NOVA IMS Information Management School

MEGI

Master degree Program in

Statistics and Information Management

The effect of football sports performance on football clubs' stocks

The Portuguese Context

Margarida Neves de Azevedo Santana Figueiredo

Dissertation

presented as partial requirement for obtaining the Master Degree Program in Statistics and Information Management

NOVA Information Management School

Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

THE EFFECT OF FOOTBALL SPORTS PERFORMANCE ON FOOTBALL CLUBS' STOCKS

By/por

Margarida Neves de Azevedo Santana Figueiredo

Master Thesis presented as partial requirement for obtaining the Master's degree in Statistics and Information Management, with a specialization in Risk Analysis and Management

Supervisor/Orientador(a): Afshin Ashofteh

November 2023

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

[Margarida Figueiredo]

[Lisbon, November 30th 2023]

DEDICATION

To my parents who supported me in my education and provided me with the tools to succeed.

To my sister who always gives the best advice and does not let me give up.

To my grandma for listening to me and supporting me no matter what.

To my boyfriend and my friends for understanding my absences and for compelling me to take breaks and enjoy life.

To my dog Pepsi, for being my emotional support.

And lastly, to myself.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Professor Afshin Ashofteh for his guidance and mentorship throughout this research. His expertise and support played a crucial role in this research, and I am truly fortunate to have had the opportunity to work under his supervision.

ABSTRACT

Sports and stock prices have been closely linked for around two decades, but their relationship has become particularly relevant in recent years, primarily focused on football. In order to gain further insight into this topic, a systematic review of literature has been conducted. After reviewing studies that presented evidence both for and against a potential connection between football performance and stock prices, we conducted a study that specifically focused on the Portuguese football landscape. Our analysis centered on the four clubs that are listed on Euronext Lisbon: Sport Lisboa e Benfica (SLB), Futebol Clube do Porto (FCP), Sporting Clube de Portugal (SCP), and Sporting Clube de Braga (SCB), with the goal of assessing any correlations that may exist. We employed the event study method, complemented by Sign and Wilcoxon Tests, to analyze the clubs as an aggregate over 3249 matches and 16 seasons, considering both national and international competitions, goal differences, and the influence of the COVID-19 pandemic. The same methodology was then applied to the individual clubs, except for SCB due to low share liquidity. Key findings include significant stock price decreases following defeats and draws, with the effect more pronounced for SLB. Victories, while not statistically significant, exhibit asymmetric returns. Furthermore, FCP victories in international games have a higher positive effect on their stocks compared with national ones. Additionally, SCP defeats during COVID-19 resulted in a lower effect on the club stock prices than in the pre-pandemic period. The study shows that it may be relevant for investors who want to invest in football-related stocks in Portugal to consider the match outcomes, although some results lacked statistical significance and require further investigated.

KEYWORDS

Event Study, Behavioral Finance, Market Efficiency, Sports Sentiment, Portuguese Football Clubs

Sustainable Development Goals (SGD):

INDEX

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

AAR Average Abnormal Return

FCP Futebol Clube do Porto

SCB Sporting Clube de Braga

SCP Sporting Clube de Portugal

SLB Sport Lisboa e Benfica

AGG Aggregate

1. INTRODUCTION

Sports teams and their performance are the subject of widespread attention, especially in the football market. In recent years, there has been a growing interest in investigating the relationship between sports performance and financial markets given the rapid growth in sports revenues. According to Deloitte (2023), the top 20 clubs doubled their revenues in 10 years, from 5 billion euros in 2011/2012 to 9.2 billion euros in 2021/2022.

Consequently, private equity has increasingly invested in sports, with firms creating funds and entities to invest solely in the industry. Notable recent deals in European football demonstrate how deep private equity involvement has become, with some firms focusing on smaller teams and leagues. While this trend presents new opportunities for the sports industry, there are also potential issues to be aware of, including concerns about investors prioritizing profits over winning and the risks of tying investments to on-field performance (Deloitte, 2023).

In addition, a number of studies have examined the relationship between the two aforementioned dimensions and the nature of that relationship (Edmans et al., 2007) (Berkowitz & Depken, 2018). The findings of these studies have potential implications for investors, sports teams, and other stakeholders. If the performance of sports teams does have an impact on stock prices, this could be an opportunity for investors to make profitable trades.

This dissertation focuses on the effect of sports performance on stock prices in the context of Portuguese football. Portugal is an interesting case study for several factors. One of them is the high level of interest in football, with a fan base of 609,656 people according to Transfermarkt (2023). Secondly, the Portuguese league was placed 6th in the UEFA (2023) ranking for the 2021/2022 season. Therefore, four clubs listed on the Portuguese stock exchange (Euronext Lisbon) were selected for this study: Sport Lisboa e Benfica, Futebol Clube do Porto, Sporting Club de Portugal, and Sporting Clube de Braga.

In this dissertation, "sports performance" refers to the outcomes of a sports team's matches or competitions, such as the number of victories, draws, and losses. "Investor sentiment" refers to the attitudes and emotions of investors that influence their decision-making, such as optimism or pessimism about the prospects of a particular team. Lastly, "Behavioral finance" refers to studying how cognitive and emotional biases affect financial decision-making, particularly concerning the efficient market hypothesis.

This thesis contributes to the research on the relationship between sports performance and stock prices. The main ones are:

1. To provide an extensive overview of the literature on the impact of football performance and stock prices in the Portuguese context.
2. The addition of a new variable, COVID-19, to examine differences in the impact of match results on club stock prices between before and after the pandemic.
3. To use the largest dataset to date to analyze the four Portuguese clubs as an aggregate and individually.

According to the results of our literature review, the main research question for this work was selected as:

- What is the impact of football match results on the stock prices of the four major Portuguese football clubs – Sport Lisboa e Benfica, Futebol Clube do Porto, Sporting Clube de Portugal, and Sporting Clube de Braga?

Also, the four follow-up questions were selected to be answered as following:

1. If there is an impact, is it different across the four clubs?
2. How do the results in European competitions compare to domestic competitions in terms of their impact on Average Abnormal Returns (AAR) of stocks?
3. Is there a correlation between the goal difference in a match and its impact on stock prices?
4. Are there differences in the effect of sporting results on the stocks of football clubs between the pre-COVID-19 period and during the pandemic?

2. LITERATURE REVIEW

2.1. METHODS

A systematic search of several academic databases was conducted to identify the most relevant studies for the literature review. The search terms chosen to conduct the research were “soccer AND performance AND stock”, “Soccer AND Stocks”, “ALL=(((Soccer) OR (football)) AND((results) OR (performance)) AND (stocks))”, “Investor sentiment AND stocks AND (Sports OR soccer)”, “Impacto dos resultados desportivos nas ações de futebol”, “soccer match performance stocks” and “Football AND Stocks AND prices”. Following, different academic databases were chosen to provide a more diversified range of studies, including Scopus, Web of Science, JSTOR, and Google Scholar. No restrictions were applied at this stage to the publications screened. After screening those papers, backward citation was also performed to find other relevant papers for the discussed topic. The selected studies were screened according to the following criteria:

1. The different data sources were merged to eliminate possible duplicates.
2. Exclusion criteria were set to be left with only the most relevant and important papers. So, it was decided that papers written in languages other than Portuguese and English were excluded, as well as papers from an area irrelevant to the scope of this thesis.
3. Exclusion of papers that were not accessible online. In this phase, papers that were not published were also excluded, except for the ones focusing on the Portuguese clubs, due to their significantly low number. Also, no selection was made based on antiquity, since this is a topic that has only emerged in the last two decades.

The final dataset can be seen in Figure 1.

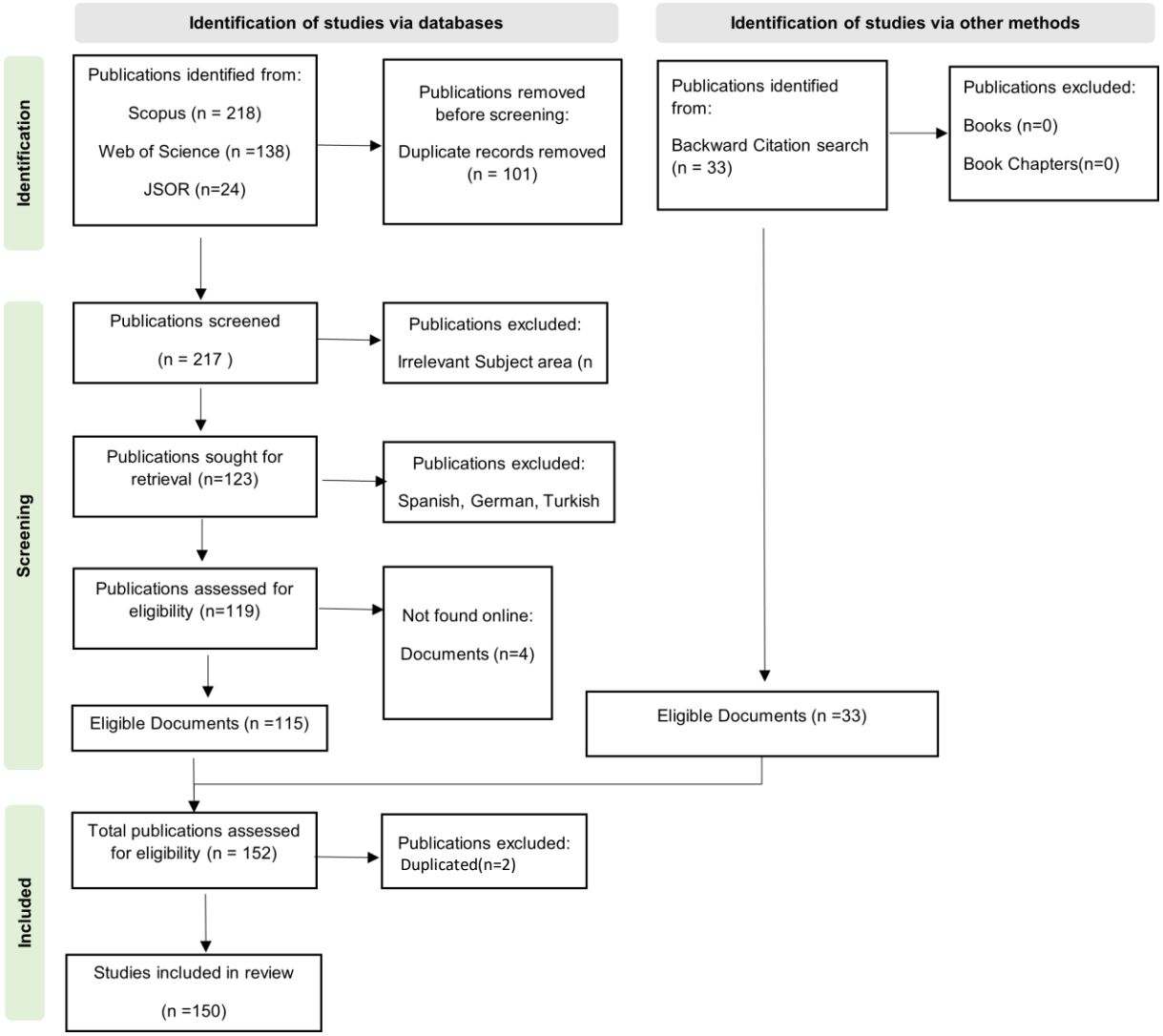


Figure 1 - Literature review flow diagram.

2.2. RESULTS

The author's occurrence analysis was conducted using VOSviewer for network analysis. The top authors, namely Hakan Berument and Stefan Prigge, wrote 3 articles. Figure 2 shows the density visualization of the 31 lead authors with at least two papers. The VOSviewer was also utilized to analyze keyword co-occurrences with the full counting method. After setting a minimum frequency of 1,265 keywords were obtained. Keyword utilization over time was also observed (Figure 3). As some of the keywords were found to have no connections, they were excluded, leaving 226 keywords in total.

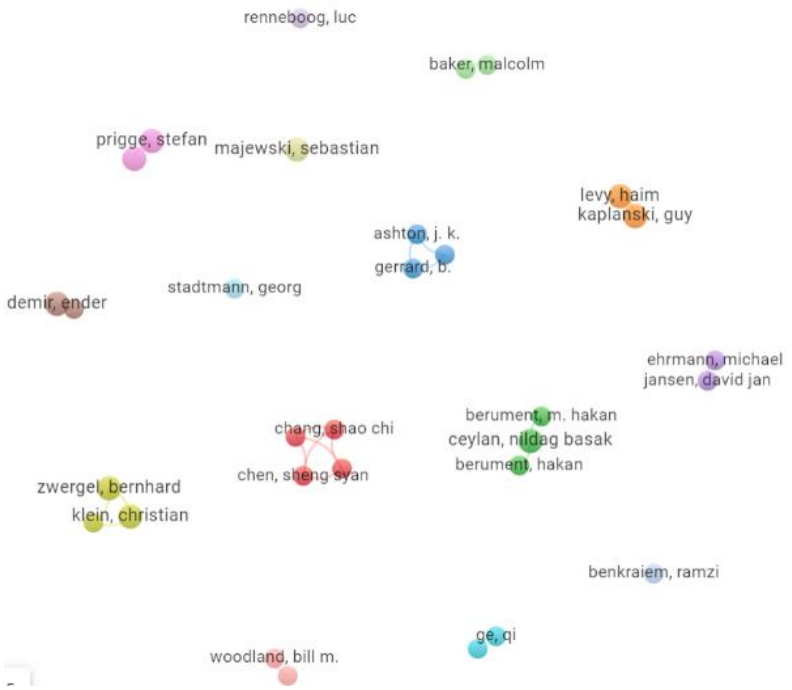


Figure 2 - Density visualization analysis of the 31 leader authors with at least two papers.

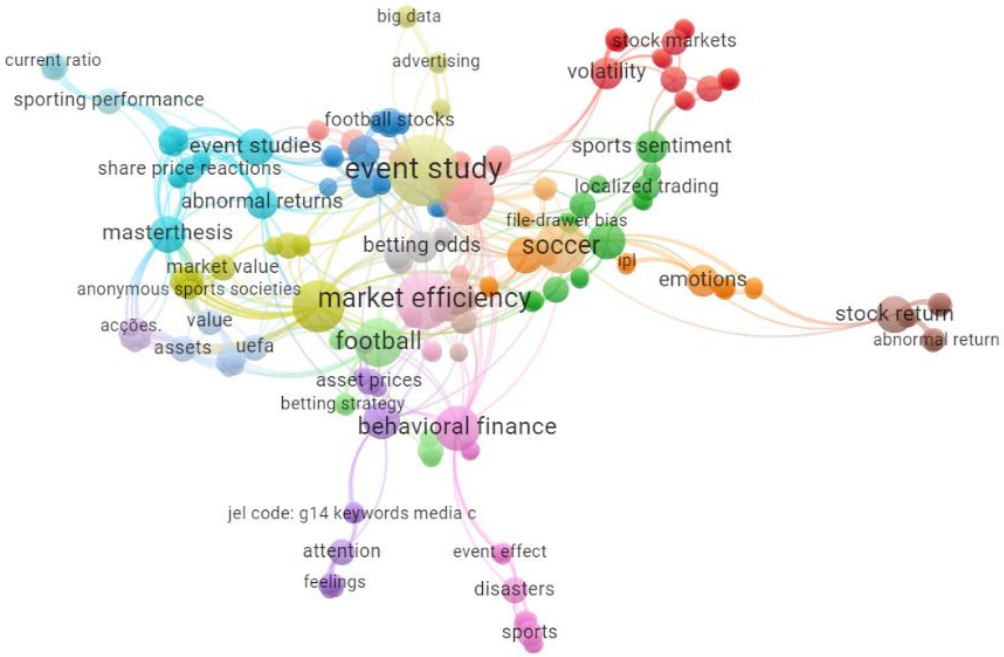


Figure 3 – Application of keywords

It is relevant to deepen the analysis on the evolution of scientific papers launched over the years. In Figure 4, there is an increased interest in the study area. In 2021, there were 14 published papers in this study area.

