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HERDING ANALYSIS IN INTERNATIONAL MARKETS

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ABSTRACT:

El estudio del efecto herding ha ganado importancia en los últimos años en la literatura financiera. Siguiendo esta línea de investigación, este trabajo de fin de grado tiene como objetivo profundizar en el efecto herding a nivel internacional. Utilizando datos diarios de los índices más representativos de treinta y nueve países de todo el mundo, y un periodo que comprende desde enero de 2018 a junio de 2021, se ha contrastado si se detecta el denominado "herding behavior" en el mundo en su conjunto, y segmentado por zonas geográficas: Europa, América y Asia. Para ello, tres diferentes modelos se han utilizado. Los resultados muestran que existe una disparidad dependiendo de la metodología que se haya empleado. No obstante, el principal resultado es que en la zona del este de Europa se detecta herding entre los distintos índices de los países, y dichos resultados son robustos a las diferentes metodologías empleadas.

The study of the herding effect has gained importance in recent years in the financial literature. Following this line of research, this final degree work aims to delve into the herding effect at the international level. Using daily data from the most representative indices of thirty-nine countries around the world, and a period spanning from January 2018 to June 2021, it has been contrasted whether the so-called "herding behavior" is detected in the world as a whole, and segmented by geographical areas: Europe, America and Asia. For this purpose, three different herding tests were used. The results show that there is a disparity depending on the methodology used. Nevertheless, the main result is that herding between the different country indices can be said to be detected in the Eastern European area, and these results are robust to the different methodologies employed.

KEY WORDS: Herding effect, behavioral finance, market index, herding test, international herding.

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1. INTRODUCTION

Herding, what exactly does this phenomenon mean? At the beginning of this paper, I was not really aware of the impact that the herding effect can have on the markets. This study is based on the analysis of the herding effect in international markets, with the information of market index prices from different countries around the world.

As it is well known, globalization has caused that everything that happens in the world affects us as individuals in one way or another. One of my motivations for this study is having the possibility to explain numerically, thanks to mathematical and economic models, something that many people assume: the imitation by many investors of other agents, following the actions of their actions instead of their own thoughts or conclusions.

Additionally, I have chosen this topic because since I started to be interested in economics, financial derivative assets attracted my attention. But not only that, I was curious to know how the world is connected and how other markets can be affected by the decisions that other investors, even in a remote part of the world, make. As a student of business administration and economics, I would like to know more about the stock markets with the goal of being able to invest one day. That is why this project has an extra motivation for me.

Moreover, for my final end-of-degree project, I wanted to conduct research that had not been carried out before, since I wanted this study to contribute something to current herding research. In addition, models and methodologies that have been previously employed have been used in this work, although applied to novel data.

The aim of this TFG is to gather information about the index markets, analyze them and observe if there is herding presence in the diverse trading markets around the world. In other words, the objective is to attempt to identify whether investors are imitating each other rather than following their own judgments, using information from the most representative indexes of different markets for this purpose. So as to try to detect herding, three different methodologies are going to be used: Christie and Huang (1995), Chang, Cheng and Khorana (2000), and Chiang and Zheng (2010). Moreover, data are from countries all over the world, although for some calculations countries are going to be divided by zones.

The study is structured as follows. The second section contains a review of the literature on herding. The third section explains the database and the models that have been used. The fourth section presents the empirical results. In addition, the fifth section comments on the limitations of the work. Finally, the sixth section presents the conclusions of the project.

2. REVIEW OF THE LITERATURE

Even though the efficient markets hypothesis suppose that individuals have the same expectations and agents do rational actions, the reality could be different. Individuals may show signals of limited rationality, principally attributed to psychological factors (Blasco, Corredor, & Ferreruela, 2016). Although, this fact does not imply the inefficiency of markets, it could lead to non-efficient markets in some cases, or at least find anomalous patterns of behavior.

Imitation is a relevant phenomenon, which has been studied by numerous research in several areas such as zoology, sociology, and social psychology (Bikhchandani, Hirshleifer, & Welch, 1998). When economic agents imitate each other, they base their own private decisions depending on what other investors do, and it is called herding (Patterson & Sharma, 2007). In other words, herding appears when investors repress their own impressions and follow the actions of the other agents (Zhou & Anderson, 2011). This process of herding started being analyzed in psychology. After that, multiple number of economists such as Chang, Cheng and Khorana (2000), Rajan (2006), Chiang and Zheng (2010), or Bouri, Demirer, Guota and Nel (2021) among others, have done some research about it.

During decades, experts have been trying to explain why do people herd and in which certain circumstances the process of herding takes place. Scharfstein and Stein (1990) came to conclusion that herd behavior can appear in a huge variety of circumstances. One of the most common scenarios is the "sharing-the-blame" effect that provokes herding. The reason why this happens is that investment has unpredictable components which may cause correlated prediction errors. In addition, they conclude that when we talk about labor market, herding may become a huge problem when managers outside opportunities are unattractive or when compensation depends on performance (Scharfstein & Stein, 1990).

Another main reason of the presence of herding is the reputation preservation. As Rajan (2006) stated, the herd effect can be viewed as "insurance against manager underperformance". Consequently, younger agents are afraid of being fired, so they do not make forecast in which they divert from the usual decisions.

In accordance with Trueman (1994), analysts' compensation can be affected by the understanding of agents' skills. That is why, there are investors who tend to forecast similarly to others who have previously announced their expectations, with the objective of copying abilities and obtaining more compensations, despite the fact that their own private information may not justify such a decision.

Furthermore, herd behavior can be classified as a rational choice when analysts have short horizons. Research carried out by Froot (1992) confirmed that when there are short horizons expectations, investors may herd on the same information, as they will strive to learn what other agents know. When speculators have not long horizons, they may allocate resource in a non-optimal way, which violates informational efficiency as individuals may search only for one source of information instead of several sources (Spyrou, 2013).

It should be taken into consideration informational cascade phenomenon. It occurs when investors follow the actions that other individuals have already done, without considering their own information as it is optimal (Bikhchandani, Hirshleifer, & Welch, 1992). An example can be when an individual enters the market after others, and thus may mimic the trend behavior as previous investors may have more information than he does. It is important to mention that such informational cascades can result in "bubbles", as they may influence the rational behavior of investors. Additionally, in relation to information cascades, Avery and Zemsky (1998) came to the conclusion that when complex structures exist and there is uncertainty, herding can appear, and the creation of price bubbles is possible.

On the other hand, there are other economists who propose that agents act irrationally. Moreover, the presence of this irrationality can lead to phenomena similar to bubbles and the herd effect. It should be added that herd behavior may appear due to psychological stimuli. In fact, Keynes (1936) stated that individuals are influenced by sociological factors, and as a consequence, investors mimic others during episodes of uncertainty.

