U.PORTO

FEP FACULDADE DE ECONOMIA
UNIVERSIDADE DO PORTO

The impact of cultures and religions in herding behaviour - A stock markets analysis before and during Covid-19 crisis.

Jéssica Alexandra Rodrigues Cardoso

Dissertation
Master in Finance

Supervised by
Jorge Bento Ribeiro Barbosa Farinha

2023

Abstract

Herding behaviour in financial markets has been a subject of growing interest within the academic community. Herding behaviour occurs when investors disregard their own market analysis and beliefs to mimic the strategies of other investors.

This dissertation aims to assess whether the uncertainty brought by the Covid-19 pandemic affected herding behaviour in international equity markets and the impact of culture and religion on adopting this behaviour.

Our empirical results reveal that during the Covid-19 pandemic, more developed countries copied the strategies of other investors. In contrast, the number of developing countries exhibiting herding behaviour remained consistent before and during the pandemic. Moreover, we found evidence that some cultural dimensions significantly influence herding behaviour. Before the pandemic, we observed that collectivist societies are more prone to imitate the strategies of other investors, and the 'power distance index' positively influences herding behaviour, meaning that societies that better accept hierarchies and unequal power distribution tend to exhibit herding behaviour. During the pandemic, only the masculinity index prove significant, indicating that societies with values of caring and nurturing show a greater tendency to mimic the market than more assertive and competitive societies. On the other hand, our study suggests that religion does not influence herding behaviour in financial markets.

This research provides valuable insights for investors, portfolio managers, and market regulators, allowing a deeper understanding of market dynamics and, therefore, adapting investment strategies according to cultural characteristics and the economic context.

Keywords: Herding Behaviour; Covid-19 pandemic; Culture; Religion; Hofstede variables; Developed markets; Developing markets.

Resumo

O ´herding behaviour' (comportamento em manada) nos mercados financeiros tem sido objeto de crescente interesse por parte da comunidade académica. Considera-se herding behaviour quando os investidores ignoram as suas próprias análises do mercado para copiar as estratégias de outros investidores.

Esta dissertação pretende avaliar de que forma a pandemia do Covid-19 afetou o herding behaviour no mercado de ações a nível internacional, e qual o impacto da cultura e religião na adoção desse comportamento.

Os nossos resultados empíricos revelam que durante a pandemia do Covid-19 houve mais países desenvolvidos a copiarem estratégias de outros investidores, enquanto o número de países em desenvolvimento a exibirem herding behaviour manteve-se constante nos dois períodos. Para além disso, provámos que algumas dimensões culturais influenciam significativamentte o herding behaviour. Antes da pandemia, observámos que sociedades coletivistas têm maior tendência para imitar as estratégias de outros investidores e que o 'power distance index' influencia positivamente o herding behaviour, ou seja sociedades que aceitam melhor as hierarquias e a divisão desigual do poder tendem a exibir herding behaviour. Durante a pandemia apenas o índice de masculinidade mostrou-se significativo, evidenciando que sociedades com valores de preocupação e de encorajamento para com os outros apresentam maior tendência para imitarem o mercado do que sociedades mais assertivas e competitivas. Por outro lado, o nosso estudo indica que a religião não influência significativamente o herding behavior nos mercados financeiros.

Esta pesquisa oferece informações importantes para investidores, gestores de portfólios e reguladores de mercados, permitindo uma compreensão mais profunda das dinâmicas de mercado e a adaptação de estratégias de investimento de acordo com as características culturais e o contexto econômico.

Keywords: Efeito manada; Pandemia do Covid-19; Cultura; Religião; Variáveis de Hofstede; Mercados desenvolvidos; Mercados em desenvolvimento.

Index

List of Tables

List of Figures

1. Introduction

The uncertainty brought by the Covid-19 pandemic affected the global economy and, therefore, the stock markets. With the Covid-19 pandemic, there was a significant increase in the price volatility and return predictability of stock markets, creating market inefficiencies. (Hong, Bian, & Lee, 2021) Indeed, some studies have shown that the rise in the growth rate of Covid-19 cases amplified volatility while reducing market returns. (Chatjuthamard, Jindahra, Sarajoti, & Treepongkaruna, 2021).

The financial market instability can generate different reactions in investors because market participants have heterogeneous expectations. Moreover, the fact that individuals are influenced by external factors, together with the assumption that investors do not always make rational decisions (due to behavioural biases), raises some questions about how investors reacted under the scenario of market stress caused by Covid-19.

One of the biases that have drawn the attention of many scholars is herding behaviour. Investors suffer from herding behaviour when individuals dismiss their own information and beliefs to trade in the same direction as their peers, even if they disagree with it. Various authors have found evidence of herding behaviour in financial markets; however, there is still no consensus in the literature about whether investors herd during market stress periods or trade under their own information.

As mentioned, individuals' decisions are impacted by external factors, as is the case of national cultures and religions. Several scholars studied the impact of cultures in the decision-making process of investors, indeed some of them investigated explicitly the influence of the cultures in herding behaviour, revealing that cultures can significantly affect herding. However, few studies were made to study the influence of both national cultures and religion on herding behaviour in stock markets. Moreover, as individuals from different religions and cultures have different perceptions, it is interesting to study how people with different backgrounds reacted to the uncertainty of the 2020 pandemic.

For this purpose, we followed the same approach conducted by Chang & Lin (2015), dividing our study into two moments. In the first moment, we studied if there is herding behaviour in international stock markets, analyzing the impact and significance of the quadratic mean of the stock returns in the cross-sectional absolute deviation (CSAD) of market returns

before and during Covid-19 pandemic. In the second moment, we investigated whether the 6 Hofstede cultural dimensions (power distance, uncertainty avoidance, individualism, masculinity, long-term orientation, and indulgence) affect the presence of herding behaviour. As there is still no consensus regarding how religions can impact investors' decision-making, we also studied whether the countries' official religions influence herding behaviour. This research covers 44 stock markets from 2011 to 2021, which includes almost two years under the Covid-19 crisis.

Following this context, this dissertation seeks to contribute to the existing body of knowledge on this topic, using a more recent period and providing more updated results while studying whether previous findings of evidence of herd behaviour in markets hold for 2011 to 2021. Moreover, our period includes the Covid-19 crisis, which will contribute to the existing literature on how investors behaviour during uncertainty periods. Finally, we also intend to study whether national cultures and religions impact the new results regarding herding behaviour in international stock markets.

2. Literature Review

2.1 Herding

Conventional valuation models assume that investors are entirely rational; however, in recent years, several studies conducted in the behavioural finance fields show that investors do not always make rational decisions, suffering from different behavioural biases. Indeed, some literature suggests that individuals can exhibit herding behaviour in their financial decisions.

Herding behaviour is the tendency of individuals to copy the same trading decisions of their peers. Additionally, an investor herd when he is predisposed to dismiss his beliefs to follow the herd opinion, even when he does not agree with it. (Vieira & Pereira, 2015) Likewise, Nofsinger and Sias (1999) described herding behaviour as "groups of investors buying (or selling) the same stock over a period of time"(p.3). In 1996, Devenow and Welch (1996) distinguished between two types of herding behaviour: rational and non-rational. The non-rational approach centers on investor psychology, where investors blindly follow their peers and neglect rational analysis. The rational approach focuses on the intermediate view, in which it is assumed that rational herding can be due to three effects: payoff externalities, principal-agent problems, and informational externalities (cascades). Payoff externalities cause herding when "the payoffs to an agent adopting an action increases in the number of agents adopting the same action" (Devenow & Welch, 1996, p. 605). The principal-agent problem states that to preserve or gain status when there is information asymmetries in the market, managers tend to "hide in the herd" in order to do not be assessed, or to "ride the herd" to prove excellence. Informational externalities (cascades) defend that later investors, collecting information from the strategies used by prior investors, decide to ignore their own information and copy their peers's actions. (Devenow & Welch, 1996)

According to Lobão & Serra (2002), herding behaviour cannot be broadly defined as the correlation in investors' behaviour; instead, it should be limited to the correlation in trades resulting from interactions between investors, in particular by copying or imitation. This narrower definition is important because a group of investors trading in the same direction in the same period does not necessarily imply that investors are coping their peers' strategies, those investors can only be basing their opinion on the same information. Similarly, low dispersions in asset returns do not necessarily mean that the market has no herding

behaviour. For instance, "the lack of new information during a trading interval would generate low dispersion, even in the complete absence of herd formation" (Christie & Huang, 1995, p. 32).

It is also essential to highlight the difference between intentional herding and "spurious herding". Intentional herding is the obvious intent to copy other investors' strategies. In contrast, "spurious herding" refers to groups that trade in the same direction because they face similar decision-making challenges and have access to the same information, leading to making the same decision as their peers. While intentional herding is not necessarily efficient, "spurious herding" is an efficient outcome. Although making this distinction is important, it is difficult to distinguish intentional herding from "spurious herding" in practice since an investment decision can be affected by several factors. (Bikhchandani & Sharma, 2000)

2.2 Herding behaviour in financial markets

Several studies were conducted to detect herding behaviour in financial markets. Christie and Huang (1995) suggested that as individuals tend to "suppress their own beliefs in favour of the market consensus, during periods of unusual market movements, herd behaviour would most likely emerge during periods of market stress"(p.32). Thus, adopting the herding behaviour approach, the dispersion of returns is expected to be lower in cases of market consensus. However, rational asset pricing models offered a different expectation for the behaviour of dispersions during market stress times. These models expect that in large variations in the market returns, when stocks differ in their sensitivity to market movements, individual returns move away from the market returns, increasing the dispersion. (Christie & Huang, 1995) With their study, Christie and Huang (1995) concluded that there was no evidence of herding during the periods of market stress in the returns of NYSE and Amex firms between 1925 and 1988.

Although Chang, Cheng and Khorana (2000) observed no evidence of herding behaviour in the United States and Hong Kong's equity markets, during 1963-1997, they detected herding behaviour in South Korea and Taiwan, and partial herding in Japan. Later, Chiang and Zheng (2010) found significant evidence of herding behaviour between May 1988 and April 2009 in advanced stock markets (Australia, France, Germany, Hong Kong, Japan, and UK) and in Asian markets (China, South Korea, Taiwan, Indonesia, Malaysia, Singapore, and Thailand),

however it did not find any evidence of herding behaviour for US (advanced stock market) and Latin America markets (Argentina, Brazil, Chile, and Mexico). Contrarily results were found by Bensaida and Jlassi (2014), who detected herding behaviour in the United States financial markets between the 2000-2012 period. In 2015, Chang and Lin investigated the 1965-2011 period in 50 countries, stating that only 18 stock markets had significant herding behaviour, including Australia, Austria, Chile, Hong Kong, Hungary, Ireland, Japan, Malaysia, Poland, Portugal, Switzerland, Taiwan, Thailand, Turkey, the UK, the US, and Venezuela.