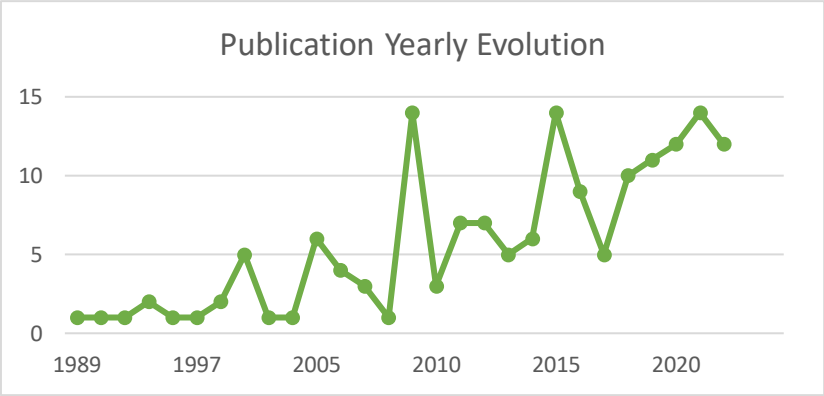


Figure 4- Evolution of the papers published from 1989 until 2023.

An analysis was also conducted to find the most cited articles per year, which top 20 can be observed in Appendix A.

Moreover, an analysis of the 80 journals included in the sample was also performed, shown in Table 1. The International Journal of Sport Finance and the Journal of Sports Economics were the ones with the most articles (6 articles each).

Table 1 - Journals with more than 2 papers published, included in the analysis.

Name	# Articles	Country	Publisher	H-Index
International Journal of Sport Finance	6	United States	Fitness Information Technology	25
Journal of Sports Economics	6	United Kingdom	SAGE Publications Ltd	51
Applied Economics	5	United Kingdom	Taylor and Francis Ltd.	91
The Journal of Finance	4	United States	American Finance Association	103
SSRN Electronic Journal	3	United States	Social Science Electronic Publishing	129
Journal of Financial Economics	3	Netherlands	Elsevier	273
Sport, Business and Management: An International Journal	3	United Kingdom	Emerald Group Publishing Ltd.	20
Journal of Financial Markets	3	Netherlands	Elsevier	63
Social Science Journal	3	United States	Elsevier Inc.	43
Journal of Finance	3	United Kingdom	Wiley-Blackwell Publishing Ltd	317
Review of Behavioral Finance	3	United Kingdom	Emerald Group Publishing Ltd.	15
Finance Research Letters	3	Netherlands	Elsevier BV	62
European Sport Management Quarterly	3	United Kingdom	Routledge	40

Additionally, Table 2 presents a list of 3 conferences regarding this theme.

Table 2 – Most important conferences

Conference	*Location*
ESEA – EUROPEAN SPORT ECONOMICS ASSOCIATION	*Europe*
Research in International Business and Finance	*Europe*
World Finance Conference	*Worldwide*

2.3. CONTENT ANALYSIS

The Efficient Market Theory has been a prominent area of research in finance for the last century, with Fama (1991) proposing that stock prices reflect all available information at any given time. However, Huberman & Regev (2001) and others have questioned the theory's assumptions, suggesting that the market may not be completely rational and can be influenced by psychological biases and other non-rational factors.

As a result, behavioral finance has emerged as an alternative framework that explores deviations from rationality in financial decision-making. An example of this is the Adaptive Markets Hypothesis proposed by Lo (2004), which suggests that investor behavior can be influenced by a variety of factors and incorporates insights from different study disciplines to explain market evolution over time.

Recent literature has explored the relationship between mood and stock returns, indicating that investor sentiment can impact the stock market. Multiple variables have been tested to influence the investor's mood, including weather conditions such as clouds and temperature (Cao & Wei, 2005; Chang et al., 2008). Furthermore, negative market reactions have been observed following aviation disasters (Kaplanski & Levy, 2010), highlighting the impact of external events on the stock market.

Given this background, studying the impact of sports performance on stock prices is relevant. This is because sports performance can affect investor sentiment, ultimately influence the stock market and may provide insights into the complex relationship between financial markets and non-financial factors.

In fact, studies on the impact of sports performance on the stock market have analyzed the impact of various sports, such as basketball (Brown & Hartzell, 2001; Gkillas et al., 2020). However, as expected, football has received the most extensive research, mainly targeting the European leagues, with England being the most studied country. However, studies on national teams have also been

performed, for instance one of the most famous studies by Edmans et al. (2007) found a positive correlation between victories and a more pronounced negative effect after defeats. On the other hand, the effect of Croatia's national team on the Zagreb exchange stocks, where it was found no significant effects of winning or losing a football match (Škrinjarić & Barišić, 2019).

Studies have produced conflicting findings, with some papers finding evidence of a relationship (Benkraiem et al., 2009; Renneboog et al., 2000), while others have not been able to draw a significant relationship (Soana et al., 2022) (Klein et al., 2009). Furthermore, for Scholtens & Peenstra (2009) and Berkowitz & Depken (2018) the stock market exhibits a positive reaction to victories, whereas it demonstrates a stronger negative response to defeats, uncovering an asymmetric effect. However, in general, one can conclude by this literature review that losses significantly affect the stock price, while wins do not have a significant effect.

On the other hand, different variables have been studied to drive even more significant conclusions on the impacts on the game's stocks. One of the first studies by Renneboog et al. (2000) researched the effect of relegation games. Furthermore, Stadtmann et al. (2004) focusing exclusively on Borussia Dortmund, introduced the use of betting odds to only consider the unforeseen aspect of match outcomes, seeking to capture the unexpected elements that might significantly impact stock performance. Moreover, Benkraiem et al. (2009) was among the pioneering studies to account for the influence of the match venue variable, distinguishing between games played at home or away. In the same year, Palomino et al. (2009) was one of the first to introduce the goal difference variable, in pair with Bell et al. (2012). Furthermore, Galloppo & Boido (2020) seek to explore whether games at the start of the season lead to greater AAR compared to those towards the end of the season.

One of the last literature reviews on the theme is from Marcelo (2022), and, as most of this theme's papers, it explores different authors that have studied the impact of the club's or countries' results on their stock price, focusing on football, but also mentioning other sports, like basketball. Unlike the latter, this literature review aims to offer a more quantitative vision of the literature on the topic. The goal is to provide a more objective and numerical comparison between different studies that can help identify trends and patterns, and possibly new insights that have not been addressed in other qualitative reviews.

While there is a scarcity of studies exclusively dedicated to Portuguese football clubs, certain research endeavors incorporate Portuguese clubs into their comprehensive analysis of European football. In Table 3 is possible to see the different data bases and methods as well as sample size and the period for Portuguese focused papers:

Table 3 - Details of the studies focusing only on the Portuguese context.

Author	Method	Game Database	Stock Price Database	Period (Years)	# Clubs	Sample
Ribeiro (2001)	OLS	n.a.	n.a.	2	2	n.a.
Duque & Ferreira (2005)	ARCH + GARCH	n.a.	Bloomberg	5	2	n.a.
Reis (2011)	Event study + OLS + ARCH	LPFP+ Zerozero	Datastream	4	3	494
Pinto & Gonçalves (2012)	Event Study	LPFP	Euronext	2	3	174
Carrilho et al. (2015)	Reversed News Model + Regression	Zerozero	Bloomberg	16	3	>600
Teixeira et al. (2020)	Event Study	Zerozero	Euronext	3	1	176
Serra (2021)	Painel Data	Zerozero	Yahoo Finance + Euronext	19	4	n.a.
Godinho & Teixeira (2021)	Event Study	Zerozero	Euronext	6	1	302

Regarding the specific findings for Portuguese clubs, studies have shown mixed results. Ribeiro (2001) found no correlation between sportive performance and stock price, while Duque and Ferreira (2005) found a positive relationship associated with wins and a negative relationship associated with defeats or draws, except for FCP where only draws were found to have statistical significance. It was also found that stock returns are sensitive to changes in relative points difference, increasing when the difference in points rises and decreasing when it falls.

More recent studies have concluded that a positive abnormal return was observed in days following victories, while a negative abnormal return was observed after losses (Teixeira et al., 2020). There was no evidence that the stock value of SLB and SCP is affected by wins or losses, but such evidence was found for Porto. The results were consistent in the behavior of investors between domestic and international results.

Furthermore, a variety of methodologies has been used, including OLS (Ribeiro, 2001), ARCH (Duque & Ferreira, 2005), GARCH (Godinho & Cerqueira, 2018), reversed news model (Carrilho et al., 2015) and event study (Pinto & Gonçalves, 2012).

In conclusion, the results of the reviewed studies suggest that there might be a relationship between football performance and stock prices, particularly in the Portuguese context. However, some papers have not been able to prove such correlation. The disparate findings suggest that the impact of sports performance on stock prices may depend on several factors, including the type of sport, competition level, and even the club's country. However, the methodology used, and the length of the studies also influence the findings, making it difficult to compare results across studies.

These results can be especially relevant for investors who are interested in sports-related stocks so they can start considering the team's performance and even game importance in their investment decisions.

Finally, it is essential to emphasize the relevance of the reviewed literature to finance and the importance of understanding the complex relationship between the financial markets and non-financial factors.

2.4. RESEARCH GAP

Although there is already some literature on the effects of football clubs' performance on stock prices for different countries and sports, after this literature, it is clear that there are still gaps on the topic. For instance, there is only one not published paper (Santos & Silva, 2021) to the best of our knowledge that seeks to identify a clear trend of the behavior of only Portuguese clubs as an aggregate and so there is a need to conduct further research on this topic in the Portuguese context. Furthermore, the most extensive period analyzed for the individual Portuguese clubs was 16 seasons (Miguel Mendes Carrilho et al., 2015) for FCP and SCP. This thesis aims to add 7 more seasons to this analysis, overlooking a timeframe of 25 seasons for SCP and FCP. Also, for the only paper with aggregate Portuguese results, the time horizon was 12 seasons, which is 4 less than our 16-season horizon.

On the other hand, as stated in the literature review, several variables have been studied. However, this thesis will introduce a new variable that has not been tested to the best of our knowledge, which will compare the periods before COVID-19 and during COVID-19, to provide understanding about the behavior of the stock prices on these distinguished periods.

3. METHODOLOGY

3.1. EVENT STUDY

For this thesis, the methodology used is going to be the event study, in line with previous studies (Benkraiem et al., 2009; Kaplanski & Levy, 2010; Renneboog et al., 2000; Scholtens & Peenstra, 2009; Škrinjarić & Barišić, 2019).

The value of employing an event study lies in the possibility to examine the immediate impact of an event on asset prices in a rational market and to quantify the economic impact of the event using asset price data observed over a relatively short period of time (Campbell et al., 1997).

The structure used is going to be the one defined by Campbell (1997) that goes as in the following Figure 5:

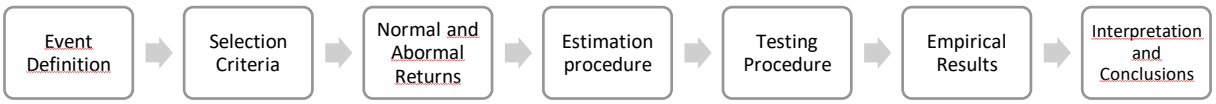


Figure 5 – Event study methodology approach by Campbell

Furthermore, the subsequent sections will provide a comprehensive explanation and description of each step involved in conducting an event study. In addition, Table 4 presents a summary of the key findings:

Table 4 – Main important features of the study

Event	Day of each match
Event Window	1 day (day after the game)
Estimation Window	250 days
Robustness Tests	Sign Test; Wilcoxon Rank Tests

3.2. EVENT DEFINITION

The initial step in an event study is to identify the event of interest and the period when the stock prices will be analyzed, commonly known as the event window. In this case, the event is the football match. While some studies have used a larger interval of 3-5 days (Renneboog et al., 2000), we consider, like Scholtens & Peenstra (2009) that a 1-day event window is the most suitable to minimize the risk of information distortion from concurrent events that may be unrelated to the outcome of the

football match (Galloppo & Boido, 2020), and to avoid event overlap, since there is a risk that the event window would include two games if clubs contest both European and domestic matches in the same week (Marcelo, 2022). Thus, our event window will be the day after the football match, since the games usually take place after Euronext Lisbon's closing hours.

3.3. SELECTION CRITERIA

The teams chosen for this study were selected based on the criteria of being quoted on the Portuguese Stock Market, due to stock price data availability. Furthermore, each club's study time frame was selected according to their listing date on Lisbon Euronext.

The study may be subject to selection biases, as the sample size only includes the four largest football clubs in Portugal, which may not be representative of all football clubs in the country. In addition, there may be confounding variable biases, as the study may not be able to account for all factors that could impact the match results.

3.4. NORMAL, ABNORMAL AND ACTUAL RETURNS

The purpose of utilizing event study methodology is to distinguish Average Abnormal Returns (AAR), which are returns that cannot be explained by market factors but may be potentially linked to the event under examination.

To achieve the stated objective, it is necessary to calculate two additional returns: the normal return and the actual return. The former refers to the return that would be anticipated in the absence of the event, and the latter to the realized return of the stock. The difference between the actual returns and the normal returns is the abnormal return, which represents the impact of the sports performance event on the stock price, after accounting for any market trends that may affect it.

To estimate the AAR, the market model is applied using an Ordinary Least Squares (OLS) regression. Firstly, the market model equation is in Equation 1:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

Where R_{it} is the return of stock i at time t during the event window, R_{mt} is the return of the market index at time t during the event window, α_i is the intercept of stock i, β_i is the slope coefficient of stock i, representing the sensitivity of stock i to changes in the market index and lastly ε_i is the error term.

The expected return of each club's stock during the event window is calculated using Equation 2:

$$E(R_{it}) = \hat{\alpha}_i + \hat{\beta}_i R_{mt} \quad (2)$$

Where the estimates for αi and βi are obtained through the OLS regression using the returns of the security during the estimation period.

Then, to find the abnormal returns, Equation 3 will be applied:

$$AR_{ji} = R_{ji} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \quad (3)$$

After calculating abnormal returns for each event (game), the next step is to determine the abnormal returns for wins, losses and draws. Once separated, more segregation is performed based on other variables of analysis, such as international matches or COVID-19-related draws, and the average abnormal returns for each group must be calculated. This requires calculating the AAR, which is simply the average of all abnormal returns for the specific group. To find the AAR, Equation 4 will be used:

$$AAR_r = \frac{1}{N_R} \sum AR_{ji} \quad (4)$$

Where N represents the number of times each outcome is verified, and R stands for each group mentioned above.

On the other hand, it is also relevant to calculate cumulative average abnormal returns (CAAR) over the event window, aggregating the average abnormal returns. However, due to the fact that there is only one day on the event window, Equation 5 is not applicable.

$$CAAR_t = \sum_{t=i}^{t} AAR_r \quad (5)$$

3.5. Estimation Procedure

The next step is to choose an estimation window, which is the period over which the parameters of the model are going to be estimated. Although Campbell (1997) advised to not include the event window of previous events in the estimation window, due to the frequent occurrence of football matches, it becomes challenging to exclude their influence on the returns. So, following the example of other studies such as Brown & Hartzell (2001) and Scholtens & Peenstra (2009), our event window is going to be included in the estimation window. Furthermore, this estimation window will be 250 trading-days.

3.6. Robustness Test

To ensure the robustness and validity of the findings obtained through the event study methodology, three non-parametric robustness tests are employed: the Sign Test, the Single Sample Wilcoxon

Signed-Rank Test and the Wilcoxon Rank-Sum Test. Those tests were chosen in detriment than parametric ones due to previous works have indicate that football games have a non-normal distribution (Reis, 2011).

The Sign Test is a basic binomial test to determine whether the positive abnormal residuals occur at a frequency of 50%. It only considers the sign of the AAR and not the magnitude, which is considered in the Wilcoxon Tests.

The Single Sample Wilcoxon Signed-Rank Test is a robust non-parametric statistical method employed to assess whether the mean of a single sample is equal to a known standard or theoretical value. The null hypothesis of this test asserts that there is no significant difference between the mean of the observed data and a hypothesized mean.

The Wilcoxon Rank-Sum Test is used to compare the mean of two independent samples. It is a nonparametric alternative to the unpaired Student's t-tests. The data in both groups being compared is initially arranged and listed in order of increasing value. Then each number in the two groups must receive a rank value.

The use of multiple robustness tests increases the rigor and credibility of the analysis and provides a comprehensive assessment of the impact of football match results on the stock prices of their clubs.

