Luís Pedro da Silva Fernandes Ferreira

Champions In The Market

Dissertação de Mestrado em Contabilidade e Finanças, orientada pelo

Prof. Doutor Pedro André Ribeiro Madeira Cerqueira e apresentada à Faculdade de Economia da Universidade de Coimbra

Setembro/2018

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Abstract

This work consists on the analysis of the relation between the three biggest Portuguese football clubs' match results and their stock value fluctuations. To do so it is use models that consider Portuguese League's, Champions League's and Europa League's unexpected points (based on a model that uses betting odds to calculate expected points for each game) unweighted and weighted by the teams' objectives in each competition and the odds for qualifying a knockout stage, which it is going to be called the probability comparison variable and it is used to study the results of these type of European competitions' games. The study is made using a GARCH model. Results show that these variables have a significant impact on Sporting's stock value, which show a significant improvement when the team achieves positive results in the Champions League, whether it is in the group stage or the knockout stage, however a qualification for the Europa League knockout stage, caused by finishing third in the Champions League group stage, would have a negative impact on this entity's stock value. As for Benfica, the results show a positive effect if the team achieves its goals in the Portuguese League, Champions League and Europa League, but being eliminated in the Champions League group stage, even if it translates to a qualification for the Europa League knockout stage, would be a negative outcome that would affect negatively the club's stock value. On the other hand, Porto's models indicate that the team's performances on these competitions do not affect the sports company's stock value.

Key Words: GARCH Model, Match Importance, Probability Comparison, Sports Companies, Unexpected Points.

Resumo

Este trabalho consiste numa análise da relação entre os resultados desportivos dos três maiores clubes portugueses e as variações do valor das ações de mercado dessas instituições. Foram usados modelos que se baseiam nos pontos não esperados obtidos na Liga Portuguesa, Liga dos Campeões e Liga Europa (baseados num modelo que usa as “odds” de apostas para calcular os pontos esperados para cada jogo), sendo que esses pontos não esperados são usados apenas com base no jogo mas também em conjunto com uma variável que calcula a importância do jogo para os objetivos das equipas. Foi também criada a variável de comparação de probabilidades, baseada nas “odds” para a equipa se qualificar em fases a eliminar de competições europeias e usadas para estudar os jogos deste género. Foi usado um modelo GARCH para este estudo. Estas variáveis têm um impacto significativo no valor das ações do Sporting, que apresentam uma valorização significativa quando os resultados da Liga dos Campeões são positivos, no entanto um progresso para as fases a eliminar da Liga Europa causaria um efeito negativo. Quanto aos resultados do Benfica, há indícios de que os resultados positivos na Liga Portuguesa, da Liga dos Campeões e da Liga Europa têm um efeito positivo no valor das ações, sendo que ser eliminado da Liga dos Campeões, mesmo que signifique ir à fase a eliminar da Liga Europa, tem um efeito negativo. Os resultados do Porto, no entanto, levam a concluir que os resultados dos jogos não têm efeito nas ações da sociedade anónima desportiva.

Palavras-Chave: Modelo GARCH, Importância do Jogo, Comparação de Probabilidades, Sociedades Anónimas Desportivas, Pontos Não Esperados.

Tables

Abbreviations

- ***CL:*** "Champions League";
- ***EL:*** "Europa League";
- **FCP**: "Futebol Clube do Porto – Futebol SAD";
- ***PC:*** **"**the probability comparison variable";
- ***PL:*** "Portuguese League";
- **SCP:** "Sporting Clube de Portugal – Futebol SAD";
- **SLB:** "Sport Lisboa e Benfica – Futebol SAD";
- ***UP:*** "unexpected points";
- ***UP*Imp:*** "unexpected points weighted by match importance";
- ***UP*Imp (CL2):*** "unexpected points weighted by match importance for finishing second in the Champions league group stage";
- ***UP*Imp (CL3):*** "unexpected points weighted by match importance for finishing third in the Champions league group stage".

Summary

1. Introduction

There are not many events that move crowds the way a football match does. Every week we see stadiums with over fifty thousand people, all around the world, people travel hundreds of kilometers to see their favorite teams and players, expecting their glory in the end of the season. So, it is safe to say that it is a very emotional sport. But, football teams are more than a group of people that play a sport, they are companies, that manage their finances and make investments, just like any company involved in other areas of business. However, what distinguishes this market is the connection it has to the crowds' emotions. This paper intends to analyze the way the three biggest football team managing companies in Portugal are valued, considering the effects of game results, and the importance of the games considering the "big picture", winning the competition. More specifically, the goal of this study is testing if, after a Champions League or Europa League group stage, Champions League and Europa League knockout, or a Portuguese League game, it is possible to observe significant fluctuations on the companies' stock market value, caused by those games.

The Portuguese sports companies: "Sport Lisboa e Benfica – Futebol SAD", "Futebol Clube do Porto – Futebol SAD" e "Sporting Clube de Portugal – Futebol SAD". Also known as the "big three" in the Portuguese league, reference to their historic dominance when it comes to the sport itself, these three companies are the biggest on and off the Portuguese football field. When it comes to international glory, Porto clearly has the higher ground with 7 trophies, followed by Benfica with 2 trophies and, in the back of the line, comes Sporting that has only 1 trophy (the extinct UEFA Cup Winners' Cup).

Returning to the theme, it was already established that this study aims to analyze the effect that Champions League, Europa league and Portuguese league games' results, based on its importance related to winning the respective competition, have on the sports companies' stock market value. To do so, it was built a database, based on the work of Godinho and Cerqueira (2018), that studied these effects, focusing on the Portuguese league. It is important to understand that the game results that are considered to study the effect of a game in the stock market are not viewed in an objective way, that is, the number of points is not applied directly. To make the estimation it is considered how positive a result is which is not the same as simply counting how many points the team achieved. Before the game happens, the stock value is based on the expected outcome of the game. The objective of the work is to understand if the difference between that expected outcome and the game's actual result causes a fluctuation of the stock value. So, the testing of the games' influence stands on two points: how positive or negative the result was and how important was it to the outcome of the season.

Taking the analysis above into consideration and after a literary review of the works already developed related to this mater, it is understandable that the main contribution of this work is the introduction of the European competitions into this line of work. We will see forward that Barajas et al. (2007) were the only authors to take these competitions into consideration, however their study is set upon a series of yet to prove assumptions. Having this in mind, we will make an estimation that includes not only a point based competition (the Portuguese League) but also two tournaments that have the previous system and also a knockout stage (the Champions League and the Europa League), being these competitions part of all the observed teams' realities.

Regarding the statistical model, since this study focuses on financial models, Baum (2013), stated that, due to the importance of the "dynamics of the conditional variance", the ARCH model has proved to have effects in "higher-frequency financial data", which is characterized by the importance of movements in frequency. Several studies that are mentioned on the literary review section provide evidence on the existence of ARCH effects, in financial data analysis and more exactly sports companies financial markets' products' behavior.

Following this introduction, the second chapter of this thesis makes a brief review of the literature that it is directly related to the theme. Most of the papers give attention to the sporting events and how they affect the market values, using different approaches regarding the data analysis and statistical methods. In the third chapter it is referred the sources of information that are used to collect data as well as the data itself. The fourth chapter gives attention to the methodology, that includes the econometric model and the variables that are the base for it. The empirical results of the models introduced in the previous chapter are analyzed in the fifth. In the last chapter presents the conclusions of the thesis.

