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Doctoral Thesis

Stock Market Crises and Their Effects on Investors, and Financial Markets: Insights from Global Events.

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Declaration of Authenticity and Author's Rights

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Signed: 

Date: 25th April 2025

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The first chapter of this thesis has been accepted and is scheduled for publication in the October 2025 issue of The Journal of Investing - Publisher: Portfolio Management Research. The title of the first chapter is ***''The Impact of Stock Market Crises on Local and Global Safe-haven Assets; Evidence from Global Financial Crises (GFC) 2008, COVID-19 pandemic and Russia-Ukraine Conflict 2022.''***

The thesis has also benefited from discussions and comments from the seminars and conferences.

Previously, I Attended and Presented My Research in the Following Conferences:

- 6th Doctoral School Multidisciplinary Symposium (DSMS) 2024, Conference at DSMS Strathclyde University, Glasgow, Scotland, UK (27/11/2024 – 29/11/2024).
- British Accounting & Finance Association (BAFA) Doctoral Colloquium - 2024 Corporate Finance & Asset Pricing SIG Annual Conference on 06/09/2024 at Greenwich Business School, University of Greenwich, Old Royal Naval College, Park Row, London, England, UK. I received £50 PhD Registration Grant from BAFA to attend this conference in person.
- 17th International Accounting & Finance Doctoral Symposium (IAFDS) 2024 at the Parthenope University (Università degli Studi di Napoli Parthenope), Naples, Italy (14/06/2024 – 18/06/2024).

- British Accounting and Finance Association (BAFA) Scotland doctoral Colloquium on 24/11/2023 at Queen Margaret University Edinburgh 2023, Scotland, UK.
- Doctoral School Multidisciplinary Symposium Horizons (DSMS) 2023 on 14/06/2023 – 16/06/2023 at University of Strathclyde Glasgow, Annual PGR Conference 2023 at the University of Strathclyde Glasgow, Scotland, UK.

Through this acknowledgement, I express my heartfelt gratitude to my Parents and siblings for being the backbone for my success and for encouraging and supporting me to achieve PhD degree. I cannot repay my family in any possible way for whatever they have done for me. I am successful because of their supportive decisions for my life. A huge thanks to my family for all this.

Introduction of PhD Thesis (Chapters One, Two and Three)

Assets and stocks are affected by the volatility and crises in financial markets. This thesis is driven by the strong interest in identifying the impact of stock market crises on Financial Markets and Investors. As opposed to previous studies based on a single firm, single country, single case study, and a single technique, this thesis is based on five different natures of crises to show the big picture by comparative analysis.

The collection of three studies tries to explore the effect of volatility on various assets and stocks during different financial market crises and which assets and stocks can maintain their value as a safe haven or a hedge during three financial market crises including

1) **Global Financial Crises (GFC) in 2007–2008** that happened due to financial system failure in the USA,
2) **The COVID-19 pandemic in 2019,** which was a worldwide pandemic,
3) **The Russia- Ukraine Conflict in 2022,** which is a political war,
4) **The Monkeypox (MPX) global outbreak in 2022,** which is a pandemic, and
5) **The Federal Reserve's Quantitative Easing (QE) program,** which was the US government action or policy intervention in response to the GFC 2007–2008.

Chapter One:

This chapter, already scheduled for publication in the Journal of Investing, provides a comparative analysis of the performance and volatility of assets and stocks during the Global Financial Crisis (GFC) in 2008, the COVID-19 pandemic, and the Russia- Ukraine conflict in 2022. This chapter used daily data (1 January 1990 – 13 May 2022). The purpose of using daily data is to observe short-term, day-by-day changes. Besides the GFC 2007-08, COVID-19, and the Russia-Ukraine War 2022, the period from 1990 to 2022 also covered the dot-com bubble, where many people invested in internet companies expecting high returns, which caused stock prices to increase. However, firms could not generate profits, and investors sold their assets and stocks to recover their money. Consequently, stock prices suddenly decreased, causing the bubble to burst. This chapter includes six assets and ten stocks. To address volatility, the GARCH methodology (univariate and multivariate) is used. The basic idea of this research is that if there's a negative

correlation between assets and stocks, then investors can benefit from portfolio diversification. However, if assets and stocks are positively correlated, investors should invest in safe haven and hedged assets and stocks. Chapter One used various methodologies to identify which assets and stocks have the potential to act as hedges and safe havens during financial crises. To address hedging effectiveness (HE), four HE techniques are used: the HE formula method, the OLS method, the portfolio method, and the GARCH-in-mean method. The results showed that gold and silver can be considered safe haven assets because of their hedging properties, even during global crises. Furthermore, gold and silver tend to reduce volatility and can generate higher returns.

Chapter Two:

The objective of chapter two is to explore whether the Monkeypox (MPX) 2022 global outbreak has any impact on the firm's average stock returns. Daily data of MPX for 110 countries (01 May 2022 – 10 Nov 2022) and daily data of 59 countries' average stock returns are used. Because 52 countries' stock returns data was missing. Daily data is used to show the short-term changes day by day. The difference-in-differences (DID) methodology has been used to identify the causal relationship. This chapter focuses on the performance of these stocks during three phases which are: Before MPX (01–01–2021 to 30–04–2022), During MPX (01–05–2022 to 10–11–2022), and After MPX (11–11–2022 to 30–04–2023). This study's findings reveal that the stock returns are not highly affected by MPX.

Chapter Three:

This chapter aims to identify the outcome of implementing the Quantitative Easing (QE) program. This chapter provides a comparative analysis of whether the financial constraints of US financial and non-financial firms will increase or decrease specifically because of the implementation of QE. Annual data (1990 – 2023) is used to show the long-term changes over the years. The difference-in-differences (DID) methodology has been used to identify the causal relationship. The findings of this chapter show that because of the implementation of QE, financial firms have easy access to finances and tend to face fewer financial constraints in accessing the funds as compared to non-financial firms.

Practical Implications of Chapters One, Two and Three:

This thesis provides learning lessons to build a better model to predict the future. It also provides important implications for the following stakeholders.

- **For Investors:** To make informed investment decisions
- **For Policymakers:** To develop better policies
- **For Government:** To take necessary actions to control too big-to-fail situations.
- **For Managers:** To prepare useful strategies
- **For Firms:** To understand the factors affecting stock prices.
- **For Researchers:** For a better understanding of analysis and future directions.

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increased volatility. Table 4.1 provides insights into how volatility, stock size, and the nature of news (positive or negative) influence stock or asset returns. The statistical significance of the p-values for the volatility effect, as presented in Table 4, determines whether volatility affects the stock or asset returns. Additionally, Table 4.1 reveals the impact of big and small stocks on volatility, as indicated by the size effects (+/–) ARCH (α) values shown in Table 4. Furthermore, Table 4.1 examines how positive and negative news affect volatility, utilizing the effects (+/–) GARCH (β) values from Table 4. The results of each variable are shown in section 1.3 Results and discussion (page 38).

5. Table 5 expresses the results of Multivariate models (DCC and BEKK Models). Table 5.1 shows the Heteroskedasticity (ARCH) test results, Table 5.2 represents DCC GARCH Model results, and Table 5.3 demonstrates BEKK Model results. The results are discussed in section 1.3 Results and Discussion (page 39).

6. Table 6 displays the results of 4 different techniques of hedging effectiveness. Tables 6.1 and 6.3 show the GARCH-in-Mean results and the OLS method, respectively; both tables categorized the 16 variables as hedged assets against risk and unhedged assets against risk. Table 6.2 displays Hedging effectiveness Formula techniques that represent a specific percentage of reduction of investment risk because of adding each asset to the portfolio. Furthermore, Table 6.4 demonstrates the Portfolio method results that show each stock weight (w), each stock's total average return (μ) and variance, and the covariance matrix for 16 stocks and assets, 10 stocks and 6 assets. It also represents a comparative analysis based on the portfolio method. The results of Tables 6, 6.1, 6.2, 6.3, and 6.4 are discussed in section 1.3 Results and discussion, page 42).

7. Table 7 displays the mean and variance of the portfolio of 1 stock (France) with one precious metal (Gold) versus 2 stocks only (France and USA). Furthermore, this table also shows 10 10-asset portfolios, versus 6 6-precious-asset assets portfolios, versus all-asset and stocks portfolio. Furthermore, Table 7.1 shows a comparative analysis of all 16 assets based on the hedging effectiveness of four techniques. Meanwhile, by considering the conditional

variance graphs, Table 7.2 shows the volatility analysis of all 16 variables during the 3 financial market crises that we observed in our study (the Global Financial Crises of 2008, COVID-19, and the Russia-Ukraine conflict, 2022). The results of Tables 7, 7.1, and 7.2, in more depth, have been discussed in section 1.3 Results and discussion (page 47).

8. Table 8 (page 81) reflects all equations and models along with references that we employed in this study. This represents ARCH 1,1, GARCH 1,1, Threshold GARCH/ GJR GARCH, EGARCH, and GARCH in Mean models.
9. Table 9 represents the correlation results. *TAR* (treated group average returns), *CAR* (control group average returns), *IR* (Interest Rate), *MC* (Market Capitalization), *NS* (Net Sales), *TA* (Total Assets), *TC* (Total Capital), *TD* (Total Debt), and *SHE* (Total Shareholders' Equity). The results are discussed in section 2.3 Results and Discussion (page 95).
10. Table 10 represents four models, including 120,812 observations to examine the behavior of the average stock market because of the Monkeypox event. Models 1 and 2 show the impact with a 99% confidence level without control variables and with control variables, respectively. Similarly, Models 3 and 4 show the impact with a 95% confidence level without control variables and with control variables, respectively. The results are discussed in section 2.3 Results and Discussion (page 95).
11. Table 11 shows the VIF analysis. To address multicollinearity, we calculate the variance inflation factors (VIFs) for the *Total Asset, Market Capitalization, Net Sales, Interest Rate, Treated Average Returns and Control Average Returns.* The results are discussed in section 2.3 (page 98).
12. Table 12 shows how average returns are affected before and after the MPX event by using the DID estimation method. $\beta_{0\ (Before\ MPX)}$ represents the trend or gains over time ''before the treatment'' (MPX). The control group has a dummy value of 0 if the country is less/not affected by MPX, while the treated group has a dummy value of 1 if the country is more affected by MPX. The coefficients of the β_0 (average returns) show the average outcome of the control group does not change during the post-treatment period (QE), and the difference between the control and treated groups is 0. It shows that the DID model holds because of the parallel trend assumption

existence, which states that before treatment (Monkeypox) happened, there was a constant difference between the treated group (countries affected by MPX) and the control group (countries not affected by MPX) over time. Furthermore, it is also an indication that there is no impact of MPX on Average returns before the MPX outbreak for the control and treated group from 1st Jan 2021 to 30 Apr 2022 because there is no MPX outbreak in that duration. Table 12(a) shows the event study methodology results. The results are in section 2.3 results and discussion (page 98).

13. Table 13 shows the outcome of two-sample t-tests with equal variance in model 1 and unequal variance in model 2 for testing the return differences. According to the outcomes, models 1 and 2 show the same results, where the mean difference between the two groups (control group and treated group) is 0.0220917. Hence, we accept our H_0 that also supports the results that there is almost no difference between the *Control Group* and *Treated Group*, and parallel trend assumption holds here. The null Hypothesis (H_0) of this table states that the difference between the control group and the treated group is equal to 0; however, the two-sided alternative hypothesis (H_A) states that the difference between the control group and the treated group is not equal to 0. We have a t-statistics value for our test as 1.0036 while the Two-side p-value is 0.3156. Standard error values in Models 1 and 2 are approximately 0, showing there is very minor or no difference between actual and estimated values of the regression line. Results in detail are discussed in section 2.3 Results and discussion (page 100).

14. Table 14 reports a one-way ANOVA test for the Control group and the Treated group for three phases as follows: *Before MPX*, *During MPX*, and *After MPX*. In Model 1, the average stock return before MPX is 0.0198, which is higher than the average stock return. During MPX (–0.000093) and after MPX (0.000262). It shows that the MPX event has a negative impact on average stock returns (–0.000093) during the MPX phase. Furthermore, after MPX, stock returns (0.000262) followed a little recovery but are still less than the stock returns (0.019829) before the MPX event. *Treated Groups* are the firms belonging to those countries which are highly affected by MPX while *Control Groups* are the firms belonging to those countries which are less affected by MPX. The average stock returns of the treated group are 0.000238, which is lower than the average stock

returns for the control group (0.013094). It means the countries which are highly affected by MPX (Treated group countries) have lower average stock returns as compared to the countries which are less affected by MPX (Control group countries). Results in detail are in section 2.3 (page 100).

15. Appendix A (page 112) shows the total of 110 countries' names that are included in this study specifically for Monkeypox total cases, dummy variables, and their interaction term. *Panel A* countries are the *Control Group* because these countries are less affected by MPX (MPX cases are between 0 – 736) while *Panel B* countries are the *Treated Group* because these countries are highly affected by MPX (MPX cases are between 760 – 6,471,492).
16. Appendix B (page 113) shows a total of 59 countries' names that are included in this study (specifically for the stock returns data and control variables data) after dropping 52 countries because of missing data. *Panel A (Control Group)* countries are less affected by MPX (MPX cases are between 18 – 736), while *Panel B (Treated Group)* countries are highly affected by MPX (MPX cases are between 893 – 2,205,809).
17. Appendix C (page 114) shows *Panel A (Control Group)* and *Panel B (Treated Group)* data of total MPX cases and total per million MPX cases to control the population effect, dummy variables, and their interaction term for 110 countries. The whole data is arranged in ascending order according to the total MPX cases. Dummy variables are created according to MPX total cases for 110 countries collected from https://ourworldindata.org/explorers/monkeypox. Variable Year = β_2 is a dummy variable that has a value of 0 Before MPX (Before MPX) and a value of 1 After MPX (Aft MPX). For Total MPX cases Before MPX, all cases are 0 because no country was affected, while After MPX, total cases are collected from www.ourworldindata.org and mentioned in the table below. Treatment (T) = β_1 is another variable that has a value of 0 if the country is less affected or not affected by total MPX cases (control group) that is *Panel A* and it has a value of 1 if the country is highly affected by the total MPX cases (Treated Group) that is our *Panel B*. Here, countries 1 to 56 are less affected by MPX, as shown in *Panel A,* while countries 57 to 110 are highly affected by MPX shown in *Panel B*. The last variable β_1*β_2 is the combined effect of β_1 and β_2.

18. Appendix D (page 156) shows the KZ Index formula, the variables used in KZ calculation, the definition of variables, and their COMPUSTAT's item numbers with references.
19. In Appendix E (page 157), we investigate the effect of QE (independent variable) on financial constraints (dependent variable with and without control variables. Appendix B below shows the variables used in this study and their formulas with references. The variables used in this study are Independent Variables (IVs), a Dependent Variable (DV), and Control Variables (CVs). COMPUSTAT item numbers of these variables used are displayed in Appendix F.
20. Appendix F shows the COMPUSTAT item numbers of all variables used in this chapter (pg. 158).
21. Appendix G: Data Values to Draw Graph shown in Fig 3 KZ Index graph for USA financial and non-financial firms (page 159).
22. Appendix H: The calculation of the KZ Index of USA financial and non-financial firms (page 160).
23. Table 15 represents the summary statistics for the US financial firms and non-financial firms for the period from 1990 to 2023. The results are in section 3.3 Results and Discussion (page 136). Log (F_KZ) is the log of a financial firm's KZ index, while log (NF_KZ) is the log of a non-financial firm's KZ index. The mean value of the KZ index is lower for financial firms (–0.0029) than non-financial firms (0.0008), which shows that financial firms are less financially constrained than non-financial firms. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is a dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). If firms are affected by QE, then they are considered as a Treat group; otherwise, they are considered as the control group. Post*Treat is an interaction term, which is our Difference-in-Difference. Control variables are included in this study as follows: Tobin's Q, Firm Size, Current Ratio, Return on Asset,

Tangibility, Leverage, and Interest-to-Debt Ratio. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F.

24. Table 15 (a) represents the summary statistics for each variable concerning overall, between and within the US financial firms, including the period from year 1990–2023. The results are in section 3.3 Results and Discussion (page 137). Log (F_KZ) is the log of the financial firm's KZ index. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). If firms are affected by QE, then they are considered as the Treat group; otherwise, they are considered as the Control group. Post*Treat is the interaction term, which is our Difference-in-Difference. Control variables are included in this study as follows: Tobin's Q, Firm Size, Current Ratio, ROA, Tangibility, Leverage, and Interest-To-Debt Ratio. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F.

25. Table 15 (b) represents the summary statistics for each variable overall, between and within the US non-financial firms, including the period from the year 1990 to 2023. The results are in section 3.3 results and discussion (page 137). Log (NF_KZ) is the log of the non-financial firm's KZ index. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). If firms are affected by QE, then they are considered as the Treat group; otherwise, they are considered as the Control group. Post*Treat is the interaction term, which is our Difference-in-Difference. Control variables are included in this study as follows: Tobin's Q, Firm Size, Current Ratio, ROA, Tangibility, Leverage, and Interest-to-Debt Ratio. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F.

26. Table 16 (a) represents the variance inflation factor (VIF) results for capturing the impact of multicollinearity for the US financial firms and non-financial firms. All values are below 5, which shows that there is no multicollinearity issue in the data and variables. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of Difference-in-Differences. Various control variables are used such as Tangibility, Tobin's Q, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. The results are in section 3.3 results and discussion (page 140). All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Tables 16 (b) and 16 (c) show white test and ADF test results, respectively.

27. Table 17 represents the Difference-in-Differences regression results with and without control variables for the US financial firms and non-financial firms for the period from the year 1990 to 2023. The results are in section 3.3 Results and Discussion (page 141). Columns 1 and 2 show the impact of QE with and without controls on the KZ index (financial constraints) for the US financial firms. Similarly, Columns 3 and 4 show the impact of QE with and without controls on the KZ index (financial constraints) for the US non-financial firms. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of difference-in-difference. Various control variables are used such as Tangibility, Tobin's Q, Firm Size, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F.

28. Table 18 represents the Difference-in-Differences regression results with fixed effects, including control variables for the US financial firms and non-financial firms for the period from the year 1990 to 2023. The results are in section 3.3 Results and Discussion (page 146). Column 1 shows the impact of QE with fixed effect, including control variables on the KZ index (financial constraints) for the US financial firms. Similarly, Column 3 shows the impact of QE with fixed effect, including controls on the KZ index (financial constraints) for the US non-financial firms.

KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of difference-in-difference. Various control variables are used such as Tangibility, Tobin's Q, Firm Size, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F.

29. Table 19 (page 147) signifies the overall results of Chapter 3, which highlights financial firms as less financially constrained than non-financial firms.

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1. Figure 1: This figure (page 48) shows the conditional variance of all 16 variables of this study during GFC, 2008, COVID-19, and the Russia- Ukraine War, 2022. FR represents France, SMI is the Swiss Market Index, KSE is the Karachi Stock Exchange, DE represents Germany, RU shows Russia, UA represents Ukraine, CN is China, BTC is bitcoin, AG represents silver, AU represents Gold, and VIX shows the Volatility Index. Table 7.2a (page 77) shows all values and analysis of Figure 1 (page 49, section 1.3 results and discussion).

2. Figure 2: This figure (page 96) presents five graphs analyzing stock market behavior in relation to the MPX outbreak. Graphs 1, 2 and 3 confirm the existence of a Parallel trend in the Difference-in-Differences (DID) analysis, showing a negative trend in stock returns before the MPX outbreak (Jan 2022 – Apr 2023). Graph 4 compares the stock performance of firms in heavily affected countries (Treated Group) versus less affected countries (Control Group) across three phases: before, during, and after MPX. Graph 5 illustrates the difference in monthly returns between these groups, showing that the Treated Group experienced less variance in stock returns before and after MPX compared to the Control Group. Section 2.3 results and discussion on page 94 further explain this figure.

3. Figure 3: This figure (page 135) illustrates the KZ index (proxy of financial constraints), for US financial and non-financial firms from the year 1990 to 2023. The KZ index for financial

firms is consistently lower comparatively for non-financial firms, indicating that financial firms face fewer constraints. Both sectors experienced a decreasing trend in the KZ index from 1990 to 2008, but post-GFC 2008, the index began to rise through 2023.

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Chapter 1: The Impact of Stock Market Crises on Local and Global Safe-haven Assets; Evidence from Global Financial Crises (GFC) 2008, COVID-19 pandemic and Russia-Ukraine conflict 2022.

Chapter 2: Investor's Response to a Natural Disaster/Hazard and its Effect on the Financial Market and Investment Companies of 110 Countries; The Evidence from the Monkeypox Global Outbreak, 2022.

2.1 Introduction and Literature Review

Introduction

Over time, numerous global outbreaks have had a significant impact on various aspects of life. Financial markets are also believed to be influenced by these events, leading researchers to explore their effects on the financial world. These outbreaks alerted the investors who already spent the amounts on different stocks when the epidemic negatively affected the stock market globally. Many regions, with the development of globalization and communication networks, can be affected by events that take place anywhere in the world. In the case of diseases, this is also true. Throughout history, there have been numerous outbreaks that have affected the world at large. But, unlike in the past, we are seeing more and more spread of diseases and information about these diseases. As a result, epidemics have more economic, sociological, and psychological effects.

This study investigates the impact of the Monkeypox (MPX) outbreak of 2022 on global stock market returns. Specifically, we aim to determine the extent to which the MPX virus of 110 countries influenced stock prices across 59 countries. Uniquely, this research represents the first comprehensive global examination of the MPX outbreak's effect on financial markets. Furthermore, in this study, with the help of parallel trend graphs, we investigate how stocks of the firms registered in these 110 countries behave in three different phases which are: (i) before MPX (from 1st January 2021 to 30th April 2022), (ii) during Monkeypox (MPX) global outbreak

(from 1st May 2022 to 10th November 2022), and (iii) after MPX (from 11th November 2022 – 30th April 2023).

The effects of outbreaks of monkeypox worldwide in 2022 on stock returns are investigated in this study. The Monkeypox virus, along with the variola virus, causes smallpox. Two outbreaks of a pox-like disease occurred in monkey colonies kept for research in 1958, leading to the discovery of Mpox. Human cases of Mpox were first recorded in 1970. Several African countries had reported Mpox cases before the 2022 outbreak. In May 2022, a worldwide outbreak of Mpox started. While Mpox has been endemic in some places, foreign travel has been the main source of previous outbreaks; however, this outbreak spread rapidly worldwide through contact between people (Centers for Disease Control and Prevention [CDC], 2023). Around 110 countries reported 87 thousand cases and 112 deaths due to an outbreak of Mpox in May 2022 that spread rapidly across Europe, the Americas, and then all six WHO regions. The WHO declared a Public Health Emergency of International Concern (PHEIC) on July 23, 2022, as the outbreak spread beyond the European Region (WHO, 2023).

This report advocates for action at several levels (governments, organizations, investors, and society) to work on a solution. To ensure current and future human health, well-being, and security, governments must design strategies; organizations must abide by strict sustainable protocols and rules; investors should reward or punish organizations for their responsible behaviour; and society needs to promote sustainability as a cultural value.

Our results represent total MPX cases have approximately no effect on the *Average Returns* of the 59 countries' firms while there is a very minor decline in the average returns of firms belonging to the countries highly affected by MPX which is supported by the study of Burdekin (2021); Wong (2008). Moreover, MPX has no impact on average returns before the MPX outbreak for control (less affected countries) and treated group (more affected countries) because there is no MPX outbreak in that duration. After the MPX outbreak, more affected countries' average returns decreased to 0 as compared to less affected countries' average returns of 0.042. Results also confirmed that the parallel trend assumption holds, which states that before treatment

(Monkeypox) happened, there was a constant difference between the treated group (countries affected by MPX) and the control group (countries not affected by MPX) over time. These findings are supported by the studies of Joshy Mathew (2020); Macciocchi et al. (2016). Standard error values are approximately 0, showing there is very minor or no difference between actual and estimated values of the regression line. Results also confirmed that the MPX event has a negative impact on average stock returns (–0.000093) ''During the MPX'' phase. Furthermore, ''After MPX'', stock returns (0.000262) followed a little recovery but were still less than the stock returns (0.019829) ''Before the MPX'' event. We can see there is a minor decline in the average stock returns when we compare the stock returns of the ''Before MPX'' phase (0.019829) to the ''During MPX'' phase (-0.000093). These results are supported by the studies of Burdekin (2021); Wong (2008). Furthermore, the countries which are highly affected by MPX (treated group countries) have lower average stock returns as compared to the countries which are less affected by MPX (control group countries).