4. EMPIRICAL STUDY

For the scope of this research, two different types of data are needed: match data (results, league, season) and stock price data, both from the individual clubs and the Portuguese Market Index (PSI-20). Match data, namely match results, were web scraped from the website Zerozero (https://www.zerozero.pt) using code written in Python language through Google Colab, which can be found in Appendix B. The club's stock prices, and the PSI-20 daily price were taken from DataStream and complemented with Yahoo Finance.

The timeframe selected for each club varies due to different dates of entry into the stock market and to have a larger timeframe than other studies. Therefore, for the individual analysis, the first season of the club with market quotation was chosen and the last season was the same for all clubs, which is the 2022/2023. The total sample for the aggregate analysis is 3249 matches, and a total of 16 seasons (2007/2008 to 2022/2023) were selected, as the 2007/2008 season is the first with stock price data for all selected clubs. This is the largest dataset ever used for Portuguese clubs only. In Table 5 the details of the retrieved data can be observed:

Table 5 – Overview of match datasets

	AGG	*SCP*	*SLB*	*FCP*	*SCB*
# Games	3249	1193	891	1281	899
Seasons	16	25	16	25	19
1st Quotation	N/A	1998	2007	1998	2004
1st Season	2007/2008	1998/1999	2007/2008	1998/1999	2004/2005

The specific data subset for each hypothesis and sample, including match outcomes such as victory, defeat, and draw, can be found in Appendix C.

Furthermore, Figure 6 illustrates the historical quotes of the four Portuguese clubs and the PSI20 index from June 1998 to June 2023.

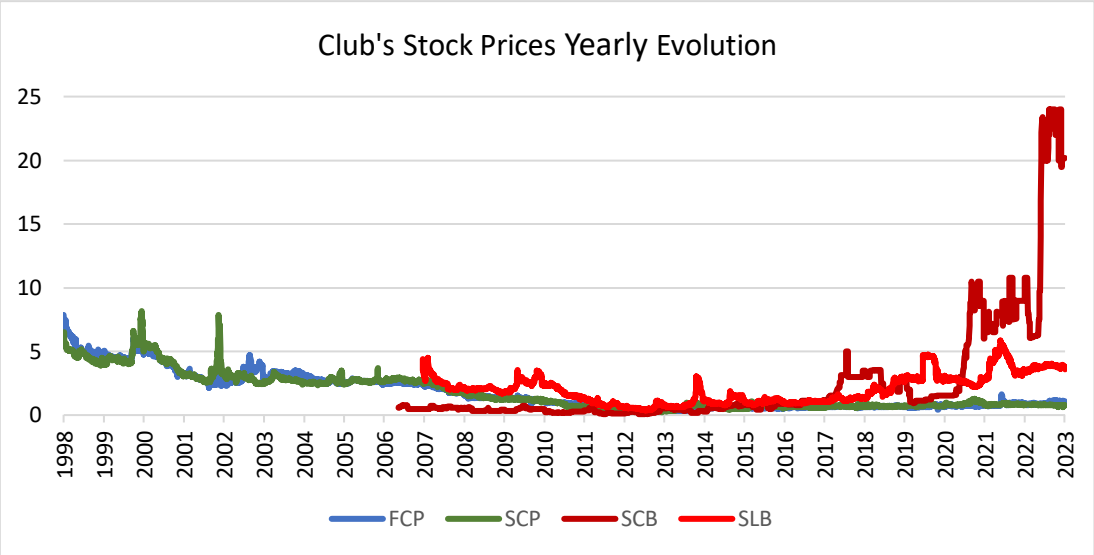


Figure 6 - Evolution of stock prices for the 4 club (1998 - 2023)

Two datasets were analyzed in this study: one containing event dates for games (*eventdates*) and the other with stock prices (*stockdata*). The R software version 4.3.1 (see Appendix D) was used for subsequent steps. Descriptive statistical techniques were applied to both datasets to address outliers and missing values, and to enhance variable comprehension. The analysis was executed for each individual club as well as the overall aggregate of clubs. It is noteworthy that, given the composition of the aggregate of individual clubs, outlier and missing value analysis was performed only on an individual basis to avoid redundancy. Subsequently, the dates for weekend games, which account for most of the matches, as shown in Appendix E, needed to be adjusted. Finally, the market model was used to determine the AAR for each result type and variable tested for each hypothesis.

4.1. Descriptive Statistics

4.1.1. For the clubs' aggregate

The descriptive statistics for game-related variables are displayed in Table 6 for the aggregate of the clubs:

Table 6 - Descriptive statistics for game-related variables (Aggregate)

Variable	*Mean*	*SD*	*Median*	*Trimmed*	*MAD*	*Min*	*Max*	*Range*	*Skew*	*Kurtosis*	*SE*
Month	6.36	3.91	5.0	6.32	5.93	1	12	11	0.05	-1.56	0.13
Year	2015.15	4.59	2015.0	2015.17	5.93	2007	2023	16	-0.03	-1.16	0.16
*season**	8.63	4.58	9.0	8.65	5.93	1	16	15	-0.02	-1.21	0.16
goal_difference	1.21	1.86	1.0	1.16	1.48	-5	10	15	0.24	0.80	0.06

Furthermore, the *stock price* dataset descriptive statistics are in Table 7:

Table 7 - Descriptive statistics for stock price and returns (Aggregate)

VARIABLE	MEAN	SD	MEDIAN	TRIMMED	MAD	MIN	MAX	RANGE	SKEW	KURTOSIS	SE
PRICE	1.57	2.50	0.83	1.10	0.51	0.05	24.00	23.95	5.91	43.37	0.02
RET	0.00	0.05	0.00	0.00	0.00	-0.77	1.14	1.92	3.08	65.79	0.00

4.1.1. Futebol Clube do Porto

The descriptive statistics of the *eventdates* dataset for FCP are presented below in Table 8.

Table 8 - Descriptive statistics for game-related variables (FCP)

Variable	*Mean*	*SD*	*Median*	*Trimmed*	*MAD*	*Min*	*Max*	*Range*	*Skew*	*Kurtosis*	*SE*
Month	6.38	3.90	5	6.34	5.93	1	12	11	0.04	-1.57	011
Year	2010.68	7.33	2011	2010.71	10.38	1998	2023	25	-0.03	-1.24	0.20
*season**	13.11	7.29	13	13.15	8.90	1	25	24	-0.05	-1.22	0.20
goal_difference	1.17	1.80	1	1.15	1.48	-5	8	13	0.10	0.64	0.05

There are no missing values in the FCP dataset. Furthermore, the only variable containing outliers that is worth analyzing is the *Goal Difference*:

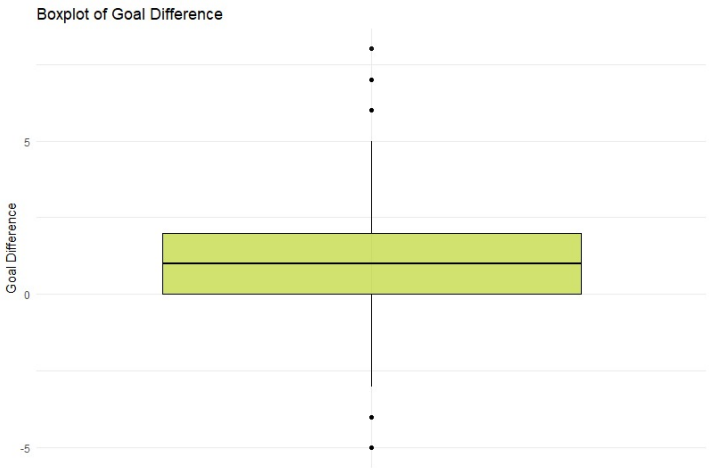


Figure 7 – Box plot of *Goal Difference* variable for FCP

The values in Figure 7 were all maintained since it is reasonable for games to be won by a margin of 8 goals or lost by a margin of 5. Moreover, Table 9 presents the key features of the main variables in the stock dataset.

Table 9 - Descriptive statistics for stock price and returns (FCP)

VARIABLE	MEAN	SD	MEDIAN	TRIMMED	MAD	MIN	MAX	RANGE	SKEW	KURTOSIS	SE
PRICE	1.79	1.47	1.01	1.57	0.75	0.16	7.98	7.82	1.09	0.35	0.02
RET	0.00	0.04	0.00	0.00	0.01	-0.46	0.85	1.31	2.16	48.23	0.00

FCP stocks have an average price of €1.79. There is significant variability and potential market sensitivity towards performance fluctuations, as the standard deviation is relatively high at €1.47. The median price of €1.01 is lower than the mean, indicating a potential right-skewed distribution that might mean occasional higher valuations.

The mean of 0.00 for returns implies a relatively stable performance trend, reinforced by the variability of 0.04 units. The positive skewness value of 48.23 indicates the existence of exceptionally positive returns, suggesting occasional high deviations from the average stock behavior.

Lastly the box plot in Figure 8 further displays the outliers for FCP.

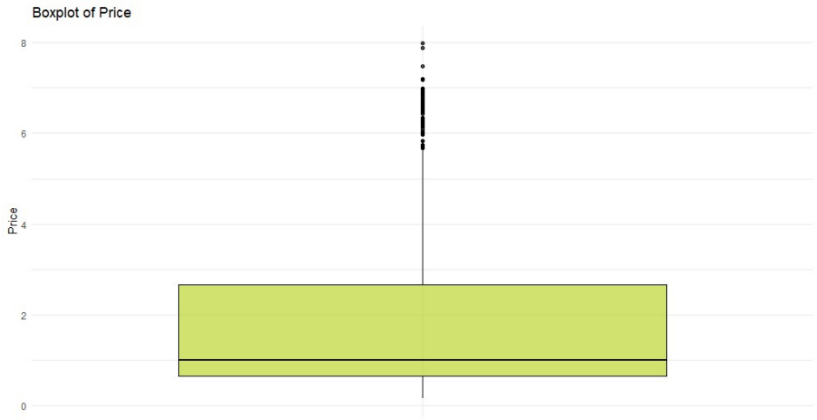


Figure 8 – Box plot of *Price* variable for FCP

For FCP the outliers correspond to two periods in which the club became national champion: in 1998 and in 2003. Despite having won more championships, these two victories coincided with an increase in the club's stock price. Therefore, the outliers were preserved in the analysis.

4.1.2. Sport Clube de Braga

The descriptive statistics for SCB's *eventdates* are displayed in Table 10.

Table 10 - Descriptive statistics for game-related variables (SCB)

Variable	*Mean*	*SD*	*Median*	*Trimmed*	*MAD*	*Min*	*Max*	*Range*	*Skew*	*Kurtosis*	*SE*
Month	6.36	3.91	6	6.32	5.93	1	12	11	0.03	-1.57	0.13
Year	2013.97	5.45	2014	2014.04	7.41	2004	2023	19	-0.09	-1.17	0.18
*season**	10.46	5.43	11	10.54	7.41	1	19	18	-0.09	-1.19	0.18
goal_difference	0.59	1.79	1	0.57	1.48	-6	7	13	0.13	0.76	0.06

In terms of missing values, once again, there are none as the dataset is also complete. Subsequently, box plots were generated for each variable to address potential outliers. Specifically, the box plot for *Goal Difference* in Figure 9 revealed the presence of noteworthy outliers. Despite their presence, it was decided to retain these values in the sample rather than eliminate them, as they were considered reasonable.

Figure 9 – Box plot of *Goal Difference* variable for SCB

Moreover, the *stockdata* for the SCB analysis of the two variables is presented in Table 11.

Table 11 - Descriptive statistics for stock price and returns (SCB)

VARIABLE	**MEAN**	**SD**	**MEDIAN**	**TRIMMED**	**MAD**	**MIN**	**MAX**	**RANGE**	**SKEW**	**KURTOSIS**	**SE**
PRICE	2.5	4.55	0.70	1.37	0.65	0.05	24.00	23.95	3.19	10.57	0.07
RET	0.0	0.06	0.00	0.00	0.00	-0.77	1.14	1.92	4.55	105.14	0.00

The average price is €2.5, and the standard deviation is €4.55, suggesting substantial variability. The median value of €0.70 indicates that a significant portion of the data is concentrated towards the lower

end. The observed prices encompass a wide spectrum, as evident from the price range spanning from a minimum of €0.05 to a maximum of €24.00. The positive skewness of €3.19 and the kurtosis value of €10.57 collectively indicate a distribution skewed to the right with heavier tails than a normal distribution, suggesting the presence of influential outliers within the price distribution.

Conversely, the dataset shows low variability with an average return and a median of 0.0 and a standard deviation of 0.06. Return values in the dataset range from -0.77 to 1.14 units, indicating a wide range. The positive skewness of 4.55, indicating a rightward skew, suggests the presence of positive outliers, further supported by the high kurtosis of 105.14. A box plot for the price variable was conducted (Figure 10) to account for the outliers.

Figure 10 – Box plot of *Price* variable for SCB

The occurrence of this high number of outliers can be attributed to the substantial investment made by Qatar Sports Investments in late 2022, which acquired 21.67% of SCB capital, leading to a significant increase in valuation (Fábio Carvalho da Silva, 2022). Thus, the rows with the outliers were retained for the analysis.

However, due to the low liquidity of SCB stocks, an individual analysis of this club was not feasible. Instead, it was only considered in the aggregate analysis.

4.1.3. Sporting Clube de Portugal

The descriptive statistics for the SCP *eventdates* dataset are described in Table 12:

Table 12 - Descriptive statistics for game-related variables (SCP)

Variable	*Mean*	*SD*	*Median*	*Trimmed*	*MAD*	*Min*	*Max*	*Range*	*Skew*	*Kurtosis*	*SE*
Month	6.93	3.93	5	6.36	5.93	1	12	11	0.02	-1.57	0.11
Year	2010.89	7.17	2011	2010.94	8.90	1998	2023	25	-0.05	-1.18	0.21
*season**	13.06	7.11	13	13.10	8.90	1	25	24	-0.04	-1.18	0.21
goal_difference	0.82	1.76	1	0.81	1.48	-6	7	13	0.07	0.64	0.05

Like FCP and SCB there were no missing values found within the dataset. Moreover, an outlier analysis was conducted for each variable using box plots. Once again, the box plot in Figure 11 for the *Goal Difference* variable displayed noticeable outliers. However, upon closer examination, these values were considered reasonable and therefore not removed.

Figure 11 – Box plot of *Goal Difference* variable for SCP

For the *stockdata* analysis, Table 13 summarizes the main dataset characteristics:

Table 13 - Descriptive statistics for stock price and returns (SCP)

VARIABLE	MEAN	SD	MEDIAN	TRIMMED	MAD	MIN	MAX	RANGE	SKEW	KURTOSIS	SE
PRICE	1.79	1.43	1.05	1.58	0.80	0.15	8.15	8.00	1.12	0.58	0.02
RET	0.00	0.05	0.00	0.00	0.01	-0.38	0.90	1.29	2.15	35.14	0.00

The average price is €1.79, and the variability is €1.43. The median price of €1.05, lower than the mean, suggests a right skewed distribution, confirmed by the skew value of €1.12. There is dispersion around the median and prices range from €0.15 to €8.15.

The returns have an average and median of 0.00. Despite the low variability, the distribution exhibits significant right-skewness with a coefficient of 2.15 and a high kurtosis of 35.14 suggests the presence of heavy tails or extreme values that affect the distribution.

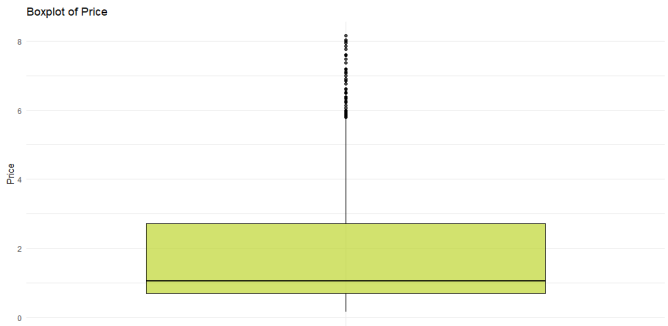


Figure 12 – Box plot of *Price* variable for SCP

The SCP outliers in Figure 12 occurred primarily in two periods: in 2000 and 2002. During these years, SCP became a national champion, and after this event, the stock prices increased extraordinarily (*Vitória Sportinguista Influencia a Bolsa – RTP Arquivos*, 2000).

4.1.4. Sport Lisboa e Benfica

Lastly, Table 14 presents SLB's descriptive statistics of the dataset for *eventdates*.