Other authors, such as Shleifer and Summers (1990), distinguish between arbitrageurs, fully rational investors, and noise traders, irrational agents. These non-rational individuals act when noise appears, and their trading behavior is systematically biased. Moreover, when decision-makers make conjectures with respect to previous decisions, it can be said that judgments are biased (Simonsohn & Ariely, 2008). Finally, the environment can be manipulated by rational investors, thereby influencing other investors (Spyrou, 2013).

Measuring herding has always been a dilemma. There is not a universally accepted methodology so as to detect herding. As a result, conclusions found in the empirical literature cannot be compared as they are not homogenous. It may happen that nonhomogeneous results appear after applying different methodologies (Blasco, Corredor, & Ferreruela, 2016).

Studies on herding have been carried out in a variety of areas. In 2009, Choi and Sias (2009) investigated the herd effect among industries and came into the conclusion that "institutional investors follow each other into and out the same industries". In 2010, Chiang and Zheng (2010) analyzed the herding in the US market. The found out that most individuals, who invest in Latin American markets herd with the US market. Furthermore, crisis provoke herding activity in the crisis country of origin and after that, it generates a contagion effect to the neighboring countries. The study carried out by Demirer, Leggio and Lien (2019) related to the individual stock included in the S&P 500 Index, shows evidence of herd effect over the Flash Crash in 2010. It should be mentioned that Spyrou (2013) carried out a literature review related to herding in financial markets.

Moreover, many authors have studied a new subject which is very popular now: digital currencies. For instance, Bouri, Gupta and Rouband (2019) found evidence of herding behavior in cryptocurrencies and Kyriazis (2020), concluded that empirical findings about whether herd effect is present or not in digital currency markets suggest that herding behavior takes place only in bull markets. In addition, it should be pointed out that during the COVID-19 pandemic, which has increased volatility, there has been a decreasing trend in herding in the cryptocurrency market (Yarovaya, Matkvoskyy, & Jalan, 2021). This conclusion questions the assertion of Zhou and Anderson (2011), which states that during turbulent periods of market, individuals tend to follow others instead of following their own beliefs.

Furthermore, COVID-19 effect has been analyzed deeply. An example of this is the research of Kizys, Tzouvanas and Donadelli (2019) about the effects of the Government Response Stringency Index and the restrictions during the COVID-19. They confirmed the evidence of herd behavior in the first three months of 2020. In 2021, Espinosa-Méndez and Arias (2021) also studied this phenomenon's effect in European capital markets and conclude that COVID-19 has increased the herding behavior. It should be added the study carried out by Bouri, Demirer, Gupta and Nel (2021), as they examined the effect of the coronavirus pandemic on investor herding behavior in global stock markets. They concluded that the herd effect of the uncertianty caused by COVID-19 is particulary pronunced in both emerging stock markets and in the European stock markets of the PIIGS, which comprise some of the European economies heavily affected by the pandemic. Their conclusions suggest that herding depends on the state of development of the economy analyzed.

Even though this study cannot cover everything collected by Spyrou (2013), the different limitations commented in that study will be mentioned. Firstly, it can be affirmed that the empirical evidence is inconclusive due to the diversity of results (Spyrou, 2013). For instance, regarding institutional investing, numerous studies such as Christie and Huang (1995) or Whylie (2005) confirmed the presence of herd behavior, while there are others that found evidence of herding for example in US or in Germany (Walter & Weber, 2006 or Choi & Sias, 2009). In addition, there are authors who affirm the presence of herd behavior in some European markets, while Chang, Cheng and Khorana (2000) concluded that there was no herd effect in US and Hong Kong.

Secondly, there exists limitations in the main empirical methodologies to measure herding (Spyrou, 2013). Maybe this is a possible explanation for the inconclusive empirical evidence commented before. For instance, the methodology designed by Christie and Huang (1995) is able to detect just one herding form, and as a consequence, it does not capture the herd effect in other contexts. Moreover, the Chang, Cheng and Khorana (2000) method does not include the asymmetric effect of the market returns value with its sign, and it may happen that once this element is taken into account as a determinant of CSAD, the significance of the quadratic form disappears. That is a reason why Chiang and Zheng (2010) presented an expanded methodology, with respect with the one proposed by Chang, Cheng and Khorana (2000), which analyzes simultaneously the

interaction between two or more markets. In addition, according to the measure proposed by Lakonishok, Shleifer and Vishny (1992), also called the LSV measure, Lakshman, Basu and Vaidyanathan (2013) suggest that it has some drawbacks such as detecting herding when just small number of agents are active, not distinguishing between investors who follow their beliefs and those who imitate others or the need of very precise information. Furthermore, in relation to this limitation, it is important to point out the heterogeneity of the sectors analyzed, which it is not taken into account most of the time.

Third, another limitation is that there are implications that are difficult to assess empirically with existing databases. There is huge discrepancy among theoretical advances and methodologies which are able to evaluate predictions (Spyrou, 2013). One example is the issue of informational cascades, as there are many theoretical approaches but there are limitations in order to test it as researchers need detailed data. As a result, unless empirical tests are carried out indirectly and with assumptions, it is not a possible to study that. As a result, it is difficult for agents to fully understand the process of herding (Spyrou, 2013).

Fourth, many research do not investigate whether their results are due to spurious or intentional herding (Spyrou, 2013), and some empirical studies do not consider whether the reasons for herding have changed or remain the same.

Finally, studies, which measure "active" herding, do not pay attention to "silence" (herding expressed with an invested decision instead of being shown with an action) or "passive" herding (Spyrou, 2013). For instance, if an investor wants to invest in a share, but before doing so observes that the rest has avoided that investment and consequently does not invest, then this investor individual is herding. Nevertheless, this herd effect is not measured in any empirical study, as there is no data, which makes this measurement difficult.

In order to improve our knowledge on herding, some research about measuring the intensity of herding should be conducted below.

3. DATABASE AND METHODOLOGY

3.1. Database

Our study analyzes thirty-nine countries around the world. For each country, the most representative index of the stock market has been selected. For instance, in the case of Spain, the IBEX35 is the one which is going to be observed, as it is the most representative of the market. The period which is examined is from the 1st of January of 2018 to the 30th of June of 2021. The data has been obtained from a database called DataStream, which comprises the daily prices of these indexes.

These thirty-nine countries may be classified into different groups according to the continent where the country is located. We have distinguished three groups: countries located in America, countries located in Asia and countries located in Europe.

In order to be more specific and to obtain evidence of herding, we have also differentiated inside these three groups. In the case of the database of America, which contains data from Argentina, Brazil, Canada, México, and the United States, we have also carried out the analysis for only North American countries (Canada, México, and the United States). Moreover, Asia databases included information from China, Hong Kong, Indonesia, Japan, South Korea, Philippines, Taiwan and Thailand. However, as from Oceania we only had records from Australia and New Zealand, we have incorporated these two countries to the Asian database. Finally, referring to the European database, it consists of twenty countries such as: Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Portugal, Poland, Romania, Spain, Sweden, Switzerland and United Kingdom. Nevertheless, we have studied diverse combinations of European countries with the main objective of looking for possible herd behavior. These combinations are as follows:

- European countries
- European countries without East European countries.
- European countries which belong to the Eurozone (Austria, Belgium, Finland, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain).
- Only East European countries (Bulgaria, Hungary, Poland, and Romania)
- European countries which have the central European time zone (Austria, Belgium, Denmark, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Spain, Sweden, and Switzerland).