2. Literature Review

This is not the first analysis of the connection between sporting events or the everyday of its entities and the value of its market assets. The following studies have a clear connection to the subject that is being discussed:

Caiado (2004) analyzed the behavior of the Portuguese stock index PSI-20. This analysis consisted in observing the volatility of the daily and weekly returns. To make it, the authors used observations of the daily and weekly index and its return through January 2, 1995 to November 23, 2001. Using the GARCH and TGARCH models it was possible to obtain results that show asymmetric shocks in the volatility of daily returns, although the weekly returns did not have the same outcome. This study contributed as an observation on the behavior of the Portuguese stock market as well as an application of the ARCH and GARCH models to the context that includes the entities analyzed (the fact that the index is also considered in the estimation and included in the statistical model is a clear proof of its importance).

Duque and Ferreira (2005) studied the effect of sporting performance on the stock market using information regarding Sporting and Porto. The database used to make this investigation involved data from the years between 1998 to 2003, which are the year's corresponding to the observations of the quoted stock exchange of these two clubs. Using a daily database, the authors used dummy explanatory variables in various scenarios. For instance, they introduced three dummies related to the three possible outcomes of a game, that is, the variable assumes value "1" when the result of the game is the one the dummy is related to (i.e. dummy for victory assumes value "1" in a game the team won). Another variable assumes the value "1" when the team has a game, this way the authors can observe the fluctuations on the clubs' stock values when the team actually plays. Other variables were included such as the "relative points to victory" (RPV), which was first mentioned by Ribeiro (2001), and tests the idea that the difference of points between a team and their rival for the same position should be weighted by the amount of points that are in dispute until the end of the season (RPV is a positive ratio when the team under observation is the leader and a negative ratio when its rival is leading). Also, the PSI returns, the trading volume and the lagged daily stock returns were added to the estimation. Regarding the statistical model, the authors used the Autoregressive Conditional Heteroskedasticity (ARCH) model to consider the variation on the volatility of the time series. This data and methodology led the authors to some conclusions. The estimated model corroborated that the model used is the most efficient when it comes to analyzing the variation of sports companies' stock prices. Duque and Ferreira (2005) determined that there is a positive correlation between the final league position and stock prices variation, that is, winning the league leads to a growth on the stock value and the opposite is also verified. Considering the Sporting games' results the tests show that the stock prices rise when Sporting wins and decreases when they draw or lose. Porto's games show a different tendency as only the draws show a negative significant effect. The tests also show that when the RPV rises (bigger point difference between the leading observed team compared to the following rival team or smaller point difference between the following observed team and the leading rival team) the stock prices also rise and when the RPV falls the stock prices have that same tendency.

Barajas et al. (2007) aimed to make this kind of analysis applied to Spanish football. To obtain the sample that was needed to make this study the authors requested the first and second divisions' teams' annual accounts between 1998 and 2002. This paper is one of the few that analyses the effect of sporting performances to knockout competitions such as "Copa del Rey" and "Champions League". When it comes to league competitions, in a point-based system, the authors measure the teams' performances by the accumulated points of those teams along the season weighted by the possible point those teams could get. As the aim is to see the tendencies over several seasons they used a "position average value", based on the article of Deloitte and Touche (2000). The knockout based competitions require a more complex analysis as there is no point base that could be used to make an estimation, so the authors needed to create a method to make the examination. They imagined a point system that was not weighted considering the individual win of a game but a system that assigned points to the team that passed the stage (in example for “Copa Del Rey”, when a team wins a one game stage they get 3 points and the other team does not get any, but if a team wins a two game stage they get 6 points, this happens even if the team progresses without winning both games). In the “Champions League” the authors assign more points as the stages get closer to the final, winning the quarter finals means the team gets 7 points and not 6 as it would happen in “Copa Del Rey” or the last 16 stage of the “Champions League”, and 8 points if they win the semi-final, and so on. The variable that reflect the performances of all teams also weights the importance of the competition on the financial results so the “Copa del Rey” points are multiplied by one, “UEFA Cup” (now known as “Europa League”) points and League points are multiplied by three and “Champions League” points are multiplied by three, this way the authors attributed more importance on the competitions they believed were more significant for this matter. The authors reached the conclusion that sporting performances have a strong statistical significance in their influence on the financial results of the sports companies. They contributed to this field of study by applying it to a new sample, transforming the study that was mainly made using observations of British clubs into a model that analyses not only the Spanish first division teams but second division teams too. Furthermore, introduced the knockout based competitions that involved a more complex methodology. Although this paper made several contributions it is important to point out the fact that the authors made it based on unproved assumptions like the difference of the importance of the competitions.

Bell et al. (2012) studied the effect of the match result had in 19 English clubs' stock prices. To do that they considered each team with a corresponding influence measured by what they calculated as its importance. To make that calculous they considered two things: the rivalry between the teams playing (in view of their league positions) and the amount of games remaining till the end of the season. The data used to make the study goes from the beginning of the 2000/01 season and the end of the 2007/08 season, although for some of these clubs this period was shortened by various reasons, for instance the acquisition of some of them by private investors. From the estimated model the authors came to the conclusion that there was a weak influence of the match results on the stock prices. The main importance of this study is the fact that the authors used the rivalry between teams to make it, which is a component used in the current work to assess the match importance variable.

Demir and Rigoni (2017) observed Roma and Lazio's games results. These two teams have a well-known rivalry and the authors aimed to discover if investors were influenced by the rivals' results. To make this test they collected the stock prices since December 31, 2002. Since Lazio had several stock splits between 1999 and 2004, the authors considered best to use its data starting from the beginning of the 2004/2005 season. It was used an ordinary least squares (OLS) regression to analyze the abnormal returns after a game that are the difference between the returns that are observed and the returns that would be expected. The authors also included variables to verify the effect of a surprising results of the rival teams. They concluded that there is a contrarily reaction to the rival result since the investors react positively to a bad result from the other team and vice-versa. That observation is stronger when the result is unexpected. This paper is interesting, especially due to the conclusions regarding the effect of the emotional factor in football linked to the investment world.

Hang et al. (2018) made an analysis based on the aggregate of 1126 estimations of the return effects of game results. This study considers both national teams and individual clubs. The authors went further and introduced other variables they thought would influence the outcome of the study, those variables were "regional differences, time period under examination, and the design of empirical analysis to be responsible for the wide variation in previous study outcomes". They concluded that wins did not have a significant influence on the stock market returns, but, on the other hand, losses had a strong significance on the team's stock returns. Taking into consideration all the variables introduced on the analysis the results lead to assumption that, when it comes to national teams, stock market returns are not influenced by emotional factors associated to sporting events. These estimations brings more accurate results of this kind of reports.

Godinho and Cerqueira (2018) studied these same variables, these authors used data from 13 clubs from 6 different national football competitions to study the effects of the match results unexpected points (difference between the points the team expect to take from the match, variable calculated based on the betting houses' odds, and the points the team actually gets) had in the stock market value of those same organizations. These observations are gathered from the data available from September 1st, 2000 to March 13th, 2013. The study considered the outcome of the match itself considering all the games had the same influence. After that analysis the authors considered the results considering how they affect the final league table. To make these last estimation Godinho and Cerqueira (2018) measured a variable designated as "match importance". Regarding the statistical methodology Godinho and Cerqueira (2018) used the GARCH model, except when they analyzed data from more than one team belonging to the same country as they considered that "common factors may affect the volatility of residuals of different teams" and so they judged the MGARCH model as more suitable. The authors found evidence of the unexpected point influence in 12 of the 13 observed teams, evidence that they considered consistent, and found improvement when match importance was included in the model.