Luong and Luu (2020) showed that herding behaviour can vary between industries, and industries respond differently to market fluctuations and situations of crisis. These scholars documented herding behaviour in some Taiwanese and Vietnamese industries and reported that herding has a greater impact in industries than in the aggregated market.

There are already some studies made for the period of Covid-19 crisis. Aziz, Jalan, Matkovskyy and Bouraoui (2021) detected herding behaviour in the global energy market between April 2019 and April 2020. The authors reported no significant changes in herding behaviour during the Covid-19 crisis in that sector. Furthermore, Donadelli, Kizys and Tzouvanas (2021) studied 72 stock markets and documented evidence of herding behaviour during the first quarter of 2020. Additionally, Donadelli, Kizys and Tzouvanas (2021) found that "a more stringent government response to the coronavirus crisis mitigates investor behaviour"(p.9). When analyzing the green cryptocurrency market, Lobão (2022) found that herding behaviour increased among investors during the Covid-19 pandemic between January 2021 and June 2022. The same conclusion was reached by Espinosa-Méndez & Arias (2020) when studying herding behaviour in the stock exchanges of France, Germany, Italy, United Kingdom, and Spain before and during Covid-19. Bogdan, Suštar, & Draženović (2022) obtained similar results: the authors did not find herding behaviour prior to the Covid-19 pandemic in any of the countries studied, however during Covid-19 the results indicate the appearance of herding behaviour in emerging and frontier markets, while developed countries continued without showing herding behaviour. Market liquidity, stability and transparency can cause different results between market groups. Less developed countries have lower liquidity and are less stable; these markets are riskier, making the environment more conducive to herding behaviour among investors. Additionally, less developed markets

often lack transparency; when investors have access to less information, they tend to question their own assessments and follow others. (Bogdan, Suštar, & Draženović, 2022)

Contrary conclusions were taken by Ferreruela and Mallor (2021). These scholars reported that although there was evidence of herding behaviour before and after the 2008 crisis and before the Covid-19 crisis in Portugal and Spain, there was no evidence of herding behaviour during the 2008 crisis and the Covid-19 pandemic. These findings suggest that investors negotiate under their own information in periods of crisis.

2.3 Culture

Several external factors influence investors' behaviour, as is the case of national culture.

Culture can be defined as "those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation". (Guiso, Sapienza & Zingales, 2006, as cited in Matters, 2008) Professor Geert Hofstede, a renowned scholar in intercultural research and studies, gives another definition. Hofstede (2011) classified culture as "the collective programming of the mind that distinguishes the members of one group or category of people from others"(p.3). With his various studies, Hofstede reached six dimensions to classify national cultures: Power Distance, Uncertainty Avoidance, Individualism versus Collectivism, Masculinity versus Femininity, Long Term versus Short Term Orientation, and Indulgence versus Restraint. (Hofstede, 2011) Following is the description of each dimension according to Hofstede (2011).

Power Distance dimension is defined as the degree to which the less powerful individuals of groups/institutions accept and expect that power is allocated unequally.

Uncertainty avoidance measures society's tolerance for ambiguity, indicating how comfortable or uncomfortable the individuals are in unstructured situations. Therefore, uncertainty-avoiding cultures seek to reduce uncertainty situations through strict social codes, laws and rules, the disapproval of different beliefs, and by defending one absolute Truth.

Individualism vs Collectivism dimension is the extent to which the members of a society are integrated into groups. Individual cultures have weaker ties between the members ("everyone

is expected to look after him/herself and his/her immediate family"). On the other hand, people from collectivist cultures are expected to be integrated into "strong, cohesive in-groups, often extended families (…) that continue protecting them in exchange for unquestioning loyalty, and oppose other in-groups". (Hofstede, 2011, p. 11)

Masculinity vs Femininity index describes the distribution of values between the genders. In this dimension, masculinity represents assertive and competitive values, whilst femininity represents modest and caring values. Moreover, Hofstede (2011) suggests that women in nations with a higher femininity degree have the same modest, caring values as men, however, in masculine countries, women are assertive and competitive, but not as much as men.

Concerning Long-Term vs Short-Term orientation, countries with long-term oriented cultures have values such as "perseverance, thrift, ordering relationships by status, and having a sense of shame". In contrast, short-term oriented cultures have values like "reciprocating social obligations, respect for tradition, protecting one's 'face', and personal steadiness and stability". (Hofstede, 2011, p. 13)

Finally, the sixth dimension Indulgence vs Restraint is related to happiness. Countries with high levels of indulgence allow "relatively free gratification of basic and natural human desires related to enjoying life and having fun", on the contrary, restraint cultures are used to describe societies that restraint gratification of needs and control it with strict social norms. (Hofstede, 2011, p. 15)

Hofstede's cultural dimensions allow us to "measure" the countries' culture and are an important contribution to the development of studies related to the culture factor. Indeed, these dimensions seem to have much acceptability, considering that several scholars conduct their research based on these findings, as was the case of Chui, Titman and Wei (2010), who stated that culture has a significant influence on stock returns, because distinct cultures interpret information in different ways and are exposed to different biases. Therefore, these scholars observed that in less individualistic societies, people give less importance to their own information and more weight to reach a consensus with their peers.

Moreover, Amirhosseini and Okere (2012) concluded that power distance, masculinity and uncertainty avoidance influence investment decisions. Furthermore, the authors stated that investors in Iran, a collectivistic nation, follow market trends since collectivist societies are

associated with loyalty, promoting stronger relationships. Also, the individualism dimension impacts how people learn, being that investors are more willing to learn from others in collectivistic cultures.

Almeida Ferreira Maio (2014) also showed that countries with a higher level of masculinity and power distance are less susceptible to herd around the market.

Chang and Lin (2015) stated that four of the five countries with Confucian culture exhibited herding behaviour in their stock markets, suggesting a connection between individuals from Confucian cultures and herding behaviour. Besides, Chang and Lin (2015) found evidence in other countries indicating that cultural dimensions, such as power distance, individualism, and masculinity, impact the presence of herding behaviour in financial markets.

Kristjánsdóttir, Guðlaugsson, Guðmundsdóttir, and Aðalsteinsson (2017) studied the influence of national cultures in 21 countries between 2000 and 2011. Kristjánsdóttir et al. (2017) stated that overall, national cultures influence countries' international trade. However, when the authors evaluated the impact of each Hofstede dimension, they concluded that only the Masculinity dimension had a significant impact on the international trade of nations, showing that countries with high levels of masculinity are more willing to import foreign goods, and also "these countries tend to value competitiveness, assertiveness, ambition, as well as the accumulation of wealth and material possessions". (Kristjánsdóttir et al., 2017, p. 5799)

Finally, Lobão (2020) documented that people do not always make rational decisions and are influenced by culture. The author studied how often a strategy that effectively reduced the competitor's probability of winning to zero was used by the players from different countries. The results showed that individualistic countries are more prone to use strategic advantages than collectivistic nations. Nevertheless, collectivistic countries make better use of the informational advantage, because people from these countries "consider past information to be more relevant in understanding reality, recall past event with greater detail and show a greater awareness of the past" (Lobão, 2020,p.13), which complies with the study of Chui, Titman and Wei (2010). Moreover, the author stated that cultures with a higher level of uncertainty avoidance, can induce individuals to follow more structured and optimal strategies to reduce their exposure to ambiguity.

2.4 Religion

As far as we know, there are few published studies that analyse the impact of religion on herding behaviour in financial markets, however that analysis was already done in other financial fields.

Hofstede does not include the dimension of religion to define cultures. Indeed, Minkov & Hofstede (2014) stated that "a shared national heritage is an important determinant of cultural similarity at the societal level whereas a shared global religion produces no such effect"(p.820). Some of the reasons presented are that being "Catholic", "Muslim" or "Protestant" are terms often employed in self-identification, moreover, Minkov & Hofstede (2014) are in line with the functional theory and the complexity theory. The first theory states that "a particular culture will emerge among people who share a particular geographic, economic, and social habitat and must find functional responses to its specific challenges" (Minkov & Hofstede, 2014, p. 820). The complexity theory assumes that a specific culture is developed as a result of the complex interactions among the individuals who share a habitat, instead of an outcome of mass indoctrination. Thus, both theories assume that national environments develop shared habitats however, religion does not create such shared environments. Therefore, according to Minkov and Hofstede (2014), religion does not meet those requirements and it "cannot contribute much to the creation of differences in subjective culture"(p.821).

Nonetheless, other studies found evidence that religion impacts investors' behaviour. Hilary and Hui (2009) found evidence that companies in nations with higher degrees of religiosity exhibit lower levels of risk exposure, invest less in capital and experience lower growth. However, investors have a more positive reaction (market reaction) to the announcement of new investments than investors from countries with lower levels of religiosity. These results stood out even when the authors added other variables to control for cultural, social, and economic variations. Kristjánsdóttir et al. (2017) also found significant effects of religion on countries' international trade in the 2000 -2011 period.

Esteban, Farinha and García-Gomez (2018) found that certain religions can impact corporate risk-taking, for instance, there was evidence that Catholic and Islamic countries have a negative impact on corporate-risk taking, while the Protestant nations have a positive impact. Moreover, the authors showed that for countries with Catholic and Eastern religions,

the (Hofstede) cultural dimensions have a significant and higher impact on results than religion; however, in Protestant nations, just the power distance and long-term orientation trait had an additional effect over religion. As for Islam-based countries, only the uncertainty-avoidance dimension had a marginal significance over religion.

Aziz, Jalan, Matkovskyy and Bouraoui (2020) stated "Shariah firms with a positive analyst forecast tend to herd on both up and down market days, while those pessimistic forecast, tend to herd on up-market days only" (p.8). However, non-Shariah companies are likely to herd only on up-market days, apart from the analyst forecasts. These results show that religious philosophy can influence individuals' reactions to the financial markets, their decision-making and their tendency to herd.

3. Research Questions, Data and Methodology

3.1 Research Question

This research addresses three main research questions concerning herding behaviour in international markets.

1. By exploring the patterns and dynamics of stock market returns, this dissertation seeks to study whether herding behaviour manifests and persists across international markets between 2011 and 2021.
2. Considering the previous literature which reveals that periods of crisis and market stress can significantly impact investor behaviour, the second research question aims to investigate to what extent the uncertainty associated to Covid-19 pandemic have influenced the presence of herding behaviour among market participants.
3. The third research question explores the potential influence of national cultures and religious beliefs on herding behaviour. By examining the cultural and religious dimensions, this study intends to elucidate whether and in which way these country characteristics shape and impact the occurrence of herding behaviour in international stock markets.

