcome of R&D spending and how R&D spending affects accounting-based financial performance indicators (Wang, 2011).

The R&D investment dedicated by companies has been studied extensively by scholars. While some studies emphasize that current-year R&D spending positively affects financial performance, others argue that they either have no or a negative effect. According to Freihat and Kanakriyah (2017), R&D spending aids in improving firm performance immediately, as measured by ROA, ROE, and EPS. Furthermore, Erdogan and Yamaltdinova (2019) state that prudent management of R&D funds would afford the firm a competitive advantage and report positively in both ROA and ROE. According to Cooper (2008) the relationship between R&D investments and earnings can yields positive benefits. Rao, Yu, and Cao (2013) checked the correlation between R&D investment and company performance, calculated the lag period and effect period of the correlation, and concluded that the relationship between R&D and performance is positive in both periods.

However, R&D alone cannot bear the total weight of driving the firm's performance. For R&D to aid performance, it is contingent upon many firm-specific factors. It must be noted that the performance indicators of firms differ; thereby, the investment strategies on R&D too could vary to a certain extent. Atuahene-Gima (2005) explores the positive effects of R&D spending on firm growth. Here, performance is measured on the potential to affect the firm's overall growth. Similarly, Huergo and Jaumandreu (2004) found that R&D investment positively impacts productivity and innovation and affects the firm's performance.

Having explored the widely acclaimed positive relationship between R&D spending, this study will also provide an overview of the negative relationship between firm performance and R&D

spending. The consensus of these studies is that the benefits of R&D spending may not always translate into improved firm performance for various reasons. Shin, Kraemer, and Dedrick (2016) state that the firms may be overinvesting in R&D; notably, a negative relationship is observed between R&D and ROA. Vithessonthi and Racela (2016) further strengthened this argument claiming that investing in building new knowledge and capability is likely to benefit a firm in the long run but harms the firm's short-term performance measured by ROA.

Cazavan-Jeny, Jeanjean, and Joos (2011) discussed accounting for R&D, a contentious US issue. According to SFAS N2 (FASB, 1974), all R&D costs must be immediately expensed. However, International Accounting Standards N38 (IASB, 2004) allows for the capitalization of R&D costs if they meet specific criteria. They found that when firms both capitalize and expense R&D expenditures, the expensed portion has a stronger negative relationship with future performance. This is because R&D reduces short-term accounting profitability as measured by ROA.

The relationship between R&D and firm performance is complex. Liu et al. (2019) found that only when R&D intensity exceeds 4% does it lead to increased financial performance. Some studies have shown that the effects of this relationship are delayed, with a significant portion of the firm's revenue improving with a time lag effect (Branch, 1974; Granbowski and Mueller 1978; Ravenscraft and Scherer 1982; Parasuraman and Zeren 1983). However, other evidence suggests that the positive relationship between R&D and financial performance cannot be sustained even with a lagged effect. Özkan (2021) found that two-year lagged R&D spending still harms financial performance. Lin, Lee, and Hung (2006), revealed no apparent correlation between R&D and company performance. Hence, complete dependence on R&D for positive company performance is not always prudent.

2.2.2 R&D Intensity and Market-based Indicators

Many scholars have studied R&D intensity and its effect on market-based indicators. The studies containing market-based financial performance indicators investigate the effect of R&D spending specifically on firm value, since it's the most determinant market-based indicator, which can be measured through stock returns, market value, and Tobin's Q (Ehie and Olibe, 2010). The management division of a firm plays a pivotal role in the decision-making process. The decision made by the division on R&D spending will influence the trajectory of the firm in terms of viability, growth, and competitiveness which ultimately decide the firm's market value (Morbey, 1988).

R&D projects yield mixed results and can be associated with uncertainty due to the inability to evaluate future results. The inability to observe an immediate return adds to its unpredictability. However, the unpredictability of the outcomes generated by R&D and the difficulties of quantifying its effect prior to investing have drawn scholars' interest. Ehi and Olibe (2010) investigate the relationship between R&D expenditure and concluded that R&D positively affects firm value since the potential benefits are captured in future cash flows and firm value is the present value of future estimated cash flows.

Similarly, Vithessonthi and Racela (2016), on their Short-run and long-run effects of internationalization and R&D intensity on firm performance, discusses the positive effects of R&D and the correlation of the outcome of the firm performance. Interestingly, the study looks at both the short and the long-term effects of not only R&D intensity but internationalization, which creates an interesting dynamic in the study. Their research indicates higher the internationalization the more positive the effect of R&D on the firm value.

However, Erickson and Jacobson (1992) discovered that though popularly advocated, R&D and advertising spending do not increase a company's market value more than other investments. They believe the positive link between R&D spending and stock market performance found in earlier studies results from the combined effect of company profitability and discretionary spending. In addition, Chan, Lakonishok, and Sougiannis (2001) also found that there is no direct relationship between R&D spending and future stock returns. Accordingly, the research indicates that portfolios of stocks from companies that invest in R&D have similar returns to those that do not invest heavily in R&D.

Regarding the other elements that can affect the outcome of R&D spending Pindado, Queiroz, and De La Torre (2010) found that factors such as firm size, growth, and market share positively impact the relationship between R&D spending and firm value. However, factors such as dependence on external finance, labour density, and capital intensity negatively impact this relationship. Thus, providing a counterpoint to the argument. Hall (1999) concluded that firms with a higher market share in their industry have a higher market value due to innovative activity as measured by R&D spending. Ravselj and Aristovnik (2019) found that different accounting treatments of R&D expenditure have different effects on a firm's market value, which provides another dimension to the measuring of the returns of R&D spending. Capitalizing R&D expenditure has a positive impact on market value, while expensing R&D expenditure has a negative impact.

Through this section, it becomes evident that the measurement of the outcomes of R&D spending is diverse and is contingent upon many factors. The literature emphasizes the complex relationship between R&D and firm value and the need for further research to understand better the factors that may influence this relationship. Therefore, it is essential to distinguish between accounting-based and market-based performance when studying this relationship.

2.2.3 R&D Intensity and Firm Characteristics

2.2.3.1 Employee Training

Employee training holds direct links with nurturing a skilled workforce. Thereby, R&D and a skilled workforce are two factors closely associated with innovation (Banker, Wattal, Liu, and Ou, 2009). An effective employee training policy is crucial for any organization as it enhances employee productivity and efficiency. This section examines the impact of employee training on the relationship between R&D and firm performance.

Recently, there has been an increased focus on employee training. It is considered an essential aspect of maintaining firm performance as it enhances the knowledge and skills of employees. Firms invest in training activities to gain a sustainable competitive advantage (Barney, 1991) and improve performance (Kozlowski and Klein, 2000).

Furthermore, Thang and Buyens (2008) found that firm-provided training designed to develop talent and skills improves productivity and performance as the training is more firm-oriented, addressing issues unique to that firm. Martins (2021) also found that several dimensions of firm performance, including sales, value-added, employment, productivity, and exports, are positively impacted by training. The study also found that training positively affects the employability of less educated workers. Further research is needed to understand this relationship better.

A recent study by Freixanet and Federo (2022) found that investments in R&D and employee training complement each other as learning capability sources and positively correlate with firm performance. Chen and Huang (2018) found that employee training can enhance a firm's absorptive capacity, improving the effectiveness of R&D investment. Absorptive capacity refers to a firm's ability to acquire, assimilate, and apply external knowledge. Firms that invest in employee training tend to have higher absorptive capacity, leading to better R&D outcomes and higher ROA. This is further evidenced by Lima, Resende, and Hasenclever (2004), who found a positive relationship between R&D and training intensities on the performance of ISO-certified firms.

However, Borlea, Achim, and Mare (2017) revealed no significant relationship between the training carried out for the board members and financial performance measured by ROA or firm value measured by Tobin's Q. Tharenou and Burke (2002) reported, although there is less positive evidence of the links between training and indices such as ROA and ROI, the companies invest in training were valued higher on Wall Street than their peers with a lower investment in training. They further concluded that the impact of training might not be immediate and subject to time lags of 2-4 years.

In conclusion, employee training is crucial for enhancing the relationship between R&D and firm performance. Even though majority of literature highlights that employee training can improve the quality of R&D output, enhance the absorptive capacity of firms, improve the innovative capability of firms, and enhance collaboration between R&D and firm performance, some suggest that the benefits from training are lagged, or no significant relationship is observed.

Thus, this research aims to contribute to methodological advancements in the field by capturing the moderating effect between R&D and accounting-based performance (measured by ROA) and market-based performance (measured by Market Capitalization).

2.2.3.2 Employee Productivity

In addition to the effects of employee training, this study aims to examine whether employee productivity has a moderating effect on the relationship between R&D and firm performance. According to the RBV, firm resources include physical and human assets, capabilities, organizational processes, attributes, information, and knowledge that enable a firm to improve its efficiency and effectiveness (Daft, 1983). Barney (1991) classified firm resources into physical capital, human capital, and organizational capital. Firms use these resources to enhance performance. Traditional financial indicators are commonly used to measure firm performance across industries and firm sizes (Nawrocki and Carter, 2010). However, employee-productivity-linked indices have not been significant despite their potential value for knowledge-based industries.

Afshan, Chakrabarti, and Balaji (2014) further suggest that organizations in both the manufacturing and service sectors should use employee productivity indicators such as revenue per employee and profit per employee to measure firm performance. These indicators are considered determinants of firm performance.

Furthermore, Dewenter and Malatesta's research (2002) on the relationship between profitability and employee productivity found that government non-financial firms have significantly higher employee productivity (measured by the employees-to-sales ratio) than private firms.

In conclusion, it is suggested that employee productivity-linked indicators of firm performance should be used to assist the current literature. The authors decided to examine the moderating effect of employee productivity on the relationship between R&D and firm performance.

2.2.3.3 Firm Size, Intangible Assets, Director Independence, Board Size and Leverage

When discussing R&D, many believe that the strategy involved can be equated to a 'one-size-fits-all' strategy. This approach to R&D spending can be disastrous, especially if the firm is small with limited funding. According to Huergo and Moreno (2019) large firms incur more benefits from a significant allocation for R&D spending. As large firms have access to more resources and capabilities, they are able to fund R&D within their firms more lavishly, yielding positive results in relation to the scale of their investment. Furthermore, empirical studies have also found that larger firms are driven toward spending on R&D rather than avoiding maintaining their established equilibrium of performance (Cohen, Nelson, and Walsh, 2018). The "size advantage" that has been aptly discussed has also been challenged by some researchers in the field. In their studies, Colombo, D'Adda, and Pirelli (2015), and Mairesse and Mohnen (2010) hypothesize that smaller firms can also benefit from appropriate R&D spending. However, these studies specify industries with immense technological change and market volatility.