Looking at the previous works it is clear that there was an evolution and implementation of methodologies. Data processing is clearly not consensual among authors, which is a characteristic that does not apply to the statistical model. Some authors opted by using dummies to apply the outcome of various events, for instance Duque and Ferreira (2005) used dummies to introduce sporting events, like games' results, in the equation. On the other hand, authors like Godinho and Cerqueira (2018) viewed those variables from a different perspective, believing that the true effect of those games was in the unexpected factor and calculating variables that expressed that perception. Contrarily to the clash of ideas that characterized the variables and its place on the estimations, the statistical model was clearly more consensual as most of the authors, at least the ones that made a more extensive explanation on the matter, used the ARCH model, and its derivatives, being the study made by Demir and Rigoni (2017) an exception as they opted to use the OLS model.

3. Data

This work focuses on the sports companies of the three major clubs from the Portuguese league: “Sporting Clube de Portugal” (hereafter, SCP), “Futebol Clube do Porto” (hereafter, FCP) and “Sport Lisboa e Benfica” (hereafter, SLB). The database goes from the 22^{nd} of July 2007 to the 31^{st} of May 2017. It is important to refer that Benfica only released its first shares on the 21^{st} of May 2007. The beginning of the database was defined to ensure that the study was not biased by a different time range between the observed teams, which would mean different contexts associated with the time under observation and to exclude the process of the public launch of Benfica’s first shares. Using the Reuters database, it was possible to obtain the daily share prices of the sports companies and the PSI20 index throughout this timeline. The website http://www.football-data.co.uk gave the information regarding the league odds necessary to calculate the unexpected points variable as well as the obtained points and dates of each game to all the teams during the season’s league games included in the study’s timeline. To both European competitions (Europa League and Champions League) the same information was obtained and with the same goal but this time using the website http://www.oddsportal.com. This last website was also helpful to obtain the necessary odds to analyze the knockout stages importance. The referred analysis depended of the probability of passing a certain stage calculated before and after the observed game. To calculate that probability, it was needed the odds that represented the chance that the observed team had of qualifying from a certain stage.

To calculate the match importance variable for point based stages of all competitions, it was necessary to get the number of points of the team in the positions the clubs pointed at, in the domestic league the first position (and the second in case the first was the team under observation), the second and third position in the champions league group stage as they give access to the next stage or at least access to the knockout stage of the Europa League and the second position of the Europa League as it also gives access to the following stage of that same competition. The data was taken from the website www.zerozero.pt.

4. Methodology

Following the work of Godinho and Cerqueira (2018), the estimation is based on the work of Bell et al. (2012). This last report defends that the analysis of the influence of sporting events on the exchange market happens due to the unexpected factors that characterizes these events. So, instead of simply use the results and compare it to the fluctuations of the stock value, it is introduced a variable denominated “unexpected points”, that confronts the points obtained from a game and the points that the teams were expected to get. Godinho and Cerqueira (2018) also introduced another variable called “match importance” that weighted the importance of a game based on the number of games that are left until the end of the season, under the thought that a different time of the sporting season means a different effect on the league table and, consequently, different significance on the stock value variation. After all the data is obtained and all the variables are calculated a regression based on the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model will be estimated.

4.1. Econometric Model

Some papers that discussed this theme used the ordinary least squares (OLS) model, but other authors tested the existence of ARCH effects and these models had a positive result, which means the nonlinear autoregressive conditional heteroskedastic (ARCH) model is more efficient to make estimations using data with such inconstant volatility as financial data.

Cragg (1982) and Engel (1994), when analyzing macroeconomic data found indications that, for some data, there was a lack of stability, when compared to what was expected, in the disturbance variances in time series models. The data indicated that there was heteroskedasticity, in which the variance of the forecast error was correlated to previous disturbance. These indications lead to the suggestion that the ARCH model should be used to analyze such kind of data.

This contribution is now considered groundwork to the nowadays study of information that shows heteroskedastic characteristics, like financial data (i.e. stock and exchange markets studies).

Following Greene (2012), namely the chapter he dedicated to time series, the ARCH model is vastly represented and examined. According to this author, the simplest form of this statistical model is the following:

$$y_t = x_t' \beta + \varepsilon_t \tag{1}$$

$$\varepsilon_t = u_t \sqrt{\alpha_0 + \alpha_1 \varepsilon_{t-1}^2} \tag{2}$$

where u_t is distributed standard normal. ε_t is *conditionally heteroscedastic* with respect to ε_{t-1}, that means:

$$Var[\varepsilon_t \mid \varepsilon_{t-1}] = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 \tag{3}$$

To apply the model above to a more general model, with longer lags, is used the extension of the ARCH(1) model, the ARCH(*q*) model,

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \ldots + \alpha_q \varepsilon_{t-q}^2 \tag{4}$$

which is a q^{th} order moving average process.

The generalized autoregressive heteroskedastic model (GARCH) has a base on the ARCH model simplest form. The distribution of the disturbance is

$$\varepsilon_t \mid \Psi_t \sim N[0, \sigma_t^2] \tag{5}$$

where Ψ_t is the information set at time *t*, which the distribution of the disturbance is conditioned on. The conditional variance is

$$\sigma_t^2 = \alpha_0 + \delta_1\sigma_{t-1}^2 + \delta_2\sigma_{t-2}^2 + \ldots + \delta_p\sigma_{t-p}^2 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + \ldots + \alpha_q\varepsilon_{t-q}^2 \tag{6}$$

If we define,

$$Z_t = [1, \sigma_{t-1}^2, \sigma_{t-2}^2, \ldots, \sigma_{t-p}^2, \varepsilon_{t-1}^2, \varepsilon_{t-2}^2, \ldots, \varepsilon_{t-q}^2]' \tag{7}$$

$$\gamma = \left[\alpha_0, \delta_1, \delta_2, \ldots, \delta_p, \alpha_1, \alpha_2, \ldots, \alpha_q\right]' = [\alpha_0, \delta', \alpha']' \tag{8}$$

Then,

$$\sigma_t^2 = \gamma' Z_t \tag{9}$$

The *conditional variance is defined by an autoregressive-moving average process in the innovations* ε_t^2. The mean of the random variable of interest γ_t is defined by a heteroskedastic regression model. Bollerslev (1994) demonstrated that a GARCH model with a few number of terms performs, at least, as good as an ARCH model with many.

4.2. Unexpected Points

As referred above, in this study, unexpected points are a result of the difference between the points a team obtains in a game and the points that the team is expected to get. Using this variable, it allows to exploit the unexpected factor of the result. It is safe to say that the public reacts differently if a team wins a game that they are expected to win in the first place than if that same team wins a complicated game that it was, supposedly, not going to win. Previous authors already concluded that the unexpected factor has influence when studying the effects of match results, so that component will be included in the analysis.