Through a careful analysis of these research questions, this dissertation seeks to contribute to the existing body of knowledge on herding behaviour in international markets, adding an important period in our society's history, the Covid-19 pandemic, and enlightening how culture and religion might influence investors' behaviour before and during that period. Hence, we expect to bring a deeper understanding of the relationship between these factors and herding behaviour, increasing our comprehension of investor decision-making processes.

3.2 Data

Data was collected for the following 44 countries: Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, China, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hong Kong, Hungary, India, Indonesia, Italy, Japan, Korea South, Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Philippines, Poland, Portugal, Romania, Russia, Singapore, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, United States of America, and Vietnam.

We obtained the daily close prices from Refinitiv Workspace, collecting the stock prices from each country exchanged market between 1 January 2011 and 31 December 2021.

Table 1 presents the minimum, maximum, mean, and standard deviation regarding the number of stocks observed in each country. Similarly to what was done in Almeida Ferreira Maio (2014), to ensure that we only considered stocks that are actively traded in the market we removed the companies whose stocks did not have any positive or negative daily returns during five days in a row. Additionally, in each country, it was considered a minimum of 8 actively stocks traded in the market, shortening the observed period if the number of stocks was under 8.

The number of stocks increase over the period since Refinitiv workspace only considers stocks currently traded in the market, meaning that delisted stocks are not considered in the sample, but companies that entered the stock market after 2011 are considered.

Table 1: Descriptive Statistics of number of stocks per country

Country	Number of Stocks			
	Min	Max	Mean	Std. Deviation
Argentina	15	20	17,8	3,4
Australia	106	355	148,7	48,6
Austria	28	33	29,4	1,3
Bangladesh	8	19	15,2	3,0
Belgium	45	64	52,1	5,1
Brazil	68	166	90,5	21,6
Canada	238	469	282,4	49,4
Chile	25	26	25,2	0,4
China	207	1956	631,5	481,8
Denmark	36	83	45,6	11,5
Estonia	8	15	9,5	1,8

Finland	40	102	54,6	14,2
France	151	261	191,5	28,1
Germany	154	246	188,6	26,6
Great Britain	317	462	369,3	37,1
Greece	22	26	22,6	0,9
Hong-Kong	187	541	281,8	95,9
Hungary	11	15	11,5	0,6
India	814	1238	969,1	116,5
Indonesia	28	131	47,2	23,3
Ireland	8	14	10,1	2,0
Italy	93	208	122,3	27,2
Japan	1762	2677	2139,5	263,5
Malaysia	25	68	36,5	11,1
Mexico	28	48	41,9	6,4
Netherlands	36	64	46,7	8,3
New Zealand	13	25	18,3	3,0
Norway	44	157	64.5	26,7
Pakistan	82	112	94,7	8,3
Philippines	29	56	38,7	6,5
Poland	51	139	71,6	19,1
Portugal	21	23	21,8	0,5
Romania	8	30	11,6	5,6
Russia	50	64	56,8	3,4
Singapore	25	35	25,8	1,8
South Korea	892	1550	1149,9	182,2
Spain	44	69	53,2	6,9
Sweden	122	611	274,9	134,6
Switzerland	85	123	105,1	10,6
Taiwan	576	883	696,7	78,7
Thailand	36	162	70,2	32,9
Turkey	128	241	164,7	23,0
USA	1901	3514	2478,9	421,7
Vietnam	18	160	48,1	35,8

The countries with more observed stocks are the USA, with a minimum of 1901 to a maximum of 3514; Japan, with a minimum of 1762 to a maximum of 2677; and Korea South, with a minimum of 892 to a maximum of 1550. Those with a lower number of stocks observed are Bangladesh, with a minimum of 2 and a maximum of 19; Romania, with a minimum of 3 and a maximum of 30; Ireland, with a minimum of 8 to a maximum of 14; and Estonia, with a minimum of 8 and a maximum of 15. In Bangladesh and Romania, to achieve a minimum of 8 stocks observed per day, it was shortened the period of observation.

In Bangladesh, the observed period was from 20 January 2021 to 29 December 2021, and in Romania we analysed the period between 22 December 2016 and 30 December 2021.

Regarding the cultural variables, all values were retrieved from Hofstede Database, which, as explained before, conducted many studies to divide cultural aspects into 6 main dimensions: Power Distance (PDI), Individualism (IDV), Masculinity (MAS), Uncertainty Avoidance (UAI), Long-term orientation (LTO) and Indulgence (IVR). All these parameters are scored from 0 to 100 for each country. The bigger the score, the greater the presence of the cultural trait in the population of that country.

To obtain the main religion practiced, we follow the same approach as Díez-Esteban, Farinha and García-Gómez (2019) and Stulz & Williamson (2001), recurring to 2020 World Factbook and categorizing religions into 3 main groups: Christians, which include Catholicism, Orthodox, and Protestantism religions; Muslim (Islamic); and Eastern Religions, such as Shintoism, Buddhist, and Hinduism. It was considered the most frequent religion of each country, even if it is not majoritarian. (Stulz & Williamson, 2001) The most considerable fraction of the population from China, Estonia, Germany, Hong Kong, South Korea, Netherlands, New Zealand, and Vietnam, are not affiliated with any religion, therefore it was chosen the most common religion in the country.

The cultural dimensions index and the religion category are displayed in Table 2.

Table 2: Cultural dimensions and religion category

Country	Cultural Dimensions						Religion
	PDI	IDV	MAS	UAI	LTO	IVR	
Argentina	49	46	56	86	20	62	Christian
Australia	38	90	61	51	21	71	Christian
Austria	11	55	79	70	60	63	Christian
Bangladesh	80	20	55	60	47	20	Muslim
Belgium	65	75	54	94	82	57	Christian
Brazil	69	38	49	76	44	59	Christian
Canada	39	80	52	48	36	68	Christian
Chile	63	23	28	86	31	68	Christian
China	80	20	66	30	87	24	Eastearn Religions
Denmark	18	74	16	23	35	70	Christian
Estonia	40	60	30	60	82	16	Christian
Finland	33	63	26	59	38	57	Christian
France	68	71	43	86	63	48	Christian
Germany	35	67	66	65	83	40	Christian

Great Britain	35	89	66	35	51	69	Christian
Greece	60	35	57	112	45	50	Christian
Hong-Kong	68	25	57	29	61	17	Eastearn Religions
Hungary	46	80	88	82	58	31	Christian
India	77	48	56	40	51	26	Eastearn Religions
Indonesia	78	14	46	48	62	38	Muslim
Ireland	28	70	68	35	24	65	Christian
Italy	50	76	70	75	61	30	Christian
Japan	54	46	95	92	88	42	Eastearn Religions
Malaysia	104	26	50	36	41	57	Muslim
Mexico	81	30	69	82	24	97	Christian
Netherlands	38	80	14	53	67	68	Christian
New Zealand	22	79	58	49	33	75	Christian
Norway	31	69	8	50	35	55	Christian
Pakistan	55	14	50	70	50	0	Muslim
Philippines	94	32	64	44	27	42	Christian
Poland	68	60	64	93	38	29	Christian
Portugal	63	27	31	104	28	33	Christian
Romania	90	30	42	90	52	20	Christian
Russia	93	39	36	95	81	20	Christian
Singapore	74	20	48	8	72	46	Eastearn Religions
South Korea	60	18	39	85	100	29	Christian
Spain	57	51	42	86	48	44	Christian
Sweden	31	71	5	29	53	78	Christian
Switzerland	34	68	70	58	74	66	Christian
Taiwan	58	17	45	69	93	49	Eastearn Religions
Thailand	64	20	34	64	32	45	Eastearn Religions
Turkey	66	37	45	85	46	49	Muslim
USA	40	91	62	46	26	68	Christian
Vietnam	70	20	40	30	57	35	Eastearn Religions

Finally, to ensure the robustness and accuracy of our analysis, we recognize the importance of including control variables that help us to control external factors that may influence our investigation. We opted to add control variables only in the second part of the study where we studied the impact of culture and religion on herding behaviour. In our case, where the dependent variable is fixed and does not vary over time, it is inappropriate to incorporate control variables exhibiting temporal fluctuations. Therefore, we have utilized the mean values of selected control variables. The variables chosen were GDP per capita and the Financial Market index. GDP per capita is used to control for countries' economic status, this indicator was retrieved from Refinitiv Workspace. Since we did not find the market capitalization of listed companies (% of GDP) for all 44 countries, we opted to use the

Financial Market index developed by International Monetary Fund, this index contemplates the depth, access and efficiency of financial markets of each country.

3.3 Methodology

To analyze the presence of herding behaviour in stock market and whether it is influenced by the national culture and religions we replicated part of the study of Chang and Lin (2015). These authors also based their first part of the study on Chang, Cheng and Khorana (2000) and Chiang and Zheng (2010) research.

Considering the cross-sectional absolute deviation of returns (CSAD) as a measure of dispersion, Chang, Cheng and Khorana (2000) demonstrated that rational asset pricing models predict that an increasing and linear relationship between market returns and equity returns dispersions. Additionally, if investors tend to herd during periods of large average price movements, then the function between CSAD and market returns can become non-linearity increasing or even decreasing.

Similarly, to search for evidence of herding behaviour in stock markets, we evaluate the relationship between the cross-sectional absolute deviation of returns and the market return volatility to test the existence of herding behaviour in markets. (Chang & Lin, 2015) Thus, for each country *i* we calculated the cross-sectional absolute deviation $(CSAD_{i,t})$ between the observed return of firm *j* for day *t* $(R_{i,j,t})$ and the average return of the *n* listed stocks for day *t* $(R_{i,m,t})$. (Ferreruela & Mallor, 2021)

(1) $CSAD_{i,t} = \frac{\Sigma|R_{i,j,t} - R_{i,M,t}|}{n}$

If there is a high deviation between these two indexes, there is probably no herding behaviour in the market; otherwise, if the individual daily returns follow the average market returns, investors may suffer from herding behaviour. Nevertheless, we ran a regression to confirm if investors have herding behaviour (Eq.2) and if it is significant in the cross-sectional absolute deviation results. (Chang & Lin, 2015)

Stationarity tests were performed to analyse the series' behaviour. If a time series is not stationary, this compromises the estimation of the baseline model by traditional methods,

since average, variance and autocorrelation are not constant over time. It is then difficult to predict its future behaviour due to lack of stationarity. Using OLS estimators in a non-stationary time series produces unreliable and spurious results, giving poor inference and forecasting. So, to test for stationarity the Augmented Dickey Fuller unit root test was used. Augmented Dickey Fuller test was created to check whether time series Y_t has a unit root and to ascertain whether the process is stationary or not. In the null hypothesis is the non-stationarity of the series (H0: γ=1), in the alternative hypothesis is stationarity (H1: γ <1), and the following model is estimated by OLS, considering a constant and a trend:

$$\Delta Y_{it} = \alpha + \beta t + \gamma Y_{it-1} + \sum_{l=1}^{4} \Delta Y_{il} + \varepsilon_t \quad \text{i=1,…,N; t=2,….,T}$$

Using the model proposed by Chang & Lin (2015) and to explore the impact of Covid-19 on possible herding behaviour among investors, a dummy variable P was included, considering Covid-19 pandemic period since 11 March 2020:

where $P=\begin{cases}1 & \text{During pandemic Covid-19 period}\\ 0 & \text{Before pandemin Covid-19 period}\end{cases}$

The specified model for each country was stated as:

(2) $$CSAD_{i,t} = \gamma_{i,0} + \gamma_{i,1}R_{m,t} + \gamma_{i,2}\left|R_{m,t}\right| + \gamma_{i,3}R_{m,t}^2 + \gamma_{i,4}P_{i,t}R_{m,t} + \gamma_{i,5}P_{i,t}\left|R_{m,t}\right| + \gamma_{i,6}P_{i,t}R_{m,t}^2 + \gamma_{i,7}P_{i,t} + \omega_t$$ i=1,…I (country), t=1,…,T (time), m=1,…, M (stocks)

being ω_t the error term.

