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Erasmus School of Economics

Bachelor Thesis:

Using financial statements to assess the technological investments in enhancing companies' performance

Writer: Mu-Yang, Hsu (560056)

Supervisor: Wenjiao Cao

Second assessor: Rien van Dongen

The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

Abstract

Companies who want to stand out among the competition in the industry often seek opportunities to invest in. Nowadays with beneficial technologies, various applications can improve a firm's performance in different magnitudes. As this paper introduces, the usage of AI, Blockchain, and Electronic Data Interchange (EDI) system have been proven by many researchers that they indeed enhance the company's sale growth, in an individual case. In the spirit of such investment, this study has drawn up data from WRDS database of 7,106 companies (6,387 data points for the second hypothesis) located in North America and conduct two hypotheses to test the relationship between investment in innovative technologies and its effectiveness for one's performance. The two hypotheses made are the relationship between R&D expenses to Revenue and the increase in R&D spending to the deduction of Operating account.

The first hypothesis confirms that R&D expenditure presents a positive influence on revenue growth. However, as for hypothesis 2, the result shows a weak effect of the yearly increase in R&D expense related to the decreasing level of operating costs. Moreover, the adjusted R-square also indicates an insufficient explanatory power of the independent and control variables. Thus, the second hypothesis is rejected in this study.

Potential limitations of the study include the sole use of R&D expense to represent the whole technological investment made by firms. However, such usage of the proxy is to present the general trend of technology investment among firms and has been justified. For further investigation, the author recommends using more specific data available for each individual technology spending to test the regression analysis.

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Chapter 1. Introduction

1.1 Background & Motivation of the research

Investors seeking to assess the potential of a company often rely on financial analysis and accounting audits as primary and direct methods to evaluate its performance. Financial statements play a crucial role in determining, forecasting, and evaluating a firm's effectiveness. Managers utilize these statements to communicate the economic conditions of the company to shareholders, thereby informing investment decisions (Hasanaj & Kuqi, 2019).

In today's rapidly evolving business landscape, characterized by internet innovation and globalization, companies are not only competing for international customers but also responding to stakeholders and investors worldwide. Investment decisions typically involve comparing similar opportunities to identify those with greater growth potential. Consequently, the disclosure of financial reports has become increasingly vital for internal boards of directors and external investment seekers alike. However, the reporting products or services that were previously unavailable, for instance, the classification of digital currencies, remains a subject of ongoing debate for an appropriate treatment. To properly account for them, various classifications such as 'Cash or Cash Equivalents', 'Financial Instruments', 'Inventory', or 'Intangible Assets' have been considered (Sterley, 2019). However, none of these classifications are perfect fit, leading to inconsistencies and gaps in reporting. Therefore, until the International Accounting Standards Board (IASB) establishes final regulations, companies are urged to strive for the most accurate information.

Predicting the future value of an item remains uncertain, despite guidance provided by International Financial Reporting Standards (IFRS). Such estimations often involve

significant managerial judgment, raising concerns about potential bias. While the purpose of financial reporting is to provide relevant information for strategic decision-making, subjective estimations can mislead investors. Clear disclosure regarding the prediction of future value and the use of fair value measurement, as advocated by Barth (2006), are essential for stakeholders to understand how a company calculates its forecasts. This underscores the importance of financial statement disclosure, particularly for non-traditional investments whose values are difficult to estimate and may take time to materialize.

Non-traditional investments, such as investments in technology, pose unique challenges. With ongoing innovation in the business world, multinational companies are accumulating vast amounts of accounting data, necessitating more advanced tools for management. Research conducted by Smith (2018) suggests that adopting Accounting Information Systems (AIS), coupled with technologies such as Artificial Intelligence (AI) and Blockchain, can enable companies to efficiently integrate, store, and analyze large volumes of data, thereby enhancing their financial performance. Therefore, this research aims to analyze the relationship between a company's technology investment and its economic output.

1.2 Central research question

With this objective in mind, this paper aims to investigate the effectiveness of investments in technology and their contribution to a company's financial position. The primary research question is formulated as follows:

How do financial statements aid investors in evaluating the technologies implemented by firms to improve their economic performance?

This question serves as a guiding inquiry for investors assessing the rationale behind such investments. As previously discussed, financial statements play a pivotal role in addressing

such inquiries. Accordingly, the present research is structured around hypotheses derived from the problem statement, addressing various facets thereof, and establishing connections to elucidate how investors can utilize the information gleaned from financial reports to make informed decisions.