- European countries which belong to the Eurozone and have the central European time zone.

Initially, the data search was carried out in free sources such as Investing or Yahoo Finance. Nevertheless, when collecting the data, some problems appeared. Firstly, in some databases (not in DataStream) there were just data for some specific days. For example, if the DAX, the German index, is closed the 1st of April, there is no row of that day in the databases. Therefore, there were daily data for thirty-nine indexes, but with nonidentical calendar. The main consequence of this obstacle is that we needed to change it one by one so as to be able to compare the data. This is the reason for finally taking the information from Datastream, as this base unifies the information for all markets.

Another concern we found is the presence of several time zones. In other words, the stock market of for example New York does not open at the same moment as the stock market of Hong Kong. Consequently, it is not easy to compare data, especially when you want to observe whether they are following each other. To solve this issue, when comparing world data of the thirty-nine countries, we have taken Europe as reference. As a result, we utilize European data at time t, Asian data at time t+1 and American data at time t-1.

In relation to the reference indexes, for America we have selected the Stoxx America and for North America the Stoxx North America. In addition, for each case, we have computed the return average of those countries and we have made use of it as a reference index. In the case of Asia, the Stoxx Asia Index is the one which has been chosen. Moreover, the return average has been used as well here. Regarding to Europe, three indexes have been applied alternatively. These indexes are MSCI Europe, Stoxx Europe, Euro Stoxx 50 and MSCI World. It should be pointed out the fact that not only the return average has been used, but also the average of the MSCI Europe, the Stoxx Europe and the Euro Stoxx 50. Finally, when analyzing all countries together, MSCI Europe, Stoxx Europe, Euro Stoxx 50, Stoxx Asia, Stoxx America, the return of these five and MSCI World are the ones studied.

3.2. Methodology

To try to find herd behavior in the index market, three different methods are going to be used. It should be mentioned that each one analyzes the data using diverse models and taking into account nonidentical information.

3.2.1. Christie and Huang method (1995)

Christie and Huang (1995) affirm that during periods with high levels of volatility in terms of assets prices, investors ignore their own beliefs and base their decisions on what other agents do. Christie and Huang (1995) proposed a model, which uses the cross-sectional standard deviation (CSSD) of individual returns relative to the market return as the target variable. In other words, CSSD is used as a measure of individual return dispersion. The equation, which shows that, is as follows:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}(R_{i,t} - R_{m,t})^2}{N-1}}$$

Where $R_{i,t}$is the return of stock i at time t and it is estimated as $\ln \frac{(p_{i,t})}{(p_{i,t-1})}$. $R_{m,t}$ is the cross-sectional average return of the N stocks available in the market on time t. To test for the existence of the herd effect during extreme market conditions, a linear regression model is estimated, illustrated in the equation:

$$CSSD_t = \alpha + \beta_1 D_t^L + \beta_2 D_t^U + \varepsilon_t$$

The dummy variables in this regression model are employed as exploratory variables with the main objective of differentiating periods of turbulence from normal periods. It should be mentioned that market stress periods take place when aggregate return are in the upper or lower tails of return distributions (Prosad, Kapoor, & Sengupta, 2012). D^L is a dichotomous variable which takes value 1 if the market return at time t is at the lower extreme of the distribution, and zero otherwise. On the other hand, D^U is defined as a dichotomous variable which takes value 1 if the market return is at the higher extreme of the distribution, and zero otherwise. The coefficient α is defined as the average dispersion of the sample and it excludes the two areas covered by the dummy variables (Duarte-Duarte, Sierra-Suárez, & Garcés-Carreño, 2014). Following this model, the presence of negative values and statistical significance in β_1 and β_2 indicate a decrease of the average dispersion, which suggest the presence of herding.

In this work the active i is taken as the index of a country in an area, trying to analyze the CSSD among the set of indexes in that zone. In other words, the models are described for specific stocks of a market, and in this study the idea is extended by considering each index of a country as if it were a stock.

3.2.2. Chang, Cheng and Khorana's method (2000)

This empirical methodology has the same objective as the previous method: to try to detect the presence of herd behavior. The previous method was based on the cross-sectional standard deviation (CSSD), which can be affected by atypical values.

This approach designed by Chang, Cheng and Khorana in 2000 is based on the cross-sectional absolute deviation of returns (CSAD), which uses the mean of absolute deviations from return, considered the best measure of dispersion. This model analyses how agents tend to follow other investors' beliefs and opinions, instead of following their own ideas. The underlying idea is that the individual return would remain close to the general market return.

Initially, this method is based on Christie and Huang (1995) model. However, they proposed it as a less stringent alternative approach, as it does not limit the detection of herding only to specific moments (high and low ends) and the relationship to be linear. In fact, the model proposed by Chang, Cheng and Khorana (2000) analyzes a non-linear relationship, and that is why, it uses the square of the returns. Therefore, even though both methods are similar in terms of objectives, they do not always draw the same conclusions.

Chang, Cheng and Khorana (2000) declared the equity return dispersion is an increasing function of the market return with a linear relationship, when that dispersion is measured by CSAD.

It should be mentioned that this model is a less intuitive measure in comparison to the previous one. The CSAD is estimated as follows:

$$CSAD_t = \frac{\sum_{t=1}^{N} \left| R_{i,t} - R_{m,t} \right|}{N - 1}$$

Where $R_{i,t}$is the return of stock i at time t and $R_{m,t}$ is the cross-sectional average return of the N stocks available in the market on time t.

There is a parameter in order to identify a possible nonlinearity between the market returns and the dispersion of individual assets returns, which is the quadratic form of $R_{m,t}$ (Correia Lima Signorelli, Camilo-da-Silva, & da Silveira Barbedo, 2020). Moreover, Chang, Cheng and Khorana (2000) stated that when herding arises, in turbulent periods, there is a possibility of a non-proportional increase or decrease in the CSAD parameter with a growth of $|R_{m,t}|$. Nevertheless, when there is no presence of herd effect, the relationship is linear and proportional. They proposed a general quadratic equation to test this behavior and to show the nonlinear relationship between dispersion and return in the market:

$$CSAD_t = \alpha + \gamma_1 |R_{m,t}| + \gamma_2 R_{m,t}^2 + \varepsilon_t$$

According to this model, if the regressor γ_2 is negative and statistically significant, there will be presence of herd behavior, as it means that there is a nonlinear relationship between asset dispersion and market return. The quadratic relation proposes that when $R_{m,t}^* = -(\frac{\gamma_1}{2\gamma_2})$, $CSAD_t$ amounts to its maximum value. This affirmation means that the increase of $R_{m,t}$, over the range where $R_{m,t}$ is lower than $R_{m,t}^*$, $CSAD_t$ tends to go up.