The capital asset pricing model (CAPM) shows that equity return dispersions are an increasing and linear function of the market return, however if investors in periods of large average price movements suppress their own beliefs and follow market consensus instead, that linear relationship no longer holds. As a result, asset returns tend to be more correlated, leading to a decrease in the dispersion of returns, or at least, leading to a smaller increase in dispersion compared to the market return. $R_{m,t}^2$ coefficient allows us to capture that non-linearity relationship. (Chang, Cheng, & Khorana, 2000) A negative and statistically significant parameter for $\gamma_{i,3}$ and $\gamma_{i,3} + \gamma_{i,6}$ indicate herding before and during the Covid-19 pandemic period, respectively. On the other hand, if the $\gamma_{i,3}$ and $\gamma_{i,3} + \gamma_{i,6}$ coefficients are positive and statistically significant, the dispersion of stock returns increases at an

increasing rate, which is consistent with the rational models, and the hypothesis of the presence of imitative behaviour should be set aside.

The models were estimated by OLS using the Newey and West estimator (Mobarek, Mollah, & Keasey, 2014); Chiang & Zheng, 2010). Newey-West standard error method is a robust method/estimator which is very accurate in the presence of heteroskedasticity and autocorrelation of residuals. This HAC estimation method is used when there is suspicion of heteroscedasticity and serial correlation in the underlying data, especially in time series data. (Newey & West, 1987)

According to Chang and Lin (2015), "when coefficient $\gamma_{i,3}$ has a significant negative value, it indicates the existence of investor herding behavior"(p.383). Similarly, we can assume that when $\gamma_{i,3} + \gamma_{i,6}$ has a negative significant value, it will indicate the presence of herding behaviour during Covid-19.

To proceed with the second part of the study, new variables $D_{\gamma_{i,3}}$ and $D_{\gamma_{i,4}}$ were created to indicate whether stock markets exhibit herding behaviour before pandemic ($D_{\gamma_{i,3}}$) , or during the pandemic ($D_{\gamma_{i,4}}$) . These variables will assume values one if the coefficient $\gamma_{i,3}$ or $\gamma_{i,3} + \gamma_{i,6}$ have a statistically significant negative value, minus one for those coefficients statistically significant positive value, and zero otherwise.

To decide the value of the variable $D_{\gamma_{i,4}}$, the t-test with null hypothesis $H_0: \gamma_{i,3}+\gamma_{i,6} = 0$ was done, with test statistic given by:

$$t = \frac{\hat{\gamma}_{i,3} + \hat{\gamma}_{i,6}}{\sqrt{\hat{\sigma}^2_{\gamma i,3} + \hat{\sigma}^2_{\gamma i,6}} + 2 \times \widehat{cov}(\gamma_{i,3}, \gamma_{i,6})} \sim N(0,1)$$

If the null hypothesis is not rejected, the variable $D_{\gamma_{i,4}}$ take value zero, if the null hypothesis is rejected and alternative was $H_0: \gamma_{i,3}+\gamma_{i,6} > 0$, $D_{\gamma_{i,4}}$ has value minus one; if the null hypothesis is rejected and alternative was $H_0: \gamma_{i,3}+\gamma_{i,6} < 0$, $D_{\gamma_{i,4}}$ has value one.

To evaluate whether the presence of herding behaviour can be explained by cultural and religious factors, we used the six dimensions of Hofstede and 2 dummies for religions. We also included to control variable – the logarithm of GDP per capita and Financial Market Inde (Equation 3 & 4).

(3) $$D\gamma_{i,3} = \alpha_0 + \alpha_1 PHI_i + \alpha_2 IDV_i + \alpha_3 MAS_i + \alpha_4 UAI_i + \alpha_5 LTO_i + \alpha_6 IVR_i + \alpha_7 EASTERN_i + \alpha_8 ISLAM_i + \alpha_9 LGBPB_i + \alpha_{10} FMIB_i + \varepsilon_i$$, i=1,…,43 (before Covid-19 pandemic)

(4) $$D\gamma_{i,4} = \alpha_0 + \alpha_1 PHI_i + \alpha_2 IDV_i + \alpha_3 MAS_i + \alpha_4 UAI_i + \alpha_5 LTO_i + \alpha_6 IVR_i + + \alpha_7 EASTERN_i + \alpha_8 ISLAM_i + \alpha_9 LGBPD_i + \alpha_{10} FMID_i + \varepsilon_i$$, i=1,…,44 (during Covid-19 pandemic)

Where PHI_i is the power distance index, IDV_i is the individualism index, MAS_i represents the degree of masculinity of the country, UAI_i is the uncertainty avoidance, the LTO_i is the long term orientation, and IVR_i represents the indulgence vs restraint index. Regarding the religions, $EASTERN_i$ is a dummy variable that is equal to 1 for Eastern religions nations, and equal to 0 otherwise; and $ISLAM_i$ is a dummy variable that is equal to 1 for Islamic nations, and equal to 0 otherwise. (Díez-Esteban, Farinha, & García-Gómez, 2019) Finally, we have LGBPB_i and LGBPD_i control variables which represents the logarithm of GDP per capita, and $FMIB_i$ and $FMID_i$ which is the Financial Market Index before and during Covid-19, respectively.

Before estimating the models, a correlation study between the predictors is made through Pearson´s correlation coefficient to avoid multicollinearity problems that may compromise the accuracy and the interpretation of the estimated coefficients.

A robustness analysis of the models was made using two main procedures. The first one involves detecting the presence of outliers in the quantitative predictors by the Boxplot graph, since those may affect the results of the multinomial regressions; the second one consists in testing the impact of different variable sets on the dependent variables, assessing if the inclusion of specific variables substantially changes the estimated coefficient and the overall model fit. A bootstrapping methodology allows to estimate the uncertainty around the coefficients and assess the stability and reliability of the model was also performed, using 1000 samples of the same size as the original data set randomly drawn with replacement. If some variable is not significant, it was removed from the final model.

A missing data treatment for Taiwan was made for the variable Financial Markets Index (FMI), before (FMIB) and during (FMID) Covid-19, using a linear trend at a point, which involves the estimation of two multiple linear regressions models for FMIB and FMID as

dependent variables and as independent the cultural and religion variables, plus GDPB and GDPD for the remaining 43 countries and through those models predict the values for FMIB and FMID in Taiwan.

Then the final models

(5) $D_{\gamma_{i,3}} = \alpha_0 + \alpha_1 PHI_i + \alpha_2 IDV_i + \alpha_3 ISLAM_i + \alpha_4 EASTERN_i + \alpha_5 LGDPB_i + \alpha_6 FMIB_i + \varepsilon_i$, i=1,…,43 (before Covid-19 Pandemic)

(6) $D_{\gamma_{i,4}} = \alpha_0 + \alpha_1 IDV_i + \alpha_2 MASC_i + \alpha_3 LGDPD_i + \alpha_4 FMID_i + \varepsilon_i$, i=1,…,44 (during Covid-19 Pandemic)

were estimated through a multinomial logistic regression analysis, leaving as reference the category "No Herding behaviour" ($D_{gi,3}$ and $D_{gi,4}$ equal to -1), being ε_i the residual on observation i.

For all statistical tests, significance levels of 10%, 5%, and 1% were used.

Given the data collected, the analysis was held in EViews ®12 and in IBM SPSS, version 29.

4. Results and Discussion

This chapter aims to understand the data collected and the respective analysis performed according to the methodology presented previously in the methodology chapter. The main goal is to reach conclusions for the research questions proposed earlier. A brief characterization of the sample is given, followed by the model's estimation. Proceeding with the stationarity study of the time series, the analyses progressed in two parts: the first one was dedicated to estimating the regressions models, originally proposed by Chang et al (2015), to obtain the estimated coefficients $\gamma_{i,3}$ and $\gamma_{i,3} + \gamma_{i,6}$ indicating whether there is herding behaviour before and during Covid-19 pandemic. After obtaining $D_{\gamma_{i,3}}$ and $D_{\gamma_{i,4}}$ (dependent variables), for before and during Covid-19 Pandemic, we evaluated whether the cultural and religious factors could explain the herding behaviour.

4.1 Sample characterization

The daily stock returns of 44 countries were analysed between 2011 and 2021. In Table 3 the results of the minimum, maximum, mean, standard deviation, skewness, and Kurtosis are presented for the cross-sectional absolute deviation in stock markets (CSAD) and the market index return $(R_{i,m,t})$.

The countries with higher mean CSAD, and therefore higher dispersion between the individual daily stock returns and the average stock returns are Brazil, USA, Poland, Indonesia, India, Norway, South Korea, Greece, Sweden, Bangladesh, and Taiwan. A higher value of CSAD could indicate a lower propensity to herd in those markets. Contrarily, Mexico, Netherlands, Great Britain, Belgium, Switzerland, Chile, Estonia, New Zealand, Singapore and Romania are the countries with a lower CSAD, which could indicate a higher propensity to imitate other investors' strategies.

A greater standard deviation could indicate that the market experienced atypical cross-sectional variations due to unanticipated news or shocks. (Chiang & Zheng, 2010) Bangladesh is the nation with the highest standard deviation (0,0404), followed by Greece (0,0198) and Estonia (0,0097). The reason why Bangladesh differs so much from other countries might be explained by the fact that we have a much smaller number of observations for this region (N=328) because we only have data starting from 20th January 2021 for that

nation. On the other hand, Taiwan (0,0029), Singapore (0,003), and Switzerland (0,0033) are the countries with the lowest standard deviation.

The series CSAD has positive skewness and a leptokurtic distribution in most countries, since kurtosis is over 3. Also, the series of returns, Rm, always indicated a negative skewness and a leptokurtic distribution, which is usual in empirical finance.