1.3 Relevance of the research

1.3.1 Social relevance

Financial statements serve as crucial tools for evaluating a firm's financial health and prospects. With globalization and technological innovation shaping the business landscape, the disclosure of financial reports is more vital than ever.

Transparency in financial reporting is key to fostering investor confidence and mitigating uncertainty. It is especially important in assessing the impact of technological investments, which significantly influence long-term performance.

This research aims to explore the relationship between technology and economic performance, addressing how financial statements help investors in evaluating these spendings. By investigating this intersection of financial data and technology, the paper contributes to understanding corporate efficiency in the digital age.

1.3.2 Scientific relevance

In the realm of scientific inquiry, this research holds significance as it delves into the intersection of accounting information and innovative tools, addressing the impact of technologies on companies' sale growth.

This research aims to bridge this gap by investigating the role of financial statements in providing insights into the outcomes of technology investments. This inquiry not only

contributes to theoretical frameworks in financial data but also offers practical implications for investors and industry practitioners. By exploring how these technologies can streamline data processing and improve strategic decision-making, the research offers insights into the potential benefits and challenges associated with technological innovation in the accounting field.

1.4 Paper structure

The paper is structured as follows: Chapter 2 will be dedicated to dissecting the research question into hypotheses to explore the role of financial statements and their contribution to disclosing relevant information. This will be followed by a review of past literature on the utilization of AI, Blockchain, and Electronic Data Interchange (EDI) systems to support the notion that technology indeed enhances a company's operations and output. In Chapter 3, the methodology employed in this study will be explained, including the data sources, the organization of data collection, and the design for linear regressions. Chapter 4 will present the findings and provide an overview of the methods employed. Finally, in the concluding chapter, the findings will be summarized, potential limitations and recommendations for future research will be provided.

Chapter 2. Theoretical Framework

2.1 Using financial statements for investment decisions

While companies vary in their structures, industries, and ideologies, they all share the need to systematically record transactions for internal management decisions and external reporting to interested stakeholders. Financial statements serve essential tools in this regard, guided by regulations such as U.S. Generally Accepted Accounting Principles (GAAP) and IFRS, which provides frameworks for firms to communicate their economic conditions. Investors, often external to the company, rely on financial reports to assess firm's potential. The primary financial statements used for this purpose are the Balance Sheet, Income Statement, and Statement of Cash Flows. The Balance Sheet offers insights into a company's assets, liabilities, and equity, while the Income Statement provides an overview of resource utilization. Meanwhile, the Statement of Cash Flows details the movement of cash, facilitating a deeper understanding of liquidation (Hasanaj & Kuqi, 2019).

Understanding a firm's current cash position and future cash flow predictions are crucial for strategic decision-making (Stranix, 2024). However, the complexity of operation can pose challenges in tracking these metrics. Hence, financial statements play a pivotal role in improving understanding by providing clarity on income items and expense accounts (Stranix, 2024). Hasanaj & Kuqi (2019) underscore the importance of leveraging balance sheet items to calculate financial ratios, such as Liquidity Ratio and Profitability Ratio, which offer valuable insights into a company's economic health. Additionally, financial reports boost confidence in investors by reflecting current economic conditions and offering up-to-date estimations of future growth (Barth, 2006)

Apart from financial indicators, accounting standards mandate the disclosure of non-financial

information, particularly regarding Environment, Society, and Governance (ESG) and Corporate Social Responsibility (CSR). As consumer preference evolve, organizations are increasingly expected to report their efforts in fostering ethical business practices (Poole & Sullivan, 2021). Research by Litfin et al. (2017) suggest that sustainability reports should be constructed to orient readers effectively, with embedded sustainability statements yielding positive feedback.

However, given that financial statements are prepared by employees, concerns regarding bias and inaccurate reporting arise. Cheng et al. (2021) warn of the potential for managers to manipulate financial information to obscure poor future performance, particularly in environments where such interventions are difficult to detect. Hence, a robust internal control system is essential to enhance the transparency and reliability of financial statements (Kusuma et al., 2021).

In summary, accounting statements provide both financial and non-financial information. They serve as crucial inputs for strategic movements, enabling investors to evaluate business opportunities wisely. Therefore, leveraging financial statements to assess a company's effectiveness in technology investments is a justifiable approach to answer the central research question.