To collect the data regarding the teams' performance in each game along the season it is used the information provided by the website http://www.football-data.co.uk, that furnishes every result in every game from an internal competition during a season. The previous website also offers us those games' betting houses' odds. This information is essential to assess the expected points the respective team would get. Based on the work of Stadtmann (2004), the calculations to obtain the mentioned expected points it is used the following equation:

$$EP = 3 * P(W) + 1 * P(D) + 0 * P(L) \tag{10}$$

Being "EP" the expected points, "P(W)" the probability of the team ends up victorious in the game, "P(D)" the probability of a draw in the game and "P(L)" the probability of a win to the team's opposition. These variables are multiplied by the points each result translates on the league table. Observing equation (10) it is obvious that the probability of a loss does not affect the expected points, and so the calculations of the dependent variable in equation are the subsequent:

$$EP = 3 * P(W) + P(D) \tag{11}$$

Defined the previous equation another question is raised: how are the two independent variables calculated? This is the part the betting odds get in the picture. Like Stadtmann (2004) estimated, the probabilities to each result are a product of the expectancy before the game, and that expectancy is demonstrated in the odds that betting houses define before the game is played. So, using the odds to the final result, defined before the game is started, we reach the formulas that give us the probability of a victory to the studied club or a draw, respectively:

$$P(W) = \frac{\frac{1}{o_W}}{\frac{1}{o_\omega} + \frac{1}{o_D} + \frac{1}{o_L}} \tag{12}$$

$$P(D) = \frac{\frac{1}{o_D}}{\frac{1}{o_\omega} + \frac{1}{o_D} + \frac{1}{o_L}} \tag{13}$$

In this equation o_ω, o_D and o_L are, respectively, the odds of a win, a draw and a loss. After applying the result of equations (12) and (13) to the equation (11) we obtain the expected points. Since the unexpected points are a result of the difference between the obtained and the expected it is easy to understand that the expression is:

$$UP = OP - EP \tag{14}$$

Where “UP” are the unexpected points and “OP” the obtained points (three in case of victory, one in case of draw and zero in case of defeat), that is the points the team got in the observed game.

This study introduces the UEFA competitions in this kind of studies, to do so the equations above are applied to the information regarding UEFA Champions League and UEFA Europa League (in the first years of the database it was named UEFA Cup) group stage, gathering data from the group stage and qualifying and knockout stages of both competitions. The website http://www.oddsportal.com/ provided the information regarding the mentioned competitions, offering information about the games’ results and the betting odds that allows the points that the Portuguese clubs were expected to get in each game to be calculated.

4.3. Match Importance

The variable “match importance” is an important part of this regression. Observing the work of Godinho and Cerqueira (2018), these authors studied the effect of the progression of the season has on the influence of the sporting performances on the clubs’ financial assets.

Several authors already included a variable to estimate the difference of the effect that games played in different parts of the season have on the evolution of financial value of those companies. This is based on the assumption that the leagues final position has an influence on the effect that games’ results have on stock market values, for instance a game that could decide a team’s final position on the league is more likely to have significant effect on the stock market value than a game played early in the season. Previous to these two authors work other researchers also believed that this was an important factor, but they always opted by including dummies in the equations. The problem with this last perspective is that dummies do not consider how the teams’ current leagues positions are affected by the result of a game.

It is possible to conclude that there are two major principles that support the "match importance" variable: it should be measured taking into account the position the team aims to finish (in this teams' case they all want to end in the first position) and "match importance" needs to be calculated after all the games between the end of a market's session and the beginning of the next are finished, considering the teams' and their rivals' games.

The first principle comes from the fact that some games are more important than others and, in order to know how important a game really is, we need to know what the teams' goals are.

The second principle bases itself on the influence of a rivals' result, that is, it is possible that a team's game have no effect on the league standings due to a rival's result. If a team needs 3 points to surpass a rival on the league table and wins its game, that only has the desired effect if the rival loses its game, otherwise everything stays the same as it before both games start.

To calculate the importance that a match has it is first necessary to define the team that we are observing (A) and the position it aims to finish in the end of the season (*p*). Then we need to identify the rival of team A, that is, the team that is going to challenge team A for position *p*. This last team will be referred as team B(*p*). To understand which team, at each point, is team B(*p*) the points the team in position *p* has and the points of the immediately below are collected, this way it is possible to foresee two situations: one in which team A is occupying position *p* (team B(*p*) is the closest, that is, the position below position *p*) and another in which team A is not being capable of reaching its desired position, so team B(*p*) is the one in that position. Position *p* is the desired position for this teams which is not the same as leading the table. For the league table all three teams want to be at the top in order to become champions in the end of the season, so *p*=1. The objectives change when it comes to the European competitions' group stages. For the champions league's group stage there are two possible goals: finishing in the second position which qualifies the team to the next stage or finish third and qualify for Europa League's knockout stage, so the two possibilities (*p*=2 and *p*=3)are calculated. Europa league follow the same logic as champions league, but third place only eliminates the team from the European competitions and does not qualify the team to any other tournaments. The equation that estimates “match importance”, Imp_p, is the following:

$$Imp_p = Unc_{A,B(p)} \, . \, Red_{A,B(p)} \tag{15}$$

The first independent variable of this equation, $Unc_{A,B(p)}$, measures the uncertainty of the team’s A final position in the league. The second variable, $Red_{A,B(p)}$, measures the way the game reduces the uncertainty considered in the previous variable.

Deepening the view about the first variable, in order to calculate it, the following variables are calculated:

- pt_A and $pt_{B(p)}$, which are teams’ A and B(p) number of points, respectively;
- m_A and $m_{B(p)}$, which are the number of games yet to play in the season for each team.

As referred above, the “uncertainty” variable is a measurement of the doubt regarding the final standings of the competitions. If team A has pt_A points then the maximum amount of points would be the sum between the points that it already has and the points that it would get if they won all the games until the end of the season, which translates to the expression pt_A+3*m_A. The same logic is valid to team B(p) being the respective expression: $pt_{B(p)}+3*m_{B(p)}$. It is possible to understand that the points the teams will have in the end of the season are a number inserted in the range between the last expression and the points they already have. The interception between the two ranges is defined by:

$$\min\{pt_A+3*m_A;\ pt_{B(p)}+3*m_{B(p)}\} - \max\{pt_A;\ pt_{B(p)}\} + 1 \tag{16}$$

When the point difference is far enough to define the final position the uncertainty is eliminated, so the expression is null or negative. Taking this last information into consideration, the interception of the two ranges should be defined by the following expression:

$$\max\{\min\{pt_A+3*m_A;\ pt_{B(p)}+3*m_{B(p)}\} - \max\{pt_A;\ pt_{B(p)}\} + 1;\ 0\} \quad (17)$$

This last expression makes sure that the range is always at least 0 to eliminate the invalid possibility of negative ranges.