Table 14 - Descriptive Statistics for Game-Related Variables (SLB)

Variable	*Mean*	*SD*	*Median*	*Trimmed*	*MAD*	*Min*	*Max*	*Range*	*Skew*	*Kurtosis*	*SE*
Month	6.35	3.93	5	6.32	5.93	1	12	11	0.04	1.57	0.07
Year	2015.16	4.63	2015	2015.19	5.93	2007	2023	16	-0.04	-1.18	0.08
*season**	8.65	4.61	9	8.68	5.93	1	16	15	-0.04	-1.21	0.08
goal_difference	0.98	1.84	1	0.95	1.48	-6	10	16	0.10	0.69	0.03

There were no missing values for any variable in the dataset. In the subsequent step, outliers were imputed by conducting a box plot for each variable. Figure 13 reflects the box plot for the *Goal Difference* variable, indicating the presence of some outliers. However, their values are reasonable and hence not removed from the sample.

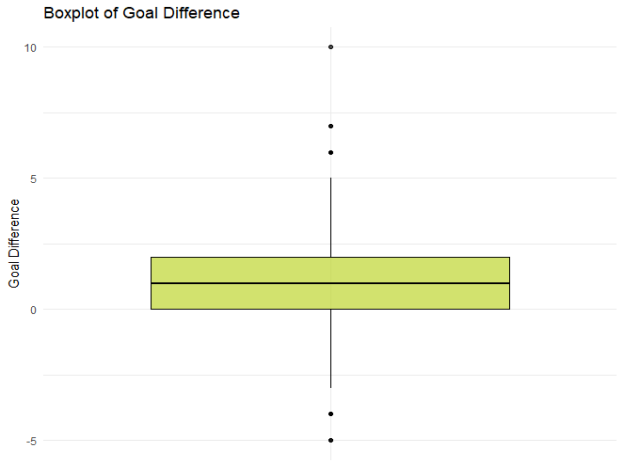


Figure 13 – Box plot of *Goal Difference* variable for SLB

Furthermore, the *stockdata* dataset was also inspected, and a descriptive statistical analysis was performed. The main results are presented in Table 15.

Table 15 - Descriptive statistics for stock price and returns (SLB)

VARIABLE	MEAN	SD	MEDIAN	TRIMMED	MAD	MIN	MAX	RANGE	SKEW	KURTOSIS	SE
PRICE	2.00	1.14	1.84	1.89	1.28	0.37	6.00	5.63	0.76	-0.13	0.02
RET	0.00	0.04	0.00	0.00	0.02	-0.38	0.70	1.08	2.38	34.43	0.00

The relatively higher standard deviation of prices (€1.14) compared to returns (0.04) reveals that prices display greater variability than returns. This may suggest that while prices fluctuate, returns are more stable. The average return of 0.00 suggests a balanced performance for the stocks, with no significant change in returns on average. Additionally, the high positive kurtosis of 34.43 for returns signifies an extreme right tail, contrasting with the -€0.13 slightly lighter tails for price.

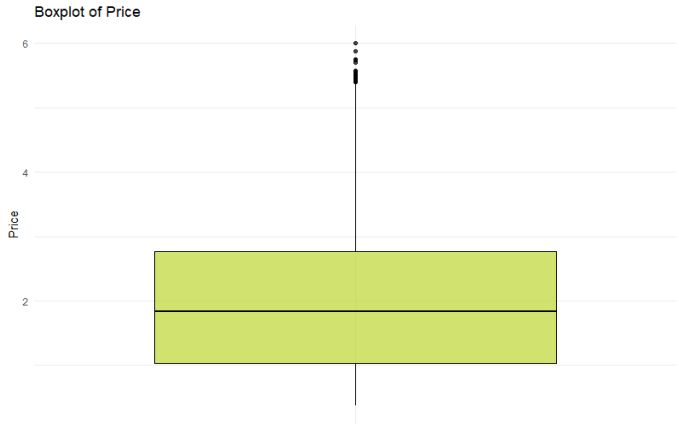


Figure 14 – Box plot of *Price* variable for SLB

The observed outliers (Figure 14) occurred in the final two months of 2021 are likely due to the announcement of the former president of SLB, Luís Filipe Vieira, who stated his intention to sell 3.28% of SAD's capital (Bruno Roseiro, 2021). This unexpected announcement led to a sudden increase in stock prices, resulting in the emergence of these outliers. The outliers were, once again, not excluded from the sample.

4.2. HYPOTHESIS

4.2.1. First Hypothesis

This first hypothesis aims to examine how victories (V), defeats (D), and draws (T) influence the stock price of the aggregate sample as well as individually for each club. As previous studies have found a correlation between these variables (Benkraiem et al., 2009; Demir & Danis, 2011; Scholtens & Peenstra, 2009), our alternative hypothesis will be as follows:

H1: Portuguese club's sporting outcomes impact their stock prices.

The null hypothesis definition is therefore:

H0: There is no significant impact of Portuguese club's sporting outcomes on their stock prices.

Abnormal Average Returns (AAR) calculations and subsequent testing can be used to determine whether to accept or reject the null hypothesis. Rejecting the null hypothesis occurs when the p-value from the Single Sample Wilcoxon Signed-Rank Test is greater than 0.05, indicating sufficient evidence for significant correlation between the sporting results of Portuguese clubs and their stock prices. Although the Sign Test was also performed, the p-values from the Single Sample Wilcoxon Signed-Rank Test are the ones going to be considered for the purpose of this analysis. Moreover, Table 16 displays the AAR values for all clubs and the aggregate, as well as their significance based on the Single Sample Wilcoxon Signed-Rank. The values for the Sign Test and the Single Sample Wilcoxon Signed-Rank Test can be found in Appendix F.

Table 16 – AAR and significance

Outcome	AGG	FCP	SCP	SLB
V	0.29%	0.19%	0.22%	0.27%
D	-0.58%**	-0.82%**	-0.48%**	-2,19%**
T	-0.47%**	-0.28%*	-0.81%**	-1,12%**

**, * indicate statistical significance at the 1% and 5%-level, respectively.

4.2.1.1. For the clubs' aggregate

The findings of the Single Sample Wilcoxon Signed-Rank Test show a statistically significant difference of -0.58% between the actual return of AGG in the case of defeats when compared to the market return, since p-values are close to 0 and thus lower than 0.05. Furthermore, draws influence negatively the AAR by less than defeats, with a value of -0.47%. Conversely, the test fails to confirm a significant difference between the actual return of AGG and the market return (P-value > 0.05) in the case of victories. Despite this, the positive value of 0.29% suggests a higher performance level in terms of returns, signifying that victories are associated with a positive abnormal return on average.

So, it can be concluded that there is enough evidence to reject the null hypothesis for both defeats and draws in the case of the sample for the aggregate results. However, the test did not provide enough evidence to reject the null hypothesis for wins, suggesting that, despite the positive returns, the difference between actual and market performance may not be statistically significant.

4.2.1.2. Futebol Clube do Porto

When analyzing FCP, the results in Table 16 were found to be comparable to those of AGG, with differences only in the magnitude of the average abnormal returns. The Single Sample Wilcoxon Signed-Rank Test demonstrated a statistically significant difference of -0.82% and -0.28% in the actual AGG returns for defeats and draws, respectively, as compared to the market return. On the other hand, when assessing victories, the test fails to detect a significant difference between AGG's actual return and the market return (P-value=0.904) with a positive value of 0.19%, indicating a higher level of performance in terms of returns, and evidence that victories are associated with a positive abnormal return on average.

Like for the aggregate results, only for victories there is not sufficient evidence to reject the null hypothesis, however abnormal returns showed evidence that victories are associated with a positive abnormal return on average.

4.2.1.3. Sporting Clube de Portugal

The results of the Single Sample Wilcoxon Signed-Rank Test in Table 16 indicate a significant difference of -0.48% and -0.81% in SCP's actual returns for losses and draws versus the market returns. These results are further supported by small p-values, nearing 0, and are statistically significant at the 1% level. In the case of SCP, draws yield more unfavorable AAR results than losses. In the case of SCP, draws have higher negative AAR than defeats. When analyzing the influence of victories on AAR, SCP's returns mirror the pattern observed in both the aggregate and the individual club samples, with a positive value of 0.22%, but again not being statistically significant, with a high p-value of 0.839.

Once again, only victories do not provide enough evidence to reject the null hypothesis. Nonetheless, the abnormal returns strongly suggest that victories are linked to a positive abnormal return on average.

4.2.1.4. Sport Lisboa e Benfica

Based on the SLB test results, it is apparent that defeats and draws have a negative effect on stock prices, which is supported by the low p-values of the Single Sample Wilcoxon Signed-Rank test performed with returns of -2.19% and -1.12%, respectively. Similarly to the other two clubs and the AGG sample, there was not enough evidence found to confirm a significant difference between the actual return of SLB and the market return for victories (P-value= 0.680). However, the AAR of 0.27% suggests a positive abnormal return on average after victories.

Based on the above, the null hypothesis is rejected only for defeats and draws but wins suggest a positive abnormal return on average.

4.2.2. Second Hypothesis

The second hypothesis aims to determine whether international victories, draws, and defeats result in higher AAR (either positive or negative) in the Champions League, Europa League, and their antecedents, compared to those achieved in national competition matches such as the Liga Portugal, League Cup, Portuguese Cup, and Portuguese Super Cup.

To facilitate this analysis, the data for each sample was categorized into two types: National Games and International Games. A variable, *Location*, was created to distinguish between a national competition and an international competition.

We propose the alternative hypothesis and the respective null hypothesis based on the results from Reis (2011):

H0: Results in international competitions do not have a more substantial impact on abnormal stock returns than national competitions.

H1: Results in international competitions have a more substantial impact on abnormal stock returns than national competitions.

To rigorously test the null hypothesis, the Sign Test and the Single Sample Wilcoxon Signed-Rank Test were performed for each match outcome for each category, national or international, to access whether the actual return average equals the market return, thus providing evidence of AAR. Secondly, the Wilcoxon Rank-Sum Test was performed to access whether the means of the abnormal returns of the corresponding match outcomes of the two categories were equal.

Table 17 and 18 present the results of the AAR for each set and their significance based on the Single Sample Wilcoxon Signed-Rank. Additionally, the detailed results for the Sign Test and the Single Sample Wilcoxon Signed-Rank are presented in Appendix F.

Table 17 – AAR for national outcomes and significance

National Outcome	ALL	FCP	SCP	SLB
V	0.30% **	0.11%*	0.28%	0.27%
D	-0.39% **	-0.67%**	-0.45%**	-1,96%**
T	-0.54% **	-0.39%	-0,91%**	-0.97%**

**, * indicate statistical significance at the 1% and 5%-level, respectively.

Table 18 – AAR for international outcomes and significance

International Outcome	ALL	FCP	SCP	SLB
V	0.18%	0.67%	-0.19%	0.25%
D	-0.98%**	-1,04%**	-0.53%	-2,50%**
T	-0.24%	0.00%*	-0.32%	1,50%

**, * indicate statistical significance at the 1% and 5%-level, respectively.

4.2.2.1. For the clubs' aggregate

According to the Single Sample Wilcoxon Signed-Rank Test and the first column of Table 17, it is clear that there is a statistically significant difference between the actual return and the market return (P-value < 0.05) with a positive value for victories (0.30%) and negative values for defeats (-0.39%) and ties (-0.54%). Conversely, in Table 18, this test fails to confirm a significant difference between the actual return and the market return (P-value > 0.05) in the case of victories and ties in international outcomes.

Table 19 – Wilcoxon Rank-Sum Test results (p-values)

Match Outcome	ALL	FCP	SCP	SLB
V	0.127	0.014	0.469	0.908
D	0.404	0.806	0.984	0.913
T	0.260	0.369	0.132	0.547

The findings of the Wilcoxon Rank-Sum Test in Table 19 do not show a statically significant difference between the mean AAR for national victories, defeats, and draws and the mean for international victories, defeats and draws. This conclusion is supported by p-values that are all above 0.05 (0.127, 0.404, and 0.260). However, there are differences between the calculated AAR, suggesting that national victories can have a 0.12% higher impact on stock prices than international victories, and national ties can have a -0.30% higher impact than international ties. On the contrary, international defeats might have a -0.59% greater effect on stocks than national defeats.

Although the numerical results indicate variations between the AAR, the null hypothesis cannot be rejected as these results are not statistically significant.

4.2.2.2. Futebol Clube do Porto

The FCP AAR displays a consistent pattern for both national and all matches. Wins result in a positive 0.11% effect, while losses and draws have more substantial negative effects of -0.67% and -0.39%, respectively. The trend is unchanged for domestic matches, except that draws AAR are associated on average with a null AAR. According to the Single Sample Wilcoxon Signed-Rank Test, only international defeats and draws and national victories results show a statistically significant difference between the actual return when compared to the market return (P-value < 0.05), which points towards the evidence of international draws having abnormal returns.

Table 19 indicates a statistically significant difference between the mean AAR of national victories and the mean of international victories, as the p-value is <0.05 (P-value=0.014), according to the findings of the Wilcoxon Rank-Sum Test. On the other hand, the test fails to confirm significant difference between the mean AAR of national draws and defeats and the mean of international draws and defeats, since the p-values are considerably higher than 0.05, specifically 0.806 and 0.369. Despite this, international losses demonstrate a greater level of performance regarding returns (0.37%) than national losses.

Therefore, although the comparison of ARR results suggests a potentially higher impact on stock prices for both international wins and losses, only the difference for wins is statistically significant, leading to the rejection of the null hypothesis for wins exclusively.

4.2.2.3. Sporting Clube de Portugal

For national SCP outcomes, results from Table 17 show that victories have a 0.28% positive impact which lacks statistical significance. Meanwhile, draws and defeats have significant AAR based on the Single Sample Wilcoxon Signed-Rank of -0.45% and -0.91%, respectively. Notably, in Table 18 all

international outcomes lead to a negative AAR, ranging from 0.19% for victories to -0.53% for defeats. None of the AAR for international outcomes are statistically significant.

The results of the Wilcoxon Rank-Sum Test in Table 19 fail to demonstrate a notable distinction between the mean AAR of all national outcomes and international outcomes, with p-values higher than 0.05. Nevertheless, international defeats exhibit a slightly higher return performance (0.08%) than national defeats whereas national ties may have a greater impact (0.59%) on SCP stock prices compared to international ties.

In summary, the results of the Wilcoxon Sum-Rank Test suggest that there is insufficient evidence to reject the null hypothesis, as it cannot be concluded that the mean difference exceeds 0.

4.2.2.4. Sport Lisboa e Benfica

National outcomes in Table 17 show a positive AAR of 0.27% for wins, while losses and draws have a negative impact of -1.96% and -0.97%, respectively. The AAR for international outcomes in Table 18 are similar, with the exception of international draws, which have a high positive AAR of 1.50%. These results are statistically significant except for national and international victories as well as international draws.

The Wilcoxon Rank-Sum Test in Table 19 shows that, like SCP, there is no significant difference in the mean AAR of all national outcomes and international outcomes, with p-values above 0.05. However, international defeats reveal a higher return performance (-0.56%) compared to national defeats and SLB has a slightly higher AAR for national wins than for international wins, the difference being 0.02%. Additionally, the returns for draws vary in opposite directions for domestic and international matches, with higher returns for the latter.

Consequently, based on our statistical analysis, there is insufficient evidence to confidently reject the null hypothesis for any match outcome.

4.2.3. Third Hypothesis

For the third hypothesis, the samples were divided into two categories: one with a goal difference greater than 3 (Dominant) and the other with a goal difference of 3 or less (Moderate). Only victories and defeats were considered since ties have a goal difference of 0, and thus not relevant to this concern. Following the results obtained by Marcelo (2022), the third hypothesis is:

H1: Victories or defeats with a goal difference greater than 3 have a higher impact on the stock price of football clubs compared to other victories or defeats.

Consequently, the null hypothesis being tested is the following:

H0: Victories or defeats with a goal difference greater than 3 do not have a higher impact on the stock price of football clubs compared to other victories or defeats.

The use of the tests to access statistical significance are as described in the second hypothesis. Tables 20 and 21 display the AAR results and their corresponding significance based on the Single Sample Wilcoxon Signed-Rank Test. Detailed results of the Sign Test and Wilcoxon Signed-Rank Test can be found in Appendix F.