However, if γ_2 is positive (or negative and no significant), there is not presence of herd effect. Additionally, the incrementation of the quadratic terms is so as to make a more sensitive and rigorous model (Correia Lima Signorelli, Camilo-da-Silva, & da Silveira Barbedo, 2020). To apply this model to our data, the same idea proposed in section 3.2.1 is followed.

3.2.3. Chiang and Zheng method (2010)

Chiang and Zheng (2010) presented a model that is similar to the one presented by Chang, Cheng and Khorana (2000). Nevertheless, it has some differences as this new method takes into account not only the absolute value of $R_{m,t}$ and its quadratic form, but also the value of $R_{m,t}$. Consequently, the formula is as follows:

$$CSAD_t = \alpha + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t$$

Where $CSAD_t$ measures the return dispersion, $R_{m,t}$ is the cross-sectional average return of the N stocks available in the market on time t and $|R_{m,t}|$ the absolute term of $R_{m,t}$.

The main advantage of including a new additional variable ($R_{m,t}$) is that the model allows us to observe any variances in the investor's behavior, among different market conditions (Jabeen & Rizavi, 2019). In addition, the sum of variables $\gamma_1 + \gamma_2$ shows the relationship between return dispersion and market return when $R_{m,t} > 0$. On the other hand, $\gamma_2 - \gamma_1$ captures that relation when $R_{m,t} < 0$. Moreover, the ratio of $\frac{\gamma_1 + \gamma_2}{\gamma_2 - \gamma_1}$ can be explained as the asymmetry in relative terns between stock return dispersion and the market's return (Chiang & Zheng, 2010).

In accordance with the theory, when there is an increase in the variable $|R_{m,t}|$, the dispersion in individual assets return has to increase as well. In addition, agents show signs of herd behavior by presenting a similar reacting during changes in the market (Jabeen & Rizavi, 2019). Because of this behavior, the correlation among asset returns increases while the dispersion among return decreases (or increases but at a less-than-proportional rate with the market return). Therefore, the coefficient γ_3 is included and when it is negative and consistent, it can be affirmed that there is presence of herding (Chiang & Zheng, 2010). To apply this model to our data, the same idea proposed in section 3.2.1 is followed.

3.2.4. Hwang and Salmon Method (2004)

This approach proposed by Hwang and Salmon (2004) measures herding according to the cross-sectional dispersion of the factor sensitivity of assets within the given market. This model captures "market-wide herding".

Hwang and Salmon (2004) methodology considers that when agents are motivated by behavioral biases, their risk-return relationships of assets' understanding may be distorted. They proposed a new measure of herding as they proved that in the presence of herding, the equilibrium CAPM relationship do not hold as the beta and the expected return asset are biased. In addition, they assume that when there is herding, the relationship can be expressed as follows:

$$\frac{E_t^b(r_{it})}{E_t(r_{mt})} = \beta_{imt}^b = \beta_{imt} - h_{mt}(\beta_{imt} - 1)$$

Where h_{mt} is a new parameter which changes over time and is conditional on market fundamentals. Moreover, $E_t^b(r_{it})$ and β_{imt}^b are defined as the conditional expectation on returns of asset i at time t, which are biased in the short run.

However, a problem appears as both h_{mt} and β_{imt} are unobserved, and it is difficult to measure them. As a consequence, they realized that they need to calculate herding employing all assets in the market, instead of using just one asset. Moreover, to measure h_{mt}, the cross-sectional dispersion of β_{imt}^b is calculated as follows:

$$Std_c(\beta_{imt}^b) = Std_c(\beta_{imt})(1 - h_{mt})$$

With these assumptions, the authors, using a state-space model, propose the calculation of a parameter H that would represent the measure of herding and which is based on the fact that if there is herding around the market value, the beta will be extremely close to the value 1, i.e. it would behave like the reference index of that market. Although the idea is intuitive, its empirical application is complex as advanced methodologies such as the Kalman filter must be applied. For this reason, even though the essence of the model is presented here theoretically, it has not been used empirically.

4. EMPIRICAL ANALYSIS

After analyzing the data by these different methods explained before, some results are obtained. In addition, some tables have been made in order to show the most significant results and to examine the possible herding effect. As more than one method has been used and there are distinct areas, results will be separated in accordance with the zone (Asia, America, Europe, or World) and the method employed.

The table 1 presents the coefficients obtained after studying the data of Europe, of the European countries which have the central European time zone (Austria, Belgium, Denmark, France, Germany, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Spain, Sweden, and Switzerland) and of the East European countries (Bulgaria, Hungary, Poland, and Romania). The results shown are those obtained with the proposed by Christie and Huang (1995). Additionally, each of the table's rows corresponds to a

specific estimation carried out with various global reference indices for the distinct zones considered, taking into account that closing prices have been used for all markets.

The reason why these results are shown and not the others is that the first intuition is to think that maybe East European countries present herding effect, as they are very similar. Moreover, it can be thought that countries with the same time zone can follow more each other than those countries with different time zone.

As it can be seen, all coefficients are positive. Moreover, the majority of them are statistically significant with a confidence interval of 99%. It should be pointed out that numerous reference indexes have been used, and in spite that, results are still positive. These affirmations suggest that there is no herding effect between the index prices, according to Christie and Huang (1995) methodology. It implies that investors do not copy other agents' actions and that investors follow their own beliefs when making decisions. It can be said that in relation to these results, far from imitating each other, what can be detected is an opposite behavior, since in extreme situations the different indexes of each market move further away from the global reference.

Additionally, as it has been commented before, these are not the only areas studied. There are three other geographic zones examined (European countries without East European countries, European countries that belong to the Eurozone and European countries which belong to the Eurozone and have the central European time zone). The results (Appendix) are very similar to those presented in the table above as all model coefficients are positive and most are statistically significant. Consequently, it can be concluded that according to Christie and Huang (1995) method, there is not presence of herding in Europe in relation to index prices and the period analyzed.

Although the first instinct may be that all models will present similar results and conclusions, the reality is that there are discrepancies between the different methodologies. As will now be analyzed, depending on the model used, there may or may not be evidence of herding behavior in the markets.

The table 2 exhibit the coefficients obtained from the estimation using the Chang, Cheng, and Khorana Model (2000) in the areas of Europe, European countries, which have the central European time zone, and the East European countries. For ease of visibility, only

the estimates based on the global indices are shown. As it can be observed, all squared coefficients in Europe and East European countries areas, which are the quadratic form of $R_{m,t}$, are negative and statistically significant. In addition, both the absolute value of $R_{m,t}$ and the intercept value of the three zones are positive and statistically significant. It should be pointed out that all values are statistically significant with a confidence interval of 99%.