The literature reviewed defines 'intangible assets' in diverse ways. While some of these definitions by authors refer to one type of specific item among intangible assets, other authors discuss definitions in a broader context, which includes patents, copyright, trademarks, design, mineral exploration, brands, software, capitalized R&D, goodwill, human capital, etc. (Ocak and Fındık, 2019. Yuan, Hou, and Cai (2021) assess the impact of patent assets on firm performance. They explored the effects of patent assets used as a proxy to measure innovation on firm performance in the US, finding that patent assets positively affect firm performance.

In US, directors are required to be composed of a majority of independent directors in a board. Although higher independence is assumed to contribute to efficient decision-making and increases firm value (Ben-Amar, Francoeur, Hafsi, and Labelle, 2013), prior empirical evidence has mixed results on the relationship between independent directors and firm performance. Bhagat and Bolton (2013) have shown a positive relationship between director independence and firm performance. These studies depicted that independent director enhance the quality of effective decision-making; hence, the firm performance increases with the board's independence. In his study, Garg (2007) concluded that director independence's impact on firm performance is more prominent when the board independence is between 50 and 60 percent. However, several studies have not found a link between director independence and higher firm value (Ferris and Yan, 2007; Johl, Kaur, and Cooper, 2013). Other studies have even indicated a negative association (Bhagat and Black, 1998; Bhagat and Bolton, 2012).

The relationship between board size and firm performance has been at the epicentre of a long-standing debate in the finance literature. While the costs of larger boards of directors have been well argued and documented, relatively little empirical attention has been paid to their potential benefits (Larmou and Vafeas, 2009). Yermack (1996) highlighted the negative association between board size and firm performance, first documented by, is one of the leading empirical regularities of the role of boards.

Bhagat and Welch (1995) show that Leverage is negatively correlated with R&D expenditures for US firms and O'Brien (2003) found that R&D intensity is negatively associated with Leverage. Singh and Faircloth (2005) further strengthen these findings by concluding the negative relationship between R&D expenditures and Leverage for large US manufacturing firms.

2.3 Hypothesis Development

While many studies show empirical evidence for the positive influence of R&D on ROA (Freihat and Kanakriyah, 2017; Rao et al., 2013), based on the recent literature, the authors argue that the effect of R&D intensity on firm performance measured by ROA is negative in the short run (Vithessonthi and Racela, 2016; Shin et al., 2016).

Authors define the short-run firm performance as operating performance. To further explain this point, let’s assume that a firm decides to invest in an R&D project with a positive NPV. During early periods of the project, it is possible to record negative net actual cash flows, thus reducing firm performance, as measured by ROA.

H1: R&D Spending has a negative direct impact on firm ROA

Recent literature agrees that even though the R&D intensity on firm performance is negative in the short run, the potential benefits of R&D are captured in current stock prices; hence R&D has a positive relationship with firm value as measured by market capitalization (Vithessonthi and Racela, 2016; Ehie and Olibe, 2010). The same R&D project explained earlier, which has positive NPV and recorded negative net actual cost flows during initial periods, has a high level of positive net cash flows at later periods, which should increase firm value.

H2: R&D Spending has a positive direct impact on a firm's market value

Firm-specific training is a crucial element in building employee skills in addition to the level of education and experience. Literature suggests mixed results between Employee Training and firm performance. While some studies provide that the relationship is positive (Kozlowski and Klein, 2000; Martins, 2021; Lima et al., 2004), there are empirical shreds of evidence that there is no relationship between employee training and firm performance (Borlea et al., 2017) or actual training performances are not reflected immediately in financial performance (Tharenou and Burke, 2002).

However, there is limited or no evidence of testing the positive moderate impact of employee training on R&D and firm performance measured by ROA. This hypothesis has further theoretical support from the Resource-Based View and Human Capital theory.

H3: Employee Training has a positive moderating impact on the RDI-ROA relationship

Even though literature provides different results between Employee Training and accounting based indicators such as ROA, most studies suggest a positive relationship between employee training and firm value since training signals to the market that the cost of employee training overrides the long-term benefits (Tharenou and Burke, 2002; Martins, 2021). The authors found limited or no evidence of testing the moderate positive impact of employee training on R&D and firm value measured by market capitalization. This hypothesis has further theoretical support from the Efficient Market Hypothesis and Signaling Theory.

H4: Employee Training has a positive moderating impact on the RDI-Market Value relationship

The fifth hypothesis originates from the Resource-Based View (Barney, 1991) of the firm emphasizes the role of a firm's internal resources, such as human assets and organizational processes in improving firm performance. Against these resources, a firm's employee productivity, which concerns the efficiency and effectiveness of a firm's employees, can be hypothesized to have a significantly positive impact on firm performance. This process of thought is supported by the findings of Afshan et al (2014) who suggest employee productivity-linked measures as a useful tool to gauge firm performance. Furthermore, the human capital theory also strengthens this hypothesis as it suggests that investments in and development of human capital, can enhance an organization's innovative capabilities and performance (Becker, 1964).

H5: Employee Productivity has a positive moderating impact on the RDI-ROA relationship

Signaling Theory (Spence, 1973) suggests that the actions of firms can provide the market with information about the condition and strategic objectives of the firm, which can reduce uncertainty. Increased employee productivity may serve as a signal to the firm's commitment to human capital, which could improve productivity and competitiveness (Tsai, 2001). Hence, employee productivity, as it is an element of human capital, may moderate the relationship between R&D intensity and market capitalization, which leads to the following final hypothesis.

H6: Employee Productivity has a positive moderating impact on the RDI-Market Value relationship

Refer to Figure 01 in Appendix 01 for the visual representation of the hypotheses in the form of Libby boxes.

3. Methodology

3.1 Data collection and handling

Data was obtained from the Bloomberg and CapitalIQ databases to investigate this paper. All firms listed in the S&P 1500 Composite Index were selected. The S&P1500 consists of the S&P 500, which is the 500 largest companies listed on American stock exchanges, the S&P MidCap 400 which consists of 400 mid-range market capitalization firms, and the S&P 600 which consist of 600 small-cap firms listed on American stock exchanges. This was done in order to maximize the generalizability of the results, as these three indices capture the vast majority of the American business landscape. The time period relevant for this research is 2016-2021, this time period was selected in order to be able to provide conclusions which are relevant in today's business environment, for all stakeholders. For the ROA indicator, 2017 to 2022 has been considered since the study use one year lagged financial performance. After obtaining the data, financial firms were dropped from the dataset as they tend to be subjected to different regulations, compared to non-financial firms, they have different risk profiles and different business models which can distort the findings of an empirical paper (Jaggia & Thosar, 2017). This was done by identifying the SIC codes of all firms. Next, all observations which didn't have data points for all relevant variables were dropped, in order to not produce biased or inaccurate results. This results in a remaining dataset of 1010 unique firms and a total of 5385 observations across the years 2016 to 2021. Lastly, all relevant variables were winsorized at the 1st and 99th percentile, in order to limit the impact of outliers, while not losing an excessive amount of information by, for example, dropping the outliers from the dataset.

3.2 Variable definition

3.2.1 Dependent Variables

The present study examines the relationship between R&D and short-run firm performance as operating performance and long-run firm performance as firm value. Consistent with other studies, ROA dependent variable is determined by operating performance criteria, whereas Market Capitalization dependent variable is determined by firm value criteria (Vithessonthi and Racela, 2016; Nandy, 2020).

ROA is an accounting-based indicator that measures a company's profitability and how efficiently it uses its assets to generate profits. ROA is calculated by dividing a company's annual earnings by its total assets, and it has been considered a one-year lag in this research work since the benefits of the independent variable (R&D), if any, start yielding from the subsequent year (Özkan, 2021).

Mathematical Expression:

ROA = Annual Earnings / Total Assets

Market capitalization is a prominent market-based indicator that provides the market value of a company's equity. It is generally calculated by multiplying the total number of shares outstanding by the current price of a single share of stock (Nandy, 2020).

Mathematical Expression:

Market Capitalization = Total Outstanding Shares X Present Share Price

3.2.2 Explanatory Variable

The R&D intensity (RDI) variable is used to represent the innovation levels of the firms and calculated by dividing the R&D spending by the total revenue. Freihat and Kanakriyah, (2017), Ehi and Olibe (2010) concluded the significant relationship between RDI and firm performances.

Mathematical Expression:

R&D Intensity = R&D Spending / Total Revenue

3.2.3 Moderating Variables

3.2.3.1 Employee Training

The availability of an effective firm-provided Training Policy has been considered to measure the moderate effect of Employee Training on R&D and firm performance. This indicates whether the company has implemented any initiatives to train new and existing employees on career development, education or skills and its apply to all employee levels. Freixanet and Federo (2022) concluded that there is a significant relationship between training and firm performance. Here, a dummy variable was added that takes on a value of "one" if the company has an active and effective training policy and "zero" otherwise. Similar measurement criteria were taken by Thomas (2001) in his studies conducting the relationship between corporate environmental policy and abnormal stock price returns.

3.2.3.2 Employee Productivity

Different metrics have been used to measure the productivity or effectiveness of employees of an organization. Since this paper assesses the moderate effect of Employee Productivity on R&D and firm performance, based on the available literature, the authors decided to define Employee-Productivity based on Revenue per Employee to measure firm performance. Afshan et al. (2014) revealed a significant positive relationship between Revenue per employee and firm performance.

Mathematical Expression:
Employee Productivity = Total Revenue / Number of employees

3.2.3 Control Variables

3.2.3.1 Firm Size

Firm size plays a vital role in determining the allocation of R&D spending, which may impact firm performance (Huergo and Moreno, 2019). Previous studies have examined the firm's size measured by the firm's total assets, which influences the firm performance (Isık, Aydın Unal, and Unal, 2017). Considering the empirical evidence, total assets use as a proxy to measure the firm size (Dogan, 2013).

3.2.3.2 Intangible Assets

According to Ocak and Fındık, 2019, intangible assets have no physical substance and represent a right granted by the government or another company. In their research, they categorize intangible assets as patents, copyright, trademarks, design, mineral exploration, brands, software, formula, trade secrets, capitalized R&D, goodwill, databases, domain, human capital, motion pictures, consumer lists, customer loyalty, licenses, market share, and marketing rights. Given the broad definition, the authors decided to consider total intangibles assets reported in the balance sheet has been considered to assess the link between R&D and firm performance.

3.2.3.3 Director Independence

Numerous studies have shown a relationship between director independence and firm performance (Bhagat and Bolton, 2013). Hence, the analysis considers the total number of independent directors as a percentage of board size.

Mathematical Expression:
*Independent Directors = (Number of independent directors / Board size) * 100*

3.2.3.4 Board Size

Literature typically recognizes the link between board size and firm performance. It discusses the advantages and disadvantages of adding group members to the board (Hackman, 1990), which led authors to consider board size, measured by the number of board members.

3.2.3.5 Leverage

Substantial evidence shows that leverage affects firm performance (Bhagat and Welch, 1995; O'Brien, 2003). Hence leverage measured by total debt to total assets has been considered to assess the hypothesis.