The present study contributes to the previous literature by analyzing the recent MPX outbreak in 2022 and its impact on stock market prices, that have not been analyzed in previous literature. Furthermore, this study includes 110 countries' stock markets by focusing on emerging and developed countries instead of focusing on only 1 or 2 countries like the USA. Previous studies mainly focused on a single industry, e.g., the study of Ichev and Marinč (2018), focused on only a single specific industry like the banking industry, the study of Çolak and Öztekin (2021) focused on the restaurant industry, or the study of Kim et al. (2020) etc.

Therefore, this study seeks to answer the following key question: Does the MPX virus 2022 have any impact on the average stock returns of firms? To address this, we hypothesize that the MPX virus 2022 has approximately no impact on the average stock returns of firms. The subsequent sections will delve into the existing literature, identify research gaps, and provide a detailed analysis to test this hypothesis and answer the research question.

The remainder of chapter 2 is structured as follows. Section II develops the theoretical background, Section III explains the research design, data sources, and methodology. Section IV

presents the main results and discussion of the study. Finally, Section V presents the conclusion and practical implications of the study.

Literature Review

There is extensive research about different kinds of viruses like COVID-19, Ebola virus, and Spanish flu. The new research has been inspired by the global effectiveness of all these viruses. To the best of our knowledge, no research has been conducted to find the effect of Mpox on stock market returns in 110 countries. However, medically relevant research about Mpox has been done because many researchers have examined this virus in the medical field. There is a lack of research about the effect of MPX on stock markets worldwide, as MPX has greatly affected major countries with many of the cases reported. Hence, this study examines how global stock markets behaved in response to the MPX virus that happened in 2022. It is also equally important to observe the behavior and perception of the investors in response to this virus because investors are very concerned about their investments in stocks. So, they always consider the potential upcoming risks.

Previous research shows that different kinds of diseases which affect a huge part of a continent of the world overall have a significant effect on stock market returns as well. The most recent example is COVID-19, which happened in 2019, and many studies reported its significant negative effect on the stock market crisis. According to the study conducted by Madai (2021), COVID-19 had a negative effect on the stock market returns in 30 countries. The study conducted by Khan et al. (2020) analyzed the comparison of stock indices of sixteen countries during the COVID-19 outbreak vs. non-COVID duration. Their results confirmed that the stock market indices of these countries are negatively affected by the COVID-19 Pandemic. Furthermore, another study by Sharma et al. (2021) observed how COVID-19 cases affect the stock market returns of the top 15 most affected by the COVID-19 pandemic. Their results showed that the COVID-19 cases have a significant long-term impact on the stock market returns of these 15 countries.

According to the study by Tanjung et al. (2022), the Indonesian stock market experienced a notable downturn because of COVID-19 before vaccination efforts. However, after vaccination campaigns, there was a lack of marked influence on the stock market in Indonesia. The study of Joshy Mathew (2020) confirmed that during SARS, Swine Flu, Ebola and the Zika virus, Asian indices were not affected by the Shanghai Stock Exchange Composite Index. Moreover, the study of Macciocchi et al. (2016) also showed no impact of the zika virus on stock prices. Similarly, another study's findings indicate that the Asian Flu crisis in 1997 and the Russian virus crisis in 1998 had a negative impact on businesses that compete with exports from the crisis nation or that have direct sales exposure there (Forbes, 2004). This study identified a positive relationship between the stock returns of Thailand and CEA markets, and they are affected by the Asian-financial crisis. The variance of all markets increased after the crisis compared to before. So, the study confirmed the existence of a strong contagion effect between the stock Markets of Thailand, and the Chinese Economic Area (CEA) during the Asian Flu (Wang & Thi, 2006).

The empirical study shows that from 1918 through 1920, the Spanish flu (1918) had a significant negative impact on U.S. stock values (Del Angel et al., 2021). According to the evidence, the stock markets in Europe and the US responded negatively to the high number of deaths during the Spanish Flu pandemic (Burdekin, 2021). The study of McTier et al. (2013) investigated the negative impact of the influence of flu on the US stock market returns.

According to Nikkinen et al. (2008), the "911" tragedy had a significant negative impact on the world stock values, although they recovered eventually. According to Njindan Iyke (2020) COVID-19 has had a significant and long-lasting negative effect on the worldwide economy. The study by Panyagometh (2020) observed that the COVID-19 pandemic has had a negative impact on the Thai stock market and higher volatility of Thai stocks during the pandemic duration. Del Giudice and Paltrinieri (2017) investigated the effect of the Arab Spring and the Ebola outbreak on investment decisions, fund flows, fund performance, and fund returns.

According to Erdem (2020), the global pandemic COVID-19 has had a detrimental impact on the stock markets of 75 countries. Liu et al. (2020) showed that the COVID-19 epidemic affected the

Chinese financial markets negatively. Chen et al. (2007) investigated the negative effects of the SARS outbreak on the performance of Taiwan hotel businesses' stocks. Paarlberg et al. (2007) showed the significant economic effects of avian influenza in the United States and exposed that regionalization diminished economic success and export losses. Macciocchi et al. (2016) attempted to predict the short-term economic impacts of the Zika virus. The analysis demonstrated that the markets under consideration were resilient, with no major negative returns. Previous research has shown that epidemics have a significant influence on financial markets. Anxiety causes investors to be averse to risk, adds to pessimism about future returns, and hence determines asset price fluctuations (Baker & Wurgler, 2007; Cen et al., 2013; Lucey & Dowling, 2005). The average price dropped by 1%–3% if a region was directly affected by SARS and 1.6% for all regions after the outbreak (Wong, 2008). From 2004 to 2016, nine events on four epidemic disease outbreaks of macroscopic and immunocompromised disease in the food industry have an adverse impact on restaurant profitability. The risk mitigation factors consist of three firm characteristics. These four epidemic disease outbreaks are Avian Flu, swine flu, Bovine spongiform encephalopathy (BSE), and Salmonella Infantis (Kim et al., 2020). Stock returns across companies are negatively affected by both daily growth in COVID-19 confirmed cases and death cases (Al-Awadhi et al., 2020).

Ebola and the Arab Spring significantly affected fund flows after controlling for fund performance, expenses, and market returns. Furthermore, the Investors who made investments in African mutual funds overreacted to these major events by withdrawing their savings (Del Giudice & Paltrinieri, 2017). Before and during COVID-19, Market volatility and sentiment have had different effects on both US biopharmaceutical companies' returns, as well as different volatility behavior (Peiró-Mestres et al., 2022; Piñeiro-Chousa et al., 2022).

2.1.1 Importance of Study, Research Gaps, and Main Contributions

- **Why is MPX important to Research?**

It is relatively uncommon or not a universal fact that whenever there is any negative news or crises in the financial market, it will always negatively affect the stock market prices. Sometimes crises or negative news do not affect stock market prices, and the main aim of this chapter is to

enhance this information by checking the impact of MPX on the average stock returns. It is clear from the previous literature that different kinds of pandemics have a significant impact on financial stock prices. U.S. Treasury market, Corporate bond markets, money market funds, and S&P 500 Index are negatively impacted by COVID-19 (Goldstein et al., 2021). There is a lack of research to investigate the impact of the Monkeypox outbreak in 2022 on the stock market prices for any of the countries. MPX is an equally important topic to investigate what effects it has on financial markets globally. As of 11 July 2022, there are over 9,000 confirmed cases of monkeypox (MPX) in 57 countries (Peiró-Mestres et al., 2022). There is a clear contradiction between previous studies on the reason for spreading this MPox virus because some studies confirmed that the origin of this virus is Africa (Hraib et al., 2022); however, some studies confirmed that the MPox virus has also been found to those countries who have no travel history with Africa (Ola, 2022; Thornhill et al., 2022).

On May 6, 2022, the United Kingdom declared a monkeypox (MPX) epidemic; the outbreak was ascribed to a British citizen who travelled to Nigeria. Furthermore, as of May 21, 2022, 92 instances of the monkeypox virus (MPXV) had been reported across 13 nations (Hraib et al., 2022). Since May 2022, Monkeypox cases have been recorded across the world outside of African countries. The method of infection, risk factors, clinical symptoms, and consequences are still unclear (Thornhill et al., 2022). It is unknown why monkeypox cases with no confirmed travel ties to Africa have spread to various nations. In one week, the number of cases reported outside the continent surpassed those detected since 1970, when the virus was discovered to cause human illness. However, it is essential to identify the cause of these puzzling monkeypox outbreaks because of the potential consequences of Ebola spreading in the same manner across several nations (Ola, 2022). The study found that the events of the Ebola epidemic have had a greater impact on small businesses than on large enterprises (Ichev & Marinč, 2018).

There is a lack of research linking the Monkeypox (MPX) global outbreak in 2022 with developed and emerging economies. Hence, we study 110 countries' financial markets' behaviors, including developed and developing economies, in response to the Monkeypox outbreak in 2022. This

research is also important from the perspective of governments, organizations, policymakers, and investors. By using the knowledge of this study, governments can take necessary actions regarding public health security and safety and can make effective and useful strategies. Furthermore, by using the results of our research, organizations can develop and follow the rules. Besides this, by using the results of our study, investors can get an idea about the nature of such kinds of pandemics and how much effect these pandemics can have on stock market prices. Some investors who already invested their investments into stock markets must be worried about the fluctuation in the prices, so they can make quick decisions in such situations by using our findings. These results are equally useful for those investors who are making plans to invest their money in stock market prices. Our research covers under-developing and developed 110 countries, which is vast enough to provide information about stock market behavior.

- **Research Gaps**

a) Knowledge Gap

No study identified the impact of MPX on stock returns because the existing literature is all about the medical point of view of MPX. For example, the study of Thornhill et al. (2022) identified the MPX disease in humans across 16 countries, while the study of Altindis et al. (2022) is all about the diagnosis of MPX infection.

Our Approach: The main focus of our study is to identify the impact of MPX on stock market prices and whether or not MPX has any impact on the stock returns of developed and developing countries.

b) Limitation of Geographical Area

Previous studies on similar diseases ignored emerging markets, for example Ichev and Marinč (2018) identified Ebola's effect on stock prices in the USA only.

Our Approach: 110 countries' stock market data have been used in this study by including both emerging and developed economies.

c) Limitation of Industry

Previous studies focused only on a few countries or, specifically, a single industry. For example, the study of Kim et al. (2020) only considered the restaurant industry to identify the impact of food-related epidemic diseases, while the study of Çolak and Öztekin (2021) only considered the banking industry to identify the COVID-19 impact.

Our Approach: This study includes the daily stock prices of all registered firms in the stock market indices of 110 countries instead of focusing on only a single industry.

Theoretical Framework:

1. Efficient Market Hypothesis (EMH): The EMH indicates that all available information is rapidly incorporated into stock prices. So, it's difficult to consistently achieve abnormal returns (returns above the market average). If the market is efficient, news about Mpox would have been quickly reflected in stock prices. This means that after the initial information is available in the financial market, there would be no sustained, significant impact on returns. Investors quickly processed the information, and prices adjusted accordingly.

2. Information Asymmetry: Information Asymmetry means unequal spread of the information. In the stock market, company insiders may know about upcoming earnings reports or new products that are not yet public. The MPX created information asymmetry because some investors having a connection with the healthcare sector might have had early and better information than others.

3. Systematic Risk:

Systematic risk, or market risk, is inherent to the entire market and system, and it is unavoidable. While health crises can contribute to systematic risk, investors likely didn't think MPX would change their view of the market's overall risk. Investors might perceive MPX as a manageable risk, so they didn't make significant adjustments to their investments.

4. Behavioural Finance

Behavioral finance shows that market reactions are sometimes irrational because investor sentiment, fear, panic, and herding behavior can affect stock prices. Hence, investor decisions are not always rational and are influenced by psychological factors like risk perception, emotions, and biases.

5. Prospect Theory:

Prospect theory, a component of behavioural finance, shows how individuals make decisions in times of uncertainty. People value potential losses and gains differently, being more sensitive to loss. In the case of MPX, investors may have perceived the potential losses as less severe than initially feared, or they may have focused on potential gains in sectors like pharmaceuticals. Additionally, investors may have quickly adapted to the news, mitigating long-term negative sentiment. Investors might have treated the MPX risk as a small, separate issue not affecting their main investments

5. Risk Perception and Investor Sentiment:

Investor sentiment, the overall attitude of investors toward a particular market, plays a crucial role in stock market dynamics. Investors may have perceived the risk of Mpox as relatively low compared to other economic or health risks, for example, COVID-19. This might have meant the market didn't react strongly. Alternatively, investors may have quickly adapted to the news, minimizing the impact of negative sentiment.

Research Questions and Hypotheses:

RQ_4: Does the MPX virus 2022 have any impact on the average stock returns of the firms?

HA_4: The MPX virus 2022 has approximately no impact on the average stock returns of the firms.

2.2 Data and Methodology

2.2.1 Data

First, daily data for monkeypox from 1st May 2022 to 10th November 2022 for 110 countries (the 110 countries list is mentioned in appendix A) have been collected from the website https://ourworldindata.org/explorers/monkeypox. Then, out of 110 countries, the daily stock prices of all registered firms in the stock market indices of 59 countries (stated in Appendix B) are downloaded because stock price data for 52 countries was unavailable on the Refinitiv database. The duration of daily stock price data collection is from 01 Jan 2021 to 30 April 2023. After the collection of stock prices, the average of all firms for each day/date is calculated so that we can have single average values for each day/date. Then, stock returns are calculated by using the formula $[(P_1 / P_o) - 1]$, where P_1 is the current price and P_o is the previous day's price. This data is categorized as ''Before the Monkeypox'' pandemic (from 01 Jan 2021 to 30 April 2022), ''During the Monkeypox'' pandemic (from 01 May 2022 to 10 Nov 2022), and ''After the Monkeypox'' pandemic (from 11 Nov 2022 to 30 Apr 2023).

The parallel trend graphs 1, 2, 3, 4, and 5, as shown in Fig 2, are based on this data. The X-axis of the graphs represents the MPX phases (before MPX, during MPX, and after MPX) considering the dates from Jan 2021 – Apr 2023, while the Y-axis shows the monthly returns. These graphs show that the parallel trend of DID exists (which was a necessary condition). Furthermore, these graphs show a negative trend in stock market behavior.

The dependent variable of the study is the Average Returns of 59 Countries. The independent variable is MPX, which is measured by using the dummy variables post and treat (an explanation of variables is given in detail below in section 2.2.2). We also considered the effect of control variables of 59 countries (all listed firms in each country) in our study, which are as follows: Interest Rate, Market Capitalization, Net Sales, Total Capital, Total Debt, Total Shareholders' Equity, and Total Assets.

2.2.2 Methodology: Difference-in-Differences Models

Difference-in-differences (DID) analysis is a famous technique to identify the causal effects of variables or factors, and the parallel-trend assumption is important in the DID model (Ryan et al., 2019). Without a parallel-trend assumption, the DID model cannot hold true (Qian et al., 2021). The treatment and comparison groups show the same trends in outcomes before the intervention (Ryan et al., 2019). H_0 of the parallel trend assumption is no difference between the treated and control groups before intervention; hence, when the researcher accepts this null hypothesis, it shows that this assumption is valid and holds true (Bilinski & Hatfield, 2018). Hence, the DID model is employed in this study to identify the causal impact of a treatment (Monkeypox) by comparing the treated group (countries that are more affected by MPX) and control group (countries that are less affected by MPX) over time. This methodology is eventually better than other techniques because it removes bias and controls for the other factors that might affect treated and control groups equally, ensuring the results are more reliable and accurate. We used a Difference-in-Differences regression model with control variables and without control variables at 99% and 95% confidence levels. By using the equations below, with the help of STATA software, this study tried to identify the effect of the monkeypox pandemic on the stock prices of all firms registered in the stock market indices.

At 99% Confidence Level

$$\text{Average Returns}_{\text{59 Countries}} = \beta_0 + \beta_1(\text{Treated}) + \beta_2(\text{Time}) + \beta_3(\text{Time*Treated}) + \boldsymbol{\varepsilon} \quad \textbf{(1)}$$

$$\text{Average Returns}_{\text{59 Countries}} = \beta_0 + \beta_1(\text{Treated}) + \beta_2(\text{Time}) + \beta_3(\text{Time*Treated}) + \beta_4(\text{Interest Rate}) + \beta_5(\text{Market Capitalization}) + \beta_6(\text{Net Sales}) + \beta_7(\text{Total Assets}) + \beta_8(\text{Total Capital}) + B_9(\text{Total Debt}) + \beta_{10}(\text{Total Shareholders' Equity}) + \varepsilon \quad \textbf{(2)}$$

At 95% Confidence Level

$$\text{Average Returns}_{\text{59 Countries}} = \beta_0 + \beta_1(\text{Treated}) + \beta_2(\text{Time}) + \beta_3(\text{Time*Treated}) + \varepsilon \quad \textbf{(3)}$$

$$\text{Average Returns}_{\text{59 Countries}} = \beta_0 + \beta_1(\text{Treated}) + \beta_2(\text{Time}) + \beta_3(\text{Time*Treated}) + \beta_4(\text{Interest Rate}) + \beta_5(\text{Market Capitalization}) + \beta_6(\text{Net Sales}) + \beta_7(\text{Total Assets}) + \beta_8(\text{Total Capital}) + B_9(\text{Total Debt}) + \beta_{10}(\text{Total Shareholders' Equity}) + \varepsilon \quad \textbf{(4)}$$

DID model was implemented four times by including the control variables at 95% and 99% confidence level, then we implemented the model by excluding the control variables at 95% and 99% confidence level. Appendix A shows the total of 110 countries' names that are included in this study specifically for Monkeypox total cases, dummy variables, and their interaction term. *Panel A* countries are the *Control Group* because these countries are less affected by MPX (MPX cases are between 0 – 736), while *Panel B* countries are the *Treated Group* because these countries are highly affected by MPX (MPX cases are between 760 – 6,471,492).

Average Stock Returns (dependent variable) are the average returns of the firms registered in the stock market index of the 59 countries mentioned in Appendix B below. This Appendix shows a total of 59 countries' names that are included in this study (specifically for the stock returns data and control variables data) after dropping 52 countries because of missing data. *Panel A of Appendix B (Control Group)* countries are less affected by MPX (MPX cases are between 18 – 736), while *Panel B of Appendix B (Treated Group)* countries are highly affected by MPX (MPX cases are between 893 – 2,205,809). *Treatment* (β_1) is a dummy variable for 110 countries with a value of 0 for all countries which are less affected by MPX and a value of 1 for all countries which are more or highly affected by MPX. In Appendix A, Panel A, Control Group represents the countries that are less affected by MPX while Panel B, Treated Group, shows the countries that are highly affected by MPX. *Time* (β_2) is a dummy variable for 110 countries that has 2 situations: before MPX (value of 0 because there was no MPX before) and after MPX (value of 1 because of the existence of MPX). *Time*Treated* (β_1*β_2) is an interaction term for 110 countries, whose value we got by multiplying the time variable with the treatment variable. So, *Time*treated* is a dummy variable that has a value of 0 for the duration ''before MPX'' because there were 0 cases of MPX before it happened on 1st May 2022, and a value of 1 for the duration ''after MPX'' because from 1st May 2022 to 10th Nov 2022 there were many cases overall the world. *Control variables are Interest Rate, Market Capitalization, Net Sales, Total Assets, Total Capital, Total Debt, and Total Shareholder's Equity*, which we used in our study for 110 countries.

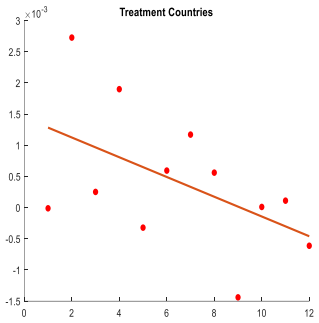
2.3 Results and Discussion

Figure 2 shows five different graphs. Graphs 1, 2, and 3 exhibit that the parallel trend of DID exists (which was a necessary condition). The parallel trend assumption in Difference-in-Differences (DID) analysis suggests that, before any intervention, the treatment and control groups would have followed similar, parallel trends over time. Furthermore, the graphs show a negative trend in stock market behaviour before the MPX outbreak duration (Jan 2022 – Apr 2023).'' Dates (before the MPX Pandemic from Jan 2021 – Apr 2022) are on the X-axis while Monthly returns are on the Y-axis. The parallel trend graph (Graph 4) indicates the control group and treated group behaviour during 3 phases: *Before MPX*, *During MPX*, and *After MPX*. *Treated Groups* are the firms belonging to those countries which are highly affected by MPX, while *Control Groups* are the firms belonging to those countries which are less affected by MPX. Graph 5 presents the trend of the *Treated Group, Control Group,* and the difference between the *Treated and Control Groups.* In Graph 5, the blue line represents the *Treated Group,* where the values of the *Treated Group* are calculated by taking the difference between ''Treated Group Monthly Returns Before MPX from May 2021 to Apr 2022'' and ''Treated Group Monthly Returns After MPX from May 2022 to Apr 2023''. Similarly, the red line highlights the *Control Group* where the values of the *Control Group* are calculated by taking the difference between ''Control Group Monthly Returns Before MPX from May 2021 to Apr 2022'' and ''Control Group Monthly Returns After MPX from May 2022 to Apr 2023''. The Yellow line indicates the difference between the *Treated and Control Groups,* which is actually the Difference-in-Difference (DID) trend. The *Treated Group* trend demonstrates less variance between average stock returns before and after MPX relatively than the *Control Group*.

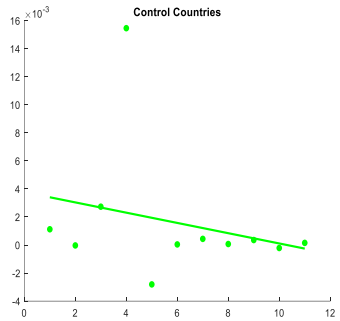
Table 9 represents the correlation results of the variables; *TAR* (treated group average returns), *CAR* (control group average returns), *IR* (Interest Rate), *MC* (Market Capitalization), *NS* (Net Sales), *TA* (Total Assets), *TC* (Total Capital), *TD* (Total Debt), and *SHE* (Total Shareholders' Equity). *TAR, CAR, IR,* and *NS* show almost zero but significant correlation with all variables, which shows that these variables have almost no impact on each other. Furthermore, *MC* shows almost zero but significant correlation with *NS*, however, it has a moderate positive and

significant correlation with *TA*, and a strong positive and significant correlation with *TC, TD*, and *SHE*, which shows that *TC, TD, and SHE* have a strong positive impact on the average stock returns. *TA, TC, TD*, and *SHE* show a highly positive correlation with each other, which shows that all variables are moving in the same direction and have a strong impact on each other. Table 10 shows the impact of the Monkeypox event on the average stock market prices by using four different models, including 120,812 observations. Model 1 represents results with a 99% confidence level without control variables by following equation 1. Model 2 represents the results with a 99% confidence level with control variables by following equation 2. Model 3 shows the results with a 95% confidence level without control variables by following equation 3. Model 4 shows the results with a 95% confidence level with control variables by following equation 4.