These results commented before suggest that there is presence of herd behavior in the areas of Europe in general and the East European countries. In relation with Europe, it is important to mention that the quadratic coefficient when using the MSCI World as the reference index (-1.14030), is much higher than the other quadratic coefficient when employing the rest reference indexes. Moreover, when analyzing the East European countries, it should be noted that apparently there are differences between the coefficients of the quadratic form of $R_{m,t}$ of East European countries and the coefficients of other areas. However, in order to determine whether this is significantly different, another type of tests would have to be performed.

In reference to the European central countries with the same time zone, its $R_{m,t}^2$ coefficients have a negative value; however, they are not statistically significant using confidence intervals of 99%, 95% and 90%. Consequently, it cannot be affirmed the presence of herding in this area, suggesting that investors do not copy each other's instead of following their own judgments. These results are strange when compared with those of Europe, since this group is more homogeneous and it would be expected that if herding occurs in the European countries, herding would occur more strongly in these countries.

On the other hand, table 3 represents the results obtained with the Chiang and Zheng (1995) methodology in the same three areas. With regard to the results of Europe, the $R_{m,t}^2$ coefficients are all negative. However, only when employing the average return and the MSCI World as benchmarks, these values are statistically significant. In the case of the average return, the confidence interval is 90%, while for MSCI World it is 99%. In addition, the absolute values of $R_{m,t}$ coefficient and the intercept values are all positive and statistically significant. Furthermore, the same is true for the $R_{m,t}$ coefficient, with the exception of the value with MSCI World as the reference index as it is not statistically significant.

In accordance with Central European countries with the same time zone, their $R_{m,t}^2$ are not statistically significant, even though those with MSCI and MSCI World as reference are negative. Moreover, the other coefficients have all positive values and are statistically significant at a 99% confidence interval, results in accordance with those obtained with CCK.

Finally, referring to East European countries, their coefficients of the quadratic form of $R_{m,t}$ are all negative and statistically significant. Additionally, the remaining values have a positive sign and are statistically significant. Overall, they are statistically significant at 99% confidence interval, expect for two coefficients of $R_{m,t}$ that have a 95% and 90% confidence interval. These finding imply that there is herd behavior in East European countries. In other words, agents tend to follow the actions of other individuals rather than making their own decisions.

In view of these results and those of table 2, it is possible that the results observed for Europe as a whole are driven by the herding detected in the East European countries. That is, if herding can be observed for Europe as a whole, taking into account that in Central Europe it is not and that in the Eastern European countries it is, it may be that the result for Europe as a whole is due to the influence that the values of the Eastern European countries may have on the results. To rule out this explanation, looking at the results of Europe without the Eastern countries could shed light on this issue. In the appendix in Tables 10, 11 and 12 this information appears. It is important to note that with the CCK model it is no longer significant, while with CZ it only remains significant with the world index. This indicates that there are indications that the herding detected at the general level in Europe is due to the strength of herding in the eastern countries.

After analyzing Europe, America and Asia need to be studied. The table 4 shows the coefficient corresponding the model proposed by Christie and Huang (1995) for both zones. Firstly, regarding America, it can be observed that all coefficients are positive and most of them statistically significant at 99% confidence interval. It is important to mention that the reference indexes are the Stoxx America and the average of returns. With reference to Asia, results are very similar to those of America. All values have a positive value and statistically significant with a confidence interval of 99%. As a consequence, it

can be affirmed that there is not presence of herding in both zones, America and Asia, according to the Christie and Huang model (1995).

When examining the data with the Chang, Cheng and Khorana (2000) model (table 5), it can be seen that the quadratic form of the $R_{m,t}$ coefficients are negative and statistically significant in both America and Asia. It is important to remark that the results of America have a confidence interval of 90% and 95%, while in Asia have a confidence interval of 99%. In addition, in both America and Asia, coefficients $R_{m,t}$ and α have positive values and are statistically significant. Furthermore, the conclusion to be drawn is that there is presence of herd behavior as $R_{m,t}^2$ coefficients are negative, which implies that investors imitate other agents.

In reference to America, when we analyze the data with the model presented by Chiang and Zheng (2010) (table 6), it can be observed that the coefficient of the absolute value of $R_{m,t}$, the coefficient of $R_{m,t}$, and the intercept value are positive. $R_{m,t}$ coefficient, with Stoxx America as reference index, have a confidence interval of 90%, while the one with the average return as reference index is not statistically significant. On the other hand, values of $|R_{m,t}|$ and α values are statistically significant at 99% confidence interval. Finally, $R_{m,t}^2$ coefficients are negative. However, it should be pointed out that they are not significant, so the presence of herding cannot be proved.

Regarding the data of Asia, it is considerable to mention that both coefficients of $R_{m,t}^2$ are positive. Even though one of the two values is statistically significant at 99% confidence interval, since it is positive, it cannot be demonstrated that there is herding. Furthermore, both $|R_{m,t}|$ and intercept values are positive and statistically significant. Additionally, the coefficient of $R_{m,t}$ with Stoxx Asia as reference index is negative and statistically significant at 95% confidence interval, while the one with the return average as benchmark is positive and is not significant.

Finally, a global analysis of all indexes worldwide is carried out. The table 7 presents the results after examining the data of all the countries together with the Christie and Huang (1995) model. It should be mentioned that there have been used seven different references indexes with two different percentages each of them and that thirty-nine countries have been included in this world database. As the previous findings obtained with this

methodology, all values are positive and statistically significant with a confidence interval of 99%. Furthermore, it can be stated that there is no herding, so investors follow their own beliefs instead of copying other's decisions.

When analyzing the world database according to the Chang, Cheng and Khorana (2000) model, there are multiple aspects to comment. Firstly, the $R_{m,t}^2$ coefficients are all positive. Nevertheless, they have different confidence intervals. The result with Stoxx Europe as reference index is not significant, the one with MSCI Europe has a 95% confidence interval, and the rest of results have a 99% confidence interval. In addition, both the $|R_{m,t}|$ and α coefficients are all positive and statistically significant at 99% confidence interval. Consequently, there is no evidence of herding in the world, in accordance with this model.

Finally, regarding to the model proposed by Chiang and Zheng (2010), all the coefficients of the quadratic form of $R_{m,t}$ are positive. Moreover, not all are statistically significant, in fact, there is a value which is not. It should be noticed that the coefficient of $R_{m,t}^2$ with the MSCI World as benchmark is much higher than the other values. In relation to the absolute term of $R_{m,t}$, all values are positive and statistically significant at 99% confidence interval. In addition, when examining the coefficients of $R_{m,t}$, some of them are negative and others are positive. The ones with negative values are those with the MSCI Europe and the average return as reference indexes. Nevertheless, just the last one is statistically significant (with 99% confidence interval). Furthermore, the intercept values are positive as well as statistically significant. Therefore, it can be affirmed that there is no herding and that the results obtained under the three models confirm this statement.