Mathematical Expression:
*Leverage = (Total debt /Total Assets) * 100*

To summarize, the following models will be employed in this study.
Model 1:

$$ROA_{i,t+1} = \beta_0 + \beta_1 * RDI_{it} + \beta_2 * MV_{it} + \beta_3 * (RDI * MV)_{it} + \beta_4 * \ln(Total\ Assets)_{it} + \beta_5 * \ln(Intangibles)_{it} + \beta_6 * Leverage_{it} + \beta_7 * IndependentDirectors_{it} + \beta_8 * BoardSize_{it} + Year_{FE} + Industry_{FE} + \varepsilon_{it}$$

Model 2:

$$MarketCap_{it} = \beta_0 + \beta_1 * RDI_{it} + \beta_2 * MV_{it} + \beta_3 * (RDI * MV)_{it} + \beta_4 * \ln(Total\ Assets)_{it} + \beta_5 * \ln(Intangibles)_{it} + \beta_6 * Leverage_{it} + \beta_7 * IndependentDirectors_{it} + \beta_8 * BoardSize_{it} + Year_{FE} + Industry_{FE} + \varepsilon_{it}$$

Where MV is the moderating variables Employee Productivity and Training and a hierarchical model is taken where each is analyzed individually, then in a common regression.

Model 1 – Fixed Effects:

$$ROA_{i,t+1} = \beta_0 + \beta_1 * RDI_{it} + \beta_2 * MV_{it} + \beta_3 * (RDI * MV)_{it} + \beta_4 * \ln(Total\ Assets)_{it} + \beta_5 * \ln(Intangibles)_{it} + \beta_6 * Leverage_{it} + \beta_7 * IndependentDirectors_{it} + \beta_8 * BoardSize_{it} + \beta_9 * Z_{it} + \varepsilon_{it}$$

Model 2 – Fixed Effects:

$$MarketCap_{it} = \beta_0 + \beta_1 * RDI_{it} + \beta_2 * MV_{it} + \beta_3 * (RDI * MV)_{it} + \beta_4 * \ln(Total\ Assets)_{it} + \beta_5 * \ln(Intangibles)_{it} + \beta_6 * Leverage_{it} + \beta_7 * IndependentDirectors_{it} + \beta_8 * BoardSize_{it} + \beta_9 * Z_{it} + \varepsilon_{it}$$

Where Z is the unobserved time-invariant heterogeneities across the entities, as measured by the Fixed Effects model. Similarly, a hierarchical model is employed where the interaction term is introduced after analyzing the direct impact of each variable first.

3.3 Methodology

Following the empirical methodology of existing papers that investigate moderating effects of various variables on the relationship between R&D expenditure and firm performance, such as Lin et al. (2006); Su, Guo, Chai & Kong (2021); and Banker, Wattal, Liu & Ou (2009), the econometric model used in this paper was a pooled-OLS hierarchical regression model. To investigate the moderating effect of Employee Productivity and Training, an interaction variable was created for each model.

One common criticism of the Pooled OLS is that it does not account for the structure of the panel data, namely the fact there can be changes in distributions across years or across different industries

(Wooldridge, 2016). To account for this, dummy variables for each year and each industry (identified by their SIC code) were included as control variables in the regression model, which helped account for year and industry-fixed effects. Bertrand, Duflo & Mullainathan (2004) emphasize the importance of clustering standard errors in order to minimize erroneous results. One key assumption in regression models is that the error terms are independent and identically distributed (i.e. homoskedastic), however, when working with panel data, this assumption is less likely to hold, as each firm is likely to have correlated error terms, over time. These error terms can contain unobservable characteristics which affect multiple periods at a time. To account for this assumption, all standard errors were robust and clustered at the firm level. Furthermore, the Breusch-Pagan test was conducted to confirm the need to cluster the standard errors, which will be elaborated on later. Refer to Table 04 in Appendix 03 for the output of the Breusch-Pagan test. The first output is for the model where firm ROA is the dependent variable. The null hypothesis for this test is that the model has homoscedastic residuals. The output for the ROA model yields a chi-squared value of 34.15 and a p-value of 0, indicating that the homoscedasticity assumption is violated and the model requires robust standard errors. Similarly, the output for the Market Capitalization model yields a chi-squared value of 13.23 and a p-value of 0.03%, which also falls below our threshold of 5% and we therefore must reject the null hypothesis and include clustered robust standard errors in this model as well.

To address the issue of multicollinearity between variables, variance inflation factors (VIF) were estimated for each variable, a score of below 10 indicates that multicollinearity is likely not an issue (Littell, Freund & Spector, 1991). Refer to Table 05 in Appendix 03 for the output of the VIF test, as can be seen, no value exceeds the value of 10, indicating that multicollinearity is most likely not an issue in the model. The highest VIF score of 5.76 is attributed to Total Assets, which is logical as the variable functions are a control factor for firm size, which is likely positively correlated with (for example) Intangibles and Board Size.

Lastly, although every precaution was taken in order to construct the most empirically valid Pooled OLS model, the nature of the panel data allows for the use of alternative, more sophisticated models. Namely, the fixed-effect and random-effect model. The key benefit of the fixed effect model is that it controls for time-invariant unobserved variables, at the individual level

(Wooldridge, 2016). This is particularly relevant as unobserved time-invariant firm variables (such as leadership style, corporate culture, and market niche) might have an influence on or be correlated with R&D expenditure and firm performance. On the other hand, the random effects model assumes that these firm-specific effects are uncorrelated with the independent variable and instead incorporates these effects as predictor variables (Wooldridge, 2016). Although from a theoretical point of view, the fixed effects model seems to be most relevant, as it is unlikely that a firms (for example) corporate culture changes, or market niche every year, the Hausman test (also known as the Durbin-Wu-Hausman test) was run to confirm whether the fixed effects or random effects model is most appropriate. After estimating the fixed effects and random effects model, where ROA was the dependent variable, the Hausman test was run, refer to Table 06 in Appendix 3 for the output. The Hausman test operates with a null hypothesis stating that individual effects are not correlated with the independent variable and that the random-effects model is a more accurate predictor (Wooldridge, 2016). The test yields a chi-squared value of 489.09, which yields a p-value of 0, since this is below the alpha of 5%, we must reject the null hypothesis, indicating that the unobserved time-invariant variable are indeed correlated and that the fixed-effects model is a more accurate predictor under this assumption. Similarly, the Hauman test was also run for the model which uses Market Capitalization as the dependent variable, yielding a chi-squared score of 251.785 and a p-value of 0, thus rejecting the null hypothesis for this model as well.

3.4 Descriptive statistics

The descriptive statistics in the Table 01 in Appendix 02 offer valuable insights into the financial landscape. The lagged ROA for the observed companies for 2017-2022 reveals an average of 6%, indicating moderate profitability. However, the relatively high standard deviation of 8.4% suggests a considerable dispersion of ROA values among the companies ranging from -30% to 34%; this signifies the presence of underperforming and outperforming entities within the sample.

The companies exhibit an average market capitalization of US$ 24,693Mn. The broad standard deviation of US$ 88,540Mn indicates significant variation in market values, spanning from a minimum of US$ 6,304Mn to a maximum of US$ 2,562,098. This highlights the observed companies' diverse financial magnitudes and market positions, ranging from smaller firms to large-scale market leaders. The logarithmically transformed variable, “ln” Market Capitalization, provides an alternative perspective on market capitalization. The mean of 8.668 and the standard deviation of 1.545 demonstrate the concentration of companies around this logarithm average, with values ranging from 5.555 to 12.661. Intangible assets represent the assets of a company that are not physical. The Intangible variable is distributed with a mean of US$ 5,088Mn and a standard deviation of US$ 6,047Mn. However, the high standard deviation signifies a wide dispersion of intangible assets, ranging from a minimum of US$ 0.034Mn to a maximum of US$ 310,197Mn.

Total Asset indicates the size of companies. One can witness that the magnitude of these companies' resources is US$ 16,102Mn on average, with a broad standard deviation of US$ 46,227Mn unfurls a spectrum, ranging from a minimum of US$ 4Mn to a maximum of US$ 958,784Mn. This demonstrates the substantial variation in total assets across the observed companies, underscoring the diversity of their asset portfolios.

Further analysis includes variables such as R&D intensity, with a mean of 4.7% and a standard deviation of 9%, suggesting a range from 0% to 70%. The minimum value of 0% suggests that some companies do not invest in R&D, while the maximum value of 70% indicates that certain companies allocate a significant portion of their revenue to R&D activities.

The leverage ratio is a financial measurement that indicates a company's ability to meet its financial obligations. The leverage ratio of the companies observed is around 30%, with a standard deviation of 21%. The minimum leverage ratio of 0 indicates that some companies do not have any debt on their balance sheet. In contrast, the maximum Leverage of 106% suggests that some companies have relatively high debt levels in their capital structure, which is more than their total assets.

The number of independent directors on a company's board is approximately 82%, with a considerable deviation of about 10%. Some companies have a relatively low number of independent directors, as indicated by a minimum of 45% of the board size, and certain companies have a higher representation of independent directors on their boards, amounting to 93%.

The training variable represents whether or not the companies have implemented any training policies. It takes values between 0 and 1. The average value of 0.541 indicates that most companies have implemented training policies in their companies. The variable has a relatively high standard deviation, indicating that Training policy implementation is not the same in the companies under observation. Employee productivity measures the revenue generated per employee in each company. The employee productivity of companies is centred around a value of US$ 0.564Mn with a high deviation of US$ 0.953Mn. The large standard deviation indicates that the employee productivity of different companies does not keep in the same way. The value of employee productivity ranges between US$ 0.011Mn and US$ 23.94Mn.

The Board Size variable explains the distribution of the number of directors on a company's board. It has a distribution with a mean equal to 9.6 and a standard deviation of 2.04. The maximum number of directors in a given company is 17.

Table 02 in Appendix 02 shows how the analysed variables differ across various industries; the construction industry has the highest ROA of 9%, while the mining industry has a negative ROA of -1.3%, suggesting the lowest profitability. The manufacturing industry has achieved the highest level of investment in R&D activities, while the construction and wholesale trades have recored the lowest. Moreover, the industries, agriculture, insurance & real states, and public administrations have relatively high RDI, indicating a high focus on innovation.

Employee productivity (EP) measures workforce's productivity within different industries, is highest in the construction and mining industries. Also, the insurance & real-estate industry has a high Employee productivity, creating more efficient utilization of employees to generate output values. Services have recorded the minimum employee productivity. All the industries have training values ranging from 0.357 to 0.735, indicating that a significant proportion of companies in each industry are implemented training policies. According to the dataset, the mining industry has the highest average level of training policies implemented, and the agriculture industry has lesser implemented training policies.