The measurement of the uncertainty is related to the number of points that are left in dispute and that brings the importance of the games left to play. It is very different to have a point difference when there are few games left in the season and that same point difference in the beginning of the season. Having this fact in mind the $Unc_{A,B(p)}$ variable should be weighted by the number of points that are possible to obtain, so, following the work of Godinho and Cerqueira (2018), the expression above is weighted by the number of points team B(p) may obtain until the end of the season, leading the equation to:

$$Unc_{A;B(p)} = \frac{\max\{\min\left(pt_A + 3*m_A; pt_{B(p)} + 3*m_{B(p)}\right) - \max(pt_A; pt_{B(p)}) + 1; 0\}}{3*m_{B(p)} + 1} \quad (18)$$

The variable that considers the reduction of the uncertainty is a measurement of the influence of the game on the points that the team will end up with, so a percentage of points that are defined by the game is made:

$$\mathrm{Red}_{A,B(p)} = \frac{3}{3*m_A} = \frac{1}{m_A} \quad (19)$$

The previous equations do not consider an event that plays a major role on the development of a team's season that is the game in which that team faces its direct rival, that is the game between a team and other one that aims to end in the same position that team aims to finish at. To introduce that importance, the variable introduced by Godinho and Cerqueira (2018) that indicates if that game is between team A and B(*p*), $F_{A,B(p)}$, is included, this way the equation will considerate the importance of that game, doubling its importance. The adjusted equations are the next:

$$\mathrm{Red}_{A,B(p)} = \frac{1 + F_{A,B(p)}}{m_A + F_{A,B(p)}} \tag{20}$$

$$Unc_{A;B(p)} = \frac{\max\{\min\left(pt_A + 3 * m_A + 3 * F_{A,B(p)}; pt_{B(p)} + 3 * m_{B(p)}\right) - \max(pt_A; pt_{B(p)} + F_{A,B(p)}) + 1; 0\}}{3 * (m_{B(p)} - F_{A,B(p)}) + 1} \tag{21}$$

4.4. The Probability Comparison Variable

The knockout stages must have a different method of analysis since, unlike the European competitions' group stages and the Portuguese League, there are no points to use as a reference to whether the games' outcome was positive or negative. Barajas et al. (2005), as referred above, used a method in which they attributed a point system to make this examination. The problem with their study is on the series of unproven assumptions such as the presumption that a specific stage is less important or has less influence on the market products than the stage that follows.

In these stages the importance of the games is based on which it contributed to the best possible outcome: qualifying to the next stage. To understand how positive or negative a game really is, the expected outcome of the game must be compared to the actual outcome. To do so the probability of being qualified for the stage, based on the betting houses odds for qualifying or not the stage, needs to be calculated. This calculus is translated to the following expression:

$$QP_{\mathrm{A}} = \frac{\frac{1}{\sigma_Q}}{\frac{1}{\sigma_Q} + \frac{1}{\sigma_{NQ}}} \tag{22}$$

The variables to calculate the qualifying probability for the team under observation, QP_{A}, are: the odd for succeeding to the next stage, σ_Q, and the odd for being eliminated (which is the odd for the opponent's success), σ_{NQ}.

To understand if the first-hand game had a positive result the equation above is calculated for the odds before the game, $QP_{\mathrm{A}_{BFH}}$, and calculated for the odds after the game, $QP_{\mathrm{A}_{AFH}}$, that are the same odds as the ones used to calculate the probability of qualifying before the second-hand game, $QP_{\mathrm{A}_{BSH}}$, which means $QP_{\mathrm{A}_{AFH}} = QP_{\mathrm{A}_{BSH}}$. After calculating both probabilities, the difference between the two, $PC_{\mathrm{A}_{FH}}$, is estimated, which translates to the equation:

$$PC_{\mathrm{A}_{FH}} = QP_{\mathrm{A}_{AFH}} - QP_{\mathrm{A}_{BFH}} \tag{23}$$

This equation result in three different outcomes: the difference is positive, which means the result of the game was positive enough to improve the possibility of qualifying, the result is negative, which means the result was negative and diminished the likelihood of qualifying for the next stage, or the difference is null and the team has exactly the same chance of going through in the competition (this last outcome is less likely but it is possible).

The second-hand game depends on the estimation of the probability of passing this stage before the game happens, $QP_{\mathrm{A}_{BSH}}$, that is calculated in the first-hand study, and the probability of passing after we know the result of the game, QP_{A_F}.

$$PC_{\mathrm{A}_{SH}} = QP_{\mathrm{A}_F} - QP_{\mathrm{A}_{BSH}} \tag{24}$$

After the game happened we already know if the team passed or not, so there are only two possible probabilities:

- QP_{A_F} = 1: team A qualifies for the next stage;
- QP_{A_F} = 0: team A is eliminated.

5. Results

Having finalized the explanation of the various variables and methodology that involves this work, an analysis of the results of the study applied to the collected data will be made. There are two sets of information: the unexpected points (*UP*), the importance of the match in relation to the outcome of the season (*UP*IMP)* (this importance is weighted by the unexpected points) and the probability comparison used to study the knockout stages of the European competitions (*PC*). Having this in mind 7 different models were formulated:

- **Model I:** only considers the unexpected points;
- **Model II:** only considers the unexpected points weighted by the match importance;
- **Model III:** only considers the probability comparison variable;
- **Model IV:** considers simultaneously the unexpected points and the unexpected points weighted by the match importance;
- **Model V:** considers simultaneously the unexpected points and the probability comparison variable;
- **Model VI:** considers simultaneously the unexpected points weighted by the match importance and the probability comparison variable;
- **Model VII:** considers all the variables simultaneously.

All the variables included in the tests are identified in respect to the observed competition, namely the Champions League (CL), the Europa League (EL) and the Portuguese League (PL). It is also included in all the tests a constant and the variation of the value of the stock index for the Portuguese stock market (PSI-20 index). The result tables identify each sports company using the initials of its football team: “Sport Lisboa e Benfica – Futebol SAD” is “SLB”, “Futebol Clube do Porto – Futebol SAD2 is “FCP” and “Sporting Clube de Portugal – Futebol SAD” is “SCP”

Table I presents the descriptive statistics for each variable applied for each competition and team. The referred statistics are the mean, standard deviation, minimum and maximum.

Table II shows the application of models I and II. Starting with model I, the stock index has a positive effect in all the entities, but that effect is only significant when it is observed regarding the Benfica and Porto data. For Porto, this model doesn´t show any significant variable other than the PSI-20 index. As for SCP a positive effect is observed when studying the effect of the European competitions, with a stronger significance of the Champions League unexpected points. Benfica's data shows a positive influence of the PSI-20 index and the unexpected points related to the Portuguese League and the Champions League, being both significant at 5%.

Model II presents the effect of unexpected points weighted by the match importance. Porto's results show a negative effect of the Champions League points that are weighted by the importance of the game related to qualifying to the Champions League group stage. On the other hand, the same variable has a strong positive effect on Sporting's stock value. As for Benfica, results show a positive relation between the unexpected points that bring the team closer to winning the Portuguese League, as well as a positive effect of the Portuguese stock index.

Table III presents models III and IV. Model III study the effect of the *PC* variable, which, in Porto's case, has no significant effect. On the other hand, Sporting's model shows a positive effect related to the Champions League's knockout stages which may mean that investors are motivated to buy stock and, consequently, make the stock value rise by the fact that the team is heading for an advance in the competition. Benfica displays a similar result as FCP, showing no significant effect of the studied variable.