Although they are not shown, the estimations have been repeated by including a lag of the dependent variable in the estimation to account for possible autocorrelation. The results remain similar to those offered in this study. Therefore, it can be said that taking this aspect into account the results are still robust.

It should be noted that the conclusions of this work follow the line of the work proposed by Bouri, Demirer, Gupta, and Nel (2021), which concludes that herding depends on the level of development of the economy studied. The results of this research indicate that it

is the Eastern European countries the ones that present more signs of herding behavior, and these are the emerging economies regarding Europe. In conclusion, although the work of Bouri, Demirer, Gupta, and Nel (2021) focuses on the European PIIGS stock markets, the results obtained in this study also suggest that herding may depend on the development of the economy of the countries studied.

5. LIMITATIONS

Regarding the limitations of this work, it can be stated that there are several aspects that have limited this study. First, it is important to highlight the type of data employed. In this case, daily data have been used. However, it is possible that the results, and therefore the conclusions, would change if different types of data were utilized. In particular, it would have been interesting to use intra-daily data of index values, in order to have more reliable results. Nevertheless, this option falls outside the scope of the possible workload.

Secondly, in relation to the study, it is important to note that this work has analyzed market indexes. The indexes include different companies in each country and therefore aggregate different sectors, which may dissolve the herding effect. This indicates that if the study had focused on specific sectors of the economy, or on specific companies, it is possible that the results would have been different and there may have been signs of herding behavior.

Thirdly, the study period is also a factor to be taken into account. In this research the time period between the 1st of January of 2018 to the 30th of June of 2021 has been analyzed. Therefore, it is possible that the herding effect would be different if another time period had been studied. It should be noted that the global pandemic of the COVID-19 virus occurred in the period studied, which has had a global influence.

Fourthly, the time zone should also be emphasized. As mentioned in the description of the database, in order to study data from markets all over the world, Europe has been taken as a reference and European data at time t, Asian data at time t+1 and American data at time t-1 have been considered. It is important to mention that this study has solved the problem in this way, but a different solution could have been sought, perhaps a little more precise than the one used, for example, using the simultaneous price at a time.

In addition, fifthly, it should be mentioned that more countries could have been included in the analysis. For example, in Europe, countries such as Ukraine, Croatia, Luxembourg, Lithuania, Estonia and Slovenia, among others, are missing. Moreover, benchmarks other than those used in this analysis could have been included. As a result, the addition of more countries and more benchmarks may lead to different results and conclusions.

Moreover, the model proposed by Hwang and Salmon Method (2004) has not been applied in this study, since, as mentioned above, it was beyond the analysis capabilities of this degree project.

Additionally, with respect to the identification of the herding effect, there are two clear limitations. The first one is that it is very difficult to detect herding behavior in a market if there are few agents imitating each other. This is why sometimes, even though the results show that the coefficients are not negative and statistically significant, there may be indications of a possible herding effect. Secondly, as discussed, it can be seen that the different models do not give a uniform conclusion. In other words, each model gives a conclusion that does not necessarily agree with other models. To conclude, it is best to rely on the model that is most complete, therefore, on the model of Chiang and Zheng (2010).

6. CONCLUSIONS

Thirty-nine countries around the world have been analyzed in this study, therefore thirty-nine indexes, considered the most representative of each country chosen, have been used for this purpose. The analysis attempts to capture the herding effect, i.e. whether investors have actually imitated other individuals when making decisions, instead of following their own instincts, in the time period from the 1st of January of 2018 to the 30th of June of 2021. To measure herding, three different models (proposed by Christie and Huang (1995), by Chang, Cheng, and Khorana (2000) and by Chiang and Zheng (2010)) have been carried out.

It should be pointed out that these models do not have a similar conclusion as its results differ in some cases. As for Europe, according to the CCK and CZ models (with MSCI as the reference index), the presence of herding can be affirmed in this area. However, the CH model suggests that there is no herding. On the other hand, in the index markets

of Eastern European countries, the herding effect is observed according to the CCK and CZ models, while the CH model concludes that investors do not imitate each other. Finally, in relation to European countries with the same time zone, all three models state that there is no herding effect. This statement may be surprising, as it is to be expected that, if there is herding in Europe, among countries with the same time zone there is also a herding effect. As mentioned above, a possible explanation for this is that the results for Europe as a whole are driven by the herding detected in the eastern countries.

In relation to Asia, both the CH model and the CZ model suggest that agents in these markets do not follow each other, since they deny the presence of herding. Nevertheless, it is important to mention that the CCK model shows that there is a herding effect in Asia. The same is true for the Americas, as both the CH and CZ models confirm that there is no herding in this continent, while the CCK model finds sufficient evidence to confirm a herding effect.

Finally, when analyzing all countries at the same time, all the models present results that indicate that there is no herding, since the coefficients are not positive and statistically significant, suggesting that agents do not follow each other when making decisions.

As it can be seen, the conclusions vary quite a lot depending on which model the calculations have been performed with. Consequently, our results and conclusions are not entirely reliable as many of them contradict each other, in other words, they are less robust. However, for example, in the case of European countries with the same time zone, or the world as a whole, the absence of herding can be affirmed since all models suggest that. To further investigate what happens, it would be a desirable option to carry out the model proposed by Hwang and Salmon (2004), in order to see what the results of their method suggest, since it is the most different, and the only one that has not been conducted in this study.

To conclude, I would like to emphasize that after conducting this work I consider that I have developed different competences. First of all, this project has helped me to improve my reading comprehension skills, since I have had to read and summarize different studies carried out so far. It has also helped me to enhance my written communication in English, as well as to organize myself during the semester, since I am taking simultaneously several subjects. However, if I had to highlight something in particular, I

would definitely mention that this final degree project has been a personal challenge, in which I have had to adapt to different problems, which has helped me to develop my critical and above all self-critical capacity.