Among the industries studied, the services industry has the highest market capitalization of about US$ 34,340Mn, and the lowest value from the construction industry amount to US$ 4,334MN. Total assets range from US$ 4,027Mn (recorded in the construction) to US$ 378,104Mn (recorded in Public Administration) among the industries considered. The other industries have recorded the same level of total assets except the highest and lowest described above. Among the industries, the insurance & real estate industry (39.4%) has a higher risk of meeting its financial obligations than the other industries. The agriculture industry has the lowest risk of meeting its financial obligation, with a value of 7.9%.

The board size represents the number of directors on a company's board. Public administration has a giant board of directors, and the number of directors is about 13 on average, while the agriculture industry has the lowest board of directors, about 8. The industry's average percentage of independent directors is around 63% to 84%. The insurance & real estate industry has the highest value at about 84%, indicating a higher representation of independent directors. In contrast, the agriculture industry has the lowest number of independent directors, at about 63%. The public administration industry has reported the highest non-physical assets account to US$ 62,949Mn. The construction industry has the lowest intangible assets, amounting to US$ 343Mn.

Over the years, as shown in Table 03 in Appendix 02, the mean ROA shows a relatively consistent performance, ranging from 3.6% to 6.9%, suggesting that, on average, the companies under observation have maintained a reasonable level of profitability, with a slight improvement in latest years.

The mean RDI values remain relatively stable throughout the years, ranging from 4.5% to 5.0%, indicating that companies have allocated similar resources to R&D activities, suggesting a consistent focus on innovation and growth. The average employee productivity slight increase from US$ 0.496Mn in 2016 to US$ 0.649Mn in 2021. This suggests that on average employee productivity has increased at a higher proportion compared to that of RDI.

The training values show a steady increase from 0.359 to 0.825 from 2016 to 2021, indicating that a higher proportion of companies in the dataset have implemented training policies over time. The average market capitalization values demonstrate a consistent upward trend, increasing from US$ 19,760Mn to US$ 37,163Mn over the period. This led to the belief that, on average, companies' market values have been growing over the years, indicating a positive market sentiment and better overall market performance.

Total assets value ranges from US$ 14,983Mn to US$ 18,578Mn during the period. The highest asset value was shown in the year of 2021, and the lowest was shown in the year of 2018. The values show a consistent pattern from 2016-2018, and an upward trend has occurred in the asset values. Therefore, the companies have experienced increased total assets, reflecting business expansion incline with market capitalization.

The leverage ratio remains relatively stable, from 0.283 to 0.336 from 2016-2021. The values suggest that the companies have maintained a consistent level of financial Leverage in their capital structure over the years. The board sizes of the companies have remained constant at around nine throughout the years, and the number of independent directors also has remained stable over time. Therefore, the data is not showing any significant pattern. The average intangible values show a gradual increase from US$ 4,588Mn to US$ 5,634Mn in 2016-2021. The results give the impression that companies have seen a rise in the value of their intangible assets, such as intellectual properties.

4. Empirical Results and Analysis

4.1 Model 1 – ROA

Refer to Table 07 in Appendix 4 for the output of the hierarchical regression series for Model 1, where Return on Assets (ROA) is used as a proxy for short-run firm performance (Vithessonthi and Racela, 2016). All regressions in this series are partial linear-log models, as some control variables were converted to log-form for ease of interpretability (Dogan, 2013). For testing the hypotheses, regression R4 will be the main regression which is relevant, however, the changes between all regression models will also be analyzed.

Regression R4 shows that total assets have a significant and positive impact on ROA. With a beta value of 0.008, it is significant at alpha of 1% (the alpha threshold for this paper is 5%), this indicates that a 10% increase in the assets of a firm, is associated with an increase in firm ROA by 0.08%. In his study Dogan (2013) have shown similar results where the sensitivity between assets and profitability is positive and an increase in 10% of total assets, resulting in 0.12% increase in ROA. Since Total Assets are used as a proxy for firm size in this model (Dogan, 2013), this finding indicates that larger firms tend to have a higher ROA. Furthermore, the value of a firm's Intangibles (such as Goodwill) was found to have a positive relationship with firm ROA (Yuan et al., 2021). With a coefficient of 0.006, this indicates that a 10% increase in the value of a firm's intangibles is related with a 0.06% increase in firm ROA.

Interestingly, the degree of leverage, was found not to have a significant impact on firm ROA. This finding goes against the findings of Bhagat and Welch (1995); O'Brien (2003); and Singh and Faircloth (2005) where there is a significant negative relationship between leverage and profitability. As it could be theorized that if a firm is highly leveraged, it has more expensive fundraising options and therefore it can expect to have a lower return on its assets, as it has greater financing costs, as well as higher opportunity costs on its investments, making the firm more selective on what projects it invests in, rather than just positive NPV projects. However, the empirical findings suggest the opposite, that the degree of leverage does not have a significant impact on firm ROA.

Likewise, independent directors were also found to have no statistically significant impact on ROA. Empirical evidence suggests otherwise, where the majority reveals a positive relationship between independent directors and firm performance (Ben-Amar, Francoeur, Hafsi, and Labelle, 2013). Lastly, Board Size was also found to have no significant impact on firm ROA. In contrast, a greater degree of empirical evidence concluded that there is a significant negative relationship between board size and profitability (Larmou and Vafeas, 2009; Yermack, 1996).

4.2 R&D Intensity and Return on Assets

To test hypothesis H1, regression model R4 will be used as that is the most complete and has the highest R-squared value of 0.259, indicating the highest goodness-of-fit. H1 states that the degree of R&D intensity (so the R&D expenditure relative to its total revenue) within a firm has a negative impact on its ROA, which is in line with Özkan (2021); Vithessonthi and Racela (2016). As mentioned previously, the dependent variable (ROA) for this model is taken from time t+1, since ROA is an accounting-based measure, some time lag must be given for the impact of R&D to be recorded on the financial statements of a firm and one year is the standard time lag when investigating this topic. Likewise, Özkan (2021); Branch (1974); Granbowski and Mueller (1978) also used lagged values for ROA.

The beta coefficient of the RDI variable, in model R4, is -0.343 and statistically significant at an alpha of 1%. This coefficient means that an increase in the R&D intensity of a firm by increase 10% yields a decrease in firm ROA by 3.43%. Hence, as the p-value is below the alpha threshold of 5%, we can reject H1 and find that RDI does in fact have a negative impact on ROA. The results are in line with the findings revealed by Özkan, 2021 where R&D intensity of a firm has a negative correlation with ROA and an increase of R&D intensity by 10% decrease firms ROA by 4.45%. Moreover, as per the US GAAP, R&D costs must be immediately expensed. Cazavan-Jeny et al. (2011) found that the expensed portion of R&D has a stronger negative relationship with ROA since R&D reduces short-term accounting profitability. However, these results are inconsistent with several prior studies (Freihat et al., 2017; Erdogan et al., 2019) revealed the positive effect of R&D intensity on firm performance.

4.3 Moderating Effect of Training on RDI & ROA

Refer to Table 07 in Appendix 4 for the regression model output. For the analysis of the moderating effect of employee training, regression R2 will be analyzed first. This regression outputs a statistically significant coefficient of -0.222 for RDI, meaning that an increase in RDI by 10% is associated with a decrease in ROA by 2.22%. Özkan, 2021 concluded the similar results. This is known as the direct effect of RDI on ROA. The coefficient for the dummy variable Training is statistically insignificant, implying that on its own, whether or not a firm has training programs for its employees, does not affect its ROA. Similar results were revealed by Borlea et al. (2017) and Tharenou et al. (2002) concluded that there is no significant relationship between training and firm performance measured by ROA. But majority of studies found out the relationship between training anf firm performances are positive (Lima et al., 2004; Thang et al., 2008). However, when looking at the interaction variable with RDI and Training, this has a statistically significant coefficient of 0.146. From this, it can be derived that if a firm has training programs for its employees and then it pursues R&D activities, this actually has a less negative impact than if a firm were to pursue R&D activities without having training programs in place. According to the RBV and KBV, efficient human capital can help convert R&D information into innovation while ensuring that R&D projects are executed efficiently. To further analyze this moderating effect, a derivative of the regression equation is taken with respect to RDI.

$$\frac{\delta ROA}{\delta RDI} = \beta_1 + \beta_3 * T$$

$$\frac{\delta ROA}{\delta RDI} = -0.222 + 0.146 * T$$

This differential equation shows that since Training is a dummy variable that is either equal to 0 or 1, the negative impact of RDI on ROA (-0.222) is decreased if the firm has a training program in place (0.146) which leads to a total impact of 0.76% decrease in ROA as RDI increase, given that the firm has a training program in place for its employees. Which is a considerably smaller decrease than the impact of RDI when there is no Training program in place, which is 2.22%. To further investigate this relationship, refer to Table 08 in Appendix 4 for the marginal effect of RDI, holding all control variables at mean, both values of Training. To visualize this, refer to Graph 01 in Appendix 04 for easier understanding. These results visualize that if a firm does not have a Training program, increases in RDI will marginally decrease ROA, the slope for this curve (curve Training = 0) is statistically significant. While if the firm does have a training program, the marginal effect is statistically insignificant, as can be seen by the Training = 1 curve, importantly, this effect is more positive than when Training is equal to 0, as RDI increases.

From the Pooled OLS model, there is sufficient empirical support to conclude that firms that do have a training program for employees, tend to experience a less negative impact of RDI on ROA, than firms that do not have any training program at all. This is aligned with RBV and KBV where skilled workforce will be equipped with the knowledge and can transfer expertise generated through R&D activities to achieve the firm performances. The Human Capital theory also support this evidence as it suggests a positive moderating link between highly trained employees on the outcome of R&D projects.

4.4 Moderating Effect of Employee Productivity on RDI & ROA

Refer to Table 07 in Appendix 4 for the output of the hierarchical regression model. To analyze the moderating impact of Employee Productivity on the relationship between RDI and ROA, regression R3 will be analyzed first. The coefficient to RDI is statistically significant and indicates that an increase of RDI by 10% is associated with a decrease in ROA by 3.12%. Employee Productivity (EP) was found to not have a significant direct impact on ROA. However, the interaction term between RDI and Productivity was found to be statistically significant and positive. To further analyze this moderating effect, the derivative of the regression model is taken with respect to RDI.

$$\frac{\delta ROA}{\delta RDI} = \beta_1 + \beta_3 * EP$$

$$\frac{\delta ROA}{\delta RDI} = -0.312 + 0.265 * EP$$

Taking the derivative shows the moderating impact of productivity while holding the level of RDI constant. This equation makes it evident that as EP increases, the negative impact of RDI on ROA is decreased. Furthermore, if a firm has employee productivity of greater than $1.18 million per employee, it will actually see a positive impact on ROA as RDI increases. This is because the moderating variable becomes so large that the moderating impact begins to outweigh the direct impact of RDI. To further understand the moderating impact of employee productivity on the RDI-ROA relationship, the marginal effects of different levels of EP are taken. For this, in line with Hayes (2018), the 16th, 50th, and 84th percentile values are chosen to measure the marginal impact.