2.2 Trending technologies

In the fiercely competitive modern business landscape, competition extends beyond geographical boundaries and persists over time. Globalization has compelled managers to devise long-term strategies aimed at sustaining competitiveness through continuous evolution. The outbreak of the Covid-19 pandemic further accelerated this trend, catalysing a shift to teleworking models and highlighting the imperative of digital transformation to

navigate changes in inter-company networks and customer dynamic (Mihai & Duțescu, 2022). Consequently, there has been a growing emphasis on advanced technology as a means to differentiate oneself in the market.

In order to excel amidst market participants, companies must optimize resource utilization through efficient operations. Given the paramount importance of data management and the proliferation of diverse information sources (Smith, 2018), numerous research endeavours advocate the adoption of innovative technologies such as AI, Blockchain, and Electronic Data Interchange (EDI) systems. In the subsequent section, each of these technologies will be briefly explained, focusing on their applications in the financial reporting process and their impact on firm's operations.

2.2.1 AI & Blockchain

In the past, traditional accounting software exhibited weaknesses such as limited data accessibility and the need for constant software updates, necessitating substantial initial funding and costly maintenance (Mihai & Duțescu, 2022). However, technological advancements have revolutionized the financial reporting process. Joshua et al. (2023) highlights that Computer Assisted Audit Techniques (CAAT) tools, including capacity building of IT auditors, utilization of AI and machine learning (ML) in audits, and the emergence of continuous auditing via blockchain, have significantly improved financial reporting efficiency.

A survey conducted by Boritz and Stratopoulos (2023) among over 1,000 executives revealed a consensus among business leaders and investors regarding the broad application of AI and ML. These technologies are expected to enhance efficiency, reduce risks, and fuel innovation. Blockchain, which supports digital currencies, represents another outstanding technological breakthrough, improving operational efficiency and reporting accuracy.

AI offers various applications in financial reporting. Mihai and Duțescu (2022) suggest that the use of AI in cloud-based services enables organizations to focus on core business activities without worrying about data inaccuracies, facilitating agile operations, real-time information quality, and promoting the reform of traditional accounting and auditing practices. These features improve both operational flow and external relationships.

Blockchain technology, as reported by Press (2023), is expected to increase industry security and transparency, leading to long-term cost reductions and real-time data access. Blockchain's decentralized nature eliminates intermediaries, resulting in faster data exchange and heightened transparency. Joshua et al. (2023) underscore the cost-effectiveness and reduced security risks associated with blockchain, attributing these benefits to the removal of intermediaries and the immutable nature of blockchain data.

Moreover, blockchain facilitates the storage of accounting data in real-time, enabling stakeholders to access data promptly, approve process monitoring and reconciliation. Giang and Tam (2023) agreed on the positive impact of blockchain on cooperate financial disclosure, highlighting its role in optimizing security, safety, and transparency of accounting information. They emphasize the impactful influence of information technology and employee training on blockchain adoption and its reflection on the accounting information system.

Despite the benefits, concerns regarding job displacement due to AI and data security risks from technological dependency persist (Mihai & Duțescu, 2022; Boritz & Stratopoulos, 2023). Similarly, Bonsón & Bednárová (2019) raise concerns about scalability, system structure, and cybersecurity in blockchain implementation due to its relative novelty and complexity.

In summary, despite potential risks, investments in AI and blockchain technology have proven beneficial for companies, enhancing operational efficiency, technical skill sets, and transactional data management processes.

2.2.2 Electronic data interchange (EDI) system

Another noteworthy technology employed by modern firms is the Electronic Data interchange (EDI) system. EDI serves as an electronic communication network that facilitates the exchange of transaction data and documents in standardized formats, enabling computer applications software to process them (Truong, 2005). Empirical evidence from various academic studies demonstrates a positive association between the adoption of EDI systems and firms' performance.

In a study by Nicolaou (2002), the application of EDI systems within the existing Cost Management System (CMS) was examined. The results not only indicated that CMS operates optimally when integrated with EDI systems, but also highlighted as significant association between EDI adoption in financial accounting and increased CMS utilization to support decision flow, particularly in organizations with flexible cost structures. Similar, Anderson and Lanen (2002) found that EDI systems accelerate transaction processes, even for complex orders. They analysed over 1.5 million office furniture orders from at least 500 dealers, their research revealed that EDI adoption mitigates most negative activities during the ordering process. Though it highlighted challenges in the error detection due to automated monitoring, the longer EDI usage was correlated with decreased error occurrence, which indicating technology adaptation over time.