Table 3 results do not discriminate between the pre-pandemic and during the pandemic period.

Table 3: Descriptive Statistics of CSAD and Rm

Countries	Variables	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	kurtosis
Argentina	CSAD	2675	0,0010	0,1255	0,0163	0,0070	1,151	1,975
	Rm		-0,2985	0,0957	0,0016	0,0200	-1,511	1,950
Australia	CSAD	2784	0,0073	0,0066	0,0150	0,0049	3,534	3,983
	Rm		-0,1019	0,0612	0,0005	0,0099	-1,343	2,458
Austria	CSAD	2739	0,0044	0,0577	0,0123	0,0040	2,366	2,578
	Rm		-0,1266	0,0775	0,0002	0,0101	-1,114	3,641
Bangladesh	CSAD	328	0,00336	0,5194	0,0335	0,0404	3,105	4,980
	Rm		-0,0889	0,2942	0,0092	0,0377	2,842	4,764
Belgium	CSAD	2815	0,0052	0,0630	0,0117	0,0039	3,288	4,707
			-0,1060	0,0531	0,0003	0,0087	-1,244	4,757
Brazil	CSAD	2720	0,0082	0,0707	0,0168	0,0049	2,191	1,035
	Rm		-0,1617	0,1062	0,0005	0,0142	-1,608	2,209
Canada	CSAD	2751	0,0072	0,0702	0,0166	0,0058	2,889	3,802
	Rm		-0,1218	0,0929	0,0005	0,0104	-1,627	3,645
Chile	CSAD	2738	0,0035	0,0618	0,0103	0,0047	1,475	1,701
	R_m		-0,1375	0,1117	0,0003	0,0113	-0,864	2,495
China	CSAD	2674	0,0048	0,0603	0,0163	0,0049	1,913	2,662
	Rm		-0,0973	0,0871	0,0008	0,0174	-0,883	1,022
Denmark	CSAD	2751	0,0056	0,1014	0,0137	0,0055	3,413	2,417
	Rm		-0,1116	0,0531	0,0006	0,0098	-0,935	3,310
Estonia	CSAD	2759	0,0012	0,4083	0,0101	0,0097	3,107	5,570
	Rm		-0,0908	0,2236	0,0003	0,0111	2,614	4,227
Finland	CSAD	2761	0,0054	0,0374	0,0121	0,0036	1,642	3,620
	Rm		-0,1030	0,0647	0,0004	0,0101	-0,728	4,040
France	CSAD	2815	0,0066	0,0620	0,0134	0,0043	3,274	3,187
	Rm		-0,1166	0,0633	0,0004	0,0101	-1,335	3,780
Germany	CSAD	2786	0,0019	0,0597	0,0143	0,0040	3,173	3,286
	Rm		-0,1224	0,0903	0,0005	0,0105	-0,921	2,420
Great Britain	CSAD	2779	0,0063	0,0666	0,0117	0,0043	2,358	4,027
	Rm		-0,0974	0,0859	0,0004	0,0095	-0,756	2,193
Greece	CSAD	2710	0,0001	0,2929	0,0193	0,0198	3,471	4,889
	Rm		-0,1934	0,2019	0,0002	0,0246	0,129	3,448
Hong-Kong	CSAD	2708	0,0083	0,0673	0,0163	0,0042	2,066	3,261
	Rm		-0,0685	0,1082	0,0004	0,0119	-0,291	3,176
Hungary	CSAD	2736	0,0026	0,1510	0,0127	0,0067	2,715	4,381
	Rm		-0,0940	0,0848	0,0002	0,0126	-0,196	4,106
India	CSAD	2725	0,0111	0,0451	0,0182	0,0035	1,903	2,989
	Rm		-0,1039	0,0555	0,0007	0,0120	-1,058	2,167
Indonesia	CSAD	2680	0,0065	0,0739	0,0174	0,0061	1,792	2,193
	Rm		-0,1037	0,0783	0,0006	0,0131	-0,525	3,566

Ireland	CSAD	2794	0,0024	0,1450	0,0153	0,0095	3,859	3,334
	Rm		-0,1281	0,1063	0,0005	0,0143	-0,300	1,618
Italy	CSAD	2791	0,0072	0,0414	0,0143	0,0037	2,035	3,055
	Rm		-0,1260	0,0600	0,0004	0,0113	-1,283	4,863
Japan	CSAD	2690	0,0090	0,0584	0,0145	0,0036	3,445	4,475
	Rm		-0,1282	0,0685	0,0006	0,0120	-1,152	4,878
Malaysia	CSAD	2697	0,0030	0,0738	0,0126	0,0054	2,752	2,260
	Rm		-0,1016	0,1158	0,0061	0,0071	2,179	4,540
Mexico	CSAD	2766	0,0048	0,0682	0,0119	0,0041	3,226	3,971
	Rm		-0,0647	0,0452	0,0004	0,0084	-0,777	1,024
Netherlands	CSAD	2815	0,0044	0,0514	0,0117	0,0041	2,706	3,206
	Rm		-0,1294	0,0805	0,0003	0,0113	-0,899	1,588
New Zealand	CSAD	2761	0,0031	0,0587	0,0099	0,0040	3,446	4,946
	Rm		-0,1110	0,0887	0,0005	0,0073	-1,228	3,184
Norway	CSAD	2759	0,0081	0,0773	0,0185	0,0060	2,132	1,012
	Rm		-0,1163	0,0616	0,0004	0,0125	-1,026	2,439
Pakistan	CSAD	2726	0,0073	0,0548	0,0164	0,0046	2,012	2,711
	Rm		-0,0871	0,0696	0,0007	0,0140	-0,364	3,551
Philippines	CSAD	2682	0,0011	0,0507	0,0139	0,0046	1,818	2,327
	Rm		-0,1258	0,0659	0,0004	0,0108	-1,403	3,883
Poland	CSAD	2745	0,0078	0,0789	0,0172	0,0052	2,545	3,112
	Rm		-0,1559	0,0668	0,0004	0,0106	-1,966	3,638
Portugal	CSAD	2816	0,0039	0,0612	0,0145	0,0054	1,693	1,957
	Rm		-0,0993	0,0713	0,0001	0,0127	-0,399	1,838
Romania	CSAD	2757	0,0003	0,0479	0,0083	0,0049	1,983	1,827
	Rm		-0,0912	0,0638	0,0004	0,0098	-0,922	3,729
Russia	CSAD	2769	0,0057	0,0586	0,0130	0,0044	2,777	3,278
	Rm		-0,1265	0,0534	0,0003	0,0104	-1,705	3,137
Singapore	CSAD	2759	0,0027	0,0459	0,0088	0,0030	2,491	4,777
	Rm		-0,0671	0,0504	0,0001	0,0080	-0,598	3,704
South Korea	CSAD	2710	0,0115	0,0544	0,0186	0,0036	2,106	1,449
	Rm		-0,1418	0,0817	0,0007	0,0122	-1,513	3,853
Spain	CSAD	2813	0,0054	0,0754	0,0131	0,0046	2,587	3,904
	Rm		-0,1435	0,0792	0,0003	0,0121	-0,884	3,111
Sweden	CSAD	2769	0,0002	0,0616	0,0206	0,0051	0,852	1,110
	Rm		-0,1297	0,0525	0,0009	0,0096	-1,794	2,781
Switzerland	CSAD	2762	0,0051	0,0420	0,0110	0,0033	2,905	3,862
	Rm		-0,0958	0,0722	0,0004	0,0089	-1,214	3,861
Taiwan	CSAD	2702	0,0082	0,0350	0,1360	0,0029	1,559	1,515
	Rm		-0,0845	0,0639	0,0004	0,0104	-1,411	3,407
Thailand	CSAD	2682	0,0069	0,0469	0,0152	0,0040	1,386	1,591
	Rm		-0,1131	0,0742	0,0007	0,0121	-1,034	2,081
Turkey	CSAD	2764	0,0078	0,0502	0,0159	0,0047	1,719	1,306
	Rm		-0,1194	0,0775	0,0011	0,0133	-1,641	3,231
USA	CSAD	2768	0,0089	0,0874	0,0168	0,0057	2,223	2,186
	R_m		-0,1280	0,0998	0,0006	0,0128	-0,817	1,771
Vietnam	CSAD	2745	0,0015	0,0367	0,0158	0,0044	0,559	0,691
	Rm		-0,0738	0,0507	0,0008	0,0131	-0,603	2,681

4.2 Cross-sectional absolute deviation in stock markets (CSAD) model's estimation

Before estimating the regression models, the Augmented Dickey-Fuller stationarity test was made for the series CSAD and $R_{i,m,t}$, in each country. Results are presented in Appendix 1. All the series prove to be stationary.

The models were estimated by OLS Newey and West procedure already presented in methodology. In Table 4 the estimated coefficients of those models are displayed, as well as the classification of $D_{\gamma i,3}$ and $D_{\gamma i,4}$. $D_{\gamma_{i,3}}$ is the coefficient of the predictor ${R^2}_{i,m,t}$, in the model estimated for the pre-pandemic period, and $D_{\gamma i,4}$ is the coefficient of the ${R^2}_{i,m,t} + P_{i,t}{R^2}_{i,m,t}$, in the model estimated for during the pandemic period.

To decide whether $D_{\gamma i,4}$ takes value -1, 0 or 1, a t-student test for the linear combination of coefficients $\gamma_{i,3} + \gamma_{i,6}$ was performed, having as an alternative hypothesis $\gamma_{i,3} + \gamma_{i,6}$ higher (lower) than zero. The results are presented in Appendix 2. A negative and statistically significant coefficient indicates evidence of herding behaviour, and investors imitate the actions of others. This means that the cross-sectional dispersion returns have a non-linear relation with the market return.

Table 4: Regression model's coefficients estimates.