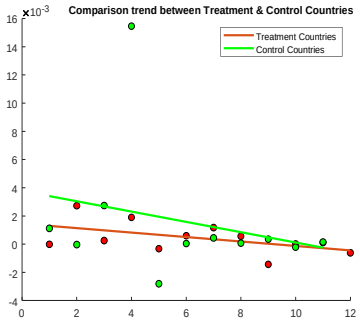
Fig 2: Five Graphs of Treatment and Control Countries



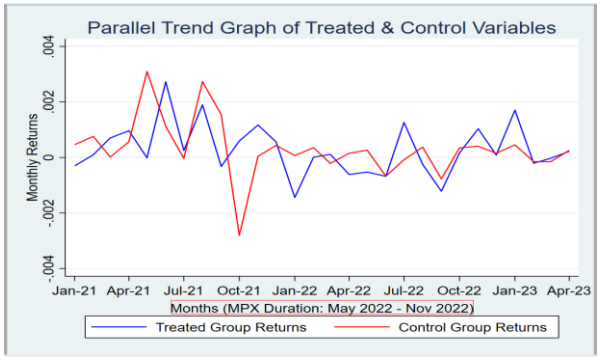
Graph 1



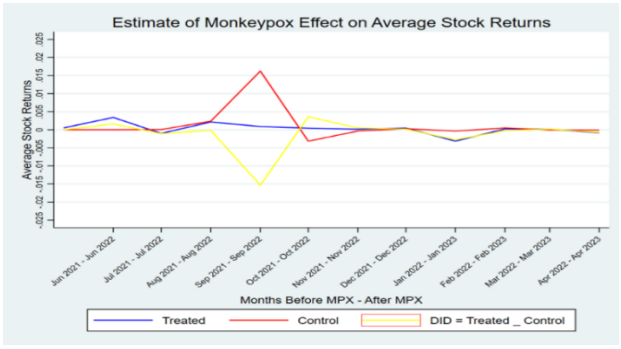
Graph 2



Graph 3



Graph 4



Graph 5

Figure 2 presents five graphs investigating how the stock market behaves due to the MPX outbreak. The x-axis of the graphs shows the time duration in months, while the y-axis shows average stock returns. Graphs 1, 2, and 3 confirm the existence of a parallel trend in the Difference-in-Differences (DID) analysis, showing a negative trend in stock returns before the MPX outbreak (Jan 2022 – Apr 2023). Graph 4 compares the stock performance of firms in highly affected countries (Treated Group) versus less affected countries (Control Group) during three phases: before MPX, during MPX, and after MPX. Graph 5 shows the difference in monthly returns between these groups, showing that the Treated Group experienced less variance in stock returns before and after MPX compared to the Control Group.

In Table 10, the dependent variable is the *Average Stock Returns of 59 countries*. *Total MPX* cases are the total cases of monkeypox reported. *Treatment (β_1)* is the dummy variable which is equal to 0 if the country is less/not affected by MPX *(control group),* while treatment (β_1) is equal to 1 if the country is highly affected by MPX (see total cases) - *(treated group). Time (β_2)* is another dummy variable that is equal to 0 for the ''before MPX'' duration while *Time (β_2)* is equal to 1 for the ''after MPX'' phase. *Time*Treated (β_1*β_2)* is the interaction term, and this is actually the Difference in Difference. *Interest Rate, Market Capitalization, Net Sales, Total Assets, Total Capital, Total Debt,* and *Total Shareholders' Equity* are the control variables. *Cons* is the constant term.

Furthermore, in Table 10, the coefficient of all four models is 0 for the *Total MPX cases,* which means total MPX cases have approximately no effect on the *Average Returns (DV)* of the 59 countries' firms. *Treatment (β_1)* has a negative impact (–0.0001) on Average Returns, which shows almost no effect or a very minor decline in the average returns of firms belonging to the countries highly affected by MPX. *Time (β_2)* has a positive impact (0.0420) on the *Average Returns. Time*Treated (β_1*β_2)* is DID, and this DID shows a slight negative impact (–0.0420) on the *Average Returns*. Model 2 and Model 4 are with control variables, so Model 2 and Model 4 show that control variables (*Interest Rate, Market Capitalization, Net Sales, Total Assets)* have no impact on *Average Returns* because of 0 coefficient, *Total Capital* has almost 0 impacts with a coefficient of 0.0001, *Total Debt* has a minor negative impact with a coefficient of –0.0001 by Model 2 while Model 4 shows same coefficient but with positive impact (0.0001), *Total Shareholders' Equity* shows the negative impact of –0.0001 on *Average Returns* in Model 2 and Model 4.

In Table 10, all four models show the same impact (coefficients) of *Total MPX cases, Treatment* (β_1), *Time* (β_2), and *Time*Treated* (β_1*β_2) on the *Average Returns*. Model 2 and Model 4 are with control variables (*Interest Rate, Market Capitalization, Net Sales, Total Assets, Total Capital, Total Debt,* and *Total Shareholders' Equity*), and both models have the same impact (coefficients) on the *Average Returns (Dependent variable).* Almost all variables show very little and nearly no impact on the *Average Returns,* which confirms our hypothesis HA_4 that the MPX virus 2022 has approximately no impact on the average stock returns of the firms.

Standard errors show the distance between actual values and estimated values in the regression best-fitted line. These distance values are actually the error terms. Ideal values are with minimum errors of the distance between actual and estimated values. Standard error values in all four models are almost 0, indicating that there is almost no difference between actual and estimated values, and the majority of values lie on the best-fitted line of the regression.

Table 11 shows the VIF analysis. To address multicollinearity, we calculate the variance inflation factors (VIFs) for the *Total Asset, Market Capitalization, Net Sales, Interest Rate, Treated Average Returns* and *Control Average Returns.* We find that all values of the VIFs are from 1 to 2.10, which are below 5, indicating that there is no multicollinearity between the explanatory variables. However, multicollinearity exists for the *total shareholders' equity, total capital,* and *total debt,* so we dropped these variables.

Table 12 shows how average returns are affected before and after the MPX event by using the DID estimation method. $\beta_{0\ (Before\ MPX)}$ represents the trend or gains over time before the treatment (MPX) from 1st Jan 2021 to 30th Apr 2022. The control group has a dummy value of 0 if the country is less/not affected by MPX, while the treated group has a dummy value of 1 if the country is more affected by MPX. The coefficients of the β_0 (average returns) show the average outcome of the control group does not change during the post-treatment period (QE), and the difference between the control and treated groups is 0. It shows that the DID model holds because of the parallel trend assumption's existence. As previously mentioned in the introduction of the parallel trend assumption, this assumption states that before treatment (Monkeypox) happened, there was a

constant difference between the treated group (countries affected by MPX) and the control group (countries not affected by MPX) over time. So here in Table 12, this difference is 0 for both groups (treated and control), which is the same and constant, hence, the parallel trend assumption holds here. Furthermore, it is also an indication that there is no impact of MPX on Average returns before the MPX outbreak for the control and treated group from 1st Jan 2021 to 30 Apr 2022 because there is no MPX outbreak in that duration.

Moreover, in Table 12, $\beta_{1\ (After\ MPX)}$ represents the difference of 0.042 between the treated and the control group after the treatment (MPX) from 11th Nov 2022 to 30th Apr 2023. It means the control group's average return is 0.042 as compared to the treated group, which has a 0 value. It shows that when the MPX outbreak happened, it had no impact on the average returns of the treated group and a minor impact on the control group. The average returns of more affected countries decreased to 0 as compared to less affected countries' average returns of 0.042.

In Table 12, β_2 indicates that the average return of the treatment group is decreased by 0.042 in the ''after-treatment (MPX)'' period compared to what would have happened to the same group if the intervention had not taken place. Standard errors are nearly 0, showing there is a very minor difference between actual and estimated values of the regression line.

The event study results are shown in Table 12 (a), which was conducted to examine the impact of the MPX event on stock returns, mirroring the approach taken in the Difference-in-Differences (DID) model shown below.

The event study defined three windows: an estimation window before the MPX event (January 1, 2021, to April 30, 2022). The event window matches with the during MPX period (May 1, 2022, to November 10, 2022) and a post-event window (November 11, 2022, to April 30, 2023).

The regression results indicated that the coefficient for the MPX event dummy (MPX_Event) was -7.54, suggesting a potential decrease in returns during the event window. However, this effect was not statistically significant, with a p-value of 0.665. Similarly, the coefficient for the estimation window dummy (Before_MPX) was -0.51, also statistically insignificant, with a p-value of 0.973, showing no statistically significant impact of the MPX event or the pre-event period on returns.

The coefficient for the post-event window (Post_MPX) was effectively zero, indicating no obvious impact during that period.

These findings align with the results obtained from the DID model shown below, which also showed no significant impact of the MPX event on stock returns. The consistent lack of statistical significance across both methodologies suggests that, within the parameters of these models, the MPX event did not have a measurable effect on the returns observed.

Table 13 shows the outcome of two-sample t-tests with equal variance in model 1 and unequal variance in model 2 for testing the return differences. According to the outcomes, model 1 and 2 shows th#e same results, where the mean difference between the two groups (control group and treated group) is 0.0220917. Hence, we accept our H_0 that also supports the results that there is almost no difference between the *Control Group* and the *Treated Group*, and the parallel trend assumption holds true here. The null Hypothesis (H_0) of this table states that the difference between the control group and the treated group is equal to 0; however, the two-side alternative hypothesis (H_A) states that the difference between the control group and the treated group is not equal to 0. These findings are supported by the study of (Joshy Mathew, 2020; Macciocchi et al., 2016). We have the t-statistics value for our test as 1.0036, while the two-sided p-value is 0.3156. Here, we will accept our H_0 that also supports the results that there is less difference between the *Control Group* and the *Treated Group*, and the parallel trend assumption holds true here. Standard error values in Models 1 and 2 are approximately 0, showing there is a very minor difference between actual and estimated values of the regression line.

Table 14 reports a one-way ANOVA test for the *Control Group* and the *Treated Group* for three phases as follows: *Before MPX*, *During MPX*, and *After MPX*. In Model 1, the average stock returns before MPX are 0.0198, which is higher than the average stock returns during MPX (–0.000093) and after MPX (0.000262). It shows that the MPX event has a negative impact on average stock returns (–0.000093). During the MPX phase, there is a decline in the average stock returns (-0.000093) as compared to the average stock returns (0.019829) of ''before MPX'' phase, which is supported by the studies (Burdekin, 2021; Wong, 2008). Furthermore, after MPX, stock returns

(0.000262) followed a little recovery but are still less than the stock returns (0.019829) before the MPX event. *Treated Groups* are the firms belonging to those countries which are highly affected by MPX, while *Control Groups* are the firms belonging to those countries which are less affected by MPX. The average stock returns of the treated group are 0.000238, which is lower than the average stock returns for the control group (0.013094). It means the countries which are highly affected by MPX (Treated group countries) have lower average stock returns as compared to the countries which are less affected by MPX (Control group countries). In Table 14, Model 2 reports a one-way ANOVA test for the Control group while Model 3 reports a one-way ANOVA test for the Treated group. This test is performed to observe if the dependent variable (average stock returns) significantly differs between more than three variables. These results show whether our research hypotheses are supported or not. Both p-values are 0, which is statistically significant; hence, it supports H_A that the mean of the control group and treated group both significantly differ between different groups of dependent variables (average stock returns). P-value shows that we will reject our H_0 that the mean of both groups is the same, where H_0 states there is no difference between groups (e.g., the means of the control and treated groups are the same). If the p-value is very small (typically less than 0.05, significance level), it means the observed differences between groups are unlikely due to chance. Therefore, we reject the null hypothesis (H_0) and conclude that there is a significant difference between the groups.

The empirical findings of this study, indicating a very small or almost no impact of MPX on stock returns across 59 countries, can be better understood by looking at the theories outlined in the theoretical framework section above. Firstly, the Efficient Market Hypothesis (EMH) suggests that since information about MPX spread rapidly, stock prices likely adjusted immediately, meaning there were no long-term effects on returns, leading to prices quickly reflecting the news. Moreover, the investors perceived low systematic risk associated with MPX, compared to other macroeconomic or health threats, so they didn't make significant adjustments to their investment portfolios. Behavioural finance, particularly prospect theory and risk perception, suggests that investors may have perceived MPX as a manageable risk or quickly adapted to the news. So, it

reduced any negative sentiment. Consequently, investor sentiment remained relatively stable, and the market didn't fluctuate. It shows that investors did not consider MPX as a substantial risk to their investment strategies.

2.4 Conclusion and Practical Implications

2.4.1 Conclusion

By considering the data from developed and emerging economies, this study examines the average stock returns of the 59 countries (all registered firms) that are less or more affected by the Monkeypox (MPX) global outbreak 2022 of 110 countries. This study uses the correlation coefficient (Table 9), four DID models (Table 10), multicollinearity test (Table 11), impact on average returns before and after MPX by using the DID estimation (Table 12), two-sample t-tests with equal and unequal variance (Table 13), and one-way ANOVA test for the control group and treated group (Table 14).

Correlation results in Table 9 show that the *TAR, CAR, IR*, and *NS* show almost no impact on each other. *MC* shows almost zero but a significant correlation with *NS*; however, it has a moderate positive and significant correlation with *TA* and a strong positive and significant correlation with *TC, TD*, and *SHE*, which shows that *TC, TD, and SHE* have a strong positive impact on the average stock returns. *TA, TC, TD*, and *SHE* show a highly positive correlation with each other, which shows that all variables are moving in the same direction and have a strong impact on each other. In Table 10, DID four models (120,812 observations) are used to test the behavior of the average stock market because of the MPX event. By looking at the MPX coefficients, total MPX cases have approximately no effect on the *Average Returns* of the 59 countries' firms. Similarly, the *Treatment* (β_1) Coefficient shows almost no effect or a very minor decline in the average returns of firms belonging to the countries highly affected by MPX. Model 2 and Model 4 (with control variables), (*IR, MC, NS, TA, TC)* have no impact on *Average Returns, Total Debt* has a minor negative impact (Model 2) while the same coefficient but positive impact (Model 4), *SHE* shows the negative impact *Average Returns* in Model 2 and Model 4. Standard errors show the distance between actual values and estimated values in the regression best-fitted line. These distance values are actually

the error terms. Ideal values are with minimum errors of the distance between actual and estimated values. Standard error values in all four models are almost 0, which shows that there is almost no difference between actual and estimated values, and the majority of values lie on the best fitted line of the regression. Table 11 shows that there is no multicollinearity between the explanatory variables (*TA, MC, NS, IR, TAR and CAR)*.

Table 12 represents Before and After MPX results, which indicate that the DID model holds because of the parallel trend assumption existence. The difference is 0 for both groups (treated and control), which is the same and constant, hence, the parallel trend assumption holds. Furthermore, according to the results, the control group's average return is 0.042 as compared to the treated group, which has a 0 value. β_3 indicates that the average return of the treatment group is decreased by 0.042 in the after-treatment period (QE) compared to what would have happened to the same group if the intervention had not taken place. Only the DID for ''after MPX'' is significant. Standard errors are nearly 0, showing there is a very minor difference between actual and estimated values of the regression line. Table 13 shows the results of the Two-Sample t-tests; equal & unequal variance is for testing the return differences. Models 1 and 2 show the same results, where the mean difference between the two groups (control group and treated group) is 0.0220917. We will accept our H_0 that also supports the results that there is less difference between the *Control Group* and *Treated Group*, and the parallel trend assumption holds true here. Standard error values in Models 1 and 2 are approximately 0, showing there is a very minor difference between actual and estimated values of the regression line. The one-way ANOVA test in Table 14 for the *Control Group* and *Treated Group* where the MPX event has a negative impact on average stock returns. It means the countries which are highly affected by MPX (Treated group countries) have lower average stock returns as compared to the countries which are less affected by MPX (Control group countries).

2.4.2 Practical Implications

The practical implications of this study are useful for financial and fund managers, risk-handling managers, policymakers, and investors to develop smart and effective investment plans, strategies, and policies to guide potential investors during such events. Our study findings guide investors of 110 countries, which includes developed and under-developing countries' stock markets. This study provides an overall idea to investors that such events cannot have a higher impact on the stock market returns where they are thinking of investing their money or have already invested their money. However, policymakers should frequently monitor the financial markets to improve their policy decisions. As the future is unpredictable, investors can consider our results when investing their money to get maximum benefit by bearing very little risk.

2.4.3 Future Research Directions

Future research can explore how the impact of viral outbreaks varies across key sectors, including healthcare, travel, technology, and finance. Specifically, sector-specific analyses could reveal the unique challenges each sector faced and the diverse adaptive strategies they employed. A qualitative approach can be used to delve deeper into the impact of viral outbreaks on stock markets using the quantitative findings of this study. During such events, interviews with key stakeholders, such as financial analysts, CEOs of affected firms, and policymakers, could provide valuable insights. Moreover, case studies of specific firms or sectors, particularly identifying the effect of the virus on small vs large firms, can provide rich context for analysis. Future studies could develop predictive models to forecast stock market reactions. These models would use machine learning to combine quantitative and qualitative data, considering outbreak dynamics and investor sentiment.

2.5 Tables

Table 9: Correlation with Significance Level for the Control Variables and Average Stock Returns
This represents the correlation results. *TAR* (treated group average returns), *CAR* (control group average returns), *IR* (Interest Rate), *MC* (Market Capitalization), *NS* (Net Sales), *TA* (Total Assets), *TC* (Total Capital), *TD* (Total Debt), and *SHE* (Total Shareholders' Equity). The results are discussed in section 2.3 (page 95).

	TAR	CAR	IR	MC	NS	TA	TC	TD	SHE
TAR	1								
CAR	0.0003	1.0000							
	(0.9843)								
IR	0.0005	0.0003	1.0000						
	(0.9707)	(0.9817)							
MC	–0.0271**	–0.0056	0.0000	1.0000					
	(0.0485)	(0.6827)	(0.9992)						
NS	–0.0162	0.0056	–0.0029	0.0631***	1.0000				
	(0.2301)	(0.6750)	(0.8472)	(0.0000)					
TA	–0.0396***	–0.0175	–0.0010	0.7071***	0.0824***	1.0000			
	(0.0033)	(0.1937)	(0.9460)	(0.0000)	(0.0000)				
TC	–0.0368***	–0.0126	–0.0009	0.9190***	0.0616***	0.8872***	1.0000		
	(0.0063)	(0.3513)	(0.9508)	(0.0000)	(0.0000)	(0.0000)			
TD	–0.0399***	–0.0161	–0.0014	0.8513***	0.0758***	0.9409***	0.9637***	1.0000	
	(0.0034)	(0.2376)	(0.9227)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
SHE	–0.0324***	–0.0087	–0.0003	0.9622***	0.0718***	0.7812***	0.9561***	0.8818***	1.0000
	(0.0161)	(0.518)	(0.982)	(0.0000)	(0.0000)	0.0000	(0.0000)	(0.0000)	

Notes:
Inference: *** p < 1% (0.01); ** p < 5% (0.05); *p < 10% (0.1); p-values are in parentheses.
The significance level is given in the parenthesis.

Table 10: The Impact of the MPX Event on the Average Stock Market Returns

Table 10 represents four models, including 120,812 observations to analyze the behavior of the average stock market because of the Monkeypox event. Models 1 and 2 show the impact with a 99% confidence level without control variables and with control variables, respectively. Similarly, Models 3 and 4 show the impact with a 95% confidence level without control variables and with control variables, respectively. The results are discussed in 2.3 (page 95).

Average Returns	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Total MPX Cases	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Treatment (β_1)	–0.0001*	–0.0001*	–0.0001	–0.0001
	(0.0000)	(0.0000)	(0.0328)	(0.0328)
Time*Treated (β_1*β_2)	–0.0420	–0.0420	–0.0420	–0.0420
	(0.0421)	(0.0421)	(0.0463)	(0.0463)
Time (β_2)	0.0420	0.0420	0.0420	0.0420
	(0.0421)	(0.0421)	(0.0311)	(0.0311)
Interest Rate		0.0000		0.0000
		(0.0000)		(0.0015)
Market Cap		0.0000		0.0000
		(0.0000)		(0.0000)
Net Sales		0.0000		0.0000
		(0.0000)		(0.0006)
Total Assets		0.0000		0.0000
		(0.0000)		(0.0000)
Total Capital		0.0001		0.0001
		(0.0001)		(0.0074)
Total Debt		–0.0001		0.0001
		(0.0001)		(0.0078)
Total SH Equity		–0.0001		–0.0001
		(0.0001)		(0.0082)
Constant (α)	0.0001*	0.0001*	0.0001	0.0001
	(0.0000)	(0.0001)	(0.0220)	(0.0220)
No. of obs.	120,812	120,812	120,812	120,812

Notes: Coefficients are mentioned, and Std. errors are in parentheses. '' *, **, and *** ''denote the level of significance at the 10%, 5%, and 1% levels, respectively.

1) Model 1 (Equation 1) – Results with 99% confidence level – without control variables

2) Model 2 (Equation 2) – Results with 99% confidence level – with control variables

3) Model 3 (Equation 3) – Results with 95% confidence level – without control variables

4) Model 4 (Equation 4) – Results with 95% confidence level – with control variables

Table 11: Multicollinearity Results

This table shows the VIF analysis. To address multicollinearity, we calculate the variance inflation factors (VIFs) for the *Total Asset, Market Capitalization, Net Sales, Interest Rate, Treated Average Returns and Control Average Returns.* Results are discussed in section 2.3 (page 98).

Variables	**VIF**	**1/VIF**
Total Assets	2.10	0.476574
Market Cap	2.09	0.478920
Net Sales	1.01	0.992961
Interest Rate	1.00	0.999990
Treated Average Returns	1.00	0.996498
Control Average Returns	1.00	0.999267
Mean VIF	1.44	

Table 12: Impact on Average Returns Before and After MPX (DID Estimation Results)

This table shows how average returns are affected before and after the MPX event by using the DID estimation method. $\beta_{0\,(Before\ MPX)}$ represents the trend or gains over time, before the treatment (MPX). The control group has a dummy value of 0 if the country is less/not affected by MPX while the treated group has a dummy value of 1 if the country is more affected by MPX. The coefficients of the β_0 (average returns) show the average outcome of the control group does not change during the post-treatment period (QE) and the difference between the control and treated groups is 0. It shows that the DID model holds because of the parallel trend assumption existence which states that before treatment (Monkeypox) happened, there is a constant difference between the treated group (countries affected by MPX) and the control group (countries not affected by MPX) over the time. Furthermore, it is also an indication that there is no impact of MPX on Average returns before the MPX outbreak for the control and treated group from 1st Jan 2021 to 30 Apr 2022 because there is no MPX outbreak in that duration.

$\beta_{1\,(After\ MPX)}$ represents the difference of 0.042 between the treated and the control group After the treatment (MPX). It means the control group's average return is 0.042 as compared to the treated group which has a 0 value. It shows when the MPX outbreak happened, it had no impact on the average returns of the treated group and a minor impact on the control group. More affected countries' average returns decreased to 0 as compared to less affected countries' average returns of 0.042.

β_2 indicates that the average return of the treatment group is decreased by 0.042 in the ''after-treatment (MPX)'' period compared to what would have happened to the same group if the intervention had not taken place. Only DID for the ''After MPX'' phase is significant. Standard errors are nearly 0 showing there is a very minor difference between actual and estimated values of the regression line. Results in detail are discussed in section 2.3 (page 98).

Outcome Variables	**Average Ret**	**Std Err**
Before MPX (β_0) (01–01–2021 – 30–04–2022)		
Control	0	
Treated	0	
Diff (T–C)	0	0.033
After MPX (β_1) (11–11–2022 – 30–04–2023)		
Control	0.042	
Treated	0	
Diff (T–C)	–0.042	0.033*
Difference-in-Differences (β_2)	–0.042	0.046
Means & Std. Errors are estimated by linear regression		
Inference: *** p < 0.01; ** p < 0.05; *p < 0.1		

Table 12 (a): Event Study

This table presents the results of an event study regression, examining the impact of the MPX event and pre-event periods on stock returns.