Furthermore, the application of EDI system is found to be linked with a firm's organizational structure. Arunachalam (2004) evaluated EDI impacts across different organizational forms

using key performance indicators (KPIs) such as independence, saturation, and satisfaction. Their findings suggested that decentralized structures are associated with higher independence, lower saturation, and greater satisfaction in task performance, ultimately contributing to superior EDI implementation. This result is further influenced by greater IT investment intensity and longer EDI usage period.

The introduction of EDI systems yields multiple benefits across various business aspects. Firms are motivated to adopt them due to their fast, efficient, and accurate means of exchanging transactional data. Truong (2005) suggested that EDI systems not only reduce capital costs in the long run but also enhance optimal inventory policies, as evidenced by empirical research. Thus, the adoption of EDI systems represents a valid strategy to add value to the operation.

2.3 Hypotheses

To address the main research question, **"How do financial statements aid investors in evaluating the technologies implemented by firms to improve their economic performance?"**, the theoretical framework is structured into two hypotheses aimed at addressing different sides. Drawing upon insights from previous research and investors' practices, it is proven that financial statements provide investors with the necessary information, encompassing both financial data and non-financial considerations.

The paper further evaluates technological utilization and intends to employ financial reporting. As established in the preceding sections, the empirical evidence supports the notion that the adoption of AI, Blockchain, and EDI systems enhances operational efficiency and contributes to improved revenue earned. Thereafter, the first hypothesis is formulated:

Hypothesis 1 (H1): The investment in technology exhibits a positive relationship with revenue recongnized.

Moreover, it is assumed that prolonged implementation of these technologies has a more significant impact on firms' operations, both in terms of systems and employee skillsets. Consequently, the second hypothesis is formulated as follows:

Hypothesis 2 (H2): The intensity of technology investment is positively associated with the reduction in operational costs.

By utilizing information extracted from financial statements to test these hypotheses, the goal is to provide evidence that by analyzing financial data, it enables visualization of effectiveness of technologies introduced. In the subsequent chapter, the methodology and variables utilized for testing these hypotheses will be elaborated upon.

Chapter 3. Research Methodology

3.1 Research goal

The primary objective of this study is to evaluate the effectiveness of companies' investments in technology adoption by utilizing financial data. Past papers showed that investors can monitor the proper usage of funds through financial data obtained from reporting statements. This study, therefore, justifies the collection of numerical data from firms' annual reports as the foundation for the research methodology.

To identify suitable proxies for assessing technological applications, two hypotheses have been formulated, as explained in Chapter 2. These hypotheses examine the relationship between technology investments and revenue, as well as the periodic impact of such investments related to operating expenses.

3.1.1 Hypothesis 1: R&D expense and Revenue

To address the first hypothesis, a linear regression analysis will be performed to examine the correlation between Research and Development (R&D) expenditure and revenue. This will determine whether higher R&D spendings correlate with increased revenue. Pan et al. (2021) considers technological innovation due to investments in technology infrastructure and R&D personnel, thus validating the use of R&D expenses as a proxy for technology investment.

3.1.2 Hypothesis 2: R&D expenses growth and Operating expense reduction

For the second hypothesis, a linear regression will also be used. The study will employ time series data from 2010 to 2020 to calculate the annual growth, examining the annual increase in R&D investment and the corresponding annual reduction in operating costs. To accurately reflect yearly growth, the variables will be structured in a panel dataset, measuring the difference between consecutive years (e.g., 2010 to 2011, 2011 to 2012, et., up to 2019

2020).

3.1.3 Control variables

In addition to the primary dependent variables—Revenue and the reduction level in operating expenses—three control variables will be included in the regression models. Following a similar research approach by Osei-Bryson and Ko (2004), who examined IT investment and firm performance, they indicated that the number of employees might play a crucial role for each firm's strategy in technological application. In addition, this study will also include return on asset and debt ratio variables to account for potential deviations.

The rationale for these variables is that the different financial size of companies may exhibit incomparable technological characteristics, and a firm's workforce can influence its capability to adopt and invest in innovative tools.