									Before		During		
Country	γ_0	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	D_{γ_3}	$\gamma_3+\gamma_6$	D_{γ_4}	Adj-R^2	F-statistic
Argentina	0,0132***	0,0584***	0,1782***	**0,8502*** **	0,0122	-0,0201	0,6015	0,0017***	-1	**1,4518*** **	-1	0,3385	196,4990***
Australia	0,0125***	0,0328***	0,1648***	**2,1287*** **	0,0858***	0,0257	1,9192	0,0063***	-1	**4,0480*** **	-1	0,5890	570,8229***
Austria	0,0103***	0,0187***	0,2369***	0,1110	0,0771***	0,1560*	-0,4214	0,0002	0	-0,3104	0	0,3655	226,3129***
Bangladesh					0,0249***	0,0287	-0,2982***	8,3362***		**8,3362*** **	-1	0,8488	425,6528***
Belgium	0,0095***	0,0474***	0,2888***	**1,6640* **	0,0622**	0,2409*	-3,1359**	0,0014***	-1	-1,4719	0	0,4504	330,4472***
Brazil	0,0142***	0,0536***	0,2116***	**0,7113*** **	0,0389***	0,0469	-0,0630	0,0021***	-1	**0,6483* **	-1	0,4806	360,2765***
Canada	0,0143***	0,0263**	0,1362***	0,6917	0,0209	0,0968	3,0237	0,0066***	0	**3,7155** **	-1	0,4294	296,6842***
Chile	0,0077***	0,0501***	0,2387***	0,0264	-0,0024	0,0267	0,2534	0,0047***	0	0,2800	0	0,4998	391,6690***
China	0,0135***	-0,0663***	0,2201***	**-1,5510** **	-0,0056	-0,1107**	1,6585	0,0052***	1	0,1078	0	0,2758	146,4374***
Denmark	0,0108***	0,0373**	0,2305***	1,6502	0,1468**	0,1458*	-1,1734	0,0056***	0	0,4768	0	0,4362	304,9010***
Estonia	0,0090***	-0,0011	0,0112	**7,8672*** **	0,1191**	0,5401***	-8,9400***	-0,0030***	-1	**-1,0728* **	1	0,6851	858,3848***
Finland	0,0101***	0,0424***	0,2075***	**1,1482* **	0,0193	0,1090**	-1,6104	0,0018***	-1	-0,4623	0	0,3482	211,5925***
France	0,0109***	0,0435***	0,2409***	**1,0023* **	0,0774***	0,2947***	-2,3667**	0,0027***	-1	**-1,3644* **	1	0,5690	531,7565***
Germany	0,0117***	0,0155**	0,2390***	0,7146	0,0458**	0,2124***	-2,0586**	0,0027***	0	**-1,3440** **	1	0,5266	443,5623***
Great Britain	0,0095***	0,0365***	0,2853***	**3,1458** **	-0,0341*	-0,2186***	2,3831	0,0023***	-1	**5,5288*** **	-1	0,4958	391,1709***
Greece	0,0156***	0,0076	0,1594***	0,7520	0,2184***	0,0271	1,0354	0,0026	0	1,7873	0	0,0805	34,9015***
Hong-Kong	0,0135***	0,0617***	0,1562***	**2,8171*** **	0,0087	-0,0520	1,2711	0,0065***	-1	**4,0882** **	-1	0,6642	765,7604***
Hungary	0,0098***	0,0608***	0,2960***	0,5632	0,1432*	-0,1851	7,8639	0,0007	0	**8,4271** **	-1	0,3189	183,9064***
India	0,0161***	0,0598***	0,1563***	**1,9082*** **	0,0246	-0,0199	0,1304	0,0027***	-1	**2,0386*** **	-1	0,4057	266,6478***
Indonesia	0,0142***	0,0697***	0,1801***	**1,0191* **	0,0804***	-0,0307	3,01576**	0,0081***	-1	**4,0349*** **	-1	0,4495	313,5418***
Ireland	0,0124***	-0,0456**	0,3210***	**-1,2589* **	0,0827**	0,1426	0,6882	-0,0015*	1	-0,5707	0	0,1135	52,0824***
Italy	0,0121***	0,0333***	0,235***	**0,8208** **	0,0586***	0,1072*	-1,0215*	0,0009***	-1	-0,2008	0	0,3897	255,5488***
Japan	0,0126***	0,0197**	0,1744***	**1,5186*** **	0,0084	0,0510	-0,2228	0,0013***	-1	1,2958	0	0,4465	310,8440***
Malaysia	0,0092***	0,0629***	0,3951***	**2,6952*** **	0,0053	0,0201	-2,5811***	0,0048***	-1	0,1142	0	0,5325	439,7174***
Mexico	0,0097***	0,0165*	0,2736***	0,3198	0,0110	0,2778*	0,3565	0,0011*	0	0,6763	0	0,4442	316,7060***
Netherlands	0,0093***	0,0214***	0,2377***	0,5801	0,0284	0,2002**	-1,1813	0,0013***	0	**-0,6011** **	1	0,4457	324,2670***
New Zealand	0,0081***	0,0025	0,2337***	1,5405	0,0213	0,1448*	-0,6579	0,0026***	0	0,8826	0	0,3956	259,0363***
Norway	0,0153***	0,0840***	0,1986***	**2,9161*** **	0,0580**	0,1926***	-2,5394**	0,0047***	-1	0,3767	0	0,4784	360,3885***
Pakistan	0,0140***	0,0764***	0,2091***	0,1191	-0,0353**	0,1481***	-3,6045***	0,0002	0	**-3,4853*** **	1	0,2464	128,2674***
Philippines	0,0115***	0,0424***	0,2211***	1,1575	0,0195	0,1224**	-1,0984	0,0025***	0	0,0591	0	0,3286	188,4726***
Poland	0,0143***	0,0654***	0,2626***	0,6332	0,0937***	0,1220***	-0,6451	0,0045***	0	-0,0119	0	0,4993	391,8298***
Portugal	0,01178***	-0,145574	1,0755***	**-1,7660*** **	-0,2334	0,2078	0,1790	-0,0011	1	-1,5870	0	0,1620	78,7176***
Romania	0,0057***	0,0393**	0,3484***	0,0699	0,0661**	0,2240	-0,4667	0,0038***	0	-0,3968	0	0,4308	161,5427***

Russia	0,0101***	0,06450***	0,3139***	0,1049	0,0287	0,0903	-0,5534	-0,0013***	0	-0,4485	0	0,3221	188,8228***
Singapore	0,0071***	0,0271***	0,2458***	0,1792	0,0808***	0,0934	-0,3436	0,0009***	0	-0,1643	0	0,3424	206,1745***
South Korea	0,0017***	-0,0255***	0,1866***	**1,4936*** **	0,0427***	-0,0290	-0,5180	0,0014***	-1	**0,9755*** **	-1	0,4220	283,5502***
Spain	0,0109***	0,0441***	0,1688***	**1,9044** **	0,0574**	0,2772***	-2,6522***	0,0012**	-1	**-0,7478** **	1	0,3904	258,2461***
Sweden	0,0185***	0,0986***	0,0595	**3,7615*** **	0,0125	0,3212***	-4,4941***	0,0035***	-1	**-0,7326** *	1	0,3045	174,0875***
Switzerland	0,0089***	-0,0230***	0,2384***	**-1,7338** **	0,0115	0,1244	-2,0720**	0,0020***	1	**-3,8058*** **	1	0,4680	347,9280***
Taiwan	0,0114***	-0,0148**	0,2884***	**-1,6934*** **	0,0100	-0,0090	0,4844	0,0025***	1	-1,2091	0	0,4993	385,7371***
Thailand	0,0130***	-0,0305***	0,1617***	**-1,0340** *	0,0037	0,0428	-0,6789	0,0038***	1	**-1,7129*** **	1	0,3513	208,4039***
Turkey	0,0013***	-0,0180**	0,1897***	-0,0577	-0,06193	0,0776	-2,1057**	0,0070***	0	**-2,1635** *	1	0,5291	444,4401***
USA	0,0139***	0,0126*	0,1551***	**1,9632*** **	0,0549**	0,1898**	-0,8324	0,0049***	-1	**1,1308** **	-1	0,6218	650,8707***
Vietnam	0,0131***	0,0144*	0,3188***	**-5,9446*** **	-0,0250	0,1088*	1,4740	0,0024***	1	**-4,4707*** **	1	0,2312	118,8815***

*** P<0,01 ; ** P<0,05 ; * P<0,1

Our results show that before the pandemic period, only seven countries showed herding behaviour: China, Ireland, Portugal, Switzerland, Taiwan, Thailand, and Vietnam. Except the Vietnamese market, herding behaviour in these markets was already verified by Chang and Lin (2015), along with Chiang and Zheng (2010), which also found evidence of herding in Asian markets, such as Taiwan, Thailand, and China. Our findings also align with the research done by Vo and Phan (2019), who documented herding behaviour in Vietnamese markets in some sub-periods between 2005 and 2017.

Moreover, we proved that markets exhibit more herding behaviour in developing countries (4 out of 17) before the pandemic than in developed countries (3 out of 25). These results could be explained by the fact that developing countries usually have lower transparency in their markets than developed countries, thus investors may consider herding a feasible strategy. (Luong & LUU, 2020)

We follow the same approach as Ferrereula and Mallor (2021) and considered the beginning of the pandemic on 11 March 2020, since it was when the World Health Organization classified Covid-19 disease as a pandemic. (World Health Organization, 2020)

After 11 March 2020, we observed some changes in investors behaviour in some countries. Developed countries were more impacted by Covid-19 in terms of herding behaviour than countries in development. In developing countries, only 4 out of 17 nations (China, Pakistan, Taiwan, and Turkey) had a behaviour change in the stock market between the pre-Covid period and during the Covid period. Chinese and Taiwanese investors herded around the market before the pandemic, however after the pandemic was announced, they started investing under their own information. Pakistanis and Turkish markets follow the opposite behaviour: before the pandemic, market participants did not copy other investors strategies, however during the crisis, they started to copy their peers' investments. On the other hand, we reported 8 out of 25 developed countries changed their behaviour after the pandemic. Estonia, France, Germany, Netherlands, Spain, and Sweden started herding around the market, while Ireland and Portugal stopped following their peers' strategies.

Switzerland, Thailand, and Vietnam have herded before and during the Covid-19 pandemic. However, while Switzerland and Thailand documented an increase in the significance level of herding behaviour during Covid-19, Vietnam maintained the same significance level for the herding behaviour coefficient.

We also have some countries that, although they had a negative coefficient for $\gamma_{i,3}$ and $\gamma_{i,3} + \gamma_{i,6}$, those coefficients were not significant, as it is the case of Turkey before the Covid-19 pandemic, and Austria, Belgium, Finland, Ireland, Italy, Poland, Portugal, Romania, Russia, Singapore, and Taiwan during the pandemic. Therefore, we did not consider that those countries evidenced herding behaviour, and following the approach of Chang & Lin (2015), we classified $D_{\gamma i,3}$ and $D_{\gamma i,4}$ as 0. The investors' behaviour in a market which $D_{\gamma i,3}$ and $D_{\gamma i,4}$ is 0 is still a "grey area" in this field, since none of the papers consulted assigned a specific meaning to this behaviour. However, according to Chang, Cheng, and Khorana (2000), "since the non-linear term is not significantly negative, $CSAD_t$ has not increase at a decreasing rate or decreased as the average price movements increases. Hence, the prediction of rational asset pricing models (…) has not been violated"(p.1657). That said, we deduce that although these markets do not have observable herding behaviour, we also do not have evidence that this market violates the rational models, exhibiting herding behaviour. The same conclusions were taken for countries that revealed positive, but not significant, $\gamma_{i,3}$ and $\gamma_{i,3} + \gamma_{i,6}$ coefficients.