Table 20 - AAR for moderate outcomes and significance

Match Outcome	ALL	FCP	SCP	SLB
V	0.26%*	0.18%	0.11%	0.06%
D	-0.57%**	-0.66%**	-0.49%**	-2,36%**

**, * indicate statistical significance at the 1% and 5%-level, respectively.

Table 21 - AAR for dominant outcomes and significance

Match Outcome	ALL	FCP	SCP	SLB
V	0.34%	0.19%	0.56%	0.73%
D	-0.60%**	-2,34%*	-0.39%	-0.80%

**, * indicate statistical significance at the 1% and 5%-level, respectively.

4.2.3.1. For the clubs' aggregate

The first column of Table 20 shows a statistically significant difference between the actual return and the market return (P-value < 0.05), with a positive value for victories (0.26%) and a negative value for defeats (-0.57%) for moderate outcomes. Conversely, in Table 21, this test fails to confirm a significant difference between the actual return and the market return (P-value > 0.05) in the case of victories in dominant outcomes.

Table 22 - Wilcoxon Rank-Sum Test results (p-values)

Match Outcome	ALL	FCP	SCP	SLB
V	0.337	0.683	0.096	0.179
D	0.831	0.135	0.672	0.274

The Wilcoxon Rank-Sum Test results in Table 22 do not indicate significant disparities between the mean AAR for moderate wins and losses, as reflected by the notably higher p-values of 0.337 and 0.831, respectively. Despite this, AAR provides evidence of a slightly higher positive impact for moderate wins and defeats, at 0.08% and -0.03%, respectively.

While there appears to be a variation in the impact on stock prices between dominant and moderate outcomes based on returns, the statistical evidence does not strongly validate the significance of these differences. Thus, there is insufficient evidence to reject the null hypothesis.

4.2.3.2. Futebol Clube do Porto

Table 20 shows that in moderate matches, FCP experienced a moderate positive abnormal return of 0.18% following victories, indicating a slight rise in stock prices. Nevertheless, losses had a much more pronounced negative effect with an abnormal return of -0.66%. In dominant games, the positive abnormal return after victories in Table 21 showed a slight increase to 0.19%, while the influence of losses was much more noticeable with an abnormal return of -2.34%. However, the statistical significance of these findings is limited to losses based on the Single Sample Wilcoxon Signed-Rank Test.

Also, Table 22 indicates that the Wilcoxon Rank-Sum Test did not confirm a significant difference between the means of dominant and moderate outcomes. Nevertheless, the results demonstrate that dominant outcomes are associated with larger magnitudes of abnormal returns on average compared to moderate outcomes. These differences represent a 0.01% increase in victories and a -1.68% decrease in defeats. Therefore, neither of the outcomes allows for rejection of the null hypothesis.

4.2.3.3. Sporting Clube de Portugal

In moderate matches, SCP has a positive AAR of 0.11% after victories and a higher AAR of 0.56% after dominant victories. In contrast, dominant defeats have a relatively minor negative impact with an AAR of -0.39%, compared to the -0.49% for moderate defeats. The only significant result is for moderate defeats, where the Single Sample Wilcoxon Signed-Rank Test indicates a statistically significant difference between SCP's actual return and the market return (P-value < 0.05).

However, despite the numerical differences mentioned above, all p-values in Table 22 obtained from the Wilcoxon Rank-Sum Test were higher than the conventional significance level of 0.05, indicating a lack of statistical significance in the observed differences between moderate and dominant outcomes for SCP. Therefore, based on these findings, we cannot reject the null hypothesis.

4.2.3.4. Sport Lisboa e Benfica

SLB follows the same pattern as SCP, with moderate victories resulting in a positive AAR of 0.06% and dominant victories resulting in an AAR of 0.73%. However, defeats exhibit a different trend: moderate results show a greater negative impact of -2.36% compared to dominant results, which only show a negative impact of -0.80%. Like for SCP, the Single Sample Wilcoxon Signed-Rank Test only found a statistically significance difference for moderate defeats, between the actual return of SLB when compared to the market return (P-value < 0.05).

When analyzing the differences between moderate and dominant outcomes, the Wilcoxon Rank Sum Test p-values in Table 22, as for the other two clubs, did not confirm a statistical difference between the mean of the moderate outcomes and the mean of the dominant outcomes. Nonetheless, the 0.67% higher AAR for moderate wins and the -1.56% higher AAR for moderate losses are evidence that moderate outcomes are associated with higher abnormal returns on average.

Consequently, based on this analysis, there is not enough statistical evidence to reject the null hypothesis for SLB, suggesting that the observed differences may not be statistically significant in influencing stock prices.

4.2.4. Fourth Hypothesis

The fourth and last hypothesis introduces a new variable not previously studied, to determine whether variations exist in AAR for each match outcome prior to and during the pandemic. To achieve this, the variable *COVID* was created to categorize matches as pre-COVID-19 (up to the 2018/2019 season) and during COVID-19 (from the 2019/2020 to the 2022/2023 seasons). The alternative hypothesis is then:

H1: COVID-19 has a significant effect on the abnormal stock returns of football clubs.

Following, the null hypothesis is the one described below:

H0: COVID-19 has no significant effect on the abnormal stock returns of football clubs.

As with the previous hypothesis, the use of the tests to access statistical significance is as described in the second hypothesis**.** The AAR for each data set are displayed in Tables 23 and 24. In addition, the detailed results of the Sign Test and the Single Sample Wilcoxon Signed-Rank are presented in Appendix F.

Table 23 - AAR for pre-COVID-19 outcomes and significance

Match Outcome	ALL	FCP	SCP	SLB
V	0.24%	0.18%	0.08%	0.31%
D	-0.65%**	-0.81%**	-0.51%**	-2.47%**
T	-0.59%**	-0.30%*	-0.96%**	-1.28%**

**, * indicate statistical significance at the 1% and 5%-level, respectively.

Table 24 – AAR for COVID-19 outcomes and significance

Match Outcome	ALL	FCP	SCP	SLB
V	0.45%	0.19%	1.03%	0.09%
D	-0.26%***	-0.86%*	-0.17%	-1.06%*
T	0.05%	-0.15%	0.52%	-0.60%

**, * indicate statistical significance at the 1% and 5%-level, respectively.

4.2.4.1. For the clubs' aggregate

The first columns of Tables 23 and 24 confirm a significant difference between the actual and the market return (P-value > 0.05) in the case of defeats and draws in pre-COVID-19 outcomes. For draws, the AAR was negative in the period before COVID-19 (-0.59%) but was slightly positive during COVID-19 (0.05%). Even though it was always negative for defeats, its magnitude decreased from -0.65% to -0.26% during COVID-19. The Single Sample Wilcoxon Signed-Rank Test only fails to find a statistical difference between the actual return of AGG and the market return (P-value > 0.05) for victories in both periods and for COVID-19 ties. The impact of a victory was always positive in both before COVID-19 and during COVID-19, increasing from 0.24% to 0.45% during COVID-19.

Table 25 - Wilcoxon Rank-Sum Test results (p-values)

Match Outcome	ALL	FCP	SCP	SLB
V	0.748	0.229	0.142	0.803
D	0.437	0.376	0.031	0.634
T	0.869	0.787	0.654	0.143

The results of the Wilcoxon Sum-Rank Test in Table 25 fail to find statistically significant differences between all outcomes since the p-values are all higher than 0.05, meaning that there is not enough evidence to affirm that the mean AAR for all match outcomes during COVID-19 are different from the

mean AAR before COVID-19. Nonetheless, the AAR values show as evidence of a higher positive effect of 0.21% following victories during COVID-19 and a lower negative effect of -0.39% following defeats.

Therefore, based on this statistical analysis, we cannot conclusively reject the null hypothesis, indicating a lack of statistically significant differences in the stock price impact between these periods for the analyzed game outcomes.

4.2.4.2. Futebol Clube do Porto

The results in Tables 23 and 24 for before and after the pandemic follow the same direction of effect for FCP. Victories have a positive AAR, while defeats and draws have negative AAR. Only for defeats and draws before COVID-19 the Single Sample Wilcoxon Signed-Rank Test found enough statistical evidence of a difference between the actual return of FCP and the market return (P-value < 0.05).

As the AGG results, the Wilcoxon Sum-Rank Test in Table 25 failed to find statistically significant differences between all match outcomes, since the p-values are all higher than 0.05, meaning that there is not enough evidence to confirm that the mean AAR for all game outcomes during COVID-19 is different from the mean AAR prior to COVID-19. However, for FCP, the AAR value returns suggest that during COVID-19 AAR had a higher effect on stock prices for victories and defeats of 0.01%, and COVID-19 losses also have a small increase in the absolute value of AAR of 0.05%. On the other hand, draws in COVID-19 have a higher decrease in AAR of -15%.

Therefore, there is not enough statistical evidence to reject the null hypothesis for any match outcome for FCP in support of this fourth hypothesis.

4.2.4.3. Sporting Clube de Portugal

As shown in Tables 23 and 24, the AAR after wins is consistently positive for SCP, with a small potential increase in stock price of 0.08% before the pandemic but a dramatic increase of 1.03% during the pandemic. In contrast to the other two types of game outcomes, draws experienced the most drastic change, shifting from a negative effect of -0.96% to a positive value of 0.52%. For SCP, the Single Sample Wilcoxon Signed-Rank Test only found enough statistical evidence of a difference between the actual return of SCP and the market return (P-value < 0.05) for losses and ties before COVID-19.

The Wilcoxon Sum-Rank Test, as shown in Table 25, found a 0.95% impact difference in the mean AAR between COVID-19 victories and victories before COVID-19, distinguishing it from the other clubs studied. However, the difference in means for draws and defeats did not show significant confirmation, despite the AAR evidencing defeats decreasing stock prices more negatively by -0.34% during COVID-19 and ties transforming from negative to positive average abnormal returns.

Thus, the null hypothesis is rejected only for losses, as the other match results were not statistically significant.

4.2.4.4. Sport Lisboa e Benfica

During the COVID-19 period, SLB experienced a decline in AAR for all match outcomes. In fact, from 0.31% to 0.09% after a victory, while still maintaining a positive effect direction, and from -2.47% to -1.06% after a defeat. Finally, draws also decreased from -1.28% to -0.60% during the COVID-19 period. As with FCP, the findings of the Single Sample Wilcoxon Signed-Rank Test for both period wins and for COVID-19 draws failed to confirm a significant difference between the actual return of AGG and the market return (P-value > 0.05).

The Wilcoxon Sum-Rank Test presented in Table 25 failed to find statistically significant differences between all match outcomes, as the p-values are all higher than 0.05, meaning that there is not enough evidence to affirm that the mean AAR for all match outcomes during COVID-19 is different from the mean AAR prior to COVID-19. Nevertheless, the differences in calculated returns described above provide evidence of differences during the COVID-19 periods.

In essence, there are no statistically significant differences in the mean abnormal returns between the pre-COVID-19 and COVID-19 periods for any of the outcomes for SLB, including victories, defeats, or draws.

5. DISCUSSION

5.1. CLUBS' AGGREGATE

For the complete sample, our results are in accordance with Benkraiem et al. (2009) which show that the stock prices of the clubs are expected to decrease after a defeat as well as after a draw, but the latter to a lesser extent. Although our analysis did not find the results for wins to be statistically significant for the Single Sample Wilcoxon Signed-Rank, there is a clear asymmetry between these results, indicating that victories lead to a higher impact than losses. This finding is consistent with Scholtens & Peenstra's (2009) explanation that this might be due to 1) asymmetric response, meaning that the market's reaction to certain events (in this case, victories, and defeats) is not proportional or equal, with the market reacting more strongly to defeats than to victories, 2) sensitivity to losses, which states that people, and more specifically investors, tend to be more sensitive to losses than to gains, and 3) asymmetric results and returns, that is, the actual outcomes and returns themselves are inherently asymmetric.

For both national and international competitions, the latter would be expected to have a greater absolute impact than the former due to the extremely high prize money of the Champions League and the Europa League, as well as the prestige of winning games in these competitions. Reis (2011) revealed that international competition victories had a greater impact on stock prices compared to national victories. In contrast, our study observed the opposite trend for victories, with national having a greater effect than international victories. For draws, international games also exhibit a lower effect in the stock prices. It is important to note that victories and draws lack statistical significance for the difference in the results, meaning it could be due to chance rather than a reliable pattern. Although not in line with our hypothesis, this may be because national games have a stronger emotional connection and support from the local fan base, and thus wins and draws in these matches may be perceived as more significant by domestic fans, leading to increased enthusiasm and potentially more positive sentiment in the stock market. On the other hand, our results for defeats align with Scholtens & Peenstra (2009) who found that European defeats lead to higher stock price declines than national ones, although our results are not statistically significant.

Moreover, this analysis on the impact of goal difference on stock prices is consistent with the findings of Galloppo & Boido (2020). Victories by a greater goal margin have a greater effect on stock prices than games with a smaller goal difference, while losses by a larger margin result in a slightly bigger decrease in stock prices compared to games with a smaller difference in goals, although the results were not statistically significant. This behavior can be attributed to the idea that a decisive victory

demonstrates superior performance, which may enhance investor confidence and positively influence the stock market's perception of the club's financial prospects. This consistency across studies strengthens the validity of these observations and reinforces the premise that goal difference is an important factor in understanding the relationship between football performance and stock prices.

Finally, the analysis of the period before COVID-19 and during the pandemic revealed that winning in both periods raises a club's AAR, and this effect is even more pronounced during the COVID-19 period, suggesting that the market highly values winning performances, particularly in challenging circumstances. Draws, historically considered less favorable results, exhibited a shift in perception during the pandemic. They began to positively affect AAR, indicating a need to reassess their market importance. Despite a modest impact, the negativity linked to draws decreased, reflecting a nuanced response in the distinct context of COVID-19. Lastly, defeats consistently had an adverse effect on AAR, aligning with prior expectations. This pattern remained stable across the two periods, reflecting a consistent market sentiment towards losses, but decreased its effect during the pandemic. Nevertheless, the results did not demonstrate a statistically significant correlation with AAR.

5.2. FUTEBOL CLUBE DO PORTO

Unlike Floros (2014), where no effects were reported for FCP since the AAR after the games are approximately zero, this study found that defeats and draws negatively influence the club’s stock prices. However, although wins have a positive effect, this might be due to randomness or chance, as the values were not significant. On the other hand, Ribeiro (2001) and Godinho & Cerqueira (2018), found that the results of FCP were not significant for all match results.

Moreover, our results for FCP align with Carrilho et al. (2015) for victories and defeats, since the unexpected component of international games was higher than in national games, implying that the unexpected component of a European game should affect stock price returns to a greater extent than the unexpected component of a national competition. Nonetheless, this result was not statistically significant for defeats. An interesting finding was that international draws have an effect on FCP shares, however based on the value closer to 0 from the average abnormal returns, this effect might be really small. This could be attributed to the context of international tournaments where draws often occur during group stages, and their impact on a team's progression or market perception might be relatively limited at that stage of the competition.

There is a negative effect on FCP's stock prices in games where FCP loses by more than 3 goals. Conversely, in games where FCP wins by more than 3 goals, there is no significant change in the stock prices. Although these results could be due to chance since they were not found to be statistically

significant, it could also be since FCP is not a club that loses by such a difference so frequently, which might trigger negative sentiment among investors who act upon it.

Despite observed alterations in market sentiment during the pandemic, the absence of statistical significance prevents a firm link between these shifts and the pandemic's direct influence on the football club's stock prices. For instance, the effect of draws on the stock prices decreased during the COVID-19 pandemic, and the effect of victories on stocks remained consistent over the two periods. In contrast, during COVID-19, a defeat resulted in a decrease in FCP's stock price the day after the match.

5.3. SPORTING CLUBE DE PORTUGAL

Interestingly, SCP stock prices are impacted to a greater extent by draws than by defeats, diverging from the aggregate sample and causing a decline in stock price in both scenarios. Victories lead to an increase in stock prices, albeit less than losses and draws, displaying asymmetric results. Our study yields comparable results to those of N. Godinho & Teixeira (2021), although they differ in the significance of the outcomes, since, in the former, only wins are insignificant, while in the latter, neither result is significant. However, our findings differ from those of Pinto & Gonçalves (2012), as no evidence of a relationship between stock prices and match outcome was found.