Refer to Table 09 in Appendix 04 for the output table where the impact of RDI on ROA is presented, at the previously mentioned levels of employee productivity. The results show that at low levels of EP (16th percentile) the effect of RDI on ROA is -0.175, this is also the most negative effect that can be seen. The impact of RDI on ROA for firms around the 50th percentile in EP score is found to be -0.138, and lastly, for firms with high EP, RDI is found to have no significant marginal impact on ROA. To visualize this, refer to Graph 02 in Appendix 04. This graph shows that at low levels of EP, RDI has a steeper negative slope, while at high levels, RDI has a relatively neutral slope, indicating no significant impact. These findings indicate that firms with a high level of productivity cannot offset a greater portion of the negative impact of RDI, than firms with lower productivity.

This finding is consistent with the hypothesis that a more skilled workforce can more efficiently assimilate, refine and transfer knowledge, especially when it is generated from a novel source. The RBV and Human Capital theory support this evidence and provide economic justification for a possible causal effect. The theoretical motivation for the lack of a direct impact but presence of a significant moderating impact can be found in the Organizational Ambidexterity (O'Reilly and Tushman, 2013) concept, which describes the process of simultaneous innovative practices (such as R&D) and its effectiveness, when paired with highly productive employees.

4.5 Model 2 – Market Capitalization

As mentioned previously, the main difference in this model is that Market Capitalization was selected as the dependent variable. Market capitalization considered as a proxy to measure firm value which in turn used as a measure of long-run firm performances since firm value is the present value of future cash flows (Ehie and Olibe, 2010; Vithessonthi and Racela, 2016).

Refer to Table 10 in Appendix 05 for the following analysis. The log form of a firm's Market Capitalization was chosen in order to increase the interpretability of the results. The analysis shows that total assets of a firm (which is a proxy for firm size) has a statistically significant positive impact on market capitalization . The coefficient of 0.92 (regression M5) indicates that an increase in total assets by 1%, increases a firm's market capitalization by 0.92%. This finding is quite logical as the market cap is the market's valuation of a firm, so if a firm's book value (total assets) increases, one can expect the market to adjust for this information as well. Husna and Satria (2019) considered value of a firm proxied to total assets. Similarly, intangibles was also found to have a negative impact on market capitalization, with an increase in intangibles by 1% being associated with a decrease in market capitalization by 0.036%, however, this coefficient is only statistically significant at the 10% alpha level, which is below the necessary threshold of 5%. Interestingly, the leverage ratio of a firm was found to have a statistically significant, negative impact on market capitalization. The coefficient of -0.546 suggests that an increase in a firm's leverage ratio by 10%, decreases the firm's market capitalization value by 5.46%. Since Market Capitalization is sensitive to market expectations, this relationship can be explained by the fact that increases in debt can be seen as a form of greater risk taking, which could lead to the market valuing the firm as a lower level. This is align with market timing theory where changes in capital structure are long lasting and reflect through stock prices. This preposition explains that gearing ratios are negatively related to stock returns (Bessler 2004).

Lastly, it can find that board size and director independence have no significant impact on market capitalization. There are several studies support this where there were no link found between director independence and firm value (Ferris and Yan, 2007; Johl, Kaur, and Cooper, 2013). However, majority of empirical evidence suggest that there is a significant relationship between board size and future performances. (Yermack, 1996).

4.6 R&D Intensity and Market Capitalization

Reviewing all regressions, it can be seen that RDI initially was found to have a statistically significant, positive impact on market capitalization. Similar evidence was found on their research by Ehie and Olibe (2010) where R&D positively affects firm value. However, once the Training and Employee Productivity moderating variables are introduced in the model, the significance of RDI as a direct predictor variable begins to decrease, until it is no longer significant. This initial finding indicates that the market only positively values R&D activities, if the firm has a certain level of employee skill. This finding is in line with the Resource-Based view of the firm (Barney, 1991) which suggests that a firm’s human capital resources and knowledge management capabilities can facilitate greater returns from its R&D activities. However, this initial analysis is not sufficient to suggest that Training and EP have a moderation impact on this relationship, so it must be further analyzed.

4.7 Moderating Effect of Training on RDI & Market Capitalization

Similarly, to Model 1, the results presented in Table 10 in Appendix 05, the findings suggest that Training has no significant direct impact on market capitalization which is in line with the studies conducted by Borlea et al. (2017). However, the interaction term between RDI and Training is statistically significant and positive. Due to signaling effect market capture the training as positive sentiment when it conduced along with R&D and believes that the benefits will be captured in the future cash flows resulting positive relationship with market capitalization. In Model M2, this suggests that an increase in RDI by 10% yields an increase in market capitalization by 8.9% and if the firm has a training program in place, an additional 12.77% increase in market capitalization is observed. To further analyze this, the derivative of the regression model, with respect to RDI, is taken.

$$\frac{\delta MarketCap}{\delta RDI} = \beta_1 + \beta_3 * T$$

$$\frac{\delta MarketCap}{\delta RDI} = 0.89 + 1.277 * T$$

This equation shows that holding RDI constant, Training can increase the scale of the positive impact seen from RDI on market capitalization. This positive impact only occurs in collaboration with RDI, and Training itself does not have a statistically significant direct impact on market capitalization. This model suggests that having a training program would increase market capitalization by 21.67%, versus just 8.9% if the firm does not have a training program, given an increase in RDI by 10%. However, this is just the linear model prediction, to further understand the moderating effect of Training, the marginal effects have been analyzed. Refer to Table 11 in Appendix 05 for the output for marginal effects of RDI at both values of Training, and Graph 03 in Appendix 05 for a visualization of this plot. It is evident from Graph 03 in Appendix 05 that regardless of whether the firm has a training program or not, the impact of RDI on market capitalization is positive. However, if the firm does have a training program in place, it experiences a greater positive impact than firms that don't, as can be derived from the steeper slope of the Training = 1 curve owing to positive signaling sends to market on training together with R&D.

4.8 Moderating Effect of Employee Productivity on RDI & Market Capitalization

To get an initial understanding of the moderating effect of employee productivity on market capitalization, regression model M3 in Table 10 in Appendix 05, will be analyzed. The model estimation shows that employee productivity does not have a statistically significant impact on market capitalization. However, the interaction term between RDI and EP was found to be statistically significant at the 5% alpha level. To further understand this relationship, the derivative for this equation, with respect to RDI is taken.

$$\frac{\delta MarketCap}{\delta RDI} = \beta_1 + \beta_3 * EP$$

$$\frac{\delta MarketCap}{\delta RDI} = 0.815 + 0.917 * EP$$

This derivative indicates that holding RDI constant, Employee Productivity has a positive moderating impact on market capitalization. This positive impact is only present with R&D activities, as the direct impact of employee productivity was found to be statistically insignificant. Since EP is a continuous variable, the scale of the moderating impact is dependent on how productive a firm's employees are. Holding constant RDI, an increase in EP by $100,000 per employee, the firm would see an additional 9.17% increase in its market capitalization. To get a more in-depth understanding of this, the marginal effect of RDI on market capitalization at the 16th, 50th, and 84th percentile values of EP are measured (Hayes, 2018).

Refer to Table 12 in Appendix 05 for the output table of the marginal impact of RDI. The estimation indicates that firms that operate at the 16th percentile value of Employee Productivity do in fact see a positive marginal impact of RDI on market capitalization, however, the firms operate with high employee productivity (84th percentile). Firms operating at the 16th percentile, experience a 21.6% increase in market capitalization, given a 10% increase in RDI, while firms operating in the 84th percentile experience a 27.3% increase. This suggests that higher productivity firms tend to also see a greater marginal impact of RDI on their market capitalization, than lower productivity firms. To visualize this finding, refer to Graph 04 in Appendix 05. This graph emphasizes that high EP firms have a steeper positive slope than lower EP firms, indicating that as RDI increases, they tend to see a greater marginal increase than low EP firms.

Furthermore, this finding is supported by the theoretical foundation explained in previous sections. Namely, the concept of Organization Ambidexterity provides a theoretical pillar which supports the significance of Employee Productivity as a moderator, rather than direct predictor of market capitalization. Additionally, the signaling theory suggests that the market values innovation at a premium, given that it is paired with highly productive employees, as the direct impact of EP was insignificant, but moderating effect was significant.

5. Additional Models and Robustness Test

As mentioned previously, the Pooled OLS regression model used in the previous section has some notable limitations. It was chosen as the primary model in order to maintain consistency with existing research on this topic, however, its main limitation is that it may lead to an omitted variable bias of unobserved, firm-specific factors. To address these shortcomings, the Fixed Effects regression model was used as a supplemental model to check the robustness of the previous model. The Fixed Effects model allows for the control of unobserved, time-invariant firm-specific characteristics, thereby limiting the omitted variable bias present in the Pooled OLS model (Wooldridge, 2016). By examining the firm-specific changes over time, the fixed effects model can allow for the findings in the previous section to either be confirmed or rejected.

5.1 Fixed Effects Model 1

Refer to Table 13 in Appendix 06 for the output of the fixed effects regression model, where ROA is used as the dependent variable. When the interaction terms are absent (regression FER1) RDI and EP are found to have a statistically significant impact on ROA, while Training has an insignificant impact. When the interaction variables of RDI and Training, and RDI and EP are introduced (regression FER2), they are also found to have a statistically significant positive impact. The coefficient of RDI is -0.964, which means that an increase in RDI by 10% is associated with a decrease in ROA by -9.64%. EP's coefficient of 0.028 suggests that an increase in a firm's employee productivity by $100,000 per employee yields an increase in ROA by 0.28%.

The interaction between RDI and Training is found to have a statistically significant coefficient of 0.112. This suggests that, holding RDI constant, firms which have a Training program are found to experience an additional 1.12% increase in ROA, relative to firms which don't have a Training program in place for its employees. The insignificance of the coefficient of the Training variable suggests that there is no direct effect of a firm having a training program, but rather a moderating effect, where the firm experiences a smaller decrease in ROA as RDI increases, relative to firms which don't have a training program.

Furthermore, the interaction term between Employee Productivity and RDI is also statistically significant with a coefficient of 0.263. This figure suggests that holding EP constant, an increase in RDI by 10% positively influences ROA by an additional 2.63%. This is the moderating impact of EP, the direct impact of EP was 0.028, as mentioned previously.