Variable	Event	Date of Event	Coefficient	P-value
Before MPX	Estimation Window	01 Jan 2021 to 30 April 2022	-0.51	0.973
During MPX	Event Window	01 May 2022 to 10 Nov 2022	-7.54	0.665
After MPX	Post-Event Window	11 Nov 2022 to 30 Apr 2023	0.00	0.763

Note: Event Dummy = 1 if the date is during the MPX, otherwise 0

Table 13: Two-Sample t-tests With Equal and Unequal Variance

This table shows the outcome of two-sample t-tests with equal variance in model 1 and unequal variance in model 2 for testing the return differences. According to the outcomes, models 1 and 2 show the same results, where the mean difference between the two groups (control group and treated group) is 0.0220917. Hence, we accept our H_0 that also supports the results that there is almost no difference between the *Control Group* and *Treated Group* and parallel trend assumption holds here. The null Hypothesis (H_0) of this table states that the difference between the control and treated group is 0 however, the two-side alternative hypothesis (H_A) states that the difference between the control and treated group is not 0. We have a t-statistics value for our test as 1.0036 while the two-sided p-value is 0.3156. Standard error values in Models 1 and 2 are approximately 0 showing there is very minor or no difference between actual and estimated values of the regression line. Results in detail are discussed in section 2.3 (page 99).

Variables	Model 1	Model 2
Control	0.0224	0.0224
	(0.022)	(0.022)
Treated	0.0003	0.0003
	(0.0001)	(0.0001)
Diff	0.0221	0.0221
	(0.0220)	(0.0220)
t-statistics value	1.0036	1.0036
Two-sides p-value	0.3156	0.3156

Model 1: Two-sample t-test with equal variances (to test the return differences)
Model 2: Two-sample t-test with unequal variances
Mean values are reported; std errors are in parenthesis.
H_0 : The difference between the control group and the treated group is equal to 0
H_A : The difference between the control group and the treated group is not equal to 0.

Table 14: One-Way ANOVA Test for the Control Group and Treated Group

This table reports a one-way ANOVA test for the Control group and the Treated group for three phases as follows: *Before MPX*, *During MPX*, and *After MPX*. In Model 1, the average stock return before MPX is 0.0198, which is higher than the average stock returns during MPX (–0.000093) and after MPX (0.000262). It shows that the MPX event has a negative impact on average stock returns (–0.000093) during the MPX phase. Furthermore, after MPX, stock returns (0.000262) are following a little recovery but are still less than the stock returns (0.019829) before the MPX event. *Treated Groups* are the firms belonging to those countries which are highly affected by MPX while *Control Groups* are the firms belonging to those countries which are less affected by MPX. The average stock returns of the treated group are 0.000238, which is lower than the average stock returns for the control group (0.013094). It means the countries which are highly affected by MPX (Treated group countries) have lower average stock returns as compared to the countries which are less affected by MPX (Control group countries). Results in detail are discussed in section 2.3 (page 100).

Particular	**Model 1**	**Model 2**	**Model 3**
Before MPX (01–01–2021 – 30–04–2022)	0.019829		
During MPX (01–05–2022 – 10–11–2022)	–0.000093		
After MPX (11–11–2022 – 30–04–2023)	0.000262		
Control group	0.013094		
Treated group	0.000238		
Sources of variation in DV			
Between Treated		10.4267	0.0005
Within Treated		0	0.0002
p-value		0	0

Model 1: Average stock returns for ''Before MPX, During MPX, After MPX, Control, and Treated Group''.

Model 2: One-way ANOVA test for the Control group

Model 3: One-way ANOVA test for the Treated group

The mean sum of square values are reported

H_0: The mean of the control group and the treated group is the same.

H_A: The mean of the control group and the treated group is different.

Appendix A – 110 Countries List

This Appendix shows the total of 110 countries' names that are included in this study specifically for Monkeypox total cases, dummy variables, and their interaction term. *Panel A* countries are *Control Group* because these countries are less affected by MPX (MPX cases are between 0 – 736) while *Panel B* countries *Treated Group* because these countries are highly affected by MPX (MPX cases are between 760 – 6,471,492).

Panel A (Control Group)

Countries that are less affected by MPX
MPX cases between 1 to 736

Sr #	Country Name	Sr#	Country Name
1	Bahrain	29	Aruba
2	Egypt	30	Ukraine
3	Guam	31	Bahamas
4	Iran	32	Georgia
5	Jordan	33	Cuba
6	Martinique	34	Liberia
7	New Caledonia	35	Monaco
8	Saint Martin (French part)	36	Japan
9	Sri Lanka	37	China
10	Vietnam	38	Venezuela
11	Mozambique	39	Andorra
12	San Marino	40	Cyprus
13	Philippines	41	Benin
14	Indonesia	42	Honduras
15	South Korea	43	Lithuania
16	Morocco	44	Bosnia and Herzegovina
17	Guadeloupe	45	Turkey
18	Bermuda	46	Costa Rica
19	Barbados	47	Sudan
20	Paraguay	48	South Africa
21	Guyana	49	El Salvador
22	Qatar	50	Congo
23	Moldova	51	Uruguay
24	Russia	52	Latvia
25	Montenegro	53	Bulgaria
26	Greenland	54	UAE
27	Curacao	55	Gibraltar
28	Saudi Arabia	56	Lebanon

Panel B (Treated Group)

Countries that are more affected by MPX
MPX cases between 760 to 2,205,809

Sr #	Country Name	S#	Country Name
57	Thailand	85	Bolivia
58	Singapore	86	Poland
59	Jamaica	87	Ireland
60	Central African Republic	88	Denmark
61	New Zealand	89	Sweden
62	Cameroon	90	Democratic Republic of Congo
63	Estonia	91	Israel
64	India	92	Austria
65	Panama	93	Argentina
66	Slovakia	94	Nigeria
67	Iceland	95	Switzerland
68	Croatia	96	Chile
69	Dominican Republic	97	Belgium
70	Guatemala	98	Italy
71	Serbia	99	Portugal
72	Malta	100	Mexico
73	Finland	101	Netherlands
74	Romania	102	Canada
75	Slovenia	103	Colombia
76	Luxembourg	104	Peru
77	Czechia	105	France
78	Greece	106	Germany
79	Hungary	107	United Kingdom
80	Ghana	108	Brazil
81	Norway	109	Spain
82	Ecuador	110	United States
83	Australia	111	World
84	Puerto Rico		

Appendix B – 59 Countries List (For Stock Returns and Control Variables Data)

This Appendix shows a list of 59 countries included in this study (particularly for the stock returns and control variables data) because 52 countries data was missing. *Panel A (Control Group)* countries are less affected by MPX (MPX cases are between 18 – 736). The missing data countries MPX cases are less than 18 which is the reason for not including countries with MPX cases less than 18 in the list below. *Panel B (Treated Group)* countries are highly affected by MPX (MPX cases are between 893 – 2,205,809). Due to the same missing data reason, countries with 737–892 MPX cases were dropped from this group.

Establishing a benchmark or a threshold at 736 MPX cases helped to separate the highly affected countries from the less affected countries. Countries with MPX cases more than 736 MPX cases are considered as "highly affected".

Panel A (Control Group)

Countries less affected by MPX
MPX cases (18 to 736)

Sr #	Country Name
1	Qatar
2	Saudi Arabia
3	Barbados
4	Bermuda
5	Philippines
6	Bosnia and Herzegovina
7	Bulgaria
8	China
9	Cyprus
10	Indonesia
11	Turkey
12	Ukraine
13	United Arab Emirates
14	Venezuela
15	Vietnam
16	Japan
17	Latvia
18	Lebanon
19	Lithuania
20	Montenegro
21	Morocco
22	Bahamas

Panel B (Treated Group)

Countries more affected by MPX
MPX cases (893 to 2,205,809)

Sr #	Country Name	Sr #	Country Name
23	Argentina	45	Hungary
24	Australia	46	Iceland
25	Austria	47	India
26	Portugal	48	Ireland
27	Bolivia	49	Italy
28	Slovakia	50	Jamaica
29	Slovenia	51	Luxembourg
30	Spain	52	Malta
31	Switzerland	53	Mexico
32	Canada	54	Netherlands
33	Chile	55	New Zealand
34	Colombia	56	Nigeria
35	Croatia	57	Norway
36	UK	58	Panama
37	USA	59	Peru
38	Denmark		
39	Ecuador		
40	Estonia		
41	Finland		
42	Germany		
43	Ghana		
44	Greece		

Appendix C: Panel A and Panel B Data of Total MPX Cases for 110 Countries

This Appendix shows *Panel A (Control Group)* and *Panel B (Treated Group)* data of total MPX cases and total per million MPX cases to control the population effect, dummy variables, and their interaction term for 110 countries. The whole data is arranged in ascending order according to the total MPX cases. Dummy variables are created according to MPX total cases for 110 countries collected from https://ourworldindata.org/explorers/monkeypox.

Variable Year = β_2 is a dummy variable that has a value of 0 Before MPX (Bef MPX) and a value of 1 After MPX (Aft MPX). For **Total MPX cases** Before MPX, all cases are 0 because no country was affected while After MPX, total cases are collected from www.ourworldindata.org and mentioned in the table below. **Treatment (T)** = β_1 is another variable that has a value of 0 if the country is less affected or not affected by total MPX cases (control group) that is *Panel A.* While it has a value of 1 if the country is highly affected by the total MPX cases (Treated Group) that is our *Panel B*. Here countries 1 to 56 are less affected by MPX shown in *Panel A* while countries 57 to 110 are highly affected by MPX shown in *Panel B*. The last variable **β_1*β_2** is the combined effect of β_1 and β_2. Lebanon (country ID 56) has 736 MPX cases (part of the control group) while Thailand (country ID 57) has 760 MPX cases (part of the treated group). 736 cases are the benchmark to differentiate less affected countries from highly affected countries. There is a significant increase in MPX cases above this benchmark of 736 cases which gives a sensible logic to off-setting it as a scale to separate highly affected countries from less affected countries.

Panel A (Control Group)

Country ID	Country Name	Year = (β_2), Dummy		Total MPX Cases	Treatment (T) = (β_1) (Control Group)	β_1*β_2
1	Bahrain	Bef MPX	0	0	0	0
		Aft MPX	1	1	0	0
2	Egypt	Bef MPX	0	0	0	0
		Aft MPX	1	1	0	0
3	Guam	Bef MPX	0	0	0	0
		Aft MXP	1	1	0	0
4	Iran	Bef MPX	0	0	0	0
		Aft MPX	1	1	0	0
5	Jordan	Bef MPX	0	1	0	0
		Aft MPX	1	0	0	0
6	Martinique	Bef MPX	0	1	0	0
		Aft MPX	1	0	0	0
7	New Caledonia	Bef MPX	0	1	0	0
		Aft MPX	1	0	0	0
8	Saint Martin (French part)	Bef MPX	0	1	0	0
		Aft MPX	1	0	0	0
9	Sri Lanka	Bef MPX	0	1	0	0
		Aft MPX	1	0	0	0
10	Vietnam	Bef MPX	0	18	0	0
		Aft MPX	0	0	0	0
11	Mozambique	Bef MPX	1	30	0	0

		Aft MPX	0	0	0	0
12	San Marino	Bef MPX	1	30	0	0
		Aft MPX	0	0	0	0
13	Philippines	Bef MPX	1	36	0	0
		Aft MPX	0	0	0	0
14	Indonesia	Bef MPX	1	75	0	0
		Aft MPX	0	0	0	0
15	South Korea	Bef MPX	1	75	0	0
		Aft MPX	0	0	0	0
16	Morocco	Bef MPX	1	91	0	0
		Aft MPX	0	0	0	0
17	Guadeloupe	Bef MPX	0	97	0	0
		Aft MPX	1	0	0	0
18	Bermuda	Bef MPX	0	111	0	0
		Aft MPX	1	0	0	0
19	Barbados	Bef MPX	0	115	0	0
		Aft MPX	1	0	0	0
20	Paraguay	Bef MPX	0	144	0	0
		Aft MPX	1	0	0	0
21	Guyana	Bef MPX	0	152	0	0
		Aft MPX	1	0	0	0
22	Qatar	Bef MPX	0	171	0	0
		Aft MPX	1	0	0	0
23	Moldova	Bef MPX	0	176	0	0
		Aft MPX	0	0	0	0
24	Russia	Bef MPX	1	179	0	0
		Aft MPX	0	0	0	0
25	Montenegro	Bef MPX	1	180	0	0
		Aft MPX	0	0	0	0
26	Greenland	Bef MPX	1	182	0	0
		Aft MPX	0	0	0	0
27	Curacao	Bef MPX	1	184	0	0
		Aft MPX	0	0	0	0
28	Saudi Arabia	Bef MPX	1	209	0	0
		Aft MPX	0	0	0	0
29	Aruba	Bef MPX	1	211	0	0
		Aft MPX	0	0	0	0
30	Ukraine	Bef MPX	0	219	0	0
		Aft MPX	1	0	0	0
31	Bahamas	Bef MPX	0	220	0	0
		Aft MPX	1	0	0	0
32	Georgia	Bef MPX	0	231	0	0
		Aft MPX	1	0	0	0
33	Cuba	Bef MPX	0	241	0	0
		Aft MPX	1	0	0	0
34	Liberia	Bef MPX	0	259	0	0

		Aft MPX	1	0	0	0
35	Monaco	Bef MPX	0	267	0	0
		Aft MPX	1	0	0	0
36	Japan	Bef MPX	0	293	0	0
		Aft MPX	0	0	0	0
37	China	Bef MPX	1	322	0	0
		Aft MPX	0	0	0	0
38	Venezuela	Bef MPX	1	326	0	0
		Aft MPX	0	0	0	0
39	Andorra	Bef MPX	1	416	0	0
		Aft MPX	0	0	0	0
40	Cyprus	Bef MPX	1	439	0	0
		Aft MPX	0	0	0	0
41	Benin	Bef MPX	1	447	0	0
		Aft MPX	0	0	0	0
42	Honduras	Bef MPX	1	469	0	0
		Aft MPX	0	0	0	0
43	Lithuania	Bef MPX	0	469	0	0
		Aft MPX	1	0	0	0
44	Bosnia and Herzegovina	Bef MPX	0	494	0	0
		Aft MPX	1	0	0	0
45	Turkey	Bef MPX	0	517	0	0
		Aft MPX	1	0	0	0
46	Costa Rica	Bef MPX	0	526	0	0
		Aft MPX	1	0	0	0
47	Sudan	Bef MPX	0	529	0	0
		Aft MPX	1	0	0	0
48	South Africa	Bef MPX	0	553	0	0
		Aft MPX	1	0	0	0
49	El Salvador	Bef MPX	0	556	0	0
		Aft MPX	0	0	0	0
50	Congo	Bef MPX	1	557	0	0
		Aft MPX	0	0	0	0
51	Uruguay	Bef MPX	1	578	0	0
		Aft MPX	0	0	0	0
52	Latvia	Bef MPX	1	592	0	0
		Aft MPX	0	0	0	0
53	Bulgaria	Bef MPX	1	638	0	0
		Aft MPX	0	0	0	0
54	UAE	Bef MPX	1	698	0	0
		Aft MPX	0	0	0	0
55	Gibraltar	Bef MPX	1	728	0	0
		Aft MPX	0	0	0	0
56	Lebanon	Bef MPX	0	736	0	0

		Aft MPX	1	0	0	0

Panel B (Treated Group)

Country ID	Country Name	Year = (β_2) Dummy		Total MPX Cases	Treatment (T) = (β_1) (Treated Group)	$\beta_1*\beta_2$
57	Thailand	Bef MPX	0	760	1	0
		Aft MPX	1	0	1	1
58	Singapore	Bef MPX	0	890	1	0
		Aft MPX	1	0	1	1
59	Jamaica	Bef MPX	0	893	1	0
		Aft MXP	1	0	1	1
60	Central African Republic	Bef MPX	0	983	1	0
		Aft MPX	1	0	1	1
61	New Zealand	Bef MPX	0	1054	1	0
		Aft MPX	1	0	1	1
62	Cameroon	Bef MPX	0	1083	1	0
		Aft MPX	0	0	1	0
63	Estonia	Bef MPX	1	1120	1	1
		Aft MPX	0	0	1	0
64	India	Bef MPX	1	1156	1	1
		Aft MPX	0	0	1	0
65	Panama	Bef MPX	1	1203	1	1
		Aft MPX	0	0	1	0
66	Slovakia	Bef MPX	1	1314	1	1
		Aft MPX	0	0	1	0
67	Iceland	Bef MPX	1	1606	1	1
		Aft MPX	0	0	1	0
68	Croatia	Bef MPX	1	2660	1	1
		Aft MPX	0	0	1	0
69	Dominican Republic	Bef MPX	0	2805	1	0
		Aft MPX	1	0	1	1
70	Guatemala	Bef MPX	0	3114	1	0
		Aft MPX	1	0	1	1
71	Serbia	Bef MPX	0	3461	1	0
		Aft MPX	1	0	1	1
72	Malta	Bef MPX	0	3541	1	0
		Aft MPX	1	0	1	1
73	Finland	Bef MPX	0	3722	1	0
		Aft MPX	1	0	1	1
74	Romania	Bef MPX	0	4277	1	0
		Aft MPX	1	0	1	1
75	Slovenia	Bef MPX	0	5357	1	0
		Aft MPX	0	0	1	0
76	Luxembourg	Bef MPX	1	5386	1	1

		Aft MPX	0	0	1	0
77	Czechia	Bef MPX	1	6222	1	1
		Aft MPX	0	0	1	0
78	Greece	Bef MPX	1	7243	1	1
		Aft MPX	0	0	1	0
79	Hungary	Bef MPX	1	8087	1	1
		Aft MPX	0	0	1	0
80	Ghana	Bef MPX	1	8827	1	1
		Aft MPX	0	0	1	0
81	Norway	Bef MPX	1	9572	1	1
		Aft MPX	0	0	1	0
82	Ecuador	Bef MPX	0	10951	1	0
		Aft MPX	1	0	1	1
83	Australia	Bef MPX	0	12462	1	0
		Aft MPX	1	0	1	1
84	Puerto Rico	Bef MPX	0	13219	1	0
		Aft MPX	1	0	1	1
85	Bolivia	Bef MPX	0	13968	1	0
		Aft MPX	1	0	1	1
86	Poland	Bef MPX	0	16649	1	0
		Aft MPX	1	0	1	1
87	Ireland	Bef MPX	0	18687	1	0
		Aft MPX	1	0	1	1
88	Denmark	Bef MPX	0	18837	1	0
		Aft MPX	0	0	1	0
89	Sweden	Bef MPX	1	19466	1	1
		Aft MPX	0	0	1	0
90	Democratic Republic of Congo	Bef MPX	1	22119	1	1
		Aft MPX	0	0	1	0
91	Israel	Bef MPX	1	26139	1	1
		Aft MPX	0	0	1	0
92	Austria	Bef MPX	1	30148	1	1
		Aft MPX	0	0	1	0
93	Argentina	Bef MPX	1	33298	1	1
		Aft MPX	0	0	1	0
94	Nigeria	Bef MPX	1	38367	1	1
		Aft MPX	0	0	1	0
95	Switzerland	Bef MPX	0	53796	1	0
		Aft MPX	1	0	1	1
96	Chile	Bef MPX	0	68644	1	0
		Aft MPX	1	0	1	1
97	Belgium	Bef MPX	0	79998	1	0
		Aft MPX	1	0	1	1
98	Italy	Bef MPX	0	90136	1	0

		Aft MPX	1	0	1	1
99	Portugal	Bef MPX	0	111106	1	0
		Aft MPX	1	0	1	1
100	Mexico	Bef MPX	0	134975	1	0
		Aft MPX	1	0	1	1
101	Netherlands	Bef MPX	0	137135	1	0
		Aft MPX	0	0	1	0
102	Canada	Bef MPX	1	151788	1	1
		Aft MPX	0	0	1	0
103	Colombia	Bef MPX	1	162536	1	1
		Aft MPX	0	0	1	0
104	Peru	Bef MPX	1	201847	1	1
		Aft MPX	0	0	1	0
105	France	Bef MPX	1	395335	1	1
		Aft MPX	0	0	1	0
106	Germany	Bef MPX	1	414071	1	1
		Aft MPX	0	0	1	0
107	United Kingdom	Bef MPX	1	419475	1	1
		Aft MPX	0	0	1	0
108	Brazil	Bef MPX	0	652823	1	0
		Aft MPX	1	0	1	1
109	Spain	Bef MPX	0	752249	1	0
		Aft MPX	1	0	1	1
110	United States	Bef MPX	0	2205809	1	0
		Aft MPX	1	0	1	1
111	World	Bef MPX	0	6471492	1	0
		Aft MPX	1	0	1	1

Chapter 3: The Impact of Quantitative Easing on Firm's Financial Constraints in the US Stock Market; Evidence from US Financial and Non-Financial Firms

3.1 Introduction and Literature Review

Introduction

The Global Financial Crisis (GFC) 2007 – 2008 proved that a stable financial system is the backbone of the economy of any country. Following the GFC 2008, leading economies including the USA applied techniques such as reducing interest rates to almost zero, employing unconventional monetary tools, and implementing quantitative easing policies. QE policies involve Central Banks buying long-term securities to reduce long-term interest rates and encourage increased spending by households and businesses (Caldentey, 2017; Koráb et al., 2021; Park et al., 2016; Philippas et al., 2019). The United States increased the supply of money to overcome the financial difficulties of firms which ultimately reduced financial constraints (Park et al., 2016). Quantitative easing (QE) has been an important topic in academic research since the global financial crisis (GFC) 2007–2008. In recent years, central banks all around the world have economies responded to the Global Financial Crisis (2007–2008) by using both conventional (by reducing interest rates) and unconventional (Quantitative Easing - QE) monetary policies. Following the Global Financial Crisis (2007–2008), the Federal Reserve (the central bank of the United States) used Quantitative Easing (QE) programs to boost the US economy and improve financial stability. We illustrate how QE will impact the US firms' financial constraints by taking the sample for US financial firms and non-financial firms by using the empirical results.

QE began when the monetary authorities of the US, UK, and European Union adopted unconventional monetary policies (QE) to stimulate their economies (Fatouh et al., 2021). On December 16, 2008, the Fed Funds Rate in the United States reduced up to 0.17%, as compared to the 4.24% rate in the year 2007 (Giambona et al., 2020). On November 25, 2008, the Federal Reserve

acted as a lender of last resort and implemented the first round of Quantitative Easing (QE) following the reduction of the interest rate to a range of 0.00 to 0.25% on December 16, 2008 (Chen et al., 2022). The purpose of quantitative easing is generally to expand the monetary base through massive open market operations, such as a large-scale asset purchase program (Gern et al., 2015). As a response to the GFC 2007 – 2008, the Federal Reserve (Fed) has maintained short-term interest rates at zero and undertaken large-scale asset purchases (LSAPs) also known as QE (Chen et al., 2022; Sclip et al., 2021). The central bank buys assets to support the economy, called Quantitative Easing (QE) by lending more money when they reach their limits (Karadi & Nakov, 2021). Borrowers are less likely to experience default, lowering the amount of default risk, if QE improves economic prospects by easing the funding requirements for private-sector companies (Nozawa & Qiu, 2021). Banks with a higher ratio of MBS (Mortgage-Backed Securities) to total assets experience a significantly greater increase in lending (Kapoor & Peia, 2021).

Zhang et al. (2023) and Hadlock and Pierce (2010) found a significant relationship between financial constraints and firm size which indicates that larger firms tend to face the lower financial constraints while firms smaller in size face higher financial constraints. Our summary statistics results are supported by the findings of Zhang et al. (2023) and Hadlock and Pierce (2010) as Table 15 summary statistics show financial firms are less financially constrained and are larger in size while non-financial firms are more financially constrained and are smaller in size. The study of Hadlock and Pierce (2010) shows that more financially constrained firms have higher Tobin's Q. If Tobin's Q ratio of a firm is more than 1, it shows that the firm is running effectively (Charoenwong et al., 2021).

The current ratio measures how well a company manages its finances, and a higher current ratio suggests that the company is experiencing fewer financial challenges (Zhang et al., 2023). The current ratio for the non-financial firms (more financially constrained firms) is lower (0.0506) than the financial firms (less financially constrained firms) current ratio (2.6704). It means non-financial US firms are facing more difficulties in obtaining financial help and hence are more financially

constrained firms. Our results are supported by the study of Zhang et al. (2023) who represent the same results.