Unlike FCP, the results of SCP for the difference between national and international games lack significance for all results, therefore it is inconclusive whether a differentiated effect exists between the two categories. Yet, the results also reveal that victories might lead to an increase or decrease in the stock price, depending on whether the game is national or international, but with a higher effect for national matches. This result is intriguing, as it contradicts earlier studies, where both international and national victories have a positive effect on SCP stocks, with the international impact being statistically significant. Furthermore, evidence was also found that international draws might have a lower impact on SCP stock prices, compared to international. On the other hand, aligned with our hypothesis, international defeats are more relevant for investors, since they have a greater impact on the club's stocks, when compared to national.

Furthermore, SCP's analysis of the impact of victories and defeats with a significant goal difference also yields intriguing findings. Specifically, larger goal differences in victories translate into a larger stock reaction by SCP as expected, but a defeat by fewer goals equates to a higher decrease in stock prices. It can be stated that investors become enthusiastic when SCP has a big win which is in line with the study conducted by Galloppo & Boido's (2020) on several clubs including SCP, since it is evidence of

the team's good form. However, given that the results are not significant, it cannot be concluded that there is a causal relationship between the number of goals scored and the stock price for SCP.

This study found sufficient evidence of a significant difference in the effect of games on the stock prices of SCP before and during COVID-19 for defeats only, with a lower effect of defeats on SCP stock prices during COVID-19. However, although not significant, it is worth noting the high positive effect on SCP prices following a draw during COVID-19, which is typically associated with wins, although also not significant. Moreover, there is evidence of a potentially high increase in the positive effect of victories during COVID-19, although this could be by chance rather than a causal relationship.

5.4. SPORT LISBOA E BENFICA

This study reinforces Russo's (2019) findings that an SLB victory leads to a positive investor reaction, whereas an SLB defeat or draw causes a deterioration in investor sentiment. Notably, in contrast to the previous study that deemed ties insignificant, in this case, ties hold significance, but wins do not. Therefore, investors seeking to forecast the market should only take into account losses and ties.

When considering the numerical variations of both national and international competitions on SLB's stock prices, it is anticipated that the day after an international defeat or draw, the stock price will fall more than on the day after a national defeat or draw. However, the different impact on the match's outcome was not found statistically significant and thus we cannot confidently assert a clear distinction in stock price reaction between international outcomes compared to national ones. So, Carrilho et al. (2015) conclusions that for SLB the hypothesis asserting that a European game would have a greater impact on stock prices compared to a domestic game is not supported by the results of this study. However, evidence of a higher returns after international defeats and ties was found, as well as lower returns for international victories. In contrast, Russo (2019) found that both international and national victories are significant, which differs from this study's findings, since for neither was found the evidence of an impact on the market price of SLB stocks. Results might differ as the study utilized the same technique but over a period of only three years.

When analyzing the results for victories with a larger goal difference, the results are similar to SCP. Victories by more than 3 goals showed higher positive effects on stocks whereas defeats by less than 3 goals had higher negative effects. It's worth noting that these effects, although interesting, did not reach a level of statistical significance in our analysis. This suggests there may be additional factors at play in how match outcomes relate to stock market performance.

Lastly, the pandemic's impact on market sentiment in relation to SLB has been apparent, with numerical differences observed between the two periods. In fact, all match outcomes affected less SLB

stocks during COVID-19, with victories influencing stock prices positively and draws and defeats negatively. However, tests conducted failed to provide certainty on whether these differences are significant and thus require further study.

6. CONCLUSIONS AND FUTURE WORKS

This research study analyzed the relationship between the 3249 match results of four Portuguese football clubs as an aggregate and their impact on their stock price, with the largest dataset ever used for Portuguese clubs to the best of our knowledge. The study also takes into account both international and national competitions, goal difference, and whether the game took place before or during COVID-19, over 16 seasons. Additionally, an analysis of individual clubs was conducted from their first quoted season to the 2022/2023 season. The method chosen was the event study, and the Sign and Single Sample Wilcoxon Signed-Ranks were chosen to give robustness to the results, as well as the Wilcoxon Sum-Rank Test.

Firstly, it was concluded that defeats or ties lead to lower returns for Portuguese football clubs on the day following their matches, supporting previous findings by Benkraiem et al. (2009) and Demir & Danis (2011) that game outcomes do indeed affect club's stock prices, as opposed to the conclusions of Soana et al. (2022). These results apply to all clubs but are more pronounced for SLB. Although victories were not found to be statistically significant, asymmetric returns were also found, as in Scholtens & Peenstra (2009), with victories leading to lower increases, followed by ties and defeats. Only for SCP, this order is different, with ties having a higher impact than the other two match outcomes.

Secondly, the only statistically relevant finding was that FCP victories have a greater effect on its stock prices in international competitions compared to national ones. This may suggest that stakeholders perceive international victories as having a higher value, perhaps due to the associated increased visibility, prestige, or market expansion. Although the following conclusions lack significance, for the rest of the clubs, national victories caused a higher effect on stock prices than international ones. Furthermore, our study found evidence to corroborate with Reis (2011) claim that international defeats are more prejudicial for the clubs' stocks than national defeats, although the returns for all clubs following defeats were not significant, suggesting there may not be a causal effect and could be coincidental.

Moreover, our findings for the third hypothesis were inconclusive since our results were not statistically significant. However, when considering only the average abnormal returns and the sample with all clubs, it echoes the work of Galloppo and Boido (2020), highlighting that defeats with a significant goal difference strongly influence stock prices. However, those results do not apply to SCB and SLB, where there is evidence of moderate defeats having a greater impact on their stock prices. For victories, the evidence points to the matches with more than three goals having a higher positive effect on the market perception. This underscores that might be relevant for short-term investors to

consider the day after a victory a good time to sell Portuguese club's stocks, although more studies should be conducted to understand the impact of this variable.

Lastly, the fourth hypothesis presents statistical evidence that during COVID-19, defeats affected less SCP stock prices. Although the rest of the results did not present statistical evidence of the differences between the COVID-19 and the pre-COVID-19 periods not being by chance, evidence based on the abnormal returns results show that during the COVID-19 pandemic, there was a noticeable shift in the impact of match results on stock prices. Specifically, victories influenced more stock prices during the pandemic, except for SLB. Furthermore, defeats decreased their negative effect, except for FCP. And finally, ties had a positive effect on stocks for SCP and for the sample of the four clubs and decreased their negative impact for FCP and SLB. In general, this implies that markets were less sensitive to defeats and draws during the pandemic but demonstrated increased sensitivity to victories.

This study has limitations as it does not account for other variables that may potentially impact the stock prices of football clubs, such as management decisions or sponsorship deals. Additionally, the limited number of clubs quoted on the Lisbon Stock Exchange (only 4 compared to the 18 clubs in the Portuguese first league) further limits the generalizability of the findings.

A relevant study for future development would be to analyze the COVID-19 variable for a larger dataset of European clubs in order to draw more conclusive findings about this variable. Furthermore, in a few years, it would be interesting to analyze the post-pandemic period to assess whether there were changes in the impact of matches on club share prices. In addition, it would also be worthwhile to examine not only the price response, but also any fluctuations in the volume of shares traded for the club.

BIBLIOGRAPHICAL REFERENCES

Antoniou, C., Doukas, J. A., & Subrahmanyam, A. (2013). Cognitive Dissonance, Sentiment, and Momentum. *The Journal of Financial and Quantitative Analysis*, *48*(1), 245–275.

Baker, M., & Wurgler, J. (2006). Investor Sentiment and the Cross-Section of Stock Returns. *The Journal of Finance*, *61*(4), 1645–1680.

Baker, M., & Wurgler, J. (2007). Investor Sentiment in the Stock Market. *The Journal of Economic Perspectives*, *21*(2), 129–151.

Baur, D. G., & McKeating, C. (2021). Do Football Clubs Benefit from Initial Public Offerings? *International Journal of Sports Finance*, *6*(1), 40–59. https://www.webofscience.com/wos/woscc/full-record/WOS:000287831400003

Bell, A. R., Brooks, C., Matthews, D., & Sutcliffe, C. (2012). Over the moon or sick as a parrot? The effects of football results on a club's share price. *Applied Economics*, *44*(26), 3435–3452. https://doi.org/10.1080/00036846.2011.577017

Benkraiem, R., Louhichi, W., & Marques, P. (2009a). Market reaction to sporting results. *Management Decision*, *47*(1), 100–109. https://doi.org/10.1108/00251740910929722

Benkraiem, R., Louhichi, W., & Marques, P. (2009b). Market reaction to sporting results: The case of European listed football clubs. *Management Decision*, *47*(1), 100–109. https://doi.org/10.1108/00251740910929722

Berkowitz, J. P., & Depken, C. A. (2018). A rational asymmetric reaction to news: evidence from English football clubs. *Review of Quantitative Finance and Accounting*, *51*(2), 347–374. https://doi.org/10.1007/S11156-017-0673-6

Brown, G. W., & Hartzell, J. C. (2001). Market reaction to public information: The atypical case of the Boston Celtics. *Journal of Financial Economics*, *60*(2–3), 333–370. https://doi.org/10.1016/S0304-405X(01)00047-2

Bruno Roseiro. (2021). *Vieira comunica ao Benfica que quer vender 3,28% da SAD por quase seis milhões (mas não diz quem será o comprador)*. https://observador.pt/2021/09/07/vieira-comunica-ao-benfica-que-quer-vender-328-da-sad-por-quase-seis-milhoes-mas-nao-diz-quem-sera-o-comprador/

Campbell, J. Y., Lo, A. W. (Andrew W.-C., & MacKinlay, A. C. (1997). *The econometrics of financial markets*. Princeton University Press.

Cao, M., & Wei, J. (2005). Stock market returns: A note on temperature anomaly. *Journal of Banking and Finance*, *29*(6), 1559–1573. https://doi.org/10.1016/J.JBANKFIN.2004.06.028

Carrilho, J., José Carlos Dias, D., & José Dias Curto, D. (2015). *Stock market returns and football match results*.

Da, Z., Engelberg, J., & Gao, P. (2015). The Sum of All Fears Investor Sentiment and Asset Prices. *The Review of Financial Studies*, *28*(1), 1–32. https://doi.org/10.1093/rfs/hhu072

Deloitte. (2023). *2023 sports industry outlook*.

Demir, E., & Danis, H. (2011). The effect of performance of soccer clubs on their stock prices: Evidence from Turkey. *Emerging Markets Finance and Trade*, *47*(SUPPL. 4), 58–70. https://doi.org/10.2753/REE1540-496X4705S404

Duque, J. L., & Ferreira, N. A. (2005). Explaining Share Price Performance of Football Clubs Listed on the Euronext Lisbon. *SSRN Electronic Journal*. https://doi.org/10.2139/SSRN.675633

Edmans, A., García, D., & Norli, Ø. (2007). Sports Sentiment and Stock Returns. *The Journal of Finance*, *62*(4), 1967–1998. https://doi.org/10.1111/j.1540-6261.2007.01262.x

Fábio Carvalho da Silva. (2022). *Ações da SAD do Braga valorizam com entrada da Qatar Sports Investments*. https://www.jornaldenegocios.pt/empresas/desporto/detalhe/e-oficial-2167-da-sad-do-braga-ja-passaram-para-a-qatar-sports-investments

Fama, E. F. (1991). Efficient Capital Markets: II. *The Journal of Finance*, *46*(5), 1575–1617. https://doi.org/10.1111/J.1540-6261.1991.TB04636.X

Floros, C. (2014). Football and Stock Returns: New Evidence. *Procedia Economics and Finance*, *14*, 201–209. https://doi.org/10.1016/S2212-5671(14)00703-5

Galloppo, G., & Boido, C. (2020). How much is a goal in the football championship worth? Match results and stock price reaction. *International Journal of Sport Finance*, *15*(2), 83–92. https://doi.org/10.32731/IJSF/152-052020.03

Godinho, N., & Teixeira, N. (2021). *Impacto dos resultados desportivos na rendibilidade das ações do Sporting Clube de Portugal*. Instituto Politécnico de Setúbal.

Godinho, P., & Cerqueira, P. (2018). The Impact of Expectations, Match Importance, and Results in the Stock Prices of European Football Teams. *Journal of Sports Economics*, *19*(2), 230–278. https://doi.org/10.1177/1527002515626222

Goetzmann, W. N., Kim, D., Kumar, A., & Wang, Q. (2015). Weather-Induced Mood, Institutional Investors, and Stock Returns. *The Review of Financial Studies*, *28*(1), 73–111. https://doi.org/10.1093/rfs/hhu063

Graham, J. R., Harvey, C. R., & Huang, H. (2009). Investor Competence, Trading Frequency, and Home Bias. *Management Science*, *55*(7), 1094–1106. https://doi.org/10.1287/mnsc.l090.1009

Hirshleifer, D. (2015). Behavioral Finance. *Annual Review of Financial Economics*, *7*, 133–159. https://doi.org/10.1

Huberman, G., & Regev, T. (2001). Contagious speculation and a cure for cancer: A nonevent that made stock prices soar. *Journal of Finance*, *56*(1), 387–396. https://doi.org/10.1111/0022-1082.00330

Kaplanski, G., & Levy, H. (2010a). Exploitable predictable irrationality: The FIFA world cup effect on the U.S. stock market. *Journal of Financial and Quantitative Analysis*, *45*(2), 535–553. https://doi.org/10.1017/S0022109010000153

Kaplanski, G., & Levy, H. (2010b). Sentiment and stock prices: The case of aviation disasters. *Journal of Financial Economics*, *95*(2), 174–201. https://doi.org/10.1016/J.JFINECO.2009.10.002

Kaustia, M., & Rantapuska, E. (2016). Does mood affect trading behavior? *Journal of Financial Markets*, *29*, 1–26. https://doi.org/10.1016/j.finmar.2015.08.001

Klein, C., Zwergel, B., & Heiden, S. (2009). On the existence of sports sentiment: The relation between football match results and stock index returns in Europe. *Review of Managerial Science*, *3*(3), 191–208. https://doi.org/10.1007/S11846-009-0031-8

Leach, S., & Szymanski, S. (2015). Making money out of football. *Scottish Journal of Political Economy*, *62*(1), 25–50. https://doi.org/10.1111/SJPE.12065

Liga Portugal Bwin - Dados e factos para todos os clubes | Transfermarkt. (n.d.). Retrieved February 19, 2023, from https://www.transfermarkt.pt/liga-portugal-bwin/daten/wettbewerb/PO1

Mackinlay, A. C. (1997). Event Studies in Economics and Finance. *Source: Journal of Economic Literature*, *35*(1), 13–39.

Marcelo, O. (2022). *Impacto dos Resultados Desportivos na Rendibilidade das Ações de Clubes Europeus*.

Palomino, F., Renneboog, L., & Zhang, C. (2009). Information salience, investor sentiment, and stock returns: The case of British soccer betting. *Journal of Corporate Finance*, *15*(3), 368–387. https://doi.org/10.1016/j.jcorpfin.2008.12.001

Pinto, C., & Gonçalves, R. (2012). *Impacto dos resultados desportivos dos principais clubes de futebol nacional nas suas cotações no mercado de capitais*. Universidade Nova de Lisboa.

Rankings do país | Coeficientes da UEFA | UEFA.com. (n.d.). Retrieved February 19, 2023, from https://pt.uefa.com/nationalassociations/uefarankings/country/#/yr/2022

Reis, P. M. C. dos. (2011). *Impacto dos resultados desportivos nas rendibilidades das acções dos clubes portugueses de futebol cotados em bolsa*. Universidade Técnica de Lisboa, ISEG.

Renneboog, L., Vanbrabant, P., & Europe, D. (2000). *Share price reactions to sporty performances of soccer clubs listed on the London Exchange and the AIM*.

Ribeiro, S. C. A. (2001). *Sociedades anónimas desportivas : uma abordagem pela teoria financeira*. https://www.repository.utl.pt/handle/10400.5/25092

Russo, Z. M. M. (2019). *Impacto dos resultados desportivos na rendibilidade das ações das SAD portuguesas: o caso da Benfica SAD*. Instituto Politécnico de Setúbal, Escola Superior de Ciências Empresariais.

Santos, G., & Silva, P. (2021). *Impacto dos resultados desportivos nas cotações das ações dos clubes portugueses e italianos*. Universidade da Beira Interior.

Scholtens, B., & Peenstra, W. (2009). Scoring on the stock exchange? The effect of football matches on stock market returns: An event study. *Applied Economics*, *41*(25), 3231–3237. https://doi.org/10.1080/00036840701721406

Serra, J. M. V. (2021). *A influência do desempenho desportivo e económico-financeiro das SAD dos Clubes Sport Lisboa e Benfica, Futebol Clube do Porto, Sporting Clube de Portugal e Sporting Clube de Braga na taxa de rentabilidade das suas ações na Bolsa de Valores*. Universidade de Évora, Escola de Ciências Sociais.