4.3 Correlations between cultural, religious variables and economic variables

Before estimating the final models, the linear Pearson correlation coefficient between the cultural predictors was computed, along with a set of cultural, religion, type of market and external factor predictors that will be joined to the models, and if the correlation between predictors is high, they should be dropped off the model, in order to avoid multicollinearity problems.

A collection of dummy variables was defined to include the country´s religion. Our study considered the most frequent religion, even if it is not majoritarian. (Díez-Esteban, Farinha, & García-Gómez, 2019) We defined the following dummy variables: CATH as the predictor which takes the value of 1 for all countries with Catholic, Orthodox and Protestant as the most frequent religion and zero otherwise; ISLAM as the predictor which takes the value of 1 for all countries with Islamic as the most frequent religion and zero otherwise; EASTERN as the predictor which takes the value of 1 for all countries with Buddhism, Shintoism, and

Hinduism as the most frequent religions and zero otherwise. Only CATH and ISLAM were placed in the models, leaving EASTERN as the reference category.

As external factors, it was considered the logarithm of the mean GDP per capita for the period before the Covid-19 pandemic (LGDPB) and during (LGDPD), and the Financial Market index of each country before the pandemic (FMIB), and during the pandemic (FMID).

Usually, correlation values above 0,7, in absolute value, will cause multicollinearity problems and this may affect the accuracy and the interpretation of the estimated coefficients. Results are displayed in Table 5.

It can be observed from Pearson's correlation table that individualism and power distance are inversely related. Large power distance societies have a well-defined hierarchy, and people from these societies expect and accept that the power is not equally distributed, being more likely to respect and obey authority figures without questioning them. On the other hand, individualism vs collectivism shows the degree to which the members of societies are integrated into groups, that said, people from collectivist societies (lower level of individualism) are integrated in strong and cohesive in-groups, they stress to belong, and they prioritize the group harmony and the needs and goals of the group over individual desires. (Hofstede, 2011) This relationship between high power distance and collectivism is not unexpected, since the tendency to conform with the hierarchical rules may align with group harmony and interdependence values. Similarly, lower power distance is related to individualism because the societies with lower power distance tend to challenge authority, seek equality, and impose their own opinions, which are in line with the individualistic values in which people prioritize their own goals and personal freedom over the group interests.

Christianism (Catholic/Orthodox/Protestant) are positively correlated to individualism (0.636). Actually, Fischer et al. (2010) found evidence that individualism and collectivism are also defined by religious identity, to the extent that Muslims tend to react in a more collectivistic and socially oriented way than Christians. The explanation provided by the authors was that Muslims might have a greater tendency to characterize themselves and behave based on a shared religious entity, due to "historical and cultural factors that make collective identity more accessible, and (...) the relatively low status of Muslims (in comparison to Christians) may make a collective level of self-definition more

fitting".(Fischer, et al., 2010, p.377) Moreover, although with a lower level of correlation, individualism seems to be negatively correlated with Islamic religion (-0.395), giving strength to the theory that Muslims react in a more collectivist way (lower individualism index).

The strongest relation is between GDP per capita before and during Covid-19, as expected. As these two variables are going to be used in two different regressions, there is no need to remove any of them.

Table 5: Pearson's correlation coefficient values

	IDV	MASC	UAI	LTO	IVR	LGDPB	LGDPD	Catholic	Islamic	Eastern	FMIB	FMID
PHI	-,686***	,055	,170	,102	-,440***	-,638***	-,640***	-,451***	,335**	,257	-0,355**	-0,329**
IDV		,084	-,106	-,173	,469***	,602***	,600***	,636***	-,395***	-,428***	0,368**	0,377***
MASC			,140	,094	-,067	-,074	-,064	-,095	-,015	,125	0,005	0,049
UAI				,071	-,165	-,069	-,123	,318**	-,045	-,339**	-0,209	-0,225
LTO					-,427***	,134	,163	-,244	-,057	,335**	0,171	0,156
IVR						,516***	,469***	,421***	-,262	-,282	0,381**	0,389**
LGDPB							,990***	,480***	-,525***	-,136	0,688***	0,645***
LGDPD								,453***	-,528***	-,101	0,670***	0,624***
Catholic									-,553***	-,728***	0,081	0,040
Islamic										-,169	-0,330**	-0,290**
Eastern											0,176	0,199
FMIB												0,980***

*** P<0,01 ; ** P<0,05 ; * P<0,1

However, considering that in regression, multicollinearity problems only occur if the correlation between predictors is over 0,7 in absolute value, any of those pairs may create a multicollinearity problem in the model.

Even though there are no specific rules to deal with the number of predictors and the number of observations, if the number of predictors is large compared to the number of observations, there may be overfitting problems and difficulty in obtaining accurate estimates of the coefficients. The rule of thumb 1:5 is a commonly used guideline in regression analysis.

4.4 Robustness analysis

As described in the methodology, a robustness analysis of the models was made using two basic ideas. Through the boxplot graph, it was detected the presence of outliers in the quantitative predictors, and results are shown in Figures 1, 2 and 3.

Figure 1: Cultural Predictors boxplots

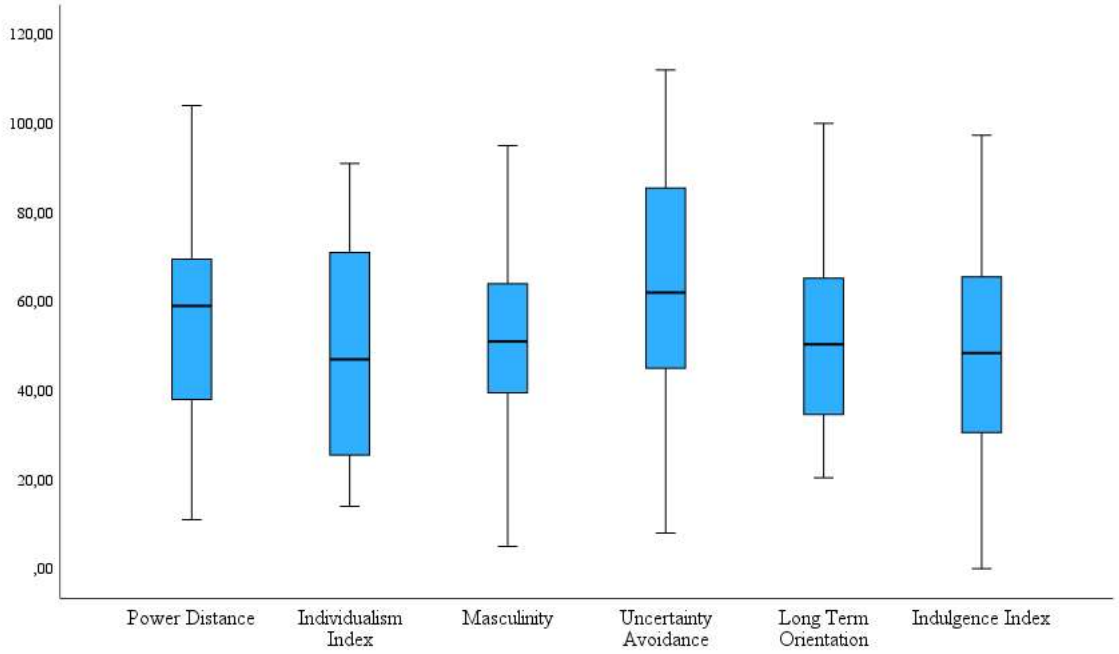


Figure 2: Logarithm of GDP per capita boxplot

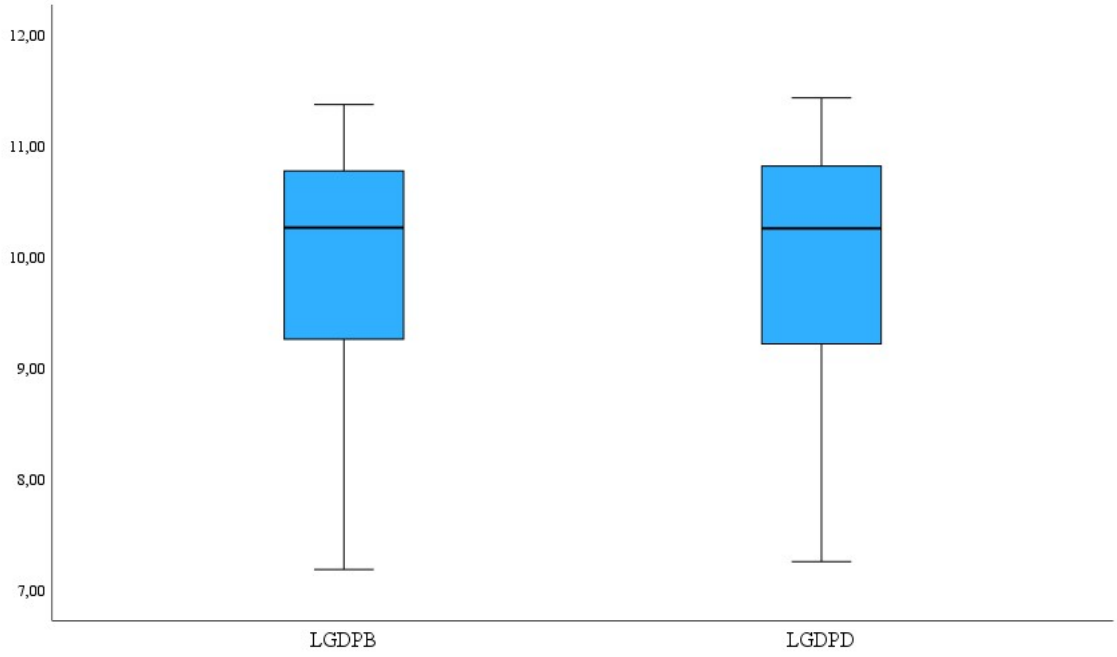
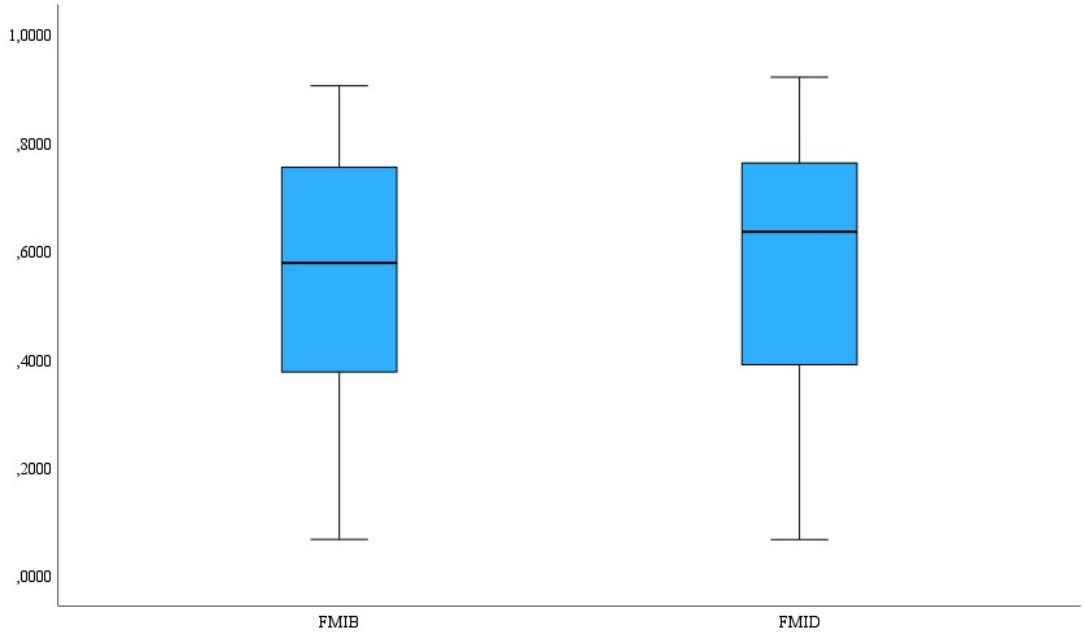


Figure 3: FMI boxplot



The presence of outliers is not observed in any of the quantitative predictors.