The positive value of *ROA* indicates that companies are more successful in generating profits and higher profits reduce the financial constraints of the firms (Hu, 2023; Zhang et al., 2023). The study of Hadlock and Pierce (2010) shows a higher firm profitability and higher book assets for less financially constrained firms than more financially constrained firms. Our study shows that financial firms (less financially constrained firms) are more profitable than non-financial firms. So financial firms tend to face fewer financial constraints than non-financial firms. Firms' profitability results are supported by the study of (Hadlock & Pierce, 2010). Tangibility is used to identify the credit constraints position of a firm e.g., whether the firm is facing any financial constraints or not, hence a higher tangibility of a firm leads to higher access to external funds and face fewer financial constraints (Almeida & Campello, 2007; Dong et al., 2012; Hovakimian, 2009; Hu & Liu, 2015; Zhang, 2011; Zhao et al., 2021). The amount of fixed-income securities (debt) used in a firm's capital structure is known as financial leverage, furthermore, firms enjoy tax-saving benefits by having debt in the capital structure as firms pay interest before paying taxes (Adenugba et al., 2016). Findings exhibit that firms with higher leverage ratios tend to have higher access to intragroup financing (Verschueren & Deloof, 2006). Our study shows that financial firms (less financially constrained firms) are more leverage and have access to external funds than non-financial (more financially constrained) firms. The interest expense to debt ratio is a firm's average interest expense for receiving the debt financing (Bräuning et al., 2023) or simply the debt financing cost (Chen & Yoon, 2022). Figure 3 of our study shows that the financial firms' KZ index is lower than the non-financial firms. It demonstrates that financial firms face fewer financial constraints than non-financial firms. Furthermore, the KZ index decreasing trend is shown for the financial firms and non-financial firms from the year 1990 to 2008, however after GFC 2008, the KZ index started increasing up to the year 2023.

This paper provides an understanding of how Quantitative Easing can affect corporate financing constraints of US financial firms and non-financial firms before and after the Global Financial

Crisis 2007–2008 by taking data from 1990 to 2023. The importance of this study is that this issue has not been discussed in the previous literature. Hence our study is adding new knowledge to the existing literature by filling the knowledge gaps. Besides this, our study shows the effect of Tobin's Q on a firm's financial constraints due to QE which is not addressed in the previous studies specifically in the QE context. Furthermore, the interpretation of Tobin's Q ratio is different in the different studies. For example, according to Charoenwong et al. (2021), Tobin's Q ratio > 1, indicates the efficiency of a firm while Liang and Chen (2023) and Hadlock and Pierce (2010) show that the greater Tobin's Q, the more likely it is that the firm will face financial constraints. This means that as Tobin's Q increases, the firm may have more difficulty accessing external funding or may be limited in its ability to invest in new projects or expand its operations. Furthermore, Tobin's Q shows if a company is worth more or less than its market value (Zhang et al., 2023).

Our results show that US financial firms have a lower KZ index (financial constraints), positive Tobin's Q, higher current ratio, higher firm profitability, higher tangibility, higher leverage, and higher interest expense to debt ratio. All these variables with the direction indicate towards less financially constrained status of financial firms. However, non-financial firms show higher KZ index (financial constraints), negative Tobin's Q, lower current ratio, lower firm's profitability, lower tangibility, lower leverage, and lower Interest expense to debt ratio. All these variables with the direction indicate towards more financially constrained status of non-financial firms. The findings of this study are valuable because of adding comprehensive and in-depth knowledge to the existing literature by providing an understanding of how corporate financing constraints of US firms can be affected by Quantitative Easing before and after the Global Financial Crisis of 2007–2008. Our results provide in-depth guidance on how to prevent large-scale systemic bank failure by providing financial stability within the banking industry. By using the findings of this study, regulators can identify the firms that are facing financial constraints to prevent early systemic risks of the firms and can make useful policies to provide financial help before it leaves a negative impact on the economy.

This study contributes to the literature in numerous ways. Our research has crucial practical significance for a comprehensive and in-depth understanding of how corporate financing constraints can be affected by Quantitative Easing before and after the Global Financial Crisis of 2007–2008. To bridge the gap of previous literature, our study examines the impact of Quantitative Easing (QE) on the financial constraints of US financial firms and non-financial firms from year 1990 to 2023. This study uses the Fed's QE programs and a difference-in-differences technique. Furthermore, to the best of our knowledge, our study is the first one to identify the effect of QE programs on the firm's financial constraints which is one of the main contributions to the previous literature. Our study is the first one to identify the impact of Tobin's Q on the firm's financial constraints caused by Quantitative Easing (QE) specifically. Furthermore, our study clarifies the explanation of Tobin's Q values in the results.

In summary, this study aims to investigate the differential impact of QE on the financial constraints of US financial and non-financial firms. Specifically, we seek to answer: Do US financial and non-financial firms face the same financial constraints to access capital? We hypothesize that US financial firms are less financially constrained than US non-financial firms (HA5). Furthermore, we explore the effect of QE, asking: Does Quantitative Easing (QE) affect the firm's financial constraints? We posit that Quantitative Easing has a positive impact due to a negative relationship with the financial constraints of US financial firms (HA6). While these questions and hypotheses are explored in detail in the dedicated 'Research Questions and Hypotheses' section, their explicit mention here underscores the core objectives driving this research. The remaining chapter is organised as follows: Section II discusses the literature review; Section III describes the empirical approach; Section IV presents the results and discussion; Section V presents the conclusion; and Section VI presents practical implications.

Literature Review

The US and European central banks implemented a massive intervention called quantitative easing (QE) after the GFC 2007–2008 by purchasing trillions of dollars' worth of assets to boost their prices and stimulate struggling economies (Geanakoplos & Wang, 2020). GFC 2007–2008

caused economic problems in many countries and made people worried that the whole world's financial system might fail (Fatouh et al., 2021). The US Federal Reserve carried out multiple rounds of quantitative easing, buying agency mortgage-backed securities and Treasury securities (Kapoor & Peia, 2021). Since the end of 2008, three QE rounds have been used i) QE1 was implemented at the height of the GFC 2008 crisis, ii) QE2 was applied when the credit market stress had already reduced significantly, iii) QE3 was initiated as a result of low-interest rates (Sclip et al., 2021). During the recession of 2008, major central banks adopted unconventional monetary policies (QE) to fix economic issues by providing money at zero interest rates (Duca et al., 2016).

During COVID-19, the post*treat dummy and the control variables Tobin's Q, and ROA have a negative impact on Chinese firms' financial constraints, while firm size has a positive impact on Chinese firms' financial constraints (Hu, 2023; Zhang et al., 2023). There is a positive impact of the firm's performance (ROA) on the firm's financial constraints (Kaplan & Zingales, 1997; Li, 2011; Livdan et al., 2009; Stikkelman, 2010; Whited & Wu, 2006; Zhang et al., 2023; Zhao, 2016) while other studies found that ROA negatively affected the firm's financial constraints e.g., (Ahamed et al., 2023; Campello & Chen, 2010; Chan et al., 2010; Chen & Wang, 2012; Hennessy et al., 2007; Hu, 2023; Lamont et al., 2001; Zhang et al., 2023). The positive or higher value of *ROA* indicates that companies are more successful in generating profits and higher profit reduces the financial constraints of the firms (Hu, 2023; Zhang et al., 2023).

To measure the firm's financial constraints, there are five methods used that are the KZ index, the WW index, the SA index, age, and size evaluated by market capitalization (Li, 2011). Previous literature could not identify an agreed-upon standard for measuring the firm's financial constraint (Hu, 2023; Wu & Huang, 2022). The higher the KZ Index, the higher the tendency of the firm to face financial constraints and lower the firm's financing efficiency (Ban & Zhu, 2023; Hu, 2023; Li, 2011; Liang & Chen, 2023; Nababan & Siregar, 2023; Pei et al., 2023). The KZ index is used to measure the financial constraints of the firms in the previous studies e.g., Liang et al. (2023), Pei et al. (2023), Yao et al. (2022), Li (2011), Lin and Bo (2012), Hu (2023), Nababan and

Siregar (2023), Liu et al. (2023), Wen et al. (2023), Wang and Zhang (2023), Cheng et al. (2023), Ban and Zhu (2023), Zhang et al. (2023), (Hu, 2023). In our study, we use the Kaplan-Zingales index (KZ Index) to determine the financial constraints of the firms.

A significant association between financial constraints and firm size is found which indicates that larger firms tend to face lower financial constraints while firms smaller in size face higher financial constraints (Hadlock & Pierce, 2010; Zhang et al., 2023). If Tobin's Q ratio of a firm is more than 1, it shows that the firm is running efficiently (Charoenwong et al., 2021). The summary statistics results of Hadlock and Pierce (2010) represent that more financially constrained firms have higher Tobin's Q than the less financially constrained firms. According to the study of Zhang et al. (2023), the current ratio measures how well a company manages its finances, and a higher current ratio suggests that the company is experiencing fewer financial challenges. Furthermore, their study stated that the current ratio is used as a proxy for the liquidity or financial constraints a company is experiencing to determine its capacity to fulfil its debt obligations. The studies of Hadlock and Pierce (2010), Zhang et al. (2023) and Hu (2023) show higher book assets for the less financially constrained firms than more financially constrained firms.

Tangibility is used to identify the credit constraints position of a firm e.g., whether the firm is facing any financial constraints or not, hence a higher tangibility of a firm leads to higher access to external funds and face fewer financial constraints (Almeida & Campello, 2007; Dong et al., 2012; Hovakimian, 2009; Hu & Liu, 2015; Zhang, 2011; Zhao et al., 2021). The amount of fixed-income securities (debt) employed in a firm's capital structure is called financial leverage, furthermore, firms enjoy tax-saving benefits by having debt in the capital structure as firms pay interest before paying taxes (Adenugba et al., 2016). Findings show that firms with higher leverage ratios tend to have higher access to intragroup financing (Verschueren & Deloof, 2006). Interest expense to debt ratio is a firm's average interest expense for receiving the debt financing (Bräuning et al., 2023) or simply the debt financing cost (Chen & Yoon, 2022).

Recent research shows that Quantitative Easing (QE) impacts financial firms differently than non-financial firms. This is because financial firms are directly involved in how monetary policy

works. Conversely, non-financial firms are affected by QE indirectly, mainly through cheaper borrowing and higher asset values. But their reactions vary depending on their financial limitations and the industry they're in. Altavilla et al. (2022) showed that the impact of negative rates (e.g., QE) on firm investment depended on bank lending strength (e.g., cheaper borrowing). Eichenbaum, Rebelo, and Wong (2022) show that how firms react to monetary policy changes depends on the economic situation. This means that the long-term impact of QE on firms changes as the economy changes. Furthermore, Dinh et al. (2023) identified, through regression analysis, significant effects of quantitative easing (QE) on firm performance, with these effects varying across different levels.

Lenza, Pill, and Reichlin (2010) suggest that the impact of quantitative easing (QE) on the non-financial sector varies based on the structure of a nation's financial system. Specifically, in the United States, a market-centered system, the Federal Reserve had to bypass banks to ensure credit flow to the non-financial sector. This contrasts with bank-centered systems, indicating a differential impact of QE across these sectors. Tao et al. (2022) found that while financial and non-financial sectors exhibited a generally similar negative response to lockdown announcements, the timing of their abnormal returns differed. The financial sector experienced sustained negative returns extending past the announcement, whereas the non-financial sector's negative returns were more immediate but short-lived. This suggests that the impact of economic events, like those related to QE, may vary in timing and duration between financial and non-financial firms.

3.1.1 Research Gaps, Main Contributions, and Importance of This Study

Our research provides vital practical significance for a broader understanding of how Quantitative Easing can affect corporate financing constraints (measured by the KZ Index) before and after the Global Financial Crisis of 2007–2008. In terms of Quantitative Easing's impact on the financial constraint of US financial and non-financial firms, to the best of our knowledge, this is the first study that explores such impact by including and excluding various control variables. Additionally, this study provides a comparative analysis of the impact of QE on the KZ Index of US financial and non-financial firms.

This research contributes to the existing literature by using the KZ index to identify the company's financial constraints, which provides an overview that financial constraints can also be measured by using different models and techniques instead of using the same models each time. This study provides a broader understanding of the financial constraints of US firms, which is important due to modifications in monetary policies. Furthermore, this study also provides significant findings on how quantitative easing can affect the US firm's ability to access financial help during times of financial need.

The implementation of QE by the Federal Reserve following the GFC 2007-08 and during the COVID-19 pandemic has stimulated extensive research on its macroeconomic effects. However, the understanding of how these policies differentially impact US financial versus non-financial firms remains a critical area of inquiry. To address this, our study provides a comparative analysis on US financial vs. non-financial firms. It is also very important to consider how QE affects companies over time. Hence, this study identifies the performance of US financial vs non-financial firms in response to QE. Furthermore, more research is needed to understand how QE affect small vs large firms. Hence, this study includes firm size as a variable to identify the impact of QE on small vs large firms. Prior research has not adequately explored the distinctions in QE's influence on financial versus non-financial entities, nor has it thoroughly analysed the evolution of its effects on firm performance. Therefore, this research specifically aims to fill these gaps.

Theoretical Framework: This study draws upon a multi-faceted theoretical framework to analyse the financial constraints faced by US financial and non-financial firms, particularly in the context of Quantitative Easing (QE).

This study follows the **pecking order theory** of finance that helps firms make and prioritize their financing decisions. This theory was presented by Donaldson (1961) and modified by Myers and Majluf (1984), who introduced the idea of following a hierarchical preference to raise the capital. This theory states that to raise capital, firms should always prefer internal financing first and the most preferable option, then debt should be the secondary preference in case firms still need

capital, and equity financing should be considered as the last and least preferable option. Internal financing is considered as the most preferable option because it maintains the firm's reputation in the external market. The reason for selecting debt as a secondary choice is because it saves the ownership rights of the firms because in equity financing, firms need to sell their shares to raise the capital, which divides its ownership rights; that's why it should be the least preferable option.

To further understand the mechanisms behind these constraints, we incorporate **financial constraints theory**, which suggests that market imperfections, e.g., information asymmetry and agency problems, limit firms' access to external capital. This theory directly addresses our investigation into whether financial constraints differ between financial and non-financial firms.

Moreover, we examine the impact of QE through the lens of **information asymmetry theory**, which explains how the unequal distribution of information between firms and investors can increase the cost of financing. We hypothesize that financial firms with easier access to public information and stronger regulations will exhibit lower levels of financial constraint due to reduced information asymmetry.

Furthermore, we consider **liquidity preference theory**, which interprets how changes in market liquidity influence the availability of credit. This theory is crucial for understanding how QE, as a direct intervention in market liquidity, affects firms' access to capital. Finally, we consider **market timing theory**, which suggests that firms attempt to optimize their capital structure by timing market valuations. This perspective provides insights into how firms, particularly financial firms, may adjust their financing strategies in response to the market conditions created by QE. By integrating these five theories, we aim to provide a comprehensive understanding of the factors influencing financial constraints and the effects of QE on US firms.

In terms of the firm's performance (measured by *ROA*) impact on a firm's financial constraints, there is a contradiction in previous research because some studies results confirmed a positive impact of the firm's performance (*ROA*) on the firm's financial constraints e.g., (Kaplan & Zingales, 1997; Li, 2011; Livdan et al., 2009; Stikkelman, 2010; Whited & Wu, 2006; Zhang et al., 2023; Zhao, 2016) while other studies' results showed a negative impact of *ROA* on the firm's

financial constraints e.g., (Ahamed et al., 2023; Campello & Chen, 2010; Chan et al., 2010; Chen & Wang, 2012; Hennessy et al., 2007; Hu, 2023; Lamont et al., 2001; Zhang et al., 2023). Hence, by using the Difference-in-Differences model, this study fills the gap in existing studies by providing an objective conclusion on how a firm's performance (*ROA*) affects its financial constraints.

There is no research paper which clearly identified the impact of Tobin's Q on the firm's financial constraints caused by QE specifically. Furthermore, there is a contradiction in previous literature about the explanation of higher Tobin's Q vs. lower Tobin's Q of the firm in the results. For example, if the Tobin's Q ratio of a firm is more than 1, it shows that the firm is running efficiently (Charoenwong et al., 2021). While a higher Tobin's Q might be an indication of a highly financially constrained firm, however, the chances of being a highly financially constrained firm can be lower if the firm's cash flows, cash holdings, and dividends are higher (Liang & Chen, 2023). The summary statistics results of Hadlock and Pierce (2010) represent that more financially constrained firms have higher Tobin's Q than the less financially constrained firms. While, according to Zhang et al. (2023), Tobin's Q might be a way to estimate the undervalued or overvalued status of the firm in the market. Hence, our study is the first one that identifies the impact of Tobin's Q on the firm's financial constrained caused by Quantitative Easing (QE) and addresses the limitations in previous studies which are still unaddressed.

Research Questions and Hypotheses:

RQ_5: Do US financial and non-financial firms face the same financial constraints to access capital?

HA_5: US financial firms are less financially constrained than US non-financial firms.

RQ_6: Does Quantitative Easing (QE) affect the firm's financial constraints?

HA_6: Quantitative Easing has a positive impact due to a negative relationship with the financial constraints of US financial firms.

3.2 Data and Methodology

3.2.1 Data

We collected annual data on financial variables for US financial and non-financial firms from 1990 to 2023. The period 1990 – 2023 is selected to capture the pre-quantitative easing and post-quantitative easing effects to explore the Federal Reserve's monetary policies. Another reason for selecting this period is because this period includes important economic events, e.g., the dot-com bubble from 1995 to 2001, the Global Financial Crisis from 2007 to 2008, and COVID-19, during which QE was implemented. It is an ideal period to identify how financial constraints are affected by QE. Utility and small firms are excluded from the sample because utility firms are often considered financially stable firms while small firms tend to face exceptional financial difficulties in accessing the funds that could make this study's findings less reliable. We used NAICS codes (North American Industry Classification System) to identify the US financial variables data for financial firms and non-financial firms. By using COMPUSTAT, we used the FS category for financial firms (SIC codes from 6000 to 7000), while the INDL category for non-financial firms (SIC codes except from 6000 to 7000). SIC codes stand for standard industrial classification. Financial Services include banks, insurance enterprises, broker/dealers, real estate, etc. While INDL Industrial contains corporations based on production, retail, construction, and other commercial operations excluding financial services. Utility firms include electric industries, water industries, gas firms, oil, coal, mining industries, etc. After data collection, by using STATA software, the whole data is winsorized at the 10^{th} and 99^{th} percentile to remove outliers that ensure a robust and representative dataset. 10th and 99th percentile achieve a smooth data distribution and ensure that a moderate percentile range is used to remove outliers instead of using too extreme a range, e.g., 1^{st} and 99^{th} percentile that might completely remove or drop the meaningful data values from the sample.

3.2.2 Methodology and Econometric Specifications

The impact of quantitative easing on the firm's financial constraints is assessed by using the Difference-in-Differences (DID) econometric model that is commonly used to estimate the different results between treatment and control groups during shocks, e.g., Quantitative Easing in our study. This method is better than other methods because it controls for bias, it is easy to generalize, and it is also useful in comparing the changes in the outcome (financial constraints) pre-treatment and post-treatment (quantitative easing). We explore whether Quantitative easing (Independent variables) has any kind of impact on the firm's financial constraints measured by the KZ index (Dependent variable) by controlling different factors that might affect the firm's financial constraints. Post and Treat are dummy independent variables. The post value is 1 during QE rounds, otherwise 0. The treat value is 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and 0 for 1st to 25th (control group). However, in the middle part of the distribution, it does not take any value (Kapoor & Peia, 2021; Rodnyansky & Darmouni, 2017). Post*Treat is an interaction term used to capture the effect of difference-in-differences. The controlling factors are Tobin's Q, Firm Size, Current Ratio, Return on Asset, Tangibility, Leverage, and Interest-To-Debt Ratio. In our estimation, we also controlled the time-fixed effect and industry-fixed effect because in a Difference-in-Differences (DID) estimation, controlling for time-fixed effects and industry-fixed effects is essential to isolate the treatment effect more accurately. Time-fixed effects basically control all external factors that are not included in the model but might affect the dependent variable. However, Industry-Fixed Effects control for unobserved, time-invariant industry-specific attributes that could affect the dependent variable.

The KZ is an appropriate index to measure the financial constraints of the firms because of its property to capture important financial indicators (cash, cash flow, Tobin's Q, leverage, and dividend). These financial indicators are appropriate in evaluating both financial and non-financial firms' access to funds, specifically during QE.

KZ index = −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) − 1.315*(Cash ÷ K)

(Hadlock & Pierce, 2010; Hu, 2023; Kaplan & Zingales, 1997; Lamont et al., 2001; Li, 2011; Liang & Chen, 2023; Lin & Bo, 2012; Liu et al., 2023; MacKay & Phillips, 2005)

KZ index is used as a measuring tool for the firm's financial constraints in previous studies, e.g., (Hadlock & Pierce, 2010; Hu, 2023; Kaplan & Zingales, 1997; Lamont et al., 2001; Li, 2011; Liang & Chen, 2023; Lin & Bo, 2012; Liu et al., 2023; MacKay & Phillips, 2005).

The KZ index is our dependent variable and a proxy of financial constraints (difficulty in obtaining external financial help and funds). KZ describes the firm's financial status. Despite its popularity, the KZ Index is criticised because its variables, such as cash and dividends, may not purely measure financial constraints. To address this, the WW Index was developed by Whited and Wu (2006), using variables like debt and sales, which are considered less influenced by the very financial constraints they are meant to measure (Hadlock and Pierce, 2010). Furthermore, using only size and age, the SA Index, developed by Hadlock and Pierce (2010), seeks to avoid the influence of current financial decisions, offering a less biased measure than the KZ Index. Despite its limitations, the KZ Index's widespread use and simplicity justify its application in this study, and the results sufficiently support our conclusions. However, future research should explore alternatives, for example, exploring the impact of using the WW index and the Size-Age (SA) index.

Appendix D presents the KZ Index formula, the variables used in KZ calculation with definition and COMPUSTAT's item numbers. Appendix E shows all variables used in the DID model, their formulas, and references, while Appendix F lists the variables' definitions, abbreviations, and COMPUSTAT's item numbers. Appendix G exhibits the dataset that is used to create the KZ index graphs illustrated in Figure 3. However, Appendix H displays the KZ Index calculation for US financial and non-financial firms from the year 1990 to 2023.

DID Model for Financial and Non-Financial Firms With and Without Control Variables

For Financial Firms *(with controls)*	**Log (F_KZ Index)** $_{i,t}$ =	$\alpha_0 + \beta_1*(Post_t) + \beta_2*(Treat_i) + \beta_3*(Post_t \times Treat_i) + \beta_4*(Tobin's\ Q) + \beta_5*(FS\_Log\ of\ Assets) + \beta_6*(CR) + \beta_7*(ROA) + \beta_8*(Tangibility) + \beta_9*(Leverage) + \beta_{10}*(Int\_Exp\_to\_Debt) + \varepsilon_{i,t}$	**[1]**
For Financial Firms *(without controls)*	**Log (F_KZ Index)** $_{i,t}$ =	$\alpha_0 + \beta_1*(Post_t) + \beta_2*(Treat_i) + \beta_3*(Post_t \times Treat_i) + \varepsilon_{i,t}$	**[2]**
For Non-Financial Firms *(with controls)*	**Log (NF_KZ Index)** $_{i,t}$ =	$\alpha_0 + \beta_1*(Post_t) + \beta_2*(Treat_i) + \beta_3*(Post_t \times Treat_i) + \beta_4*(Tobin's\ Q) + \beta_5*(FS\_Log\ of\ Assets) + \beta_6*(CR) + \beta_7*(ROA) + \beta_8*(Tangibility) + \beta_9*(Leverage) + \beta_{10}*(Int\_Exp\_to\_Debt) + \varepsilon_{i,t}$	**[3]**
For Non-Financial Firms *(without controls)*	**Log (NF_KZ Index)** $_{i,t}$ =	$\alpha_0 + \beta_1*(Post_t) + \beta_2*(Treat_i) + \beta_3*(Post_t \times Treat_i) + \varepsilon_{i,t}$	**[4]**

Equation 1 displays the difference in difference (DID) model for US financial firms including all control variables while Equation 2 exhibits the DID model for US financial firms without including any control variable. Equation 3 presents the difference in difference (DID) model for US non-financial firms including all control variables while Equation 4 demonstrates the DID model for US non-financial firms without including any control variable.