Shefrin, H., & Statman, M. (1994). Behavioral Capital Asset Pricing Theory. *The Journal of Financial and Quantitative Analysis*, *29*(3), 323. https://doi.org/10.2307/2331334

Škrinjarić, T., & Barišić, P. (2019). Effects of Football Match Results of Croatian National Team on Stock Returns: Evidence from Zagreb Stock Exchange. *Zagreb International Review of Economics and Business*, *22*(1), 13–45. https://doi.org/10.2478/ZIREB-2019-0010

Soana, M. G., Lippi, A., & Rossi, S. (2022). Do financial markets price UEFA Champions League competition events? *EuroMed Journal of Business*. https://doi.org/10.1108/EMJB-09-2021-0134

Spann, M., & Skiera, B. (2009). Sports forecasting: A comparison of the forecast accuracy of prediction markets, betting odds and tipsters. *Journal of Forecasting*, *28*(1), 55–72. https://doi.org/10.1002/FOR.1091

Stadtmann, G., Weigand, J., & Wissmann, M. (2004). Borussia Dortmund draws criticism. *Sport Und Gesellschaft*, *1*(2), 145–164. https://doi.org/10.1515/SUG-2004-0204

Teixeira, N., Russo, Z., & Brites, R. (2020). Impact of sports results on the profitability of Portuguese SAD shares: the case of Benfica SAD. *Revista Científica Da Escola Superior de Gestão de Idanha-a-Nova Gestin n.º 20/21*, 155–173.

Vitória sportinguista influencia a Bolsa – RTP Arquivos. (2000). https://arquivos.rtp.pt/conteudos/vitoria-sportinguista-influencia-a-bolsa/

APPENDIX A

Top 20 of the most citated articles per year

#	Title	Authors	Citations	Citation/ Year	Year	Source Tittle
1	Investor Sentiment and the Cross-Section of Stock Returns	Baker & Wurgler (2006)	6484	381	2006	The Journal of Finance
2	Efficient Capital Markets: II	Fama (1991)	10286	321	1991	The Journal of Finance
3	Event Studies in Economics and Finance	Mackinlay (1997)	7753	298	1997	Source: Journal of Economic Literature
4	Investor Sentiment in the Stock Market	Baker & Wurgler (2007)	4201	263	2007	The Journal of Economic Perspectives
5	The Sum of All FEARS Investor Sentiment and Asset Prices	Da et al. (2015)	1188	149	2015	The Review of Financial Studies
6	Sports sentiment and stock returns	Edmans et al.(2007)	1344	84	2007	Journal of Finance
7	Behavioral Finance	Hirshleifer (2015)	545	68	2015	Annual Review of Financial Economics
8	Investor Competence, Trading Frequency, and Home Bias	Graham et al. (2009)	840	60	2009	Management Science
9	Contagious speculation and a cure for cancer: A nonevent that made stock prices soar	Huberman & Regev (2001)	1127	51	2001	Journal of Finance
10	Cognitive Dissonance, Sentiment, and Momentum	Antoniou et al. (2013)	485	49	2013	The Journal of Financial and Quantitative Analysis
11	Sentiment and stock prices: The case of aviation disasters	Kaplanski & Levy (2010)	607	47	2010	Journal of Financial Economics
12	Stock market returns: A note on temperature anomaly	(Cao & Wei, 2005)	671	37	2005	Journal of Banking and Finance
13	Weather-Induced Mood, Institutional Investors, and Stock Returns	Goetzmann et al. (2015)	272	34	2015	The Review of Financial Studies
14	Behavioral Capital Asset Pricing Theory	Shefrin & Statman (1994)	860	30	1994	The Journal of Financial and Quantitative Analysis
15	Do Football Clubs Benefit from Initial Public Offerings?	Baur & McKeating (2021)	45	23	2021	INTERNATIONAL JOURNAL OF SPORT FINANCE
16	Making money out of football	Leach & Szymanski (2015).	140	18	2015	Scottish Journal of Political Economy
17	Sports forecasting: A comparison of the forecast accuracy of prediction markets, betting odds and tipsters	Spann & Skiera (2009)	214	15	2009	Journal of Forecasting
18	Information salience, investor sentiment, and stock returns: The case of British soccer betting	(Palomino et al. (2009)	212	15	2009	Journal of Corporate Finance
19	Does mood affect trading behavior?	Kaustia & Rantapuska (2016)	105	15	2016	Journal of Financial Markets
20	Exploitable predictable irrationality: The FIFA world cup effect on the U.S. stock market	(Kaplanski & Levy (2010b)	193	15	2010	Journal of Financial and Quantitative Analysis

APPENDIX B

Python code for web scrapping for SLB match data in ZeroZero

```
import requests
import pandas as pd
from bs4 import BeautifulSoup

# Create an empty list to store the data.
data = []

# Loop through the seasons from 1990 to 2022.
for season_id in range(120, 152):
    # Send an HTTP request to the URL of the webpage you want to access for the
current season.
    url =
f"https://www.zerozero.pt/team_matches.php?grp=1&ond=&epoca_id={season_id}&compet_i
d_jogos=0&ved=&id=4&equipa_1=4&menu=allmatches&type=season&op=ver_confronto"
    response = requests.get(url)

    # Parse the HTML content using BeautifulSoup.
    soup = BeautifulSoup(response.content, 'html.parser')

    # Find the table element in the HTML content and extract the table rows with
class "parent".
    rows = soup.select('table.zztable.stats tr.parent')

    # Loop through the table rows, extract the cell values, and append them to the
data list.
    for row in rows:
        cells = row.find_all('td')
        values = [cell.text.strip() for cell in cells]
        data.append(values)

# Create a pandas DataFrame from the data list.
df = pd.DataFrame(data, columns=['h2h', 'date', 'empty', 'competition', 'opponent',
'result', 'season', 'matchday', 'h2h_link'])

# Remove the "empty" column.
df = df.drop('empty', axis=1)

# Save the DataFrame to an Excel file.
df.to_excel('BENFICA_1990_2022.xlsx', index=False)

# Print the DataFrame.
print(df)
```

APPENDIX C

Match data for each outcome, sample, and hypothesis

		ALL	FCP	SCP	SLB
V	H1	2004	846	700	556
	H2 National	1734	739	622	474
	H2 International	270	107	78	82
	H3 Moderate	1425	573	528	381
	H3 Dominant	579	273	172	175
	H4 pre-COVID-19	1566	723	593	445
	H4 COVID-19	438	123	107	111
D	H1	639	208	250	134
	H2 National	433	124	176	78
	H2 International	206	84	74	56
	H3 Moderate	558	188	215	119
	H3 Dominant	81	20	35	15
	H4 pre-COVID-19	521	185	224	107
	H4 COVID-19	118	23	26	27
T	H1	606	227	243	154
	H2 National	466	165	200	165
	H2 International	140	62	43	43
	H4 pre-COVID-19	490	200	218	118
	H4 COVID-19	116	27	25	36

APPENDIX D

R code for the aggregate sample

```
# SECTION 1: Install and Load Packages

# Install required packages
install.packages("dplyr")
install.packages("readxl")
install.packages("lubridate")
install.packages("zoo")
install.packages("timeDate")
install.packages("bizdays")
install.packages("openxlsx")
install.packages("psych")
install.packages("ggplot2")
install.packages("writexl")

library(bizdays)
library(timeDate)
library(dplyr)
library(readxl)
library(lubridate)
library(zoo)
library(dplyr)
library(tidyr)
library(openxlsx)
library(psych)
library(ggplot2)
library(writexl)

# Set working directory
setwd("C:/Users/User/Downloads")

# SECTION 2: Read Data and Additional Processing
eventdates <- read_excel("Event_dates_total.xlsx")
stockdata <- read_excel("stockdata.xlsx")

# Convert date columns to appropriate format
stockdata$date <- as.Date(stockdata$date)
eventdates$event_date <- as.Date(eventdates$event_date)

# Sort the dataset by company_id
eventdates <- eventdates[order(eventdates$company_id), ]

# Extract the day of the week and create a new column 'weekday' in the 'eventdates'
dataframe
eventdates <- eventdates %>% mutate(weekday = weekdays(event_date))
```

```r
# Sort the dataset by company_id
eventdates <- eventdates[order(eventdates$company_id), ]

# Update event dates for Saturdays (previous day) and Sundays (two days before)
eventdates$new_event_date <- eventdates$event_date
eventdates$new_event_date[eventdates$weekday == "sábado"] <-
eventdates$event_date[eventdates$weekday == "sábado"] - 1
eventdates$new_event_date[eventdates$weekday == "domingo"] <-
eventdates$event_date[eventdates$weekday == "domingo"] - 2

# SECTION 3: Descriptive Statistics and Outliers
describe(eventdates)
summary(eventdates)
missing_values <- colSums(is.na(eventdates))
print(missing_values)

# Check outliers for specific columns
boxplot.stats(eventdates$goal_difference)
boxplot.stats(eventdates$Month)
boxplot.stats(eventdates$Year)

# Create a boxplot for goal difference
ggplot(eventdates, aes(x = "", y = goal_difference)) +
  geom_boxplot(fill = "#BED62F", color = "black", alpha = 0.7) +
  labs(title = "Boxplot of Goal Difference", x = NULL, y = "Goal Difference") +
  theme_minimal()

# Frequency Tables and Bar Plots
categorical_vars <- c("weekday", "result", "type", "Month", "Year", "Home/Away",
"opponent", "result_detailed",
                      "location", "season", "Covid", "home_team", "away_team",
"goal_difference")

lapply(categorical_vars, function(var) print(table(eventdates[[var]])))

# Create a bar plot for the frequency of events by weekday
ggplot(data = data.frame(weekday = factor(eventdates$weekday)), aes(x = weekday)) +
  geom_bar(fill = "#BED62F", color = "black") +
  labs(title = "Frequency of Events by Weekday", x = "Weekday", y = "Frequency") +
  theme_minimal()

# Section 6: Outliers for Stock Price Data
describe(stockdata)
boxplot.stats(stockdata$price)
boxplot.stats(stockdata$ret)

# Create a boxplot for stock price
ggplot(stockdata, aes(x = "", y = price)) +
```

```
  geom_boxplot(fill = "#BED62F", color = "black", alpha = 0.7) +
  labs(title = "Boxplot of Price", x = NULL, y = "Price") +
  theme_minimal()

# SECTION 4: Data Replication and Event Window Preparation

# Generate the eventcount variable
eventdates$eventcount <- ave(eventdates$company_id, eventdates$company_id, FUN =
length)

# Keep only one observation per company
eventcount <- eventdates[!duplicated(eventdates$company_id), ]

# Sort the dataset by company_id
eventcount <- eventcount[order(eventcount$company_id), ]

# Keep only the company_id and eventcount variables
eventcount <- eventcount[, c("company_id", "eventcount")]

# Save the eventcount dataset
write.csv(eventcount, "eventcount_crsp_FCP.csv", row.names = FALSE)
eventcount_crsp <- read.csv("eventcount_crsp_FCP.csv")

# Merge the eventcount_crsp dataset with stockdata dataset
merged_data <- merge(stockdata, eventcount, by = "company_id", all.x = TRUE)

# Keep only the matched observations
merged_data <- merged_data[!is.na(merged_data$eventcount), ]

# Replicate observations based on eventcount
replicated_data <- merged_data[rep(row.names(merged_data), merged_data$eventcount),
]

# Generate the 'set' variable

replicated_data <- replicated_data %>%
  group_by(company_id, date) %>%
  mutate(set = row_number()) %>%
  ungroup()

# Save the modified dataset
write.csv(replicated_data, "stockdata2_crsp_FCP.csv", row.names = FALSE)
stockdata2_crsp <- read.csv("stockdata2_crsp_FCP.csv")

# Sort the eventdates dataset by company_id
eventdates <- eventdates %>%
  arrange(company_id)

# Create the 'set' variable within each company
```

```
eventdates <- eventdates %>%
  group_by(company_id) %>%
  mutate(set = row_number())

# Save the updated eventdates dataset
write.csv(eventdates, "eventdates2_crsp_FCP.csv", row.names = FALSE)
eventdates2_crsp <- read.csv("eventdates2_crsp_FCP.csv")

# Merge stock data with event dates using 'company_id' and 'set' variables
stockdata2_crsp <- merge(replicated_data, eventdates2_crsp, by = c("company_id",
"set"), all.x = TRUE)

# Check which companies' stock information is missing
missing_companies <- stockdata2_crsp$company_id[stockdata2_crsp$eventcount == 0]
print(missing_companies)

# Create the 'group_id' variable
stockdata2_crsp <- stockdata2_crsp %>%
  mutate(group_id = paste(company_id, set, sep = "_"))

# Filter out rows without an event date value
stockdata2_crsp <- stockdata2_crsp %>%
  filter(!is.na(event_date))

# Sort the dataset by group_id and date
stockdata2_crsp <- stockdata2_crsp %>% arrange(group_id, date)

# Convert the 'new_event_date' column to Date format
stockdata2_crsp$new_event_date <- ymd(stockdata2_crsp$new_event_date)

# Convert the 'date' column to Date format
stockdata2_crsp$date <- as.Date(stockdata2_crsp$date)

# Sort the data frame by group_id and date
stockdata2_crsp <- stockdata2_crsp[order(stockdata2_crsp$group_id,
stockdata2_crsp$date), ]

# Generate the 'datenum' variable within each group_id group
stockdata2_crsp <- within(stockdata2_crsp, datenum <- ave(seq_along(group_id),
group_id, FUN = seq_along))

# Generate the 'target' variable within each group_id group based on
date==event_date
stockdata2_crsp <- within(stockdata2_crsp, target <- ifelse(date == new_event_date,
datenum, NA))

# Calculate the minimum value of 'target' within each group_id group using 'td'
stockdata2_crsp <- transform(stockdata2_crsp, td = ave(target, group_id, FUN =
function(x) min(x, na.rm = TRUE)))
```

```
# Drop the 'target' variable
stockdata2_crsp <- subset(stockdata2_crsp, select = -target)

# Generate the 'dif' variable as the difference between 'datenum' and 'td'
stockdata2_crsp <- within(stockdata2_crsp, dif <- datenum - td)

# SECTION 5: Abnormal Returns Calculation and Analysis

# Generate the 'datenum' variable within each group_id group
stockdata2_crsp <- within(stockdata2_crsp, datenum <- ave(seq_along(group_id),
group_id, FUN = seq_along))

# Generate the 'target' variable within each group_id group based on
date==event_date
stockdata2_crsp <- within(stockdata2_crsp, target <- ifelse(date == new_event_date,
datenum, NA))

# Calculate the minimum value of 'target' within each group_id group using 'td'
stockdata2_crsp <- transform(stockdata2_crsp, td = ave(target, group_id, FUN =
function(x) min(x, na.rm = TRUE)))

# Drop the 'target' variable
stockdata2_crsp <- subset(stockdata2_crsp, select = -target)

# Generate the 'dif' variable as the difference between 'datenum' and 'td'
stockdata2_crsp <- within(stockdata2_crsp, dif <- datenum - td)

# Create the event window (1 day after the event)
stockdata2_crsp$event_window <- ifelse(stockdata2_crsp$dif >= 1 &
stockdata2_crsp$dif <= 1, 1, 0)

# Count the number of event observations within each group_id
stockdata2_crsp$count_event_obs <- ave(stockdata2_crsp$event_window,
stockdata2_crsp$group_id, FUN = sum)

# Create the estimation window (250 days)
stockdata2_crsp$estimation_window <- ifelse(stockdata2_crsp$dif >= -251 &
stockdata2_crsp$dif < -1, 1, 0)

# Count the number of estimation observations within each group_id
stockdata2_crsp$count_est_obs <- ave(stockdata2_crsp$estimation_window,
stockdata2_crsp$group_id, FUN = sum)

# Create the 'predicted_return' variable and initialize it with missing values
stockdata2_crsp$predicted_return <- NA

# Generate the 'id' variable by grouping based on 'group_id'
stockdata2_crsp$id <- as.integer(factor(stockdata2_crsp$group_id))
```

```
# Loop over each unique 'id' value
for (i in unique(stockdata2_crsp$id)) {
  # Store the current 'id' and 'group_id' where 'id' matches the loop index
  curr_id <- stockdata2_crsp$id == i & stockdata2_crsp$dif == 0
  curr_group_id <- stockdata2_crsp$group_id[curr_id]

  # Run a regression within the estimation window for the current 'id'
  curr_estimation_window <- stockdata2_crsp$estimation_window == 1 &
stockdata2_crsp$id == i
  regression_model <- lm(ret ~ market_return, data =
stockdata2_crsp[curr_estimation_window, ])

  # Predict 'predicted_return' using the regression equation for the current 'id'
  curr_event_window <- stockdata2_crsp$event_window == 1 & stockdata2_crsp$id == i
  stockdata2_crsp$predicted_return[curr_event_window] <- predict(regression_model,
newdata = stockdata2_crsp[curr_event_window, ])
}
# Sort the dataset by 'id' and 'date'
stockdata2_crsp <- stockdata2_crsp %>% arrange(id, date)

# Calculate the abnormal return for observations within the event window
stockdata2_crsp$abnormal_return <- ifelse(stockdata2_crsp$event_window == 1,
                                          stockdata2_crsp$ret -
stockdata2_crsp$predicted_return,
                                          NA)

# Subset the data to show only abnormal returns rows
abnormal_returns <- stockdata2_crsp[!is.na(stockdata2_crsp$abnormal_return), ]
write.csv(abnormal_returns, "abnormal_returns_FCP.csv", row.names = FALSE)
abnormal_returns <- read.csv("abnormal_returns_FCP.csv")
write.xlsx(abnormal_returns, file = "abnormal_returns_FCP.xlsx")# Calculate the
abnormal returns (AR)

# Convert 'abnormal_return' to numeric
stockdata2_crsp$abnormal_return <- as.numeric(stockdata2_crsp$abnormal_return)

#SECTION 6: ABNORMAL RETURNS AND TESTS FOR EACH HYPOTHESIS

#HYPOTHESIS 1

# Subset the data for victories, defeats, and draws
victory_abnormal <- abnormal_returns[abnormal_returns$result == "V",
"abnormal_return"]
defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D",
"abnormal_return"]
tie_abnormal <- abnormal_returns[abnormal_returns$result == "E", "abnormal_return"]

# Calculate the average returns (AAR)
```