To further understand the moderating impact, the derivative of the regression model is taken with respect to RDI.

$$\frac{\delta ROA}{\delta RDI} = \beta_1 + \beta_4 * EP + \beta_5 * T$$

$$\frac{\delta ROA}{\delta RDI} = -0.964 + 0.263 * EP + 0.112 * T$$

This differential equation visualizes the positive moderating impact of EP and Training as well as the direct negative impact of RDI on ROA. The fixed effects model makes it evident that a firm introducing Training programs for its employees can help offset the direct negative impact of RDI. Similarly, it also suggests that continual increase in employee productivity also has a positive moderating impact on ROA, which can also help offset the direct negative impact of RDI on ROA. As EP is a continuous variable, it suggests that the scale of the moderating impact is determined by how productive a firm's employees are, compared to Training, which is just a dummy variable and is just a matter of whether the firm has a program or not.

The results of the Fixed Effects model support and allow for the confirmation of the results of the Pooled OLS, for when ROA is used at the dependent variable. Both models find a negative direct impact of RDI on ROA and a positive moderating impact of Employee Productivity and Training. One notable difference is that the Fixed Effects model found a positive direct impact of EP on ROA, which was not observed in the Pooled OLS model. One other difference was that the Fixed Effects model attributed statistically significant (at alpha 5%) coefficients to the control variables Board Size and Leverage Ratio, which was not present in the Pooled OLS model. The percentage of independent directors were found to be statistically insignificant for both models.

5.2 Fixed Effects Model 2

Refer to Table 14 in Appendix 06 for the output of the Fixed Effects regression model where market capitalization is used as the dependent variable for firm performance. In this model both Training, and EP were found to have a statistically significant direct impact on market capitalization. The introduction of interaction variables in FEM2 increases the R-squared of the model by 0.002, however, the EP interaction term is found to be statistically insignificant. The model (FEM2) suggests that an increase in RDI by 10% is associated with an increase in MC by 0.37%, however this coefficient is only significant at an alpha of 10%, which is below our threshold, and we must reject its significance. This figure is statistically significant, unlike the coefficient in the Pooled OLS model (regression R4). Similarly, if a firm has a training program for its employees, its market capitalization is on average increased by 7.9%, which are found to be statistically insignificant on the Pooled OLS model. This model also finds that an increase in EP by $100,000 is associated with an increase in MC by 1.04%, this coefficient was found to be insignificant in the Pooled OLS model.

The interaction term between Training and RDI was found to be statistically significant with a coefficient of 0.351, suggesting that a 10% increase in RDI is associated with a 3.51% increase in MC for firms which do have a training program, compared to no moderated increase for firms which do not have a training program. This finding is similar to the finding with the Pooled OLS model. However, the interaction term between EP and RDI was found to be statistically insignificant at the alpha level of 5%, with a p-value of 9.1%. Although this coefficient is positive, the fixed effects model suggests that EP has no moderating impact on the relationship between RDI and Market Capitalization. This finding goes against the conclusion for the Pooled OLS model, which found a statistically positive moderating effect of EP between RDI and Market Capitalization.

6. Conclusion

The relationship between R&D and firm performance (measured by both accounting-based and marketing-based indicators) has been studied extensively. The empirical analyses presented in this paper contribute to the existing literature in the following regard. First, to study the value relevance of R&D investment, the largest and most recent databases have been considered. Second, the paper highlights accounting-based and marketing-based performances link to short-run and long-run firm performances using the same database and attempts to distinguish different perspectives. The panel data reveals a negative short-run impact of R&D on firm performance, measured by ROA, mainly owing to the R&D spending being treated as an expense under US accounting treatment, and benefits of R&D will be factored in future cash flows resulting in a positive long-run effect of R&D on firm value, measured by Market Capitalization. According to the Signalling and Efficient Market Hypothesis theories, R&D investment can be linked to the firm's market capitalization as investors value firms which prioritize innovation as a means to achieve and maintain a competitive advantage.

Finally, although there are different studies to assess the relationship between Employee Training and firm performance and Employee Productivity and firm performance, there has been limited empirical evidence to identify how Employee Training and Employee Productivity moderate the relationship between R&D expenditure and short-run and long-run performance. This point has been the main unique contribution of this paper. The study revealed that both Employee Productivity and Training positively moderate the relationship between R&D and firm performance. This applies for both account-based measure (ROA) and the market-based measure (market capitalization). Although, the conclusion for Employment Productivity and market capitalization is somewhat more insecure due to the results of the Fixed Effect additional regression model, which found a contradictory conclusion than that of the main Pooled OLS model. The findings of this paper are in line with their existing theoretical foundation such as the Resource-Based View of the firm (Barney,1991), Efficient Market Hypothesis (Fama, 1970) and Human Capital Theory (Becker, 1964).

6.1 Limitations and Future Research

Although this study has been able to provide some novel insights into the dynamic relationship between employee skill, R&D intensity and firm performance, it does have some limitations which need to be acknowledged. Firstly, the study uses two variables, Training and Employee Productivity, as proxies for employee skill. While these proxies have been justified and motivated, there are other variables which are able to capture different aspects of employee skills, which could potentially yield different conclusions. Likewise, employee skill is a small aspect of the larger organizational culture, an investigation into the other aspects of culture would also be fruitful in understanding the broader research topic.

Furthermore, since Pooled OLS and Fixed Effects model are used, a direct cause-and-effect relationship cannot be completely confirmed and there is a risk for endogeneity errors, to address this, the use of Instrumental Variable or 2-Stage-Least-Squares model could be an interesting model to utilize. Lastly, an investigation in which different countries and specific industries are investigated would also be effective in testing the generalizability of the results of this study.

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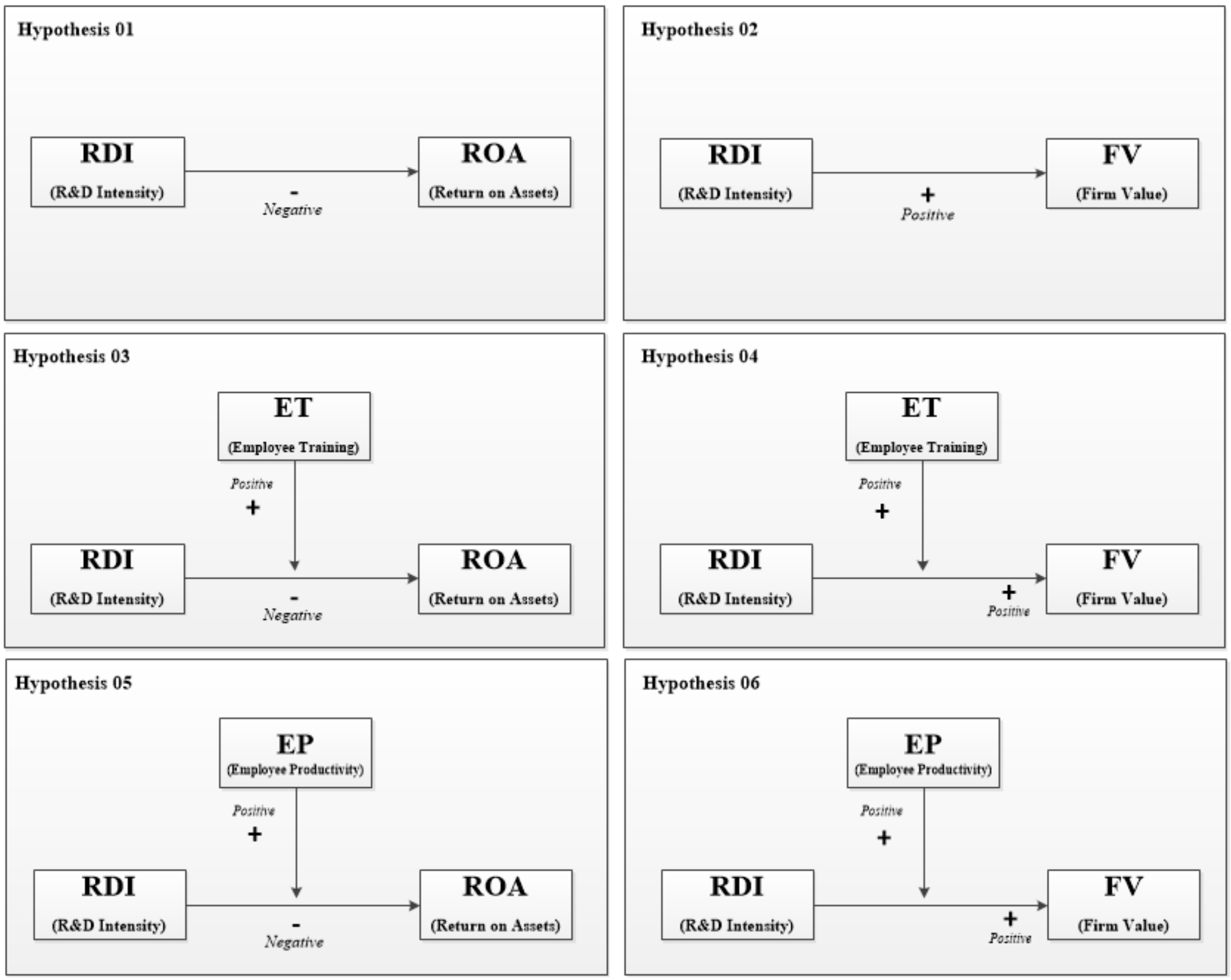
Appendices

Appendix 01

Figure 01: Hypothesis Libby Box



Appendix 02 – Summary Statistics

Table 01 - Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$ROA_{(t+1)}$	5385	.059	.084	-.295	.34
MarketCap	5385	24692.871	88539.599	6.304	2562098.3
ln MarketCap win	5385	8.668	1.545	5.555	12.661
ln Intangibles win	5385	6.607	2.155	.342	11.321
Intangibles	5385	5088.403	16047.533	.034	310197
ln TotalAssetsmn win	5385	8.358	1.541	4.717	12.374
TotalAssetsmn	5385	16102.261	46226.839	4.091	958784
RDI win	5385	.047	.09	0	.7
LeverageRatio win	5385	.305	.206	0	1.06
IndependentDirecto~n	5385	82.478	9.944	45.45	92.86
Training	5385	.541	.498	0	1
EP	5385	.564	.953	.011	23.939
BoardSize	5385	9.568	2.041	1	17

Table 02 - Descriptive statistics - mean by(Industry)

	$ROA_{(t+1)}$	RDI	EP	Training	Market Cap	Total Assets	Leverage Ratio	Board Size	Independent Directors	Intangibles
Agriculture	.027	.017	0.368	.357	7505.551	10736.489	.079	8.071	62.886	4698.218
Mining	-.013	.004	1.188	.735	13793.059	15599.932	.309	9.197	80.641	2701.799
Construction	.088	0	1.289	.57	4334.873	4026.791	.31	8.617	79.133	342.967
Manufacturing	.062	.063	0.518	.533	20963.613	13246.048	.28	9.587	83.436	4463.335
Transportation	.035	.007	0.718	.638	30048.959	38464.451	.385	10.398	82.398	15558.767
Wholesale Trade	.067	0	0.716	.428	6097.199	4827.306	.259	9.605	79.647	1283.535
Retail Trade	.067	.004	0.595	.586	29042	13119.811	.392	9.581	80.931	1988.266
Insurance & Real Estate	.043	.041	1.108	.525	23139.324	20121.309	.394	9.606	83.795	8304.053
Services	.061	.06	0.333	.502	34340.905	13715.922	.293	9.303	81.595	4504.22
Public Administration	.043	.027	0.460	.5	258545.04	378103.94	.255	12.833	80.913	62949.278