Model IV is a collective analysis of the unexpected points unweighted and weighted by match importance. Porto's model only shows a significant influence

		FCP	SCP	SLB
Observations		2,617	2,617	2,617
Stock Fluctuations	Mean	-0.0494%	-0.0572%	-0.067%
	SD (%)	0.046	0.178	0.0446
	Min (%)	-0.503	-3.47	-0.474
	Max (%)	0.511	3.2	0.434
UP (PL)	Mean	0.0192	0.000165	0.02
	SD	0.356	0.393	0.354
	Min	-2.67	-2.45	-2.54
	Max	1.9	2.07	3
UP (CL)	Mean	0.00153	-0.000493	-0.00111
	SD	0.168	0.101	0.159
	Min	-2.04	-1.7	-1.92
	Max	1.96	1.99	2.23
UP (EL)	Mean	0.00134	-0.000668	0.0179
	SD	0.0494	0.134	0.422
	Min	-1.28	-1.99	-3.84
	Max	1.46	2.12	3.48
UP*IMP (PL)	Mean	0.00134	0.000833	0.00164
	SD	0.0281	0.0211	0.0289
	Min	-0.429	-0.139	-0.457
	Max	0.569	0.417	0.342
UP*IMP (CL_2)	Mean	-0.000464	7.77e-5	1.47e-5
	SD	0.0193	0.00537	0.023
	Min	-0.837	-0.0979	-0.787
	Max	0.169	0.138	0.799
UP*IMP (CL_3)	Mean	-0.000625	-0.000633	-0.000266
	SD	0.0398	0.0405	0.0481
	Min	-1.12	-1.7	-1.05
	Max	0.565	0.533	1.6
UP*IMP (EL)	Mean	9.94e-5	0.000163	-0.00128
	SD	0.00532	0.0276	0.0709
	Min	0.128	-0.357	-2.56
	Max	0.196	0.738	1.16
PC (CL)	Mean	0.00012566	-0.000536	0.000288
	SD	0,030582	0.0147	0.0168
	Min	-0,76471	-0.606	-0.405
	Max	0,66114	0.0777	0.456
PC (EL)	Mean	0.000583	0.000223	0.00149
	SD	0.0241	0.0351	0.0346
	Min	-0.65	-0.732	-0.71
	Max	0.527	0.783	0.609

Table I. Descriptive Statistics.

	Model I			Model II		
	FCP	SCP	SLB	FCP	SCP	SLB
Const	-0.0016** (0.0007)	0.004 (0.0084)	-0.0007 (0.0007)	-0.0017** (0.0007)	0.0025 (0.0077)	-0.0008 (0.0007)
PSI-20	0.2605*** (0.0696)	0.3057 (0.5812)	0.1853*** (0.0636)	0.2591*** (0.0688)	0.4288 (0.4864)	0.186*** (0.0569)
UP (PL)	-0.0029 (0.0033)	0.0043 (0.0077)	0.0067** (0.003)	-	-	-
UP(CL)	0.0082 (0.0054)	0.2285*** (0.0871)	0.0125** (0.0058)	-	-	-
UP (EL)	-0.0015 (0.0061)	0.0152** (0.0071)	-0.0017 (0.002)	-	-	-
UP*IMP (PL)	-	-	-	-0.0347 (0.0422)	-0.0252 (0.0623)	0.0763** (0.0349)
UP*IMP (CL_2)	-	-	-	-0.0981* (0.0413)	4.2846** (2.1299)	-0.027 (0.0639)
UP*IMP (CL_3)	-	-	-	0.0686** (0.0335)	0.1005 (0.1169)	0.0317 (0.0325)
UP*IMP (EL)	-	-	-	-0.0291 (0.0532)	0.025 (0.023)	0.0033 (0.0024)
PC (CL)	-	-	-	-	-	-
PC (EL)	-	-	-	-	-	-
LAGS	8	0	3	8	0	3

GARCH Variables						
α_0	2.5942e-5 (3.4707e-5)	0.006* (0.0035)	0.0001 (0.0002)	2.7545e-5 (3.5907e-5)	0.0062 (0.0039)	0.0001 (0.0002)
α_1	0.0526* (0.0275)	0.5543 (0.4988)	0.2728 (0.2228)	0.054** (0.0262)	0.5476 (0.4622)	0.2564 (0.2078)
β_1	0.9382*** (0.0372)	0.4457*** (0.0662)	0.6948** (0.2892)	0.9361*** (0.0362)	0.4524*** (0.0768)	0.7207*** (0.2594)
Normality Test	3381.65 [0.00]	67902.8 [0.00]	2071.09 [0.00]	3387.89 [0.00]	67796.1 [0.00]	2068 [0.00]
LR Test	361.04 [3.9921e-79]	2031 [0.00]	867.112 [5.1159e-189]	358.533 [1.3978e-78]	1475.57 [0.00]	655.746 [1.2575e-144]
Akaike Test	-9362.051	-3615.309	-9952.048	-9359.686	-3533.669	-9946.246

Table II. Models I and II applied to all competitions.

Note: Values that are circumscribed between "( )" represent the standard errors of the variables, while values limited by "[ ]" represent the *p-value* of the variables. ***, ** and * signify a statistical significance at 10%, 5% and 1%, respectively. The "PSI-20" variable studies the relation between the Portuguese stock index and the dependent variable. The "UP" variable studies the effect of unweighted unexpected points for each competition. The "UP*IMP" variable studies unexpected points weighted by the importance that each game has to reach the desired position for each competition. The "PC" variable is a reference of the probability comparison variable. The competitions "LP", "CL" and "EL" are a reference to the Portuguese League, Champions League and Europa League, respectively. "CL2" is used when studying the match importance regarding finishing second in the Champions League group stage, while "CL3" is used to finish third in the Champions League group stage.

	Model III			Model IV		
	FCP	SCP	SLB	FCP	SCP	SLB
Const	-0.0017** (0.0007)	0.0092 (0.0306)	-0.0006 (0.0008)	-0.0016** (0.0007)	0.0019 (0.0088)	-0.0007 (0.0007)
PSI-20	0.2585*** (0.0691)	-0.7964 (2.1662)	0.1924*** (0.071)	0.2596*** (0.0693)	0.4469 (0.4537)	0.1961*** (0.0662)
UP (PL)	-	-	-	-0.0027 (0.0031)	-0.0024 (0.0246)	0.0085** (0.0043)
UP(CL)	-	-	-	0.003 (0.0149)	0.3658** (0.1574)	0.0351** (0.0158)
UP (EL)	-	-	-	0.0076 (0.0076)	0.0593* (0.0309)	-0.0061*** (0.002)
UP*IMP (PL)	-	-	-	-0.0056 (0.0354)	0.0502 (0.2975)	0.0498 (0.058)
UP*IMP (CL_2)	-	-	-	-0.0757 (0.1091)	-0.223 (1.6757)	0.1916* (0.1018)
UP*IMP (CL_3)	-	-	-	0.0491 (0.0946)	-0.4703** (0.2191)	-0.1285* (0.0762)
UP*IMP (EL)	-	-	-	-0.0909 (0.0607)	-0.0704** (0.0318)	0.0131*** (0.0036)
PC (CL)	0.0199 (0.0322)	0.1647** (0.0789)	0.0341 (0.0453)	-	-	-
PC (EL)	0.0351 (0.0346)	0.0087 (0.0323)	0.0849 (0.0829)	-	-	-
LAGS	8	0	3	8	0	3

GARCH Variables						
α_0	2.8665e-5 (3.7462e-5)	0.01* (0.0058)	0.0001 (0.0002)	2.6723e-5 (3.5943e-5)	0.0071 (0.005)	0.0001 (0.0002)
α_1	0.0515** (0.0235)	0.8061 (2.6331)	0.3026 (0.2298)	0.0539* (0.0294)	0.6214 (0.4406)	0.2802 (0.2284)
β_1	0.9373*** (0.0348)	0.1939 (0.3321)	0.6792*** (0.2584)	0.9367*** (0.0393)	0.3786*** (0.0797)	0.6881** (0.3025)
Normality Test	3410.71 [0.00]	67829.8 [0.00]	2040.6 [0.00]	3383.05 [0.00]	67772.4 [0.00]	2098.89 [0.00]
LR Test	151.505 [8.1269e-35]	1434.36 [0.00]	695.036 [3.5903e-153]	359.286 [9.5934e-79]	2099.03 [0.00]	866.46 [7.0884e-189]
Akaike Criteria	-9360.361	-3418.461	-9946.279	-9354.69	-3611.757	-9953.685

Table III. Models III and IV applied to all competitions.