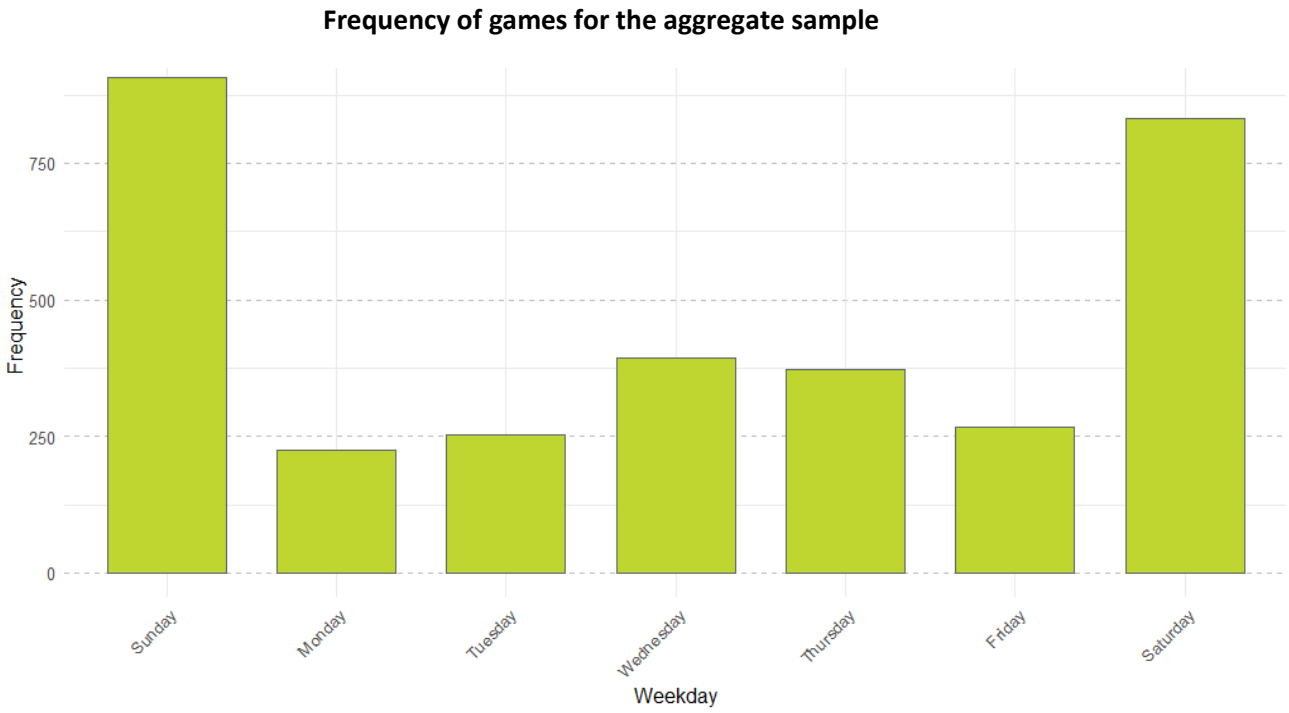
```
cat("Victory AAR:", mean(victory_abnormal), "\n")
cat("Defeat AAR:", mean(defeat_abnormal), "\n")
cat("Tie AAR:", mean(tie_abnormal), "\n")

# Sign Test
binom.test(sum(victory_abnormal > 0), length(victory_abnormal))
binom.test(sum(defeat_abnormal > 0), length(defeat_abnormal))
binom.test(sum(tie_abnormal > 0), length(tie_abnormal))

# Print Single Sample Wilcoxon Signed-Ranks for Victory, Defeat, and Tie in
Separate Lines
wilcox.test(victory_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(defeat_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(tie_abnormal, mu = 0, alternative = "two.sided")

#HYPOTHESIS 2

# Subset the data for international and national victories, defeats, and draws
int_victory_abnormal <- abnormal_returns[abnormal_returns$result == "V" &
abnormal_returns$location == "Abroad", "abnormal_return"]
int_defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D" &
abnormal_returns$location == "Abroad", "abnormal_return"]
int_tie_abnormal <- abnormal_returns[abnormal_returns$result == "E" &
abnormal_returns$location == "Abroad", "abnormal_return"]
nat_victory_abnormal <- abnormal_returns[abnormal_returns$result == "V" &
abnormal_returns$location == "Portugal", "abnormal_return"]
nat_defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D" &
abnormal_returns$location == "Portugal", "abnormal_return"]
nat_tie_abnormal <- abnormal_returns[abnormal_returns$result == "E" &
abnormal_returns$location == "Portugal", "abnormal_return"]

# Calculate the average abnormal returns (AAR)
cat("AAR for International Victories:", mean(int_victory_abnormal), "\n")
cat("AAR for International Defeats:", mean(int_defeat_abnormal), "\n")
cat("AAR for International Draws:", mean(int_tie_abnormal), "\n")
cat("AAR for National Victories:", mean(nat_victory_abnormal), "\n")
cat("AAR for National Defeats:", mean(nat_defeat_abnormal), "\n")
cat("AAR for National Draws:", mean(nat_tie_abnormal), "\n")

# Sign Test
binom.test(sum(nat_victory_abnormal > 0), length(nat_victory_abnormal))
binom.test(sum(nat_defeat_abnormal > 0), length(nat_defeat_abnormal))
binom.test(sum(nat_tie_abnormal > 0), length(nat_tie_abnormal))
binom.test(sum(int_victory_abnormal > 0), length(int_victory_abnormal))
binom.test(sum(int_defeat_abnormal > 0), length(int_defeat_abnormal))
binom.test(sum(int_tie_abnormal > 0), length(int_tie_abnormal))

# Single Sample Wilcoxon Signed-Rank
wilcox.test(nat_victory_abnormal, mu = 0, alternative = "two.sided")
```

```r
wilcox.test(nat_defeat_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(nat_tie_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(int_victory_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(int_defeat_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(int_tie_abnormal, mu = 0, alternative = "two.sided")

#Wilcoxon rank-sum test
wilcox.test(nat_victory_abnormal,int_victory_abnormal)
wilcox.test(nat_defeat_abnormal,int_defeat_abnormal)
wilcox.test(nat_tie_abnormal,int_tie_abnormal)

#HYPOTHESIS 3
abnormal_returns$goal_difference <- abs(abnormal_returns$goal_difference)

#Divide the set in moderate results and dominant results
moderate_victory_abnormal <- abnormal_returns[abnormal_returns$result == "V" &
abnormal_returns$goal_difference <3, "abnormal_return"]
moderate_defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D" &
abnormal_returns$goal_difference <3, "abnormal_return"]
dominant_victory_abnormal <- abnormal_returns[abnormal_returns$result == "V" &
abnormal_returns$goal_difference >=3, "abnormal_return"]
dominant_defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D" &
abnormal_returns$goal_difference >=3, "abnormal_return"]

# Calculate the average abnormal returns (AAR)
cat("Avg abnormal (moderate victory):",
mean(abnormal_returns$abnormal_return[abnormal_returns$result == "V" &
abnormal_returns$goal_difference < 3]),
    "| Avg abnormal (moderate defeat):",
mean(abnormal_returns$abnormal_return[abnormal_returns$result == "D" &
abnormal_returns$goal_difference < 3]),
    "| Avg abnormal (dominant victory):",
mean(abnormal_returns$abnormal_return[abnormal_returns$result == "V" &
abnormal_returns$goal_difference >= 3]),
    "| Avg abnormal (dominant defeat):",
mean(abnormal_returns$abnormal_return[abnormal_returns$result == "D" &
abnormal_returns$goal_difference >= 3]))


# Sign Test
binom.test(sum(moderate_victory_abnormal > 0), length(moderate_victory_abnormal), p
= 0.5, alternative = "two.sided")
binom.test(sum(moderate_defeat_abnormal > 0), length(moderate_defeat_abnormal), p =
0.5, alternative = "two.sided")
binom.test(sum(dominant_victory_abnormal > 0), length(dominant_victory_abnormal), p
= 0.5, alternative = "two.sided")
binom.test(sum(dominant_defeat_abnormal > 0), length(dominant_defeat_abnormal), p =
0.5, alternative = "two.sided")
```

```r
#Single Sample Wilcoxon Signed-Rank
wilcox.test(moderate_victory_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(moderate_defeat_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(dominant_victory_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(dominant_defeat_abnormal, mu = 0, alternative = "two.sided")

#Wilcoxon rank-sum test
wilcox.test(moderate_victory_abnormal, dominant_victory_abnormal)
wilcox.test(moderate_defeat_abnormal,dominant_defeat_abnormal)

#HYPOTHESIS 4

#Divide the set in COVID and PRE COVID results
Covid_victory_abnormal <- abnormal_returns[abnormal_returns$result == "V" &
abnormal_returns$Covid == "COVID", "abnormal_return"]
Covid_defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D" &
abnormal_returns$Covid == "COVID", "abnormal_return"]
Covid_tie_abnormal <- abnormal_returns[abnormal_returns$result == "E" &
abnormal_returns$Covid == "COVID", "abnormal_return"]
precovid_victory_abnormal <- abnormal_returns[abnormal_returns$result == "V" &
abnormal_returns$Covid == "PRE", "abnormal_return"]
precovid_defeat_abnormal <- abnormal_returns[abnormal_returns$result == "D" &
abnormal_returns$Covid == "PRE", "abnormal_return"]
precovid_tie_abnormal <- abnormal_returns[abnormal_returns$result == "E" &
abnormal_returns$Covid == "PRE", "abnormal_return"]

# Calculate the average abnormal returns (AAR)
cat("AAR for Covid Victories:", mean(Covid_victory_abnormal), "\n")
cat("AAR for Covid Defeats:", mean(Covid_defeat_abnormal), "\n")
cat("AAR for Covid Ties:", mean(Covid_tie_abnormal), "\n")
cat("AAR for Pre Covid Victories:", mean(precovid_victory_abnormal), "\n")
cat("AAR for Pre Covid Defeats:", mean(precovid_defeat_abnormal), "\n")
cat("AAR for Pre Covid Ties:", mean(precovid_tie_abnormal), "\n")

# Sign Test
binom.test(sum(Covid_victory_abnormal > 0), length(Covid_victory_abnormal),
alternative = "two.sided")
binom.test(sum(Covid_defeat_abnormal > 0), length(Covid_defeat_abnormal),
alternative = "two.sided")
binom.test(sum(Covid_tie_abnormal > 0), length(Covid_tie_abnormal), alternative =
"two.sided")
binom.test(sum(precovid_victory_abnormal > 0), length(precovid_victory_abnormal),
alternative = "two.sided")
binom.test(sum(precovid_defeat_abnormal > 0), length(precovid_defeat_abnormal),
alternative = "two.sided")
binom.test(sum(precovid_tie_abnormal > 0), length(precovid_tie_abnormal),
alternative = "two.sided")

# Single Sample Wilcoxon Signed-Rank
```

```
wilcox.test(Covid_victory_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(Covid_defeat_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(Covid_tie_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(precovid_victory_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(precovid_defeat_abnormal, mu = 0, alternative = "two.sided")
wilcox.test(precovid_tie_abnormal, mu = 0, alternative = "two.sided")

#Wilcoxon rank-sum test
wilcox.test(Covid_victory_abnormal,precovid_victory_abnormal)
wilcox.test(Covid_defeat_abnormal,precovid_defeat_abnormal)
wilcox.test(Covid_tie_abnormal,precovid_tie_abnormal)
```

APPENDIX E


Frequency of games for the aggregate sample
Frequency
750
500
250
0
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Weekday

APPENDIX F

Sign Test and Single Sample Wilcoxon Signed-Rank results – Hypothesis 1

	Sign Test				Single Sample Wilcoxon Signed-Rank			
Outcome	ALL	FCP	SCP	SLB	ALL	FCP	SCP	SLB
V	0.000	0.139	0.162	0.452	0.139	0.904	0.839	0.680
D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
T	0.000	0.005	0.000	0.001	0.005	0.026	0.000	0.001

Sign Test and Single Sample Wilcoxon Signed-Rank results – Hypothesis 2

		Sign Test				Single Sample Wilcoxon Signed-Rank			
	Outcome	ALL	FCP	SCP	SLB	ALL	FCP	SCP	SLB
National	V	0.000	0.023	0.186	0.890	0.009	0.022	0.845	0.675
	D	0.000	0.003	0.001	0.000	0.000	0.008	0.001	0.000
	T	0.000	0.008	0.000	0.004	0.000	0.700	0.000	0.003
International	V	0.952	0.081	0.743	0.912	0.518	0.310	1	0.956
	D	0.000	0.038	0.027	0.000	0.000	0.008	0.048	0.000
	T	0.009	0.374	0.222	0.126	0.165	0.017	0.469	0.079

Sign Test and Single Sample Wilcoxon Signed-Rank results – Hypothesis 3

		Sign Test				Single Sample Wilcoxon Signed-Rank			
	Outcome	ALL	FCP	SCP	SLB	ALL	FCP	SCP	SLB
Dominant Moderate	V	0.000	0.358	0.074	0.412	0.013	0.893	0.538	0.680
	D	0.000	0.001	0.000	0.000	0.000	0.002	0.001	0.000
	V	0.010	0.226	0.819	0.450	0.849	0.736	0.128	0.172
	D	0.007	0.115	0.090	0.607	0.006	0.014	0.123	0.389

Sign Test and Single Sample Wilcoxon Signed-Rank results – Hypothesis 4

		Sign Test				Single Sample Wilcoxon Signed-Rank			
	Outcome	ALL	FCP	SCP	SLB	ALL	FCP	SCP	SLB
Pre-COVID	V	0.000	0.882	0.163	0.925	0.058	0.738	0.728	0.765
	D	0.000	0.003	0.000	0.000	0.000	0.001	0.000	0.000
	T	0.000	0.019	0.000	0.007	0.000	0.034	0.000	0.002
COVID	V	0.000	0.000	0.847	0.850	0.352	0.263	0.204	0.608
	D	0.000	0.012	0.169	0.019	0.000	0.042	0.353	0.010
	T	0.001	0.405	0.327	0.701	0.058	0.413	0.367	0.143