Table 03 - Descriptive statistics - mean by(Year)

	ROA (t+1)	RDI	EP	Training	Market Cap	Total Assets	Leverage Ratio	Board Size	Independent Directors	Intangibles
2016	.058	.045	0.496	.359	19759.922	15067.288	.285	9.552	81.186	4588.118
2017	.063	.046	0.537	.366	21718.364	15279.886	.285	9.457	81.572	4815.202
2018	.059	.045	0.573	.437	18508.441	14983.326	.283	9.458	82.037	4933.029
2019	.036	.047	0.577	.531	22748.129	15731.697	.312	9.57	82.756	5140.536
2020	.069	.05	0.542	.696	27744.843	16839.001	.336	9.634	83.372	5338.333
2021	.069	.049	0.649	.825	37163.262	18578.373	.323	9.731	83.699	5634.396

Appendix 03 – Statistical Tests

Table 04: *Breusch-Pagan/Cook-Weisberg test for heteroskedasticity*

ROA: Breusch-Pagan/Cook-Weisberg test for heteroskedasticity

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Variable: Fitted values of ROA
H0: Constant variance
chi2(1) = 34.15
Prob > chi2 = 0.0000

Market Capitalization: Breusch-Pagan/Cook-Weisberg test for heteroskedasticity

Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Variable: Fitted values of Market Cap
H0: Constant variance
chi2(1) = 13.23
Prob > chi2 = 0.0003

Table 05: *Variance Inflation Factor*

VIF:

Variable	VIF	1/VIF
RDI	2.510	0.398
Training	1.770	0.564
EP	1.990	0.504
Total Assets	5.760	0.174
Intangibles	4.810	0.208
Leverage Ratio	1.790	0.560
Independent Directors	1.490	0.670
Board Size	2.110	0.474

Table 06: *Hausman (1978) specification test*

Hausman ROA:

Hausman (1978) specification test

	Coef.
Chi-square test value	489.094
P-value	0

Hausman MarketCap:

Hausman (1978) specification test

	Coef.
Chi-square test value	251.785
P-value	0

Appendix 04

Table 07: *Pooled OLS ROA:*

	R1	R2	R3	R4
VARIABLES	ROA_{t+1}	ROA_{t+1}	ROA_{t+1}	ROA_{t+1}
RDI	-0.177***	-0.222***	-0.312***	-0.343***
	(0.042)	(0.045)	(0.040)	(0.041)
Training	0.003	-0.004	0.004	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)
EP	0.007	0.007	0.004	0.004
	(0.005)	(0.005)	(0.004)	(0.004)
RDI*Training		0.146***		0.121***
		(0.044)		(0.044)
RDI*EP			0.265***	0.253***
			(0.053)	(0.055)
ln_TotalAssets	0.010***	0.010***	0.008***	0.008***
	(0.003)	(0.003)	(0.002)	(0.002)
ln_Intangibles	-0.007***	-0.007***	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Leverage Ratio	-0.015	-0.015	-0.013	-0.013
	(0.014)	(0.014)	(0.014)	(0.014)
Independent Directors	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Board Size	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-0.007	-0.002	0.003	0.006
	(0.019)	(0.019)	(0.019)	(0.019)
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	5,380	5,380	5,380	5,380
R-squared	0.230	0.235	0.246	0.249

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 08: *ROA x Training*

		Delta-method					
		dy/dx	std. err.	t	P>t	[95% conf.	interval]
RDI_win	_at						
	1	-0.1436254	0.0307809	-4.67	0	-0.2039686	-0.0832823
	2	0.0426216	0.0315463	1.35	0.177	-0.0192221	0.1044653

Graph 01: *Marginal effect of RDI on ROA, Given Training*

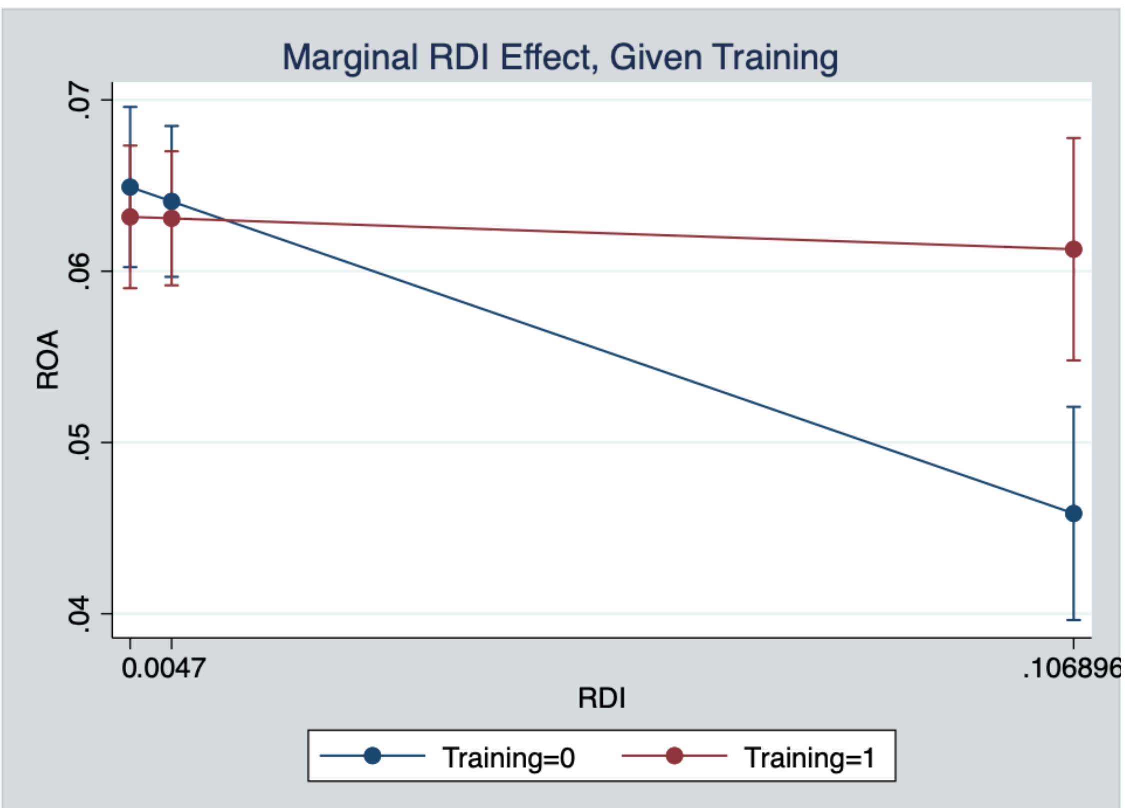
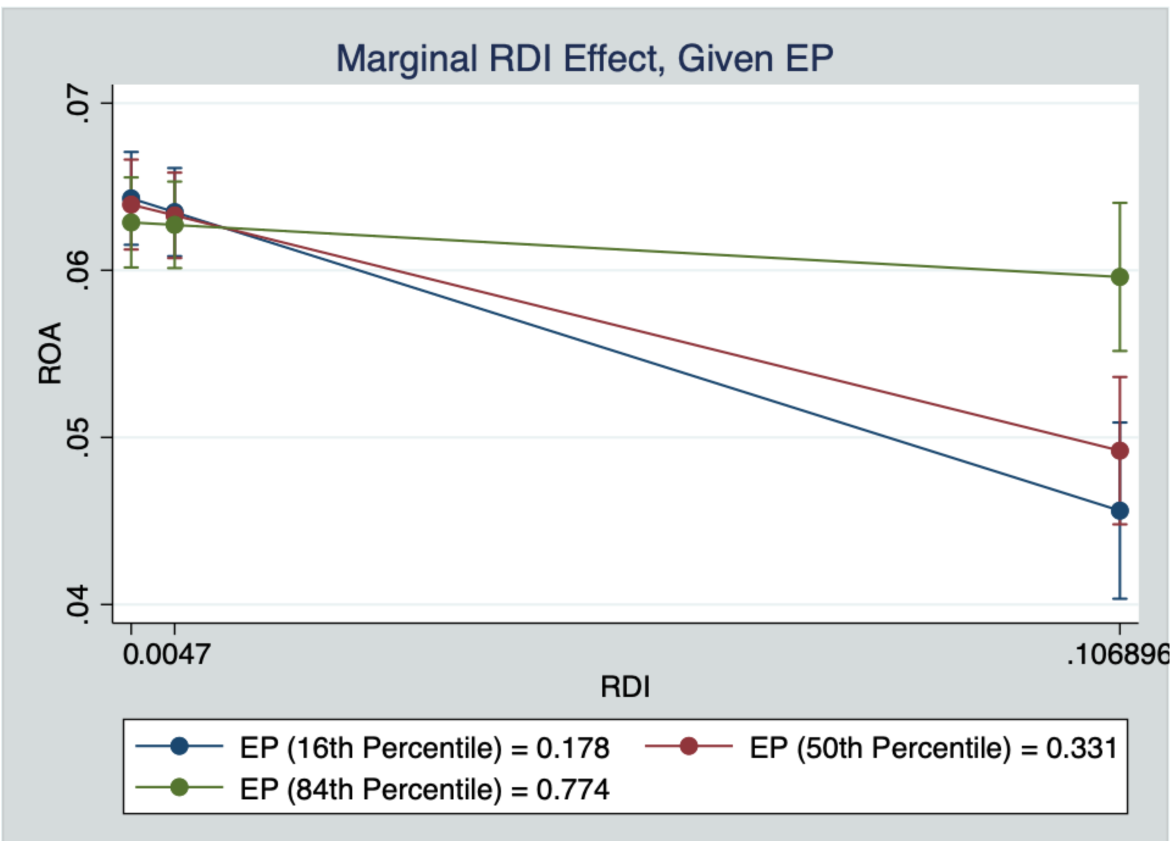


Table 09: *ROA x EP*

		Delta-method					
		dy/dx	std. err.	t	P>t	[95% conf.	interval]
RDI_win	_at						
	1	-0.1747932	0.029875	-5.85	0	-0.2333604	-0.1162261
	2	-0.1377725	0.0259019	-5.32	0	-0.1885507	-0.0869942
	3	-0.0304967	0.0244706	-1.25	0.213	-0.078469	0.0174756