Financial Constraint is our dependent variable and is measured by the KZ index and used to describe the financial status of the firms. Post and Treat variables are used to measure the effect of Quantitative Easing on the financial constraints of financial firms and non-financial firms. The Post value is equal to 1 if the time is during the Quantitative Easing (QE round 1 started in December 2008), otherwise, its value is 0. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and 0 for 1st to 25th (control group). While, in the middle part of the distribution, it does not take any value (Kapoor & Peia, 2021; Rodnyansky & Darmouni, 2017). β_3 explains the effects of QE rounds on financial constraints and it is our main target variable of this study while Post*Treat is the DID effect. The control variables

that might affect the firm's financial constraints are Tobin's Q, Firm Size, Current Ratio, Return on Asset, Tangibility, Leverage, and Interest-To-Debt Ratio. $\varepsilon_{i,t}$ is known as an error term or residual that captures the possible factors that aren't included in the model but could influence the dependent variable. Time-fixed effect and industry-fixed effect is also considered in the estimation which allows for control of specific periods and industry differences and the sole focus can be on the treatment impact. The selection of control variables used in this study is based on well-known and highly referenced corporate finance papers e.g., (Byoun, 2008; Charoenwong et al., 2021; Chen et al., 2022; Faulkender & Petersen, 2006; Flannery & Rangan, 2006; Giambona et al., 2020; Lemmon et al., 2008; MacKay & Phillips, 2005; Rajan & Zingales, 1995; Titman & Wessels, 1988; Zhang et al., 2023).

Fig 3: KZ Index Graph for USA Financial and Non-Financial Firms

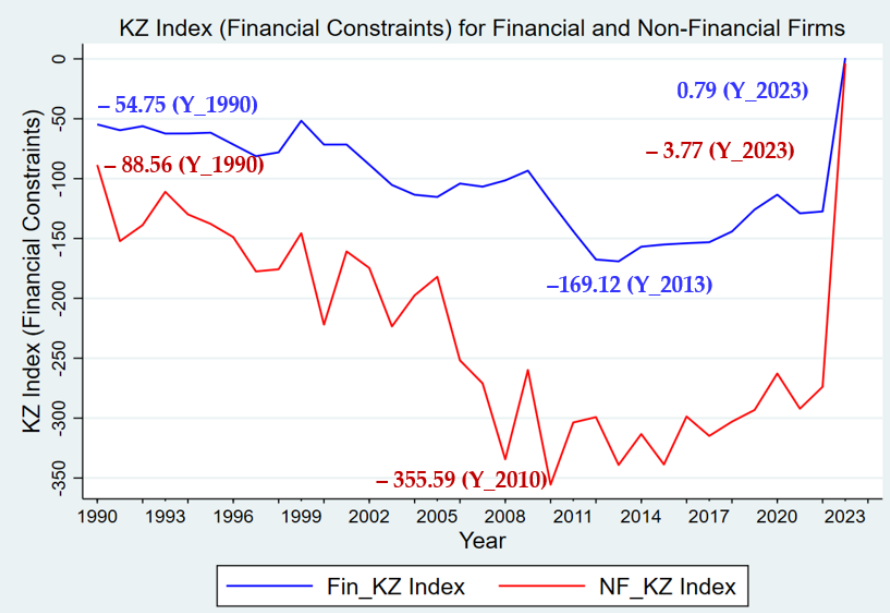


Figure 3: This figure illustrates the KZ index graph for US financial and non-financial firms from the year 1990 to 2023 where a negative value denotes the financial constraints while a positive value indicates the financial recovery. This graph is created by using the data values which are listed in Appendix G. The KZ index is used to measure the financial constraints of the firms, and the KZ Index calculation is shown in Appendix H. This graph shows that the KZ index for financial firms is constantly lower than the KZ of non-financial firms. It means financial firms are less financially constrained than non-financial firms. Financial firms are represented by the blue line while non-financial firms are

indicated by the red line. This graph shows a decreasing trend in the KZ index for both types of firms from the year 1990 to 2008, but after GFC 2008, the index shows an increasing trend up to the year 2023.

Figure 3 shows the KZ index graph for the US financial and non-financial firms from the year 1990 to 2023 where a more negative value on the KZ Index indicates higher financial constraints. KZ index is used to measure the financial constraints and is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). Appendix H shows the detailed calculation of the KZ index for financial and non−financial firms. The x-axis of the graph shows years from 1990 to 2023 while the y-axis of the graph shows the KZ index. Appendix G represents the data set which is used to create this graph. The blue line represents the financial firms whereas the red line denotes the non-financial firms. For a better explanation of the graph, the financial firm's KZ index is denoted by F_KZ while the non-financial firm's KZ index is represented by NF_KZ.

We can see from the graph that during the year 1990, F_KZ started at –54.75 as compared to NF_KZ starting at –88.56. F_KZ fluctuates over time and reaches a maximum constraint of –169.12 in the year 2013 comparatively NF_KZ with its maximum constraint of –355.59 in the year 2010. Afterwards, following a recovery in both groups of firms, during the year 2013, F_KZ ended with a positive value of 0.79 indicating improvement in the financial situation as compared to NF_KZ ending still at a negative index of –3.77. Overall, the graph shows a decreasing trend for both groups from 1990 to 2008 while afterwards, the trend starts increasing until 2023. Furthermore, financial firms are less financially constrained than non-financial firms.

3.3 Empirical Results and Discussion

3.3.1 Descriptive Statistics Shown in Table 15, Table 15(a), and Table 15(b)

Table 15 shows the summary statistics of the 14,940 US financial firms and 78,108 US non-financial firms. The data set has an unequal number of firms due to a smaller number of firms registered in the financial sector due to other factors e.g., entry hurdles, regulatory constraints, and funds intensity etc. To overcome this limitation, the industry-fixed effect is added to the DID model to

appropriately control for the unequal distribution and other industrial factors as well as to increase the fairness and validity of the results. This unequal sample does not show biasness however, the large number of non-financial firms enhances the statistical power of the results. Furthermore, the robustness ensures the reliability of results, even with an unequal sample.

Table 15(a) shows the summary stats for 14,940 US financial firms for (overall, between, and within) the groups. Table 15(b) shows the summary stats for 78,108 US non-financial firms concerning (overall, between, and within) the groups. Table 15, Table 15(a), and Table 15(b) show the number of observations of financial firms and non-financial firms in the USA, their mean values, standard deviation, maximum values, and minimum values. In Table 15(a) and Table 15(b), overall category results for all variables are the same as displayed in Table 15, hence we explained Table 15 results in detail.

Log (F_KZ) and Log (NF_KZ) are key dependent variables as a proxy for the financial constraints of the US financial and non-financial firms respectively. Key independent variables are post dummy and treat dummy while, DID is captured in terms of the interaction term Post*Treat. The post-dummy variable indicates the value of 1 during QE rounds (from the year 2008 to 2020), 0 before QE (from 1990 to 2007) and after QE rounds (from 2021 to 2023). Treat is a dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75^{th} to 100^{th} percentile (treated group) and zero for the 1^{st} to 25^{th} percentile (control group). By following the strategy of Zhang et al. (2023), we created a treated group and a control group where if firms are affected by QE, then they are considered as the treated group; however, if firms are not affected by QE, then they are considered as the control group. Control variables are included in this study that might affect the firm's financial constraints, e.g., Tobin's Q, Firm Size, Current Ratio, Return on Asset, Tangibility, Leverage, and Interest-To-Debt Ratio.

In Table 15, the KZ index is represented by log (F_KZ) for financial US firms while log (NF_KZ) for non-financial US firms. Furthermore, for F_KZ, the mean value is (–0.0029) with a standard deviation (0.1744), while for NF_KZ, the mean value is (0.0008) with a standard deviation (0.0408). These mean values and standard deviations of the KZ index indicate the differences in financial

constraints in different US firms used in our study. These results are supported by the study of (Hu, 2023).

Firm size (FS) is measured by taking the log of assets. FS is used as a control variable because firm size can affect the firm's financial constraint measured by the KZ index where the KZ Index is our dependent variable. The standard deviation of financial firms (0.3901) and non-financial firms (0.3974) indicate a significant difference between the size of all US firms used in our study. Our results are supported by the study of Hu (2023) who found similar findings.

The mean values of the KZ index and firm size show that the financial firms are less financially constrained (–0.0029) and are larger in size (3.4007) while non-financial firms are more financially constrained (0.0008) and are smaller in size (2.4804). Our results about the firm's KZ index and Firm's size are supported by the studies of Zhang et al. (2023) and Hadlock and Pierce (2010) who found a significant relationship between financial constraints and firm size, which indicates that larger firms tend to face lower financial constraints while firms smaller in size face higher financial constraints.

In Table 15, financial firms are less financially constrained and are larger in size than non-financial firms. The difference in financial constraints between financial and non-financial firms is likely due to both sector and size. Financial firms, being larger and part of the financial sector, typically have greater access to capital markets. Furthermore, these firms have more diversified funding sources and are more directly influenced by monetary policies like Quantitative Easing (QE), which increases liquidity. Non-financial firms, especially smaller ones, often face more significant financial constraints due to limited access to external financing and less diversification in funding options, making them more vulnerable to economic fluctuations and capital shortages.

Tobin's Q is the ratio of the firm's market value to total assets that indicates if the firm is overvalued or undervalued (Zhang et al., 2023). A low Tobin's Q (less than 1) shows that the market value of the firm is lower than the cost of its assets (asset replacement cost). Conversely, a high Tobin's Q (greater than 1) represents that the market value of the firm is higher than the cost of its assets. We can see from the results that the mean value of Tobin's Q (0.4369 < 1) for the

financial firms is lower than Tobin's Q (3.5142 > 1) for the non-financial firms. Financial firms are still less financially constrained because of their access to capital, liquidity and financial reputation. In contrast, the high Tobin's Q of non-financial firms (3.5142 > 1) implies that these firms' market value is higher than the cost of their assets and that these firms have growth potential. However, this result indicates that non-financial firms rely mainly on external financing and are affected by market fluctuations. Hence, these firms are still considered as more financially constrained. Our Tobin's Q results are also supported by the study of Hadlock and Pierce (2010), who identified that more financially constrained firms have higher Tobin's Q.

Table 15 also exhibits the current ratio that measures how well a company manages its finances, and a higher current ratio suggests that the company is experiencing fewer financial challenges (Zhang et al., 2023). The current ratio for the non-financial firms (more financially constrained firms) is lower (0.0506) than the financial firms (less financially constrained firms) current ratio (2.6704). It means non-financial US firms are facing more difficulties in obtaining financial help and hence are more financially constrained firms. Our results are supported by the study of Zhang et al. (2023) who represent the same results. Furthermore, their study also shows that the current ratio is used as a proxy for the liquidity or financial constraints a company is experiencing to determine its capacity to fulfil its debt obligations.

A firm's profitability is measured by ROA (Return on Assets), where the positive value of ROA indicates that companies are more successful in generating profits. Here, both values for ROA are positive (0.0164 and 0) for financial firms and non-financial firms, respectively. ROA for financial firms (less financially constrained firms) is higher (0.0164), while it is 0 for non-financial firms. This result also represents that financial firms are generating higher profits and hence are less financially constrained than non-financial firms. Our ROA results are supported by the study of (Hadlock & Pierce, 2010; Hu, 2023; Zhang et al., 2023) because their study represents higher book assets for less financially constrained firms than more financially constrained firms.

Tangibility is used to identify the credit constraints position of a firm e.g., whether the firm is facing any financial constraints or not, hence a higher tangibility of a firm leads to higher access

to external funds and face fewer financial constraints (Almeida & Campello, 2007; Hovakimian, 2009; Hu & Liu, 2015; Zhang, 2011; Zhao et al., 2021). Table 15 shows that financial firms (less financially constrained firms) are showing higher tangibility (1.2879) as compared to non-financial firms (more financially constrained firms), which is 0.0724. It shows that financial firms (less financially constrained firms) have more access to external financing and thus face fewer financial constraints.

The number of fixed-income securities (debt) utilized in a company's capital structure is known as financial leverage, furthermore, firms enjoy tax-saving benefits by having debt in the capital structure as firms pay interest before paying taxes (Adenugba et al., 2016). Similar to the findings of Hu (2023), our study also shows a higher leverage (0.4056) for financial firms as compared to the leverage (–0.3885) of non-financial firms. Findings show that firms with higher leverage ratios tend to have higher access to intragroup financing (Verschueren & Deloof, 2006). Higher leverage shows that the firm is more dependent on debt and faces less financial stability. Financial firms (less financially constrained firms) show higher leverage (0.4056) as compared to the non-financial (more financially constrained) firm's leverage (–0.3885). It shows that financial firms have access to external funds and, thus, are less financially constrained than non-financial firms.

Interest expense to debt ratio is a firm's average interest expense for receiving the debt financing (Bräuning et al., 2023) or simply the debt financing cost (Chen & Yoon, 2022). Financial firms (less financially constrained firms) show a higher Interest expense to debt ratio (2.0949) as compared to the non-financial (more financially constrained) firms (0.3878). It shows that financial firms have access to external funds and, thus, are less financially constrained than non-financial firms.

3.3.2 Multicollinearity VIF (Table 16 (a)), Heteroskedasticity White (Table 16 (b)), and Stationarity DF Tests (Table 16 (c)),

Table 16 (a) represents the variance inflation factor (VIF) results to capture the effect of multicollinearity for the US financial firms and non-financial firms. All values are below 5, which shows that there is no multicollinearity issue in the data and variables. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of

difference-in-differences. Various control variables are used such as Tangibility, Tobin's Q, Firm Size, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage.

Following the examination of multicollinearity, the White test (White, 1980) for heteroskedasticity was conducted on both financial (FF) and non-financial (NF) firms' regression models. The results are shown in Table 16 (b). The test's null hypothesis (H_0) shows that there is no heteroskedasticity in the data, while the alternate hypothesis (H_A) shows that heteroskedasticity is present in the data. The output of the test for FF and NF reveals a chi-squared statistic of 34.00 (Degree of Freedom = 33) and a corresponding p-value of 0.4192. Since this p-value exceeds the standard significance level of 0.05, we do not reject (accept) the null hypothesis. Consequently, we conclude that the assumption of no heteroskedasticity presence in both datasets is not violated in the financial firms' regression, and there is no statistically significant evidence of heteroskedasticity in either dataset.

Table 16 (c) presents the results of Augmented Dickey-Fuller (ADF) unit root tests for all variables of financial and non-financial firms from the period 1990 to 2023. ADF test is used to determine whether each variable is stationary, a crucial requirement for a valid time series regression analysis to avoid spurious results. The null hypothesis (H_0) of the ADF test is that the variable has a unit root (i.e., it is non-stationary). While the alternate hypothesis (H_A) suggests the opposite. A rejection of H_0 suggests that the variable is stationary. The results of the ADF tests for the financial and non-financial firms indicate that all variables are stationary, hence, we reject the H_0.

3.3.3 Difference-in-Difference Regression in Table 17 and Table 18 (With/Without Fixed Effect)

By using the difference in difference model, Table 17 represents the results of the impact of Quantitative Easing (QE) on US financial and non-financial firms' financial constraints (KZ index) without any fixed effect. However, Table 18 illustrates the results of QE's impact on US financial and non-financial firms' financial constraints (KZ index), including industry-fixed effects and year-fixed effects.

Table 17 (without fixed effect) represents the difference-in-difference regression results with and without control variables for the US financial firms and non-financial firms for the period from the year 1990 – 2023. Columns 1 (with controls) and column 2 (without controls) show the impact of QE on the F_KZ index (financial constraints) for US financial firms. Similarly, Columns 3 (with controls) and 4 (without controls) show the impact of QE on the NF_KZ index (financial constraints) for the US non-financial firms. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of difference-in-differences. Various control variables are used such as Tangibility, Tobin's Q, Firm Size, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. In Table 17, the Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). By following the strategy of Zhang et al. (2023), we created a treated group and control group where if firms are affected by QE, then they are considered as a treated group; however, if firms are not affected by QE, then they are considered as a control group.

In Table 17, the coefficient for Post is negative and statistically significant across all four columns. For financial firms, the coefficient is –0.0181 (0.0049 std error) with controls and –0.0176 (0.0049 std error) without controls, both significant at the 1% level, indicating a significant decrease in financial constraints for financial firms after the treatment period (QE). For non-financial firms, the post coefficient is smaller but still negative, at the coefficient of –0.0014 (0.0003 std error) with controls and the coefficient of –0.0015 (0.0003 std error) without controls, again significant at the 1% level, suggesting a similar, though weaker, reduction in financial constraints post-treatment for these firms.

The treat coefficient varies across the four columns. For financial firms, the coefficient is positive but insignificant with controls 0.0008 (0.0053 std error) and negative but insignificant without controls –0.0031 (0.0051 std error)). This indicates no significant difference in baseline financial

constraints between treated and control financial firms before the treatment (Quantitative Easing - QE). For non-financial firms, Treat is 0 (with a standard error of 0) and statistically significant at the 1% level in both the controlled and uncontrolled models, indicating no baseline difference but with a high level of statistical certainty.

Post*Treat is an interaction term that measures the Difference-in-Differences effect. For the Post*Treat interaction term, the results are mixed across the four columns. For financial firms, the coefficient is negative and statistically significant at a 5% level, at –0.0153 (0.0069 std error) with controls and –0.0153 (0.0069) without controls, both significant at the 1% level. It means QE has a positive impact due to a negative relationship with financial constraints for US financial firms, and after QE announcements, the financial constraints for the financial firms have been reduced. For non-financial firms, the Post*Treat coefficient is 0 (with a standard error of 0) and statistically significant at the 1% level in both columns, indicating no significant impact of the treatment on financial constraints for non-financial firms' post-treatment (QE), despite statistical certainty. During QE rounds, central banks are making money available to the financial market, so financial constraints should be less. For financial and non-financial firms, among the control variables, only the current ratio and tangibility are significant.

A significant current ratio means more assets will reduce the financial constraints for the financial firms. Tangibility means that the firm's assets can be sold easily to fulfil financial needs. So, firms will suffer fewer financial constraints.

A listed enterprise with a higher market capitalization has a higher financing ability and fewer financing constraints, and the market capitalisation of listed companies is reflected in Tobin's Q (Zhang et al., 2023). If the Tobin's Q ratio of a firm is more than 1, it shows that the firm is running efficiently (Charoenwong et al., 2021). Tobin's Q might be a way to estimate the undervalued or overvalued status of the firm in the market (Zhang et al., 2023). In Table 17, Tobin's Q is a control variable that is measured by taking the ratio of Market Value (MKVALT) to Total Asset (AT). For the financial firms, a small positive coefficient of Tobin's Q (0.00172) implies that these firms face fewer financial constraints due to their easy access to funds. Furthermore, a positive Tobin's Q

also suggests that the market values their assets higher than their replacement cost, indicating strong growth prospects or valuable intangible assets

Conversely, for non-financial firms, the slight negative or near-zero coefficient of Tobin's Q (–0.00002) proposes these firms face financial challenges which do not decrease even due to the treatment condition. The negative Tobin's Q also implies potential overvaluation or inefficient asset utilization. These findings align with firm valuation theory, which emphasizes the role of growth opportunities and intangible assets (Charoenwong et al., 2021). Additionally, Charoenwong et al., (2021) show that intangible assets play a large part in firm valuation. The differing Tobin's Q values between financial and non-financial firms in this study show that the market values the intangible assets of financial firms more than that of non-financial firms. From a managerial perspective, non-financial firms may need to focus on improving asset efficiency and enhancing intangible assets to increase their market valuation.

Thus, using Tobin's Q as a control variable in DID demonstrates that firms cannot be considered as less financially constrained because of their high market valuation status alone, which supports our study's finding that these firms face more financial difficulties in accessing funds. These results are consistent with the studies of the (Charoenwong et al., 2021; Zhang et al., 2023).

Firm size (FS) is measured by taking the Log of Total Assets. Previous literature shows a significant correlation between Firm Size (FS) and financial constraint, and firms large in size face fewer financial constraints in obtaining funds (Zhang et al., 2023). In our results, Table 17, column 1 shows FS (0.0032) for financial firms, which is higher than the FS (0.0004) in column 3 for non-financial firms. This result shows that financial firms are less financially constrained because of larger firm size than non-financial firms. These results are supported by the study of Zhang et al. (2023) who showed the same results in the case of COVID-19.

The current ratio (CR) in Table 17 is used as a proxy for liquidity or financial constraints a company is experiencing to determine its capacity to fulfil its debt obligations (Zhang et al., 2023). The current ratio is measured as Current Assets (ACT) ÷ Current Liabilities (LCT), which measures how well a company manages its finances, and a higher current ratio suggests that the

company is experiencing fewer financial challenges (Zhang et al., 2023). In Table 17, column 1, CR for the financial firms is higher (0.0091) and significant at a 5% level, showing that financial firms are less financially constrained than CR for non-financial firms (0) significant at a 1% level of significance shown in column 3.

The positive value of ROA indicates that companies are more successful in generating profits, and higher profits reduce the financial constraints of the firms (Zhang et al., 2023). The firm's profitability in Table 17 is measured by ROA (Return on Assets), calculated as Net Income (NITS) ÷ Total Asset (AT). Table 17, column 1 represents a positive and higher value of ROA (0.0061) for financial firms, indicating that the financial firm's performance is better in generating profit. It means positive ROA reduces the financial constraints for the financial firms, which compliments the results of studies by (Hadlock & Pierce, 2010; Hu, 2023; Zhang et al., 2023). However, for non-financial firms in column 3, ROA is 0, showing that the firm's profitability has no impact on the firm's financial constraints in the case of non-financial firms. ROA reduces a firm's financial constraint findings, which are proved in previous studies, e.g., (Hadlock & Pierce, 2010; Hu, 2023; Kaplan & Zingales, 1997; Li, 2011; Livdan et al., 2009; Stikkelman, 2010; Whited & Wu, 2006; Zhang et al., 2023; Zhao, 2016).

Tangibility is the ratio of Property, Plant, & Equipment (PPENT) to Book Assets (AT). Financial firms show higher tangibility (–0.0001) significance at a 5% level than non-financial firms (–0.0512) at a 1% significance level. These results show that financial firms have more assets to represent as collateral to receive loans and access to external funds relative to non-financial firms. Hence, financial firms face fewer financial constraints. These results are supported by the findings of (Almeida & Campello, 2007; Hovakimian, 2009; Hu & Liu, 2015; Zhang, 2011; Zhao et al., 2021).

Table 17 shows the Leverage, which is the ratio of total debt to market assets. Total debt is calculated as Debt in Current Liabilities (DLTT) + Long-term debt (DLC). Market assets are calculated as Assets Total (AT) + (Price Close Annual Fiscal (PRCC_F) x Common Shares Outstanding (CSHO)) - Common or Ordinary Equity Total (CEQ) - Deferred Taxes and Investment Tax Credit (TXDITC). According to the study of Halling et al. (2016), financially

constrained firms have more difficulty in adjusting their leverage. Interest Expenses to Debt is the ratio of interest expenses (XINT) to total debt (DLC+DLTT). However, leverage and Interest Expenses to Debt ratios for financial and non-financial firms are zero, which shows these 2 variables do not affect the US firm's financial constrained in the case of QE.

Table 18 presents the results of a regression analysis with industry and year-fixed effects by using the annual data from the years 1990 to 2023. KZ Index is used as a dependent variable and serves as a proxy to measure the financial constraints of both types of firms, where a more negative value of this index represents a higher constraint. The coefficients, standard errors, and significance levels are given for each variable, reflecting their effect on financial constraints.