Note: Values that are circumscribed between "( )" represent the standard errors of the variables, while values limited by "[ ]" represent the *p-value* of the variables. ***, ** and * signify a statistical significance at 10%, 5% and 1%, respectively. The "PSI-20" variable studies the relation between the Portuguese stock index and the dependent variable. The "UP" variable studies the effect of unweighted unexpected points for each competition. The "UP*IMP" variable studies unexpected points weighted by the importance that each game has to reach the desired position for each competition. The "PC" variable is a reference of the probability comparison variable. The competitions "LP", "CL" and "EL" are a reference to the Portuguese League, Champions League and Europa League, respectively. "CL2" is used when studying the match importance regarding finishing second in the Champions League group stage, while "CL3" is used to finish third in the Champions League group stage.

of the Portuguese stock index, being that a positive relation. Sporting's model show a positive effect of the unweighted Champions League and Europa League points, which leads to the conclusion that investors find positive that the team gets positive results in the European competitions, with a stronger significance of the Champions League variable. As for the weighted unexpected points, Sporting indicates a negative influence of the unexpected points that may contribute for a Europa League knockout stages, whether its caused by finishing third in the Champions League group stage or qualifying from the Europa League group stage. This result might indicate that investors think that Europa League is not prestigious enough and may tire the team out for more important goals like trying to win the Portuguese League. Benfica's model presents a positive effect of unweighted points for all competitions, with a stronger significance for European competitions which means SLB's stock value rises when the team gets positive results in any competition. As for weighted points, SLB's results show a positive influence of unexpected points weighted by the importance for finishing in a

qualification position in the group whether is for staying in the Champions League or the Europa League, but matches that might lead to finishing third in the Champions League group stage have negative effects. This results lead to the conclusion that investors are happy if the team makes a good run in a European competition, however, in their perspective, only qualifying for the Europa League knockout stage via the Champions League group stage means the team couldn't get the best outcome possible, so it is a negative result.

Table IV present models V and VI. Model V's results applied to Porto's data have the same tendency as most of the previous models, as there is no significance on any of the variables, which means that Porto's stock value is not affected by unweighted unexpected points or progress on European competition's knockout stages, when tested collectively. Sporting's model shows significance related to Champions League's unexpected points and the *PC* variable, that might mean that investors find positive that the team gets good

	Model V			Model VI		
	FCP	SCP	SLB	FCP	SCP	SLB
Const	-0.0017** (0.0007)	0.004 (0.0086)	-0.0006 (0.0008)	-0.0017** (0.0007)	0.0024 (0.0083)	-0.0007 (0.0008)
PSI-20	0.2601*** (0.0693)	0.3486 (0.5624)	0.2031*** (0.0706)	0.2587*** (0.0685)	0.5557 (0.4533)	0.2045*** (0.066)
UP (PL)	-0.0028 (0.0032)	0.0054 (0.007)	0.007** (0.0029)	-	-	-
UP(CL)	0.0083 (0.0054)	0.2238*** (0.086)	0.0126** (0.0055)	-	-	-
UP (EL)	-0.0015 (0.0061)	0.0049 (0.0037)	-0.0018 (0.002)	-	-	-
UP*IMP (PL)	-	-	-	-0.0332 (0.0414)	-0.0041 (0.0459)	0.0855** (0.0346)
UP*IMP (CL_2)	-	-	-	-0.0984* (0.0561)	4.602** (2.1552)	-0.0268 (0.0643)
UP*IMP (CL_3)	-	-	-	0.0687** (0.0335)	0.0645 (0.0775)	0.0315 (0.0324)
UP*IMP (EL)	-	-	-	-0.0288 (0.0532)	-0.0121 (0.0141)	0.0034 (0.0024)
PC (CL)	0.0185 (0.0312)	0.1925*** (0.0607)	0.0331 (0.0443)	0.019 (0.0317)	0.2008*** (0.0614)	0.0348 (0.0444)
PC (EL)	0.0342 (0.0343)	0.0266*** (0.01)	0.0898 (0.086)	0.0339 (0.0342)	0.0041 (0.0199)	0.0942 (0.0812)
LAGS	8	0	3	8	0	3

GARCH Variables						
α₀	2.6043e-5 (3.5218e-5)	0.0058* (0.0034)	0.0001 (0.0002)	2.7677e-5 (3.6437)	0.006* (0.0035)	0.0001 (0.0001)
α₁	0.0519* (0.0275)	0.5293 (0.5034)	0.3006 (0.2094)	0.0533** (0.0262)	0.5357 (0.4717)	0.285 (0.2062)
β₁	0.9387*** (0.0375)	0.4707*** (0.0636)	0.6745*** (0.2418)	0.9365*** (0.0365)	0.4643*** (0.0739)	0.6944*** 0.2332
Normality Test	3391.81 [0.00]	68101 [0.00]	2107.23 [0.00]	3399.49 [0.00]	67853.3 [0.00]	2113.47 [0.00]
LR Test	354.287 [1.1681e-77]	2031.83 [0.00]	871.287 [6.3448e-190]	351.806 [4.0392e-77]	1858.7 [0.00]	867.25 [4.7756e-189]
Akaike Criteria	-9359.651	-3617.26	-9961.475	-9357.297	-3530.277	-9957.418

Table IV. Models V and VI applied to all competitions.

Note: Values that are circumscribed between "( )" represent the standard errors of the variables, while values limited by "[ ]" represent the *p-value* of the variables. ***, ** and * signify a statistical significance at 10%, 5% and 1%, respectively. The "PSI-20" variable studies the relation between the Portuguese stock index and the dependent variable. The "UP" variable studies the effect of unweighted unexpected points for each competition. The "UP*IMP" variable studies unexpected points weighted by the importance that each game has to reach the desired position for each competition. The "PC" variable is a reference of the probability comparison variable. The competitions "LP", "CL" and "EL" are a reference to the Portuguese League, Champions League and Europa League, respectively. "CL2" is used when studying the match importance regarding finishing second in the Champions League group stage, while "CL3" is used to finish third in the Champions League group stage.