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Table 1: Own elaboration. Results of Europe using Christie and Huang Model (1995)

	EUROPE			CENTRAL EUROPE+TIME ZONE			EAST EUROPE		
	α	β_1	β_2	α	β_1	β_2	α	β_1	β_2
MSCI 5%	0.00708***	0.00678***	0.00630***	0.00657***	0.05290***	0.00528***	0.00959***	0.01112***	0.00995***
MSCI 1%	0.00756***	0.01500***	0.01252***	0.00686***	0.01288***	0.01057***	0.01025***	0.01822***	0.02003***
STOX EUROPE 600 5%	0.00652***	0.00591***	0.00552***	0.00591***	0.00453***	0.00461***	0.00928***	0.00989***	0.00967***
STOX EUROPE 600 1%	0.00683***	0.01416***	0.01117***	0.00616***	0.01203***	0.00878***	0.00988***	0.01849***	0.01772***
EURO STOXX 50 5%	0.00680***	0.00761***	0.00737***	0.00613***	0.00579***	0.00627***	0.00972***	0.01325***	0.01288***
EURO STOXX 50 1%	0.00722***	0.01513***	0.01713***	0.00643***	0.01329***	0.01586***	0.01056***	0.01912***	0.02657***
AVERAGE 5%	0.00657***	0.00641***	0.00601***	0.00595***	0.00473***	0.00487***	0.00937***	0.01076***	0.01093***
AVERAGE 1%	0.00694***	0.01385***	0.01103***	0.00622***	0.02339***	0.00927***	0.01020***	0.01614***	0.01868***
AVERAGE RETURN 5%	0.00610***	0.00572***	0.00600***	0.00582***	0.00466***	0.00493***	0.00642***	0.00842***	0.00701***
AVERAGE RETURN 1%	0.00643***	0.01304***	0.01192***	0.00588***	0.01230***	0.01244***	0.00692***	0.01450***	0.01142***
MSCI WORLD 5%	0.00800***	0.00977***	0.00830***	0.00777***	0.00862***	0.00774***	0.00939***	0.01390***	0.01262***
MSCI WORLD 1%	0.00850***	0.01805***	0.02122***	0.00820	0.01801	0.02056	0.01018***	0.02213***	0.03052***

Table 2: Own elaboration. Results of Europe using Chang, Cheng and Khorana Model (2000)

	EUROPE			CENTRAL EUROPE+TIME ZONE			EAST EUROPE		
	α	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$	α	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$	α	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$
MSCI	0.00406***	0.24197***	-0.26960*	0.00397***	0.19976***	-0.20697	0.00478***	0.42692***	-1.06487***
STOX EUROPE 600	0.00371***	0.21416***	-0.34702**	0.00353***	0.16828***	-0.00728	0.00488***	0.40284***	-1.61262***
EURO STOXX 50	0.00361***	0.25085***	-0.40050***	0.00344***	0.19099***	-0.06728	0.00462***	0.48678***	-2.87551***
AVERAGE	0.00369***	0.21698***	-0.25365*	0.00351***	0.16900***	-0.03710	0.00480***	0.42159***	-1.48200***
AVERAGE RETURN	0.00356***	0.23398***	-0.56852***	0.00334***	0.17672***	-0.13230	0.00335***	0.41995***	-2.16895***
MSCI WORLD	0.00451***	0.39543***	-1.14030***	0.00466***	0.33861***	-0.45428	0.00447***	0.58477***	-2.16690***

Table 3: Own elaboration. Results of Europe using Chiang and Zheng Model (2010)

	EUROPE				CENTRAL EUROPE+TIME ZONE				EAST EUROPE			
	α	$R_{m.t}$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$	α	$R_{m.t}$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$	α	$R_{m.t}$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$
MSCI	0.00405***	0.01166***	0.24132***	-0.19517	0.00396***	0.01535**	0.19891***	-0.10897	0.00477***	0.02724**	0.42540***	-0.89093***
STOX EUROPE 600	0.00370***	0.01764***	0.21257***	-0.21167	0.00352***	0.01779***	0.16667***	0.129224	0.00486***	0.04186***	0.39906***	-1.291517***
EURO STOXX 50	0.00360***	0.02521***	0.24725***	-0.22575	0.00344***	0.02521***	0.18738***	0.107499	0.00461***	0.04835***	0.47987***	-1.540333***
AVERAGE	0.00368***	0.01833***	0.21546***	-0.12648	0.00350***	0.01984***	0.16736***	0.100516	0.00478***	0.04232***	0.41809***	-1.188370***
AVERAGE RETURN	0.00356***	0.02343***	0.23092***	-0.34387*	0.00334***	0.02372***	0.17345***	0.080834	0.00335***	0.02837*	0.41412***	-1.780807***
MSCI WORLD	0.00451***	0.00418	0.03946***	-0.10724***	0.00466***	0.00014	0.33858***	-0.45315	0.00447***	0.02465**	0.54405***	-1.971915***

Table 4: Own elaboration. Results of America and Asia using Christie and Huang Model (1995)

	AMERICA		
	α	β_1	β_2
STOXX AMERICA 5%	0.00989***	0.01198***	0.00939
STOXX AMERICA 1%	0.01038***	0.02924***	0.02774***
AVERAGE RETURN 5%	0.00707***	0.00945***	0.00732***
AVERAGE RETURN 1%	0.00746***	0.02766***	0.01614***
	ASIA		
	α	β_1	β_2
STOXX ASIA 5%	0.00795***	0.00935***	0.00649***
STOXX ASIA 5%	0.00844***	0.01596***	0.01351***

Table 5: Own elaboration. Results of America and Asia using Chang, Cheng and Khorana Model (2000)

	AMERICA		
	$Intercept$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$
STOXX AMERICA	0.00406***	0.24197***	-0.26960*
AVERAGE RETURN	0.00371***	0.21416***	-0.34702**
	ASIA		
	$Intercept$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$
STOXX ASIA	0.00356***	0.23398***	-0.56852***
RETURN AVERAGE	0.00451***	0.39543***	-1.14030***

Table 6: Own elaboration. Results of America and Asia using Chiang and Zheng Model (2010)

	AMERICA			
	$Intercept$	$R_{m.t}$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$
STOXX AMERICA	0.00593***	0.02083*	0.33525***	-0.09475
AVERAGE RETURN	0.00523***	0.01994	0.45135***	-0.35989
	ASIA			
	$Intercept$	$R_{m.t}$	$\lvert R_{m.t}\rvert$	$R^2_{m.t}$
STOXX ASIA	0.00448***	-0.01838**	0.27941***	2.62413***
RETURN AVERAGE	0.00478***	0.01253	0.35092***	1.06125

Table 7: Own elaboration. Results of the World using Christie and Huang Model (1995)

	WORLD		
	α	β_1	β_2
MSCI EUROPE 5%	0.00967***	0.01377***	0.01057***
MSCI EUROPE 1%	0.01035***	0.03169***	0.02103***
STOX EUROPE 600 5%	0.00930***	0.01363***	0.01120***
STOX EUROPE 600 1%	0.01000***	0.03067***	0.02286***
EURO STOXX 50 5%	0.00967***	0.01516***	0.01285***
EURO STOXX 50 1%	0.01043***	0.03348***	0.03048***
STOXX ASIA 5%	0.01032***	0.01441***	0.01008***
STOXX ASIA 1%	0.01108***	0.02488***	0.02054***
STOXX AMERICA 5%	0.01087***	0.02591***	0.02049***
STOXX AMERICA 1%	0.01202***	0.05807***	0.05694***
AVERAGE 5%	0.00893***	0.01123***	0.00625***
AVERAGE 1%	0.00944***	0.01964***	0.01646***
MSCI WORLD 1%	0.00968***	0.01526***	0.01416***
MSCI WORLD 5%	0.01044***	0.03454***	0.03563***