Post is a dummy variable that is equal to 1 during QE rounds (2008–2020) and 0 otherwise, representing substantial changes in financial constraints for both types of firms. The data is categorized into three periods: before QE (1990–2007), during QE (2008–2020), and after QE (2021–2023). For financial firms, the Post variable coefficient is –0.0207, while for non-financial firms, the coefficient is –0.0014. Both coefficients are statistically significant at a 1% level ($p < 0.01$). It shows that after QE, financial constraints are reduced by 0.0207 units for financial firms and 0.0014 units for non-financial firms.

Treat is another dummy variable with a value of 1 if the ratio of MBS to Total Assets lies between the 75th to 100th percentile (treated group), and 0 if this ratio lies between the 1st to 25th percentile (control group). For financial firms, the treat variable coefficient is 0.0198, which is statistically significant at the 1% level, suggesting that financial constraints are increased by 0.0198 units due to the treatment. On the other hand, for non-financial firms, the treat variable coefficient is zero with a standard error of zero, and it is statistically significant at the 1% level. It shows that the financial constraints of non-financial firms are not significantly affected by the treatment. A zero coefficient for Treat shows that, before the treatment, there was no difference between the treated and control groups, and both groups were comparable in terms of financial constraints.

The Post*Treat interaction term is used to capture the difference-in-differences effect. For financial firms, the Post*Treat coefficient is –0.0097, but statistically insignificant, while for non-financial

firms, the Post*Treat coefficient is zero with a standard error of zero, and statistically significant at the 1% level. It means that both types of firms are part of the post-period, and treated groups do not collectively change financial constraints. In other words, treatment had no measurable impact on the financial constraints of both types of firms after the treatment was implemented. However, the DID model remains valid and applicable. Furthermore, its assumptions also hold, but the treatment effect is zero.

Tobin's Q coefficients for financial and non-financial firms are negative (–0.0018 and –0.00002, respectively), but statistically insignificant. This result indicates that financial constraints are not significantly affected by the market value of both types of firms. Firm size (log of assets) coefficients for financial and non-financial firms are 0.00006 and 0.0005, respectively, and both are statistically insignificant. This result implies that financial constraints are not significantly affected by the firm size. It also confirms the validity of the results, and the unequal number of firms in financial and non-financial groups does not impact the results' validity.

For financial firms, the current ratio coefficient is positive 0.02323 but statistically insignificant, showing that these firms have enough assets to pay their liabilities and do not face difficulties. For non-financial firms, the coefficient is zero, indicating no impact on financial constraints. Furthermore, for financial firms, the Return on Assets (ROA) coefficient is positive 0.0269 but statistically insignificant, indicating the firm's ability to generate higher profitability on its assets and, hence, less financially constrained. For non-financial firms, the ROA coefficient is zero, indicating no effect on financial constraints.

Asset Tangibility coefficients for financial and non-financial firms are negative (–0.0001 and –0.0666 respectively), both statistically significant at the 1% level. This result indicates that higher asset tangibility decreases financial constraints. Lastly, for both types of firms, the coefficients for leverage and the interest expense/debt ratio are zero or near zero, demonstrating no significant effect on the financial constraints.

Table 19 represents the overall findings of this chapter. KZ Index (Financial Constraints) for the US financial firms is low, while it is high for the non-financial firms. It shows that financial firms

face fewer financial constraints and have easier access to financial help during times of financial need as compared to non-financial firms. This outcome supports our hypothesis HA_5 that US financial firms are less financially constrained than US non-financial firms. Financial firms are larger in size than non-financial firms. These results are supported by the findings of (Charoenwong et al., 2021; Zhang et al., 2023).

Post*Treat is negative for financial firms while it is positive for non-financial firms. It indicates that Quantitative Easing has a positive impact due to a negative relationship with the financial constraints of financial firms, and after QE, the financial constraints have been reduced. However, the positive sign indicates that the financial constraints have been increased because of the Quantitative Easing for the non-financial firms. This result confirms our hypothesis HA_6 that for financial firms, QE has a positive impact due to a negative relationship with financial constraints and after QE announcements, the financial constraints have been reduced as compared to non-financial firms. Tobin's Q for the financial firms is positive while it is negative for the non-financial firms. It indicates that financial firms are better able to manage financial constraints under treatment conditions compared to non-financial firms, supporting the overall finding that financial firms are less financially constrained.

Return on Asset for the financial firms is higher than the non-financial firms, which shows the ability of the firm to generate the return (income or profit) on its assets. It indicates the better financial performance of the financial firms and hence, less financially constrained as compared to non-financial firms. The results of previous studies which supported this finding are (Kaplan & Zingales, 1997; Li, 2011; Livdan et al., 2009; Stikkelman, 2010; Whited & Wu, 2006; Zhang et al., 2023; Zhao, 2016).

The Current Ratio measures how well a firm manages its finances. Financial firms show a higher current ratio, indicating the availability of more assets. It indicates that these firms face fewer financial challenges and, hence, are less financially constrained. Non-financial firms have a lower current ratio, indicating these firms tend to face financial difficulties. This finding is like the results of (Zhang et al., 2023). Financial firms show a higher Tangibility than non-financial firms.

It highlights that the financial firms have higher access to external funds, their assets can be sold easily, and these firms have more assets to use as collateral for obtaining loans and meeting their financial needs, hence are less financially constrained than non-financial firms. Financial firms show a higher Leverage than non-financial firms. Leverage shows the debt proportion in capital structure; a high leverage indicates the availability of more debt to the financial firms. Furthermore, it also provides tax-saving benefits because firms pay interest before paying taxes hence, financial firms face fewer financial difficulties in accessing the funds. These results are similar to the study findings of (Almeida & Campello, 2007; Hovakimian, 2009; Hu & Liu, 2015; Zhang, 2011; Zhao et al., 2021). Interest Expense to the Debt Ratio shows the firm's access to external funds. Financial firms show a higher ratio than non-financial firms. It means financial firms have easy access to the external finances and, hence, face financial difficulties during the financial help than non-financial firms. This outcome is supported by the study findings of (Bräuning et al., 2023).

3.4 Conclusion and Practical Implications

3.4.1 Conclusion

This study examined the impact of the Federal Reserve's Quantitative Easing (QE) program on the financial constraints of US financial and non-financial firms from 1990 to 2023. Our findings reveal that Quantitative Easing (QE) had a positive impact, evidenced by a significant reduction in financial constraints for financial firms, while non-financial firms exhibited no such effect. This difference highlights that the financial firms can get and use money more easily during economic growth than non-financial firms.

Overall, our findings, including the KZ index, Tobin's Q, liquidity ratios, profitability, leverage, and interest expense, demonstrate that financial firms operate with significantly lower financial constraints compared to their non-financial firms. These findings are robust, free of multicollinearity issues, and supported by diverse evidence, ensuring the reliability of our conclusions. Specifically, financial firms demonstrated greater financial stability and access to funding, as evidenced by higher profitability, leverage, and asset tangibility. In contrast, non-

financial firms displayed signs of financial issues, including higher financial constraints and lower liquidity.

These results highlight that US financial firms have unique financial behaviors and are better able to take advantage of monetary policy interventions like QE. The observed size difference between both sectors further suggests a link between firm size and financial constraint, with larger financial firms being more stable. Ultimately, this study provides empirical support that financial firms, due to their unique position in the economy, are less sensitive to financial constraints and more responsive to accommodative monetary policy.

3.4.2 Practical Implications

Our study highlighted the importance of Quantitative Easing (QE) since the Global Financial Crisis (GFC) 2007– 2008, which created economic problems for many countries that made people worried about the whole world's financial system failure (Fatouh et al., 2021). The present study provides a detailed analysis of the impact of Quantitative Easing on firms' financial constraints before and after the GFC 2007–2008. The findings demonstrate a positive impact of Quantitative Easing (QE) on reducing financial constraints for US financial firms.

By learning a lesson from GFC 2007–2008, there should be some effective ways or resources to prevent large-scale systemic bank failure by providing financial stability within the banking industry. Furthermore, banks play an important role as financial intermediaries; hence, financial allocation strategies should be improved and made wisely. Combining a strict regulatory system with central bank involvement as a safeguard is one way for policymakers to address the potential risks of "too-big-to-fail" situations.

This study provides a comprehensive comparative analysis of the financial constraints of US financial and non-financial firms. By using the results of this study, regulators can use financial constraints to monitor early systemic risks of the firms. Our study found that non-financial firms are more financially constrained hence, there should be an effective tool to identify the financial constraints of such firms in time to avoid the difficulties of accessing funds during financial needs.

Furthermore, there should be some effective financial policies to help the non-financial firms (more financially constrained firms) get access to financial funds in times of need and by reducing the financial systemic risks.

This study's findings are valuable for policymakers and financial practitioners seeking to design more effective monetary interventions by providing information on QE's different impacts on financial constraints. Hence, a more modified and effective monetary policy decision can be made. Specifically, the observed reduction in financial constraints suggests that QE can be a potential tool for enhancing the liquidity and lending capacity of financial institutions.

Furthermore, our study findings can provide useful information to businesses for a better understanding of corporate financial situations and how external economic factors (e.g., QE) can affect their ability to access funds.

Building upon the framework provided by Bernanke et al. (2011), which discovered the broader economic implications of QE, we can generalize how our firm-level results contribute to the overall effectiveness of such policies. Bernanke et al. (2011) highlighted the transmission mechanisms through which QE influences interest rates and asset prices, ultimately stimulating economic activity. Our study complements this by demonstrating a direct impact on the financial health of financial firms, a crucial intermediary in the transmission process.

Utilizing these findings, policymakers can consider the following:

- **Targeted QE Implementation:** Given the observed positive impact of QE on financial firms, policymakers could design QE programs that explicitly target the financial sector during periods of heightened financial stress. This could involve direct asset purchases from financial institutions or the provision of liquidity facilities.
- **Monitoring Financial Constraint Indicators:** Regular monitoring of financial constraint indicators, such as those used in this study, can provide real-time feedback on the effectiveness of QE programs. This allows for timely adjustments to policy parameters and ensures that interventions are achieving their intended objectives.

- **Coordination with Prudential Regulation:** The reduction in financial constraints achieved through QE should be complemented by robust prudential regulation. This ensures that the increased liquidity is used for productive lending and investment rather than excessive risk-taking.
- **Forward Guidance and Communication:** Clear and consistent communication regarding the objectives and expected impacts of QE programs is essential for managing market expectations and enhancing policy effectiveness. By clearly articulating the expected reduction in financial constraints and the broader economic benefits, policymakers can bolster confidence and encourage market participation.
- **Considering the broader economic implications:** As Bernanke et al. (2011) indicate, QE has many impacts. Therefore, while designing monetary interventions, policymakers must consider the possibility of unintended consequences, such as inflation or asset bubbles (Excessive asset price inflation).

By incorporating these considerations into the design of monetary interventions, policymakers can leverage the findings of this study to enhance the effectiveness of QE and promote financial stability.

3.4.3 Future Research Directions

Future studies could explore how QE affects firms' access to credit and borrowing costs by using alternative measures than the KZ index, e.g., the WW index and SA index. Furthermore, future studies can investigate the trade-off between QE's short-term benefits and its long-term effects on firm investment and innovation. Comparing QE programs globally could offer insights into effective policy responses during economic downturns. Furthermore, future studies can use event studies to see the immediate market impact of QE news and panel data models to track the longer-term effects.

Conclusion of PhD Thesis (Chapters One, Two, and Three)

Chapter One:

Chapter One examined three significant global crises: the Global Financial Crisis (GFC) of 2007-2008, the COVID-19 pandemic, and the Russia-Ukraine War of 2022. The GFC originated in the US housing market, The GFC started in America when lots of people borrowed money from banks to buy houses (mortgages). Banks gave out mortgages without checking if people could pay them back. House prices then fell, but the mortgage amounts stayed the same. People couldn't pay back the bigger mortgages, and this caused problems for the banks. This initiated a wave of defaults, causing a severe financial crisis for banks. The COVID-19 pandemic, caused by the SARS-CoV-2 virus, rapidly spread across the globe, disrupting economies and causing widespread health issues. The Russia-Ukraine war started on 24 February 2022, though the conflict has been ongoing since 2014. Russia wants to control Ukraine to prevent Ukraine from strengthening ties with other nations.

This study aimed to identify assets and stocks that demonstrated lower volatility while maintaining reasonable returns during these three global crises. A portfolio with negatively correlated assets and stocks can mitigate risk, as losses in one area may be offset by gains in another. Hence, investors can enjoy the benefits of diversification. However, in the opposite scenario, if there is a positive correlation between assets and stocks in a portfolio, then investors should invest in safe haven and hedge assets. The central research problem addressed in this chapter, therefore, was to determine which assets and stocks serve as the most effective hedges and safe havens during such turbulent periods.

Ordinary Least Squares (OLS) and variance-covariance methods were employed to identify these resilient assets and stocks. The comparative analysis of four hedging effectiveness (HE) techniques is used: the HE formula method, the OLS method, the portfolio method, and the GARCH-in-mean method. This comparative analysis showed that gold and silver can be considered safe haven assets because of their hedging properties, even during global crises. Furthermore, gold and silver tend to reduce volatility and can generate higher returns.

This study found that gold and silver act as safe havens, effectively hedging against losses during global crises. Additionally, these precious metals can help reduce the overall volatility of an investment portfolio and offer higher returns. Gold and silver are considered hedges because they often have a negative correlation with other asset classes, like stocks. During times of economic uncertainty, investors often fly to these precious metals as a store of value, driving up demand and price. The high demand for gold and silver comes from their reputation as safe investments and their limited availability, making them attractive options when traditional investments become risky.

Chapter Two:

Chapter Two explored the monkeypox (MPX) global pandemic across 110 countries, and its impact on the stock markets of 59 of those nations. A Difference-in-Differences (DID) methodology was employed to isolate the impact of the MPX outbreak. This technique compares the changes over time in a treatment group (countries heavily affected by MPX) with a control group (countries less affected).

Parallel trend graphs were used to visualize how the stocks of the 59 firms behaved across three distinct phases: before the MPX outbreak, during the MPX outbreak, and after the MPX outbreak. The parallel trend assumption, crucial for the validity of the Difference-in-Differences approach, was further supported by the results presented in Table 12 (the impact on average returns before and after MPX) and Table 13 (Two-Sample t-tests). The analysis revealed that, while countries less affected by MPX experienced no change in average stock returns, countries more severely impacted by the outbreak experienced a small decline in their average stock returns.

Chapter Three:

To tackle the Global Financial Crisis (GFC) 2007-08, two types of monetary policy were used by global authorities: conventional and unconventional. The conventional policy involved reducing the interest rates up to zero. The unconventional policy (adopted by the US, UK, and European Union) involved central banks investing in long-term securities to further reduce interest rates, to increase the GDP, encourage spendings by households and businesses, and to promote economic

growth. This unconventional policy is known as Quantitative Easing (QE) or Large-Scale Asset Purchases (LSAPs). Using the Difference-in-Differences (DID) method, this study examined the impact of QE on the financial constraints of US financial VS non-financial firms.

The US was chosen because the US Federal Reserve was at the front of implementing QE and acted as a lender of last resort. The US also has the world's largest financial markets, providing lots of data and a wide range of firms. Furthermore, the US plays a central role in the global financial system, and the data is publicly available, making research easier.

The study found that QE had a positive impact on the financial constraints of US financial firms as compared to non-financial firms. However, this positive impact translated to a *negative* relationship (meaning less constraint) for financial firms compared to non-financial firms. In other words, US financial firms became less financially constrained than non-financial firms as a result of QE.

Appendix D

Note: Appendices are provided earlier than tables according to the sequence and for better understanding. To understand the tables, we first need to understand the data presented in these appendices.

Appendix D shows the KZ Index formula, variables used in KZ calculation, the definition of variables, and their COMPUSTAT's item numbers with references.

KZ Index **=** *−1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K)*

Variable Name	Formula	COMPUSTAT Data Item number
Cash Flow =	Operating Income + Depreciation	Item 18 + Item 14
Cash =	Cash + Marketable Securities	Item 1
Dividends =	Total Annual Dividend Payments	Item 21 + Item 19
Tobin's Q =	[Book Assets—Book Common Equity—Deferred Taxes + (CSHO x PRCC_C)] ÷ Book Assets	[Item 6−Item 60−Item 74 + (Item 25 × Item 24)] ÷ Item 6
Debt =	Short-Term + Long-Term Debt	Item 9 + Item 34
Total Capital =	Debt + Total Stockholders' Equity	Item 9 + Item 34 + Item 216
K =	Property, Plant, And Equipment-Total (Net)	Item 8
CSHO	Common Shares Outstanding	Item 25
PRCC_C	Price Close-Annual-Calendar	Item 24

(Hadlock & Pierce, 2010; Hu, 2023; Kaplan & Zingales, 1997; Lamont et al., 2001; Li, 2011; Liang & Chen, 2023; Lin & Bo, 2012; Liu et al., 2023; MacKay & Phillips, 2005)

Appendix E

We identify the impact of QE (independent variable) on financial constraints (dependent variable with and without control variables. Appendix B below shows the variables used in this study and their formulas with references. Variables used in this study are Independent Variables (IVs), a Dependent Variable (DV), and Control Variables (CVs). COMPUSTAT item numbers of these variables used are displayed in Appendix F.

	Variables		Formulas	References
IV's	**QE Treatment (QE)**	MBS ÷ AT	MBS ÷ Total Asset; MBS = Market-backed securities; Investment Securities-Total	(Kapoor & Peia, 2021; Rodnyansky & Darmouni, 2017)
	Post	Dummy Variable	The dummy = 1 during QE rounds (from 2008 – 2020), and 0 otherwise,	(Zhang et al., 2023)
	Treat	Dummy Variable	The dummy = 1 if MBS ÷ Total Assets ratio is in the 75 to 100th percentile (treated group). The dummy = 0 for 1 to 25th (control group). In the middle part of the distribution, it does not take any value	(Kapoor & Peia, 2021; Rodnyansky & Darmouni, 2017; Zhang et al., 2023)
	Interaction Term	Post*Treat	Post x Treat is the interaction term	
DV	**Financial Constraints**	Log (F_KZ)	Financial KZ Index measure of financial constraints	See Appendix A
		Log (NF_KZ)	Non-financial KZ Index measure of financial constraint	See Appendix A
CV's	**Tobin's Q (T.Q)**	MKVALT ÷ AT	MKT Value ÷ Total Asset; Here Total Assets = Book Value of Assets	(Byoun, 2008; Faulkender & Petersen, 2006; Giambona et al., 2020; Zhang et al., 2023)
	Firm Size (FS)	Log (AT)	Log of (Total Assets)	(Byoun, 2008; Flannery & Rangan, 2006; Hu, 2023; Lemmon et al., 2008; MacKay & Phillips, 2005; Rodnyansky & Darmouni, 2017; Titman & Wessels, 1988; Zhang, 2021; Zhang et al., 2023; Zhang & Hu, 2022)
	Current ratio (CR)	ACT ÷ LCT	Current Assets ÷ Current Liabilities	(Zhang et al., 2023)
	Return on Assets (ROA)	NITS ÷ AT	Net Income ÷ Total Asset	(Byoun, 2008; Flannery & Rangan, 2006; Lemmon et al., 2008; Zhang et al., 2023; Zhang & Hu, 2022)
	Tangibility	PPENT ÷ AT	Property, Plant, & Equipment ÷ Book Assets	(Almeida & Campello, 2007; Charoenwong et al., 2021; Chen et al., 2022; Dong et al., 2012; Faulkender & Petersen, 2006; Giambona et al., 2020; Hu, 2023; Lemmon et al., 2008; Rajan & Zingales, 1995; Zhang, 2011; Zhao et al., 2021)
	Leverage (LEV)	DT ÷ Mkt Assets	Total Debt ÷ Market Assets. *Total Debt (DT) = DLC + DLTT* *Market assets = AT+ (PRCC_F × CSHO) – CEQ – TXDITC*	(Aggarwal & Zhao, 2007; Charoenwong et al., 2021; Chen et al., 2022; Giambona et al., 2020; Lemmon et al., 2008; Zhang, 2011; Zhao et al., 2021) See appendix C
	Interest Expenses to Debt Ratio	Int Exp ÷ Debt = XINT ÷ (DLC+DLTT)	Interest and Related Expense ÷ (Debt in Current Liabilities + Long Term Debt)	(Giambona et al., 2020)

Appendix F

COMPUSTAT item numbers of all variables used are displayed in Appendix F.

Variable Abbreviation	Variable Name	COMPUSTAT Data Item number
AT	Assets Total (AT)	Item no. 6
MKVALT	Market Value Total Fiscal	N/A
IST	Investment Securities Total	N/A
ACT	Current Assets Total	Item no. 4
LCT	Current Liabilities Total	Item no. 5
NITS	Net Income Total (Statutory)	N/A
PPENT	Property, Plant and Equipment Total (Net)	Item no. 8
XINT	Interest and Related Expense Total	Item no. 15
Total Debt (DT) =	***DLC + DLTT =***	***Item 34+ Item 9***
DLC	Debt in Current Liabilities Total	Item no. 34
DLTT	Long-Term Debt Total	Item no. 9
Market assets =	***AT+ (PRCC_F × CSHO) – CEQ – TXDITC =***	***Mkt Assets = Item 6 + (Item 199 x Item 25) – Item 60 – Item 35***
AT	Assets Total (AT)	Item no. 6
PRCC_F	Price Close Annual Fiscal	Item no. 199
CSHO	Common Shares Outstanding	Item no. 25
CEQ	Common/Ordinary Equity Total	Item no. 60
TXDITC	Deferred Taxes and Investment Tax Credit	Item no. 35

Appendix G

Data values to draw the graph shown in Fig 3 KZ Index graph for USA financial and non-financial firms are below.