Lastly, to have even better predictions, two fixed effects are considered, reporting fiscal-year (fyear) and Standard Industrial Classification Code (SIC).

3.2 Data collection

The data for this research is sourced from the Wharton Research Data Services (WRDS), which provides access to comprehensive financial data. Specifically, the accounting items of companies can be retrieved based on detailed search criteria, including the most recent updates of recorded transactions. This study inputs data from the Compustat-Capital IQ section of WRDS, focusing on the North American region due to the potential variations in policies, taxation, and other regional factors.

To test the hypotheses, three primary financial items are targeted: Revenue (revt), Operating Expense (xopr), and Research & Development Expense (xrd). Additionally, to incorporate the three control variables, the number of Employees (emp) is used, return on asset (roa) is calculated by net income (ni) divided by total asset (at), and the debt ratio is derived by the

sum of Debt in current liability (dlc) and Long-term debt (dltt), divided by the total asset. Furthermore, fixed effects using the Standard Industrial Classification Code (sic), and the reporting fiscal-year (fyear) are considered in the regression as well.

The timeframe for this study is selected to capture the most current trends and to facilitate a decade-long analysis. The accounting records are set for the year 2020, with the most recent recording data available. To analyze the effects over a 10-year period (as required for Hypothesis 2), the year 2010 is included. By constructing a panel dataset based on companies and years (2010-2020), the growth and changes in the specified financial items can be observed on biennial basis.

Finally, the statistical software STATA will be used to organize and analyze the selected data. The descriptive statistics and the results of the analysis will be discussed in the next chapter.

3.3 Linear regression design

To test the first hypothesis regarding the relationship between R&D expenses and revenue, a linear regression model will be constructed. Using the statistical software STATA, the logarithms of R&D expense will be set as the independent variable, and the logarithms of revenue will be the dependent variable, both calculated by Log (1 + variable). Additionally, to account for variations in technology capabilities due to company natures, employee size, return on asset and debt ratio will be included as control variables, same as the fixed effects (sic and fyear)

The regression formula is constructed as follow:

$$\underline{log\_revt = Constant + \beta 1 * log\_xrd + Control\ variables * (emp + roa + debt\_ratio) + i.sic + i.fyear + \epsilon}$$

Where Revenue (log_revt) is the dependent variable, ***Constant*** represents the intercept

coefficient, ***β1*** indicates the effect of R&D Expense (log_xrd), and control variables ***(Control variables)*** for employee size, roa, and debt_ratio, respectively. ***i.*** shows the fixed effect on both SIC and fiscal year. Lastly, ***ϵ*** is the error term, capturing the variability in the dependent variable not explained by the model.

For the second hypothesis, the effect of the increase in R&D expenses on the decrease in operating expenses will be evaluated. A similar regression model will be designed, with the dependent variable being the difference in operating expenses from 2010 to 2020 (diff_xopr, etc. $xopr_{2011} - xopr_{2010}$), and the independent variable being the increase in R&D expenses over the same period (diff_xrd, etc. $xrd_{2011} - xrd_{2010}$). The control variables and fixed effects remain the same as in the first hypothesis.

The regression is formulated as follow:

diff_xopr = Constant + β1* diff_xrd + Control variables* (emp + roa + debt_ratio) + i.sic + i.fyear + ϵ

These regression models will help to determine the impact of technology adoption on company performance, providing insights into the effectiveness of such investments. The results of the regression and descriptive data will be discussed in the next chapter, and the tables are provided in Appendix 2.