Table 8: Own elaboration. Results of the World using Chang, Cheng and Khorana Model (2000)

	WORLD		
	$Intercept$	$\|R_{m.t}\|$	$R^2_{m.t}$
MSCI EUROPE	0.00473***	0.43123***	0.44650**
STOX EUROPE 600	0.00457***	0.42297***	0.43382
EURO STOXX 50	0.00448***	0.44716***	0.41191***
STOXX ASIA	0.00555***	0.42731***	5.15132***
STOXX AMERICA	0.00473***	0.67980***	2.09254***
AVERAGE	0.00473***	0.42293***	0.77948***
MSCI WORLD	0.00490***	0.50236***	1.02675***

Table 9: Own elaboration. Results of the World using Chiang and Zheng Model (2010)

	WORLD			
	$Intercept$	$R_{m.t}$	$\|R_{m.t}\|$	$R^2_{m.t}$
MSCI EUROPE	0.00474***	-0.00427	0.43147***	0.41922*
STOX EUROPE 600	0.00457***	0.00614	0.42241**	0.48095*
EURO STOXX 50	0.00448***	0.01686**	0.44475***	0.52877**
AVERAGE	0.00473***	0.01526	0.67734***	2.18290***
AVERAGE RETURN	0.00475***	-0.03786***	0.42581***	0.42061
MSCI WORLD	0.00489***	0.03222***	0.49619***	1.28158***

8. APPENDIX

Table 10: Own elaboration. Results of Europe using Christie and Huang Model (1995)

	EUROPE WITHOUT EAST			EUROZONE			EUROZONE+TIME ZONE		
	α	β_1	β_2	α	β_1	β_2	α	β_1	β_2
MSCI 5%	0.00648***	0.00574***	0.00541***	0.00644***	0.00537***	0.00540***	0.00557***	0.00430***	0.00445***
MSCI 1%	0.00678***	0.01468***	0.01045***	0.00672***	0.01454***	0.01038***	0.00579***	0.01225***	0.00873***
STOX EUROPE 600 5%	0.00580***	0.00493***	0.00443***	0.00581***	0.00505***	0.00442***	0.00474***	0.00415***	0.00392***
STOX EUROPE 600 1%	0.00665***	0.00977***	0.01284***	0.00604***	0.01539***	0.00923***	0.00494***	0.01393***	0.00658***
EURO STOXX 50 5%	0.00606***	0.00607***	0.00605***	0.00584***	0.00537***	0.00495***	0.00455***	0.00375***	0.00369***
EURO STOXX 50 1%	0.00637***	0.01430***	0.01507***	0.00610***	0.01361***	0.01182***	0.00471***	0.01097***	0.00931***
AVERAGE 5%	0.00585***	0.00532***	0.00471***	0.00575***	0.00499***	0.00443***	0.00463***	0.00362***	0.00352***
AVERAGE 1%	0.00612***	0.01367***	0.00895***	0.00601***	0.01351***	0.00797***	0.00480***	0.01173***	0.00591***
AVERAGE RETURN 5%	0.00548***	0.00468***	0.00497***	0.00516***	0.00451***	0.00512***	0.00400***	0.00305***	0.00416***
AVERAGE RETURN 1%	0.00576***	0.01062***	0.00915***	0.00545***	0.00996***	0.00976***	0.00420***	0.00980***	0.00590***
MSCI WORLD 5%	0.00773***	0.00891***	0.00739***	0.00781***	0.00901***	0.00730***	0.00727***	0.00831***	0.00758***
MSCI WORLD 1%	0.00817***	0.01746***	0.01955***	0.00825***	0.01700***	0.01952***	0.00770***	0.01670***	0.01988***

Table 11: Own elaboration. Results of Europe using Chang, Cheng and Khorana Model (2000)

	EUROPE WITHOUT EAST			EUROZONE			EUROZONE+TIME ZONE		
	$Intercept$	$\|R_{m.t}\|$	$R^2_{m.t}$	$Intercept$	$\|R_{m.t}\|$	$R^2_{m.t}$	$Intercept$	$\|R_{m.t}\|$	$R^2_{m.t}$
MSCI	0.00388***	0.19573***	-0.07078	0.00378***	0.19843***	-0.41857**	0.00338***	0.17216***	-0.45426**
STOX EUROPE 600	0.00342***	0.16699***	-0.03062	0.00332***	0.16813***	-0.10682	0.00281***	0.13432***	0.28897
EURO STOXX 50	0.00336***	0.19187***	-0.02175	0.00323***	0.16245***	-0.14726***	0.00270***	0.10909***	0.13190
AVERAGE	0.00342***	0.16582	0.05244	0.00329***	0.15711***	-0.14728	0.00276***	0.11976***	0.02818
AVERAGE RETURN	0.00325***	0.16886	-0.03133	0.00306***	0.15063***	-0.07656	0.00245***	0.10786***	-0.02656***
MSCI WORLD	0.00452***	0.35709***	-0.88364**	0.00450***	0.36591***	-1.11070**	0.00435***	0.33528***	-0.64553

Table 12: Own elaboration. Results of Europe using Chiang and Zheng Model (2010)

	EUROPE WITHOUT EAST				EUROZONE				EUROZONE+TIME ZONE			
	$Intercept$	$R_{m.t}$	$\|R_{m.t}\|$	$R^2_{m.t}$	$Intercept$	$R_{m.t}$	$\|R_{m.t}\|$	$R^2_{m.t}$	$Intercept$	$R_{m.t}$	$\|R_{m.t}\|$	$R^2_{m.t}$
MSCI	0.00387***	0.00776*	0.19530***	-0.02123	0.00337***	0.00731**	0.19802***	-0.37187**	0.00337***	0.00638**	0.17180***	-0.41350**
STOX EUROPE 600	0.00341***	0.01159*	0.16595***	0.05829***	0.00332***	0.00659	0.16753***	-0.05628	0.00280***	0.00227	0.13412***	0.30636
EURO STOXX 50	0.00335***	0.01942***	0.18909***	0.10290	0.00323***	0.01432**	0.16040***	-0.04809	0.00270***	0.00958*	0.10773***	0.10831
AVERAGE	0.00341***	0.01233**	0.16480***	0.13899	0.00329***	0.00928	0.15634***	-0.08287	0.00276***	0.00569	0.11928***	0.06768
AVERAGE RETURN	0.00325***	0.01688***	0.16658***	0.11822	0.00306***	0.01265**	0.14890***	0.02210	0.00245***	0.01189**	0.10625***	0.04878 ***
MSCI WORLD	0.00453***	-0.00094	0.03573***	-0.89107**	0.00450***	-0.00446	0.36677***	-1.14599***	0.00435***	-0.00794	0.33680***	-0.70833