Year	Fin_KZ Index	NF_KZ Index
1990	–54.7514	–88.5626
1991	–59.5875	–152.1845
1992	–56.2110	–138.8083
1993	–62.3494	–111.0365
1994	–62.2799	–129.8745
1995	–61.6411	–137.7895
1996	–71.4767	–148.8682
1997	–81.2770	–177.5171
1998	–78.0692	–175.6910
1999	–51.6840	–145.5887
2000	–71.5844	–221.9499
2001	–71.5499	–160.7932
2002	–88.3281	–174.6115
2003	–105.3008	–223.4384
2004	–113.4813	–197.5299
2005	–115.3319	–182.0161
2006	–104.1355	–251.7430
2007	–106.7025	–270.9914
2008	–101.4840	–334.4163
2009	–93.3695	–259.8698
2010	–119.0983	–355.5949
2011	–143.9213	–303.6518
2012	–167.5495	–299.2025
2013	–169.1186	–339.0650
2014	–156.8753	–313.3182
2015	–155.0401	–338.7182
2016	–153.9694	–298.6704
2017	–153.0837	–314.8750
2018	–144.1853	–302.9959
2019	–125.8623	–293.2088
2020	–113.3721	–262.7654
2021	–128.9942	–292.1494
2022	–127.4246	–273.8374
2023	0.7907	–3.7739

Appendix H: The Calculation of KZ Index of USA Financial and Non-Financial Firms

USA Financial Firms Yearly Average Values

KZ Index = −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K)

Year	CF/K	T_Q	Debt/Capital	Div/k	Cash/k	Fin_KZ
1990	3.0842	0.7255	0.6091	1.3660	0	−54.7514
1991	3.6330	0.7420	0.6161	1.4756	0	−59.5875
1992	4.0890	0.7194	0.6000	1.3768	0	−56.2110
1993	4.6643	0.9666	0.8848	1.5425	0	−62.3494
1994	4.6469	0.9864	0.9164	1.5439	0	−62.2799
1995	4.5534	0.9818	0.8975	1.5285	0	−61.6411
1996	5.5485	0.9973	0.9229	1.7551	0	−71.4767
1997	7.5058	0.9970	0.9178	1.9539	0	−81.2770
1998	6.6629	0.9965	0.9287	1.8947	0	−78.0692
1999	6.0781	0.9980	0.9492	1.2410	0	−51.6840
2000	6.7359	0.9969	0.9474	1.7296	0	−71.5844
2001	5.7796	0.9968	0.9466	1.7530	0	−71.5499
2002	8.3786	0.9959	0.9498	2.1133	0	−88.3281
2003	9.8836	0.9954	0.9565	2.5066	0	−105.3008
2004	10.0066	0.9916	0.9282	2.7090	0	−113.4813
2005	9.2467	0.9840	0.9216	2.7748	0	−115.3319
2006	9.7451	0.9862	0.8937	2.4755	0	−104.1355
2007	6.1401	0.9782	0.8831	2.6315	0	−106.7025
2008	3.5908	0.9797	0.8763	2.5633	0	−101.4840
2009	7.1945	0.9805	0.4399	2.2307	0	−93.3695
2010	8.7101	0.9806	0.4137	2.8436	0	−119.0983
2011	7.0020	0.9833	0.3903	3.5158	0	−143.9213
2012	9.7603	0.9778	0.3643	4.0436	0	−167.5495
2013	10.7229	0.9776	0.3656	4.0591	0	−169.1186
2014	7.4950	0.9808	0.3669	3.8304	0	−156.8753
2015	7.2275	0.9864	0.3737	3.7912	0	−155.0401
2016	8.1387	0.9866	0.3742	3.7408	0	−153.9694
2017	7.3522	0.9883	0.3694	3.7380	0	−153.0837
2018	5.2282	0.9886	0.3609	3.5653	0	−144.1853
2019	5.0338	0.9871	0.3516	3.1041	0	−125.8623
2020	2.9885	0.9877	0.3433	2.8382	0	−113.3721
2021	6.0511	0.9895	0.3104	3.1545	0	−128.9942
2022	5.4600	0.9922	0.3857	3.1357	0	−127.4246
2023	0.1558	1.0000	0.2115	0.0000	0	0.7907

USA Non-Financial Firms Yearly Average Values

KZ Index = −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K)

Year	CF/K	T_Q	Debt/Capital	Div/k	Cash/k	NF_KZ
1990	0.7942	3.8066	0.2677	1.5126	22.9180	−88.5626
1991	0.8609	4.3434	0.3647	1.4389	73.8029	−152.1845
1992	0.6823	4.1992	0.1674	1.3978	64.4934	−138.8083
1993	1.0376	4.6042	0.3604	1.7640	32.6904	−111.0365
1994	2.0554	4.4743	0.3592	2.6490	19.7132	−129.8745
1995	1.4978	4.7347	0.3210	2.3821	34.1117	−137.7895
1996	1.8225	5.2704	0.4999	2.3707	43.1721	−148.8682
1997	3.1597	5.8866	0.5179	2.9510	46.7443	−177.5171
1998	4.3407	5.8905	0.2181	3.2633	34.3906	−175.6910
1999	2.3574	6.1819	0.4070	3.0072	21.1907	−145.5887
2000	2.3709	5.8951	0.1473	3.0969	75.8820	−221.9499
2001	1.5756	5.6538	0.1218	2.5346	46.7045	−160.7932
2002	1.6198	4.7848	0.0841	2.7947	49.1128	−174.6115
2003	3.0777	5.8986	0.0674	4.1682	44.2138	−223.4384
2004	3.1561	6.5332	0.0644	3.8080	35.3665	−197.5299
2005	2.2838	6.6149	0.1263	3.9099	21.3483	−182.0161
2006	2.5255	7.2612	0.0913	4.9232	43.9057	−251.7430
2007	1.2659	7.2091	0.0892	4.8833	60.6816	−270.9914
2008	−2.0054	4.9884	0.0577	5.2811	98.9458	−334.4163
2009	3.7652	6.2081	0.0224	4.3778	65.0797	−259.8698
2010	3.2739	6.7551	−0.0391	5.8805	93.2332	−355.5949
2011	1.8774	6.2056	−0.0477	5.2130	74.6410	−303.6518
2012	0.9270	6.4404	−0.0127	5.7255	56.7713	−299.2025
2013	1.0491	7.0699	0.0404	6.6606	59.2614	−339.0650
2014	−0.4460	7.2354	−0.0176	6.4580	46.7829	−313.3182
2015	−3.1912	6.8656	−0.0184	6.9315	53.9336	−338.7182
2016	−2.6162	6.9459	0.0730	6.2435	43.8724	−298.6704
2017	−0.2357	7.5192	−0.0157	6.9940	31.8237	−314.8750
2018	−0.6836	6.6971	−0.0906	6.6350	33.5238	−302.9959
2019	0.7969	6.8773	−0.0362	6.3413	33.9161	−293.2088
2020	−3.5187	7.3004	0.0256	5.3929	42.6849	−262.7654
2021	3.6049	8.0645	0.0327	5.6052	53.4283	−292.1494
2022	−2.3028	7.0627	0.0125	5.8440	36.5916	−273.8374
2023	0.7576	0.3879	0.0081	0.0338	1.3834	−3.7739

Table 15: Summary Statistics

Table 15 represents the summary statistics for the US financial firms and non-financial firms for the period from year 1990 – 2023. Log (F_KZ) is the log of a financial firm's KZ index while log (NF_KZ) is the log of a non-financial firm's KZ index. KZ indices mean value is lower for financial firms (–0.0029) than non-financial firms (0.0008) which shows that financial firms are less financially constrained than non-financial firms. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). If firms are affected by QE, then they are considered as a Treat group, however, if firms are not affected by QE, then they are considered as a Control group. Post*Treat is the interaction term which is our Difference-in-Differences. Control variables are included in this study as follows; Tobin's Q, Firm Size, Current Ratio, ROA, Tangibility, Leverage, and Interest-To-Debt Ratio. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Results are in section 3.3 (page 132).

Summary Stats of Financial Firms

Less Financially Constrained Firms

Variable	Obs	Mean	SD	Min	Max
Log (F_KZ)	14,940	–0.0029	0.1744	–2.9771	0.5343
Post	14,940	0.5441	0.4981	0	1
Treat	14,940	0.499	0.5	0	1
Post*Treat	14,940	0.1347	0.3414	0	1
TQ	14,940	0.4369	0.8793	0	3.1036
FS	14,940	3.4007	0.3901	0	3.4454
CR	14,940	2.6704	4.3494	0	295.5114
ROA	14,940	0.0164	0.0877	–0.0036	0.7176
Tang	14,940	1.2879	2.3529	0	7.4079
LEV	14,940	0.4056	55.7714	–8096.707	9813.589
Int /Debt	14,940	2.0949	34.5102	0	2509.585

Summary Stats for Non-Financial Firms

More Financially Constrained Firms

Variable	Obs	Mean	SD	Min	Max
Log (NF_KZ)	78,108	0.0008	0.0408	–1.0822	3.1451
Post	78,108	0.6345	0.4816	0	1
Treat	78,108	0	0	0	0
Post*Treat	78,108	0	0	0	0
TQ	78,108	3.5142	7.0379	0	24.7851
FS	78,108	2.4804	0.3974	0	2.5441
CR	78,108	0.0506	0.4137	0	23.1835
ROA	78,108	0	0	0	0
Tang	78,108	0.0724	0.129	0	0.4091
Leverage	78,108	–0.3885	54.2936	–4772.83	3167.686
Int /Debt	78,108	0.3878	23.0365	0	4744.125

Tobin's Q **(TQ),** Current Ratio **(CR),** Tangibility **(Tang),** Leverage **(LEV),** Int Exp to Debt ratio (**Int /Debt**), Std Deviation (**SD**)

Table 15 (a): Summary Stats for Financial Firms (Overall, Between, Within)

Table 15 (a) represents the summary statistics for each variable concerning overall, between and within the US financial firms including the period from year 1990 –2023. Log (F_KZ) is the log of the financial firm's KZ index. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). If firms are affected by QE, then they are considered as Treat group, however, if firms are not affected by QE, then they are considered as Control group. Post*Treat is the interaction term which is our Difference-in-Differences. Control variables are included in this study as follows; Tobin's Q, Firm Size, Current Ratio, ROA, Tangibility, Leverage, and Interest-To-Debt Ratio. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Results are in section 3.3 (page 133).

Variable		Mean	Std. dev.	Min	Max	Observations
Log (FKZ)	**overall**	–0.0029251	0.1744	–2.9771	0.5343	N = 14940
	between		0.0822	–0.7671	0.4757	n = 771
	within		0.1631	–2.8189	0.7641	T-Bar = 19.3774
Post	**overall**	0.5441098	0.4981	0	1	N = 14940
	between		0.1934	0	1	n = 771
	within		0.4717	–0.3726	1.4532	T-Bar = 19.3774
Treat	**overall**	0.4990	0.5000	0	1	N = 7485
	between		0.4197	0	1	n = 686
	within		0.3004	–0.4707	1.4633	T-Bar = 10.9111
Post*Treat	**overall**	0.134672	0.3414	0	1	N = 14940
	between		0.2328	0	1	n = 771
	within		0.2745	–0.7225	1.1044	T-Bar = 19.3774
Tobin's Q	**overall**	0.4369	0.8793	0	3.1036	N = 14940
	between		0.5599	0	3.1036	n = 771
	within		0.6640	–2.2634	3.4302	T-Bar = 19.3774
FS = Log (Assets)	**overall**	3.4007	0.3901	0	3.4454	N = 14940
	between		0.1303	2.0098	3.4454	n = 771
	within		0.3690	0.0597	4.8362	T-Bar = 19.3774
Current Ratio	**overall**	2.6694	4.3386	0	295.5114	N = 14940
	between		3.0534	0	107.7557	n = 771
	within		3.9918	–58.9070	288.3282	T-Bar = 19.3774

ROA	**overall**	0.0164	0.0877	–0.0036	0.7176	N = 14940
	between		0.0620	–0.0011	0.7176	n = 771
	within		0.0661	–0.6041	0.7053	T-Bar = 19.3774
Tangibility	**overall**	1.2884	2.3533	0	7.4079	N = 14940
	between		1.0638	0	7.4079	n = 771
	within		2.0894	–4.5920	8.4244	T-Bar = 19.3774
Leverage	**overall**	0.4057	55.7928	–8096.7070	9813.5890	N = 14940
	between		46.9797	–298.1413	3271.3100	n = 771
	within		51.3254	–7858.8460	6542.6860	T-Bar = 19.3774
Int Exp/Debt ratio	**overall**	2.0949	34.5102	0	2509.585	N = 14940
	between		9.3880	0.0128	151.4412	n = 771
	within		33.0877	–149.3169	2432.891	T-Bar = 19.3774

Table 15 (b): Summary Stats for Non-Financial Firms (Overall, Between, Within)

Table 15 (b) represents the summary statistics for each variable overall, between and within the US non-financial firms including the period from year 1990 – 2023. Log (NF_KZ) is the log of the non-financial firm's KZ index. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post variable indicates the value of 1 during QE rounds and 0 before and after QE rounds. Treat is the dummy variable that is equal to 1 if the MBS/Assets ratio is in the 75th to 100th percentile (treated group) and zero for 1st to 25th (control group). If firms are affected by QE, then they are considered a Treat group, however, if firms are not affected by QE, then they are considered as a Control group. Post*Treat is the interaction term which is our Difference-in-Differences. Control variables are included in this study as follows; Tobin's Q, Firm Size, Current Ratio, ROA, Tangibility, Leverage, and Interest-To-Debt Ratio. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Results are in section 3.3 (page 133).

Variable		Mean	Std. dev.	Min	Max	Observations
Log (NF_KZ)	**overall**	0.0008	0.0408	–1.0822	3.1451	N = 78048
	between		0.0099	–0.0361	0.3471	n = 4953
	within		0.0395	–1.0454	3.0294	T-Bar = 15.7577
Post	**overall**	0.6342	0.4816	0	1	N = 78048
	between		0.2688	0	1	n = 4953
	within		0.4161	–0.3033	1.5816	T-Bar = 15.7577
Treat	**overall**	0	0	0	0	N = 78048
	between		0	0	0	n = 4953
	within		0	0	0	T-Bar = 15.7577
Post*Treat	**overall**	0	0	0	0	N = 78048
	between		0	0	0	n = 4953
	within		0	0	0	T-Bar = 15.7577
Tobin's Q	**overall**	3.5155	7.0390	0	24.7851	N = 78048
	between		2.8515	0	24.7851	n = 4953
	within		6.5799	–15.3461	27.3441	T-Bar = 15.7577
FS = Log (Assets)	**overall**	2.4805	0.3971	0	2.5441	N = 78048
	between		0.2354	0	2.5441	n = 4953
	within		0.3661	0.0113	4.3886	T-Bar = 15.7577
Current Ratio	**overall**	0.0506	0.4137	0	23.1835	N = 78048
	between		0.2068	0	2.4050	n = 4953
	within		0.3583	–2.354	22.5316	T-Bar = 15.7577
ROA	**overall**	0	0	0	0	N = 78048
	between		0	0	0	n = 4953

	within		0	0	0	T-Bar = 15.7577
Tangibility	**overall**	0.0724	0.1290	0	0.4091	N = 78048
	between		0.0958	0	0.4091	n = 4953
	within		0.0812	–0.3052	0.4629	T-Bar = 15.7577
Leverage	**overall**	–0.3885	54.2936	–4772.83	3167.686	N = 78048
	between		11.154	–144.3524	211.4356	n = 4953
	within		53.0864	–4628.866	2955.862	T-Bar = 15.7577
Int Exp/Debt ratio	**overall**	0.3881	23.0453	0	4744.1250	N = 78048
	between		7.7176	0	499.9171	n = 4953
	within		22.1838	–499.5291	4554.5150	T-Bar = 15.7577

Table 16 (a): Financial and Non-Financial Firms' Variance Inflation Factor for Multicollinearity

Table 16 (a) represents the variance inflation factor (VIF) results to capture the effect of multicollinearity for the US financial firms and non-financial firms. All values are below 5, which shows that there is no multicollinearity issue in the data and variables. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of difference-in-differences. Various control variables are used such as Tangibility, Tobin's Q, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Results are in section 3.3 (page 136).

Variable	US Financial Firms		US Non-Financial Firms	
	VIF	1/VIF	VIF	1/VIF
Post*Treat	3.2	0.3125	0	0
Treat	2.44	0.4093	0	0
Post	2.03	0.4922	0	0
Tangibility	1.24	0.805	1.30	0.7685
Tobin's Q	1.17	0.8555	1.30	0.7685
ROA	1.16	0.8627	1.04	0.9631
FS = Log (Assets)	1.06	0.9435	1.03	0.9724
Current Ratio	1.04	0.9616	1.02	0.9758
Int Exp/Debt ratio	1	0.9975	1	0.9999
Leverage	1	0.9991	1	1
Mean VIF	**1.53**		**1.10**	

Table 16 (b): Heteroskedasticity (White's Test)

Table 16 (b) represents the heteroskedasticity white test for US financial and non-financial firms. The null hypothesis (H_0) shows that the heteroskedasticity is not present in the data, while the alternate hypothesis (H_A) shows that the heteroskedasticity is present. Since the p-value (0.4192) is greater than the significance level of 0.05, we fail to reject (we accept) the null hypothesis that no heteroskedasticity is present. It means we do not have sufficient statistical evidence to conclude that heteroskedasticity is present in our data. Therefore, the conclusion is "No evidence of heteroskedasticity" for both financial and non-financial firms. The results are in section 3.3 (page 136).

White's Test	Heteroskedasticity for US Financial Firms	Heteroskedasticity for US Non-Financial Firms
Chi^2	34	34
Degrees of Freedom	33	33
P-value	0.4192	0.4192
Conclusion	No evidence of heteroskedasticity	No evidence of heteroskedasticity
For FF and NF Firms: Prob > Chi^2 = 0.4192 Chi^2 (33) = 34		
H_0: Heteroskedasticity is not present. H_A: Heteroskedasticity is present.		
Small p-value (e.g., < 0.05): Heteroskedasticity is likely present. Large p-value (e.g., > 0.05): Heteroskedasticity is likely not a significant problem.		

Table 16 (c): Augmented Dickey-Fuller (ADF) Test
This table shows the results of the ADF test for US financial and non-financial firms.

ADF Test Results for the US Financial Firms

Variable Name	Test Statistic (Z(t))	Critical Values (1%/5%/10%)	MacKinnon's approximate p-value for Z(t)	Stationarity Decision (at 5% significance)
Log (F_KZ)	-2.994	Values: -3.716 / -2.968 / -2.624	0.0354	Stationary
Tangibility	-3.252	Values: -3.723 / -2.989 / -2.625	0.0172	Stationary
Tobins Q	-2.873	Values: -3.716 / -2.986 / -2.624	0.0485	Stationary
ROA	-3.616	Values: -3.709 / -2.983 / -2.623	0.0055	Stationary
FS	-5.196	Values: -3.716 / -2.986 / -2.624	0.0000	Stationary
CR	-3.389	Values: -3.716 / -2.986 / -2.624	0.0113	Stationary
Int_Exp_to_Debt	-4.082	Values: -3.716 / -2.986 / -2.624	0.0010	Stationary
Leverage	-4.908	Values: -3.716 / -2.986 / -2.624	0.0000	Stationary
Post (Level)	N/A	N/A	N/A	Stationary (by nature of dummy)
Treat (Level)	N/A	N/A	N/A	Stationary (by nature of dummy)
Post * Treat (Level)	N/A	N/A	N/A	Stationary (by nature of interaction)

ADF Test Results for the US Non-Financial Firms

Variable Name	Test Statistic (Z(t))	Critical Values (1%/5%/10%)	MacKinnon's approximate p-value for Z(t)	Stationarity Decision (at 5% significance)
NF_KZ	-3.001	Values: -3.716 / -2.986 / -2.624	0.0348	Stationary
NF_TQ	-3.181	Values: -3.716 / -2.986 / -2.624	0.0211	Stationary
NF_CR	-5.444	Values: -3.716 / -2.986 / -2.624	0	Stationary
NF_Int_Debt	-4.709	Values: -3.716 / -2.986 / -2.624	0.0001	Stationary
NF_Lev	-5.496	Values: -3.716 / -2.986 / -2.624	0	Stationary
Post (Level)	N/A	N/A	N/A	Stationary (by nature of dummy)
Treat (Level)	N/A	N/A	N/A	Stationary (by nature of dummy)
Post * Treat (Level)	N/A	N/A	N/A	Stationary (by nature of interaction)

Table 17: DID Regression Results by Measurement of Financial Constraints (KZ Index) Without Fixed Effect

Table 17 represents the difference-in-difference regression results with and without control variables for the US financial firms and non-financial firms for the period from the year 1990 – 2023. Columns 1 and 2 show the impact of QE with and without controls on the KZ index (financial constraints) for the US financial firms. Similarly, Columns 3 and 4 show the impact of QE with and without controls on the KZ index (financial constraints) for the US non-financial firms. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of difference-in-difference. Various control variables are used such as Tangibility, Tobin's Q, Firm Size, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Results are in section 3.3 (page 137).

Variable	KZ Index for Financial Firms		KZ Index for Non-Financial Firms	
	[1]	[2]	[3]	[4]
	With Controls	Without Control	With Controls	Without Controls
Post	–0.0181***	–0.0176***	–0.0014***	–0.0015***
	(0.0049)	(0.0049)	(0.0003)	(0.0003)
Treat	0.0008	–0.0031	0***	0***
	(0.0053)	(0.0051)	(0)	(0)
Post*Treat	–0.0153**	–0.0153***	0***	0***
	(0.0069)	(0.0069)	(0)	(0)
Tobin's Q	0.00172		–0.00002	
	(0.0018)		(0.00002)	
FS = Log (Assets)	0.0032		0.0004	
	(0.0032)		(0.0004)	
Current Ratio	0.0091**		0***	
	(0.0042)		(0)	
ROA	0.0061		0	
	(0.0151)		(0)	
Tangibility	–0.0001**		–0.0512***	
	(0.0131)		(0)	
Leverage	0		0	
	(0)		(0)	
Int Exp/Debt ratio	0		0	
	(0)		(0)	
_cons	0.0053	0.0147***	0.001	0.0017***
	(0.1073)	(0.0036)	(0.0009)	(0.0002)

Coefficients are reported, Std Errors are in parentheses.
*** p < 0.01 , ** p < 0.05 , * p < 0.1

Table 18: DID Regression Results by Measurement of Financial Constraints (KZ Index) With Fixed Effect

Table 18 represents the DID regression results with fixed effects including control variables for the US financial and non-financial firms from the year 1990 – 2023. Column 1 shows the impact of QE with fixed effect including control variables on the KZ index (financial constraints) for the US financial firms. Similarly, Column 3 shows the impact of QE with fixed effect including controls on the KZ index (financial constraints) for the US non-financial firms. KZ index is calculated as −1.002*(Cash Flows ÷ K) + 0.283*(Tobin's Q) + 3.139*(Debt ÷ Capital) − 39.368*(Dividend ÷ K) −1.315*(Cash ÷ K). KZ Index formula, variables, definition of variables and COMPUSTAT's item numbers are displayed in Appendix D. Post and treat are dummy independent variables, while Post*Treat is an interaction term used to capture the effect of DID. Various control variables are used such as Tangibility, Tobin's Q, Firm Size, ROA, Firm Size, Current Ratio, Interest Expense to Debt Ratio and Leverage. All variables' definitions and COMPUSTAT's item numbers are displayed in Appendix E and Appendix F. Results are in section 3.3 (page 141).

Variable	KZ Index for Financial Firms	KZ Index for Non-Financial Firms
	[1]	[3]
	With Controls	With Controls
Post	–0.0207***	–0.0014***
	(0.0052)	(0.0003)
Treat	0.0198***	0***
	(–0.0071)	(0)
Post*Treat	–0.0097	0***
	(0.0075)	(0)
Tobin's Q	–0.0018	–0.00002
	(0.0022)	(0.00002)
FS = Log (Assets)	0.00006	0.0005
	(0.0037)	(0.0004)
Current Ratio	0.02323	0
	(0.0065)	(0)
ROA	0.0269	0
	(0.0201)	(0)
Tangibility	–0.0001***	–0.0666***
	(0.0202)	(0.0001)
Leverage	0	0
	(0)	(0)
Int Exp/Debt ratio	–0.0001	0
	(0.0001)	(0)
Firm's Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
_cons	0.0082	0.0008
	(0.0123)	(0.0010)

Coefficients are reported, Std Errors are in parentheses

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

Table 19: Overall Results

Table 19 represents the overall results of this study along with the references of the studies that support our research findings. The overall results of this table highlight that US financial firms face fewer financial difficulties than non-financial firms because of easier access to external funds during times of financial need. The explanation of this table is in section 3.3 (page 143).

Variables	US Financial Firms	US Non-Financial Firms	Previous Studies' Research Support
KZ Index (FC)	Low	High	(Charoenwong et al., 2021; Zhang et al., 2023)
Post*Treat	Negative	Positive	
Firm Size	Large	Small	(Charoenwong et al., 2021; Zhang et al., 2023)
Tobin's Q	Positive	Negative	(Kaplan & Zingales, 1997; Li, 2011; Livdan et al., 2009; Stikkelman, 2010; Whited & Wu, 2006; Zhang et al., 2023; Zhao, 2016)
ROA	High	Low	
Current Ratio	High	Low	(Zhang et al., 2023)
Tangibility	High	Low	(Almeida & Campello, 2007; Hovakimian, 2009; Hu & Liu, 2015; Zhang, 2011; Zhao et al., 2021)
Leverage	High	Low	
Int Exp ÷ Debt Ratio	High	Low	(Bräuning et al., 2023)

In this table, the results of the KZ Index (used to measure the firm's financial constraints) support our HA_5 that financial firms are less financially constrained than non-financial firms.

Furthermore, the results of the Post*Treat support our HA_6 that QE (Quantitative Easing) has a negative effect on the financial constraints of the financial firms. It indicates that due to the QE, the financial constraints of financial firms are reduced, and financial firms have easy access to financial funds to meet their financial needs.

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