Chapter 4. Results

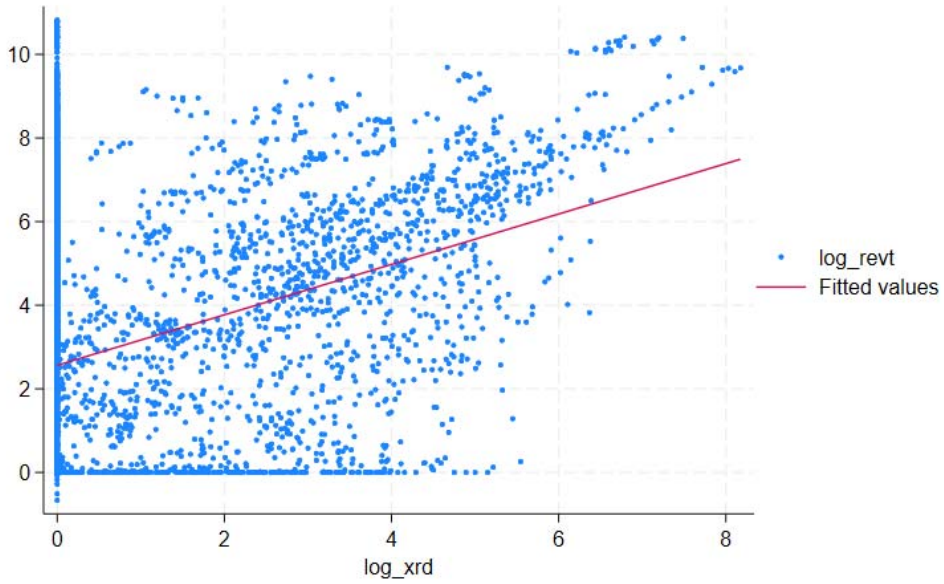
As discussed in the previous chapters, two hypotheses have been formulated to examine the importance of R&D expenses to a firm's performance. Data sourced from the WRDS database included the targeted variables, Revenue (revt), Operating Expense (xopr), and Research & Development Expense (xrd), in addition to employ size (emp), ROA, debt ratio and SIC (sic) as to control potential deviations. Detailed explanation of the variables can be found in Appendix 2, Descriptive data overview

After organizing the data retrieved, and removing errors, one important process in selecting the useful company items is to focus on the ones that do possess 10 years frame of accounting records, particularly for the second hypothesis. Furthermore, to make the data mathematically better treated, a log(1+x) formula is applied to the Revenue (revt) and R&D expense (xrd) for the first test. This is due to the fact that the companies' data might be hard to compare with one another, and such treatment can lead to improving linearity, addressing the zero values without resulting in undefined data, and handling skewed numbers. The results can also be easily interpreted in the percentage point, which makes the regression analysis more presentable.

Finally, the data set used for the later research contains 7,106 companies for the first regression, and 6,387 (gap between each observed year) data points for the second hypothesis. The detailed descriptive data summary can be found in Appendix 2 Table 1. One thing worth noticing is that in the Correlation table (found in Appendix 2 Table 2), around half of the variables are significantly correlated with each other, which supports the reasoning of choosing these variables for the regression.

4.1 Hypothesis 1: Revenue vs. R&D expense

The first hypothesis examines the linear regression relationship between Revenue and R&D expenses. The analysis reveals a significantly positive relationship between these two variables, as illustrated in Graph 1.



Graph 1. Regression graph for H1:

log_revt = Constant + β1* log_xrd + Control variables* (emp + roa + debt_ratio) + i.sic + i.fyear + ϵ

From the summary of the regression analysis provided in Table 3 (Appendix 2), it once again provides evidence of the significantly positive relationship between the two variables. After controlling for potential deviation, the R&D expenses on Revenue is calculated and has a 0.704 coefficient effect. This implies that each one-unit increase in R&D investment leads to a 70.4% growth in Revenue earned.

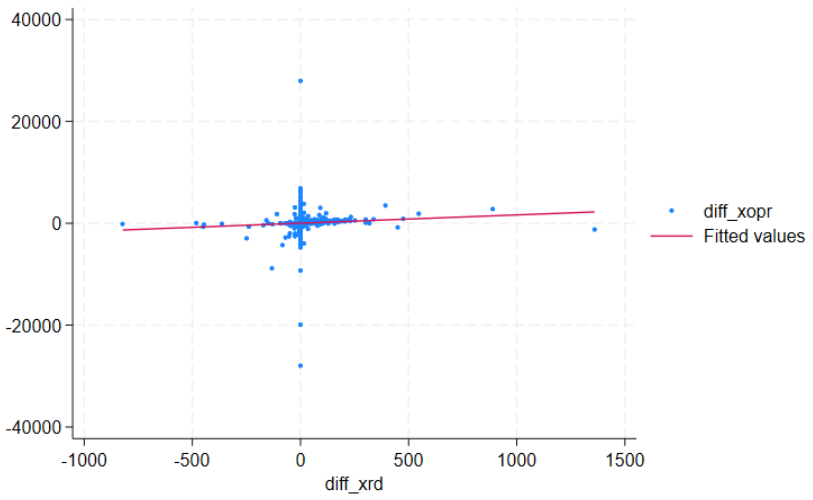
Importantly, all variables in the regression model are statistically significant at 1% level (except for roa), which reinforces the robustness of the findings. Nevertheless, the adjusted R-square value indicates that the model explains around 60% of the variability in Revenue.