Graph 02: *Marginal effect of RDI on ROA, Given Employee Productivity*



Appendix 05

Table 10: *Pooled OLS Market Capitalization*

	M1	M2	M3	M4
VARIABLES	$\ln(MarketCap)_t$	$\ln(MarketCap)_t$	$\ln(MarketCap)_t$	$\ln(MarketCap)_t$
RDI	1.282***	0.890**	0.815**	0.508
	(0.367)	(0.368)	(0.381)	(0.388)
Training	0.098**	0.036	0.101**	0.043
	(0.039)	(0.044)	(0.039)	(0.044)
EP	-0.008	-0.008	-0.018	-0.018
	(0.025)	(0.024)	(0.021)	(0.021)
RDI*Training		1.277***		1.198***
		(0.396)		(0.407)
RDI*EP			0.917**	0.799**
			(0.393)	(0.398)
ln_TotalAssets	0.930***	0.925***	0.923***	0.920***
	(0.031)	(0.031)	(0.031)	(0.031)
ln_Intangibles	-0.037*	-0.038*	-0.036*	-0.036*
	(0.021)	(0.021)	(0.021)	(0.021)
Leverage Ratio	-0.550***	-0.552***	-0.545***	-0.548***
	(0.146)	(0.146)	(0.145)	(0.145)
Independent Directors	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Board Size	0.006	0.007	0.007	0.008
	(0.012)	(0.012)	(0.012)	(0.012)
Constant	0.293	0.337	0.326	0.363
	(0.233)	(0.233)	(0.234)	(0.233)
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	5,380	5,380	5,380	5,380
R-squared	0.842	0.843	0.842	0.843

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11: *MC x Training*

		Delta-method					
		dy/dx	std. err.	t	P>t	[95% conf.	interval]
RDI_win	_at						
	1	1.927235	0.1658799	11.62	0	1.602043	2.252427
	2	3.629562	0.2537555	14.3	0	3.132097	4.127027

Graph 03: *Marginal effect of RDI on Market Capitalization, Given Training*

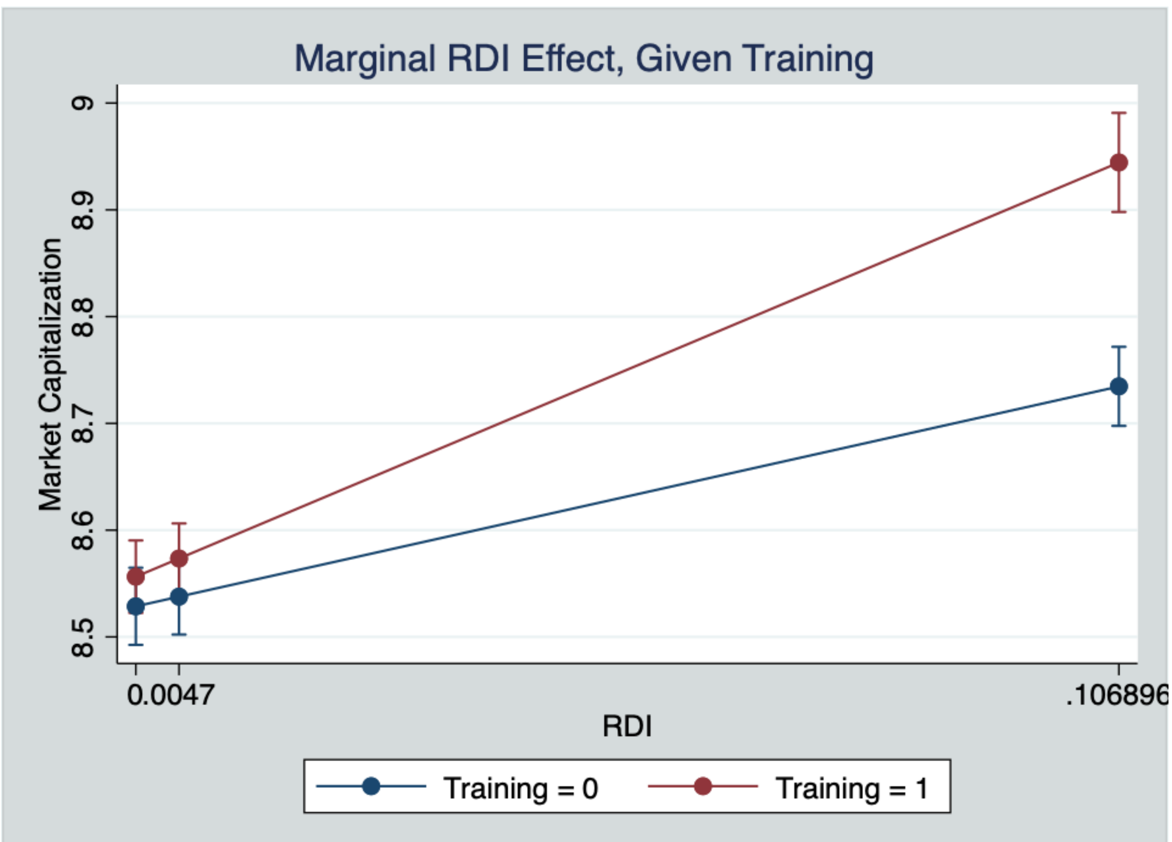
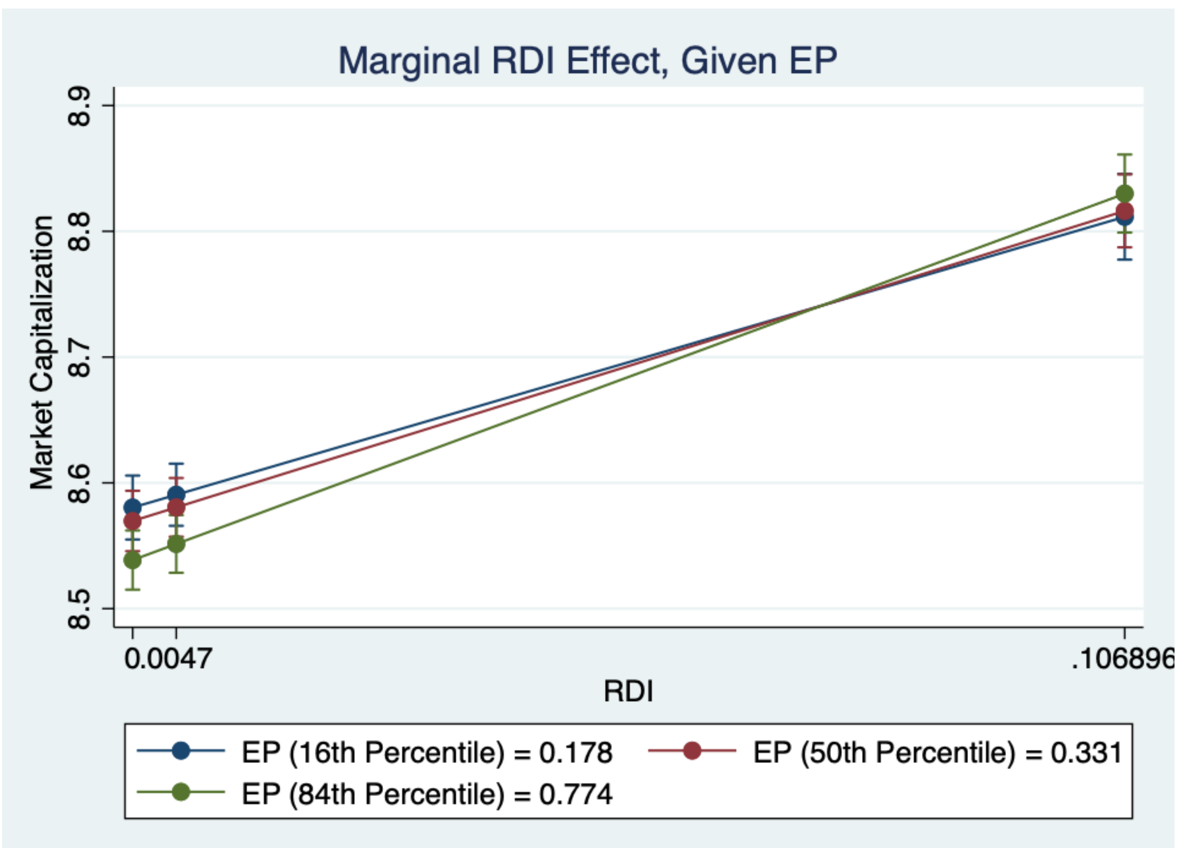


Table 12: *MC x EP*

		Delta-method					
		dy/dx	std. err.	t	P>t	[95% conf.	interval]
RDI_win	_at						
	1	2.162307	0.1764929	12.25	0	1.816309	2.508305
	2	2.306919	0.1534477	15.03	0	2.006099	2.607739
	3	2.725964	0.1578607	17.27	0	2.416493	3.035436

Graph 04: *Marginal effect of RDI on Market Capitalization, Given Employee Productivity*



Appendix 06

Table 13: *Fixed Effects ROA*

VARIABLES	(1) FER1 ROA_{t+1}	(2) FER2 ROA_{t+1}
RDI	-0.847***	-0.964***
	(0.038)	(0.040)
EP	0.032***	0.028***
	(0.003)	(0.003)
Training	0.001	-0.004
	(0.003)	(0.003)
RDI * EP		0.263***
		(0.037)
RDI * T		0.112***
		(0.029)
ln_TotalAssets	0.052***	0.047***
	(0.005)	(0.005)
ln_Intangibles	-0.007***	-0.005**
	(0.002)	(0.002)
Leverage Ratio	-0.206***	-0.199***
	(0.011)	(0.011)
Independent Directors	0.000	0.000
	(0.000)	(0.000)
Board Size	-0.002*	-0.002**
	(0.001)	(0.001)
Constant	-0.232***	-0.198***
	(0.035)	(0.035)
Observations	5,377	5,377
R-squared	0.222	0.235
Number of gvkey	1,010	1,010

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14: *Fixed Effects Market Capitalization*

	(1)	(2)
	FEM1	FEM2
VARIABLES	$\ln(MarketCap)_t$	$\ln(MarketCap)_t$
RDI	0.046**	0.037*
	(0.019)	(0.020)
Training	0.096***	0.079***
	(0.015)	(0.017)
EP	0.104***	0.104***
	(0.017)	(0.017)
RDI * EP		0.075*
		(0.045)
RDI * T		0.351***
		(0.127)
ln_TotalAssets	0.981***	0.978***
	(0.025)	(0.025)
ln_Intangibles	-0.060***	-0.060***
	(0.013)	(0.013)
Leverage Ratio	-0.763***	-0.756***
	(0.057)	(0.057)
Independent Directors	0.000	0.000
	(0.001)	(0.001)
Board Size	-0.008	-0.009
	(0.006)	(0.005)
Constant	1.038***	1.060***
	(0.179)	(0.179)
Observations	5,380	5,380
R-squared	0.398	0.400
Number of gvkey	1,010	1,010

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1