	Model VII		
	FCP	SCP	SLB
Const	-0.0017** (0.0007)	0.0054 (0.0172)	-0.0006 (0.0008)
PSI-20	0.2593*** (0.0691)	0.5834 (0.6577)	0.2159*** (0.0713)
UP (PL)	-0.0026 (0.0031)	0.0177 (0.0616)	0.0079* (0.0042)
UP(CL)	0.0032 (0.0153)	0.3409** (0.1411)	0.0354** (0.0146)
UP (EL)	0.0077 (0.0076)	0.0259*** (0.0064)	-0.0063*** (0.002)
UP*IMP (PL)	-0.0048 (0.0352)	-0.1925 (0.8488)	0.0684 (0.059)
UP*IMP (CL_2)	-0.0748 (0.1116)	-0.5434 (1.3458)	0.1947** (0.095)
UP*IMP (CL_3)	0.048 (0.0971)	-0.3827** (0.1695)	-0.1304* (0.0704)
UP*IMP (EL)	-0.0913 (0.0604)	-0.0707*** (0.0322)	0.0136*** (0.0036)
PC (CL)	0.0186 (0.0314)	0.2032*** (0.0681)	0.0326 (0.0436)
PC (EL)	0.0339 (0.0343)	-0.0288 (0.0546)	0.0953 (0.084)
LAGS	8	0	3
GARCH Variables			
α_0	2.6829e-5 (3.6563e-5)	0.0056 (0.0035)	0.0001 (0.0002)
α_1	0.0531* (0.0294)	0.5095 (0.7119)	0.3052 (0.2061)
β_1	0.9372*** (0.0398)	0.4905*** (0.072)	0.6696*** (0.2395)

Normality Test	3394.68 [0.00]	68408.9 [0.00]	2148.08 [0.00]
LR Test	352.53 [2.8122e-77]	2099.87 [0.00]	875.252 [8.7377e-191]
Akaike Criteria	-9352.274	-3640.625	-9965.328

Table V. Model VII applied to all competitions.

Note: Values that are circumscribed between "( )" represent the standard errors of the variables, while values limited by "[ ]" represent the *p-value* of the variables. ***, ** and * signify a statistical significance at 10%, 5% and 1%, respectively.

results in the prestigious Champions League and also get excited that the team progress through the Europa League's knockout stages, believing the team might make a good campaign in the competition. For Benfica, this model shows a positive effect of the Portuguese League's and Champions League's unexpected points, which means this team's investors believe that these two are more relevant and are led to invest when results are positive.

Model VI's results, when applied for FCP indicate that investors are led to invest when the team gets a positive result that might influence the team to finish third in the Champions League group stage and, consequently, qualify the team for the Europa League's knockout stages, however if the result could lead the team to finish second and go through to the Champions League's knockout stages then the effect is negative. This might mean that investors believe the team could win the Europa League but the Champions League could only tire the team for other competitions. Sporting's model shows a positive effect of the Champions League unexpected points weighted by the importance they might have on finishing second on the group stage and the variable that studies the effect of the results of Champions League's knockout stages. That leads to the conclusion that investors think the prestigious Champions League is an important competition, so a good result that improves Sporting's chances of competing in that tournament is a very positive outcome. Benfica's data show a positive influence of Portuguese League's unexpected points weighted by the importance for finishing on the top of the table in the end of the season, which is proof of the valorization that investors give to that competition and the high confidence they have that the best of the possible outcomes could be a reality.

Last but not least we take a look at table V's model VII, which presents all the variables collective results. Porto's results show no significance of the independent variables, indicating that weighted and unweighted unexpected points and the *PC* variables have no influence on the club's stock value. Sporting's data show a positive influence of unweighted unexpected points for European competitions which means investors are motivated by positive results in these competitions. However, when weighted, we observe a negative effect of points that lead to qualifying for Europa League's knockout stages, which could happen by finishing third in the Champions League group stage or at least second in the Europa League's group stage. This might mean that investors do not find positive to play in this competition and it might tire the team for other, more important, objectives. The *PC* variable show a positive effect for Champions League's knockout stages, which means that Sporting's investors, opposite to the Europa League, are motivated to invest if the team plays in this competition. Benfica's data show a positive effect of unweighted unexpected points for the Portuguese League and Champions League and a negative effect for Europa League, which might mean that investors believe that the first two are important competitions for the club but the last is not prestigious enough. Weighted unexpected points present a positive result if they contribute to winning the Portuguese League, qualifying for the Champions League's knockout stage and qualifying for Europa League's knockout stage through this competitions group stage, but a negative effect if the game contributes to finishing third in the Champions League's group. This might be explained by the fact that investors find positive if the team is successful in these competitions but finishing third in the Champions League's group and getting out of this competition is an unsuccessful outcome. As for the *PC* variable, it shows no influence on Benfica's stock value.

Concluding the models' results, it is important to mention that all normality tests show a *p-value*=0, which mean the hypothesis that the residuals are normal is rejected, so robust standard errors are estimated and used to assess the influence of the independent variables. Following this tendency, the likelihood ratio test also shows *p-values* close to 0 in all models, which means that they all reject the hypothesis that GARCH coefficients equal 0, corroborating the thesis that this model is the most efficient to study these variables.

6. Conclusions

In this work the correlation between football games and the way they affect the teams' stock values is studied. This work analyzes a group of variables that might influence those values, but not all of them. That is, there are a lot of factors that influence the sports companies, on and off the field. The everyday of a football team includes playing games but also asset management, board changes, and a lot more happenings that are not included in this study but are still occurring at the same time as the ones that are included. So, it is understood that, by making a study like this, there are a lot more variables than the ones observed, and they have an influence that is not viewed. Knowing this, the conclusions that might be taken based on the result of the tests made and explained above will be presented.

For Porto we observe a lack of influence of the match results on the stock market fluctuations, no matter what competitions is observed. All variables have their way of relating to the dependent variable, some variables have an inverse direction of variation, like the unexpected points related to the Portuguese League, that when higher the stock value decreases. Other variables like the probability comparison variable that observes the effect improving the chances of qualifying in the knockout stages, when higher the stock value increases. Regardless of this observations, none of the variables that study match results show a statistically significant influence on the stock market information.

Sporting's analysis, on the other hand, show that match results could affect the stock values, but also show that investors are rigorous but less-than-confident on the team's chances. The results lead us to think that Sporting's investors are not happy about playing the Europa League but are also not very confident about going far in the Champions League. This conclusion is based on the fact that there is a significant negative effect related to finishing third in the Champions League group stage but also a negative but not significant effect of going through in the Champions League. Even though investors do not get enthusiastic about qualifying in the group stages and going to the knockout stage, once they are there investors are motivated if the team gets closer of qualifying in a knockout stage in the Champions League (conclusion based on the PC variable that is significantly positive for this situation). The same does not happen for Europa League in which the PC variable is negative but not significant. One thing that does not make investors buy Sporting's stock is winning games that might be important to get the team closer to the Portuguese League's objectives as the unexpected points variable is negative when weighted by the match importance. This might happen due to the unsuccessful year Sporting has had, that might make investors think winning the Portuguese League is an improbable outcome.

Benfica presents a more positive result. Benfica's data shows that investors have a positive feeling when they watch the team get positive results. In the Portuguese League, when the team wins a game that might make them get closer to winning it the influence on the stock market is not significant but is positive which may mean that investors feel that the result is positive but not a motive to invest. As for European competitions, when the team gets a good result and its closer of qualifying for the next stage, whether it is the Europa League or the Champions League group stage, investors are happy and stock value increases, but stock value also decreases if the results are negative and that includes finishing third in the Champions League group stage and getting out of the competition, even if they get to play in the Europa League knockout stage. Speaking of knockout stages Benfica's data show that investors find it positive if the team gets closer of qualifying in such stages but not significantly, which may be because, although they believe it is a good outcome, Benfica shows incapacity of ending up winning those competitions.

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