This suggests that R&D expenses are a significant predictor for more than half of the Revenue account in this dataset.

4.2 Hypothesis 2: Operating vs. R&D expense

The second hypothesis explores the impact of R&D expenses on operational costs. To analyze this, the dataset was structured into a panel data format spanning a ten-year period from 2010 to 2020. Yearly differences were tracked to examine the pattern of changes in firms' operational efficiency over time. Each firm's R&D and operating expenses were recorded annually, and a new variable was created to capture the year-over-year changes (e.g. 2011 minus 2010, 2012 minus 2011, …, 2020 minus 2019). This allowed the research to observe the relationship between the increased level of R&D expenses and the change in operating costs.

The analysis results, depicted in Graph 2, do not indicate a clear pattern between R&D expenditure and operational spending. Although the general trend line suggests a slightly positive effect, this does not adequately explain most of the observations. Table 4 in Appendix 2 provides a detailed summary of the regression analysis for this hypothesis.



Graph 2. Regression graph for H2:

diff_xopr = Constant + β1* diff_xrd + Control variables* (emp + roa + debt_ratio) + i.sic + i.fyear + ϵ

The regression analysis shows a coefficient of 1.534 for the increased level of R&D expenses. For control variables, only emp is significant at 1% level, the rest are all statistically insignificant. Despite the effect of the independent variable being significant, the adjusted R-square value indicates that only 2.4% of the variability in decreasing level of the operational costs can be explained by the model. This suggests that most of the data do not support the hypothesis, highlighting the limited explanatory power of R&D expense increased on the deduction of operational costs within this dataset.

In summary, the first hypothesis confirms that R&D expenditure presents a positive influence on the revenue generated. So, regression is accepted. However, as for hypothesis 2, the result shows a weak effect of the yearly increase in R&D expense related to the decreasing level of operating costs. Moreover, the adjusted R-square also indicates an insufficient explanatory power of the independent and control variables. Thus, the second hypothesis is rejected in this study.

Chapter 5. Conclusion

Companies who want to stand out among the competition in the industry often seek opportunities to invest in. Nowadays with beneficial technologies, various applications can improve a firm's performance in different magnitudes. As this paper introduces, the usage of AI, Blockchain, and EDI system have been proven by many researchers that they indeed enhance the company's sale growth, in an individual case. In the spirit of such investments, this study has drawn up data from WRDS database of 7,106 companies (6,387 data points for the second hypothesis) located in North America and conduct two hypotheses to test the relationship between investment in innovative technologies and its effectiveness for one's performance. The two hypotheses made are the relationship between R&D expenses to Revenue and the increase in R&D spending to the deduction of Operating account.

In the first hypothesis, where test the result of Research & Development expense affects a firm's revenue generated, the regression shows a significantly 0.704 coefficient. Thus, the hypothesis is confirmed, and indicates that each one unit increase in the R&D investment can lead to a 70.4% raise in the revenue realized.

For the second regression, the result, however, does not show a strong enough effect of the increase in R&D expenditure on lowering its operating costs. The statistical analysis presented insignificant coefficients and low explanatory power. The trend line also does not give a clear direction between the two variables. Therefore, the paper rejects the second hypothesis.

So, to answer back to the central research question:

How do financial statements aid investors in evaluating the technologies implemented by firms to improve their economic performance?

Investors can use the published accounting items as proxy to examine the relationship

between the record of those items related to the technology application. In this study, mainly the R&D expense has been used to reflect the two performance indicators, revenue and reduction in operational expenses.

However, the greatest limitation of this research to be pointed out, is the only usage of R&D expense as the proxy for the entire technology investment. Due to the difficulty of finding specific investment in either AI, Blockchain, or EDI systems, the research has adopted R&D costs to present the possible inputs in these innovative costs. R&D expenses can be used for multiple purposes that may not necessarily only for advanced tool spending, so it might contain some deviations in examine the research goal. But, as suggested by Pan et al. (2021), investments in technology infrastructure and R&D personnel can be justified to use in a broader context.

For future research, to be more accurate, the recommendation is to use more specific items to test the relationship. For instance, the sole effectiveness of adopting EDI system, by investigating exactly the monetary unit invested in this system, one can conclude with better estimation in the adoption of such technology. Nevertheless, the goal of this paper is to provide evidence that technology investments have been shown to have positive outcome for a firm’s performance, learned from the information in financial statements.

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Appendix 2. Tables & Graphs

Table 1

Descriptive data overview

	N	Mean	SD	p25	Median	p75
gvkey	7106	121007.05	80870.430	19458	165691	186883
fyear	7106	2015.04	2.930	2013	2015	2018
log_revt	7106	2.998	3.066	0	2.581	5.697
log_xrd	7106	.721	1.509	0	0	.057
diff_xrd	6387	2.477	33.244	0	0	0
diff_xopr	6387	23.119	699.768	-.042	0	13.958
emp	7106	2.564	14.364	0	.011	.56
roa	7106	-6.256	355.527	-.1	0	.012
debt_ratio	7106	1.302	26.349	0	.035	.331
sic	7106	50.017	22.620	28	60	67

Note. gvkey = Global Company Key, fyear = Fiscal year, log_xrd = Logarithm of 1 + R&D expense, revt = Logarithm of 1 + Revenue-total, diff_xrd = Gap between each year of R&D expense, diff_xopr = Gap between each year of Operating expense, emp = number of employees, roa = Return on Asset, debt_ratio = total debt divided by total asset, sic = Standard Industry Classification Code

Table 2

Correlation table

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) gvkey	1.000									
(2) fyear	0.026	1.000								
(3) log_revt	**-0.435**	0.029	1.000							
(4) log_xrd	**-0.259**	**0.050**	**0.297**	1.000						
(5) diff_xrd	**-0.041**	0.003	**0.080**	**0.250**	1.000					
(6) diff_xopr	-0.020	-0.024	**0.051**	0.029	**0.077**	1.000				
(7) emp	**-0.115**	-0.007	**0.338**	**0.093**	0.013	**0.110**	1.000			
(8) roa	-0.008	0.002	0.017	0.005	0.001	0.001	0.003	1.000		
(9) debt_ratio	0.005	0.027	**-0.036**	-0.017	-0.003	-0.001	-0.007	**-0.044**	1.000	
(10) sic	**0.157**	0.029	**-0.140**	**-0.151**	0.004	0.008	-0.004	-0.006	-0.020	1.000

Note. Bolded correlations are significant at the 0.01 level.

Table 3

Linear regression for Hypothesis 1.

Dependent variable =	*log_revt*
	(1)
log_xrd	0.704***
	(0.023)
emp	0.037***
	(0.002)
roa	0.000
	(0.000)
debt_ratio	-0.004***
	(0.001)
Constant	3.236***
	(0.703)
sic F.E.	Yes
fyear F.E.	Yes
Observation	7,106
Adj. R-square	0.599

Table 3 presents the results from estimating the following linear regression:

$$log\_revt = Constant + \beta 1 * log\_xrd + C1 * emp + C2 * roa + C3 * debt\_ratio + \epsilon$$

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Table 4

Linear regression for Hypothesis 2.

Dependent variable =	*diff_xopr*
	(1)
diff_xrd	1.534***
	(0.264)
emp	5.179***
	(0.694)
roa	0.000
	(0.023)
debt_ratio	0.035
	(0.317)
Constant	60.921
	(261.700)
sic F.E.	Yes
fyear F.E.	Yes
Observation	6,387
Adj. R-square	0.024

Table 4 presents the results from estimating the following linear regression:

$$Diff\_xopr = Constant + \beta 1 * Diff\_xrd + C1 * emp + C2 * roa + C3 * debt\_ratio + \epsilon$$

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Appendix 3. List of Abbreviations

Abbreviation	Definition
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
AIS	Accounting Information Systems
AI	Artificial Intelligence
EDI	Electronic Data Interchange
GAAP	Generally Accepted Accounting Principles
ESG	Environment, Society, and Governance
CSR	Corporate Social Responsibility
CAAT	Computer Assisted Audit Techniques
IT	Information Technology
ML	Machine Learning
CMS	Cost Management System
KPI	Key Performance Indicator
R&D	Research and Development
WRDS	Wharton Research Data Services
ROA	Return On Asset
SIC	Standard Industrial Classification Code
STATA	A statistical software