The second procedure tests the impact of each cultural variable on the herding behaviour and the complete set of cultural variables on the herding behaviour, to observe considerable changes in the estimated coefficients and in the overall fit. The results of the model before

Covid-19 (Model A) are presented in Table 6, and during Covid-19 (Model B) in Table 7. A bootstrapping methodology, using 1000 samples of the same size as the original data set, randomly drawn with replacement, was performed to establish the stability and reliability of the final models.

The initial models were:

$$D_{\gamma_{i,3}} = \alpha_0 + \alpha_1 PHI_i + \alpha_2 IDV_i + \alpha_3 MASC_i + \alpha_4 UAI_i + \alpha_5 LTO_i + \alpha_6 IVR_i + \varepsilon_i \,,$$
i=1,…,43

$$D_{\gamma_{i,4}} = \alpha_0 + \alpha_1 PHI_i + \alpha_2 IDV_i + \alpha_3 MASC_i + \alpha_4 UAI_i + \alpha_5 LTO_i + \alpha_6 IVR_i + \varepsilon_i \,,$$
i=1,…,44

If some variable is not significant it was removed from the final model.

Table 6: Results of the multinomial logistic regressions with dependent variable $D_{\gamma_{i,3}}$ *(before COVID-19)*

Dependent variable: $D_{gi,3}$	Models							
coefficients	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 7 bootstrapping
a_1	0,003						0,064*	0,064**
a_2		-0,041*					-0,093**	-0,093***
a_3			0,006				0,023	0,023
a_4				-0,009			-0,013	-0,013
a_5					0,005		-0,012	-0,012
a_6						-0,008	0,015	0,015
a_0	-1,191	0,857	-1,310	-0,469	-1,282	-0,627	6,274	6,274
Pseudo R^2	0,001	0,095*	0,006	0,032	0,017	0,004	0,223	0,223
Model Fit c2	0,034	4,314	0,278	1,392	0,725	0,183	20,842*	20,842*
classification	44,2%	53,5%	51,2%	44,2%	46,5%	44,2%	46,5%	46,5%

*** P<0,01 ; ** P<0,05 ; * P<0,1

Significant variables to make the separation between herding and no herding behaviour before Covid-19 pandemic are Power distance and Individualism.

Table 7: Results of the multinomial logistic regressions with dependent variable $D_{\gamma_{i,4}}$ (during COVID-19)

Dependent variable: $D_{gi,4}$	Models							
Coefficients	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 7 Bootstrapping
a_1	-0,013						0,031	0,031
a_2		-0,004					-0,009	-0,009
a_3			-0,051**				-0,056**	-0,056***
a_4				0,009			0,018	0,018
a_5					0,025		0,037	0,037
a_6						-0,005	-0,006	-0,006
a_0	0,600	0,125	2,441*	-0,608	-1,446	0,146	1,984	1,984
Pseudo R^2	0,024	0,017	0,106	0,025	0,039	0,012	0,248	0,248
Model Fit c2	1,080	0,740	4,948*	1,114	1,751	0,539	20,533*	20,533*
classification	43,2%	47,7%	47,7%	43,2%	45,5%	47,7%	56,8%	56,8%

*** P<0,01 ; ** P<0,05 ; * P<0,1

Significant variables to make the separation between herding and no herding behaviour during Covid-19 pandemic is Masculinity.

Now testing the impact of religion in herding behaviour, the initial models were:

$$D_{\gamma_{i,3}} = \alpha_0 + \alpha_1 ISLAM_i + \alpha_2 EASTERN_i + \varepsilon_i \text{ , i=1,…,43}$$

$$D_{\gamma_{i,4}} = \alpha_0 + \alpha_1 ISLAM_i + \alpha_2 EASTERN_i + \varepsilon_i \text{ , i=1,…,44}$$

In Table 8 the results are displayed.

Table 8: Results of the multinomial logistic regressions with dependent variable $D_{\gamma_{i,3}}$ (before COVID-19) and $D_{\gamma_{i,4}}$ (during COVID-19)

Dependent variable: $D_{gi,3}$	Models			Dependent variable: $D_{gi,4}$	Models		
coefficients	Model 1	Model 2	Model 3	coefficients	Model 1	Model 2	Model 3
a_1	-17,470		-16,691	a_1	0,105		0,134
a_2		1,962**	1,828*	a_2		0,105	0,134
a_0	-18,232***	0,288	-16,404***	a_0	0,000	0,000	0,134
Pseudo R^2	0,035	0,162	0,176	Pseudo R^2	0,042	0,001	0,042
c2	1,513	7,576**	8,340*	c2	1,871	0,029	1,892
classification	44,2%	46,5%	46,5%	classification	50,0%	47,7%	50,0%

*** P<0,01 ; ** P<0,05 ; * P<0,1

Significant variables to make the separation between herding and no herding behaviour before Covid-19 pandemic are Eastern religions.

There are no significant variables related to religion to make the separation between herding and no herding behaviour during Covid-19.

4.5 The effect of Culture, Religion, GDP and FMI on herding behaviour

To analyse the impact of the predictors attached with culture, religion and GDP and Financial Markets Index on herding behaviour the final models to be estimated using multinomial regression were:

$$D_{\gamma_{i,3}} = \alpha_0 + \alpha_1 PHI_i + \alpha_2 IDV_i + \alpha_3 EASTERN_i + \alpha_4 LGDPB_i + \alpha_5 FMIB_i + \varepsilon_i \text{ , } i=1,\ldots,43$$

$$D_{\gamma_{i,4}} = \alpha_0 + \alpha_1 MASC_i + \alpha_2 LGDPD_i + \alpha_3 FMID_i + \varepsilon_i \text{ , } i=1,\ldots,44$$

Results are presented in Table 9 and Table 10 for herding behaviour compared with no herding behaviour respectively before Covid-19 pandemic and during.

Table 9: Results of the multinomial logistic regressions with dependent variable $D_{\gamma_{i,3}}$ (before COVID-19)

Dependent variable: $D_{\gamma i,3}$		
coefficients	Model	bootstrapping
α_1	0,085*	0,085*
α_2	-0,067**	-0,067**
α_3	1,359	1,359
α_4	-0,660	-0,660
α_5	3,357	3,357
α_0	12,045	12,045
Pseudo R^2	0,344	0,344
Model Fit $\chi 2$	18,104*	18,104*
classification	72,1%	72,1%
n	43	43

*** P<0,01 ; ** P<0,05 ; * P<0,1

Table 10: Results of the multinomial logistic regressions with dependent variable $D_{\gamma_{i,4}}$ (during COVID-19)

Dependent variable: $D_{\gamma i,4}$		
coefficients	Model	bootstrapping
α_1	-0,058**	-0,058**
α_2	0,099	0,099
α_3	-0,309	-0,309
α_0	1,976	1,976
Pseudo R^2	0,230	0,230
Model Fit $\chi 2$	11,507*	11,507*
classification	54,5%	54,5%
n	44	44

*** P<0,01 ; ** P<0,05 ; * P<0,1

The herding behaviour before the Pandemic Covid-19 only depends positively on Power Distance and negatively on Individualism. Our results show that societies mostly performing herding behaviour accept unequal power distribution and individuals tend not to question decisions made by those in higher positions (positive relation with PHI) and at the same time, people do not prioritize their own needs (negative relation with IDV), they prioritize group cohesion and interdependence relatively to the societies with no herding behaviour. Chang and Lin (2015) and Almeida Ferreira Maio (2014) already documented these two cultural traits impact investors behaviour, showing that investors from countries with a lower individualism index (collectivistic countries) or a higher power distance index tend to imitate the strategies from their peers.

Although Eastern religions were significant in the robustness analysis, when we join this variable with Power Distance and individualism index, it seems to lose their significance, therefore it cannot be used to explain herding behaviour. Indeed, no religious categories are relevant to explain the market. Our results align with Minkov and Hofstede's (2014) studies; the authors documented that a shared national history holds significant cultural influence, while a universally shared religion does not have the same level of impact.

During Covid-19, only masculinity prevails, but in a negative relation with herding behaviour. This result can enlighten us on how society perceive uncertain times. Our results show that feminine societies (low score) may foster a cooperative and consensus-driven decision-making approach in uncertain times, leading to greater susceptibility to herding behaviour. Uncertainty increases the perceived risk, hence we can expect that feminine societies may disregard their own beliefs to copy other investors' strategies and follow the herd in order to try to minimize risk. Indeed, prior research shows that, independently of gender, investors with a higher level of masculine traits tend to assume greater financial risks. When people are willing to take greater risks, competitiveness increases, stimulating financial markets' scale, access and efficiency (Meier-Pesti & Penz, 2008; Khan, Gu, & Meyer, 2022) In efficient markets, most investors must be rational, and herding behaviour should not be a standard behaviour (although it can exist in few market participants); feminine societies seem to increase markets inefficiency.

We also documented that herding behaviour does not depend on GDP per capita or Financial Market index (used as a substitute for market capitalization) before or during the pandemic. Empirically, our evidence contrasts with the results of Zhou and Lai (2008), which

documented that herding negatively depends on market capitalization, meaning that countries with a lower market capitalization are expected to have more herding behaviour.

5. Conclusions

Herding behaviour is a key concept in behavioural finance. This phenomenon happens when investors copy their peers' strategies instead of trading based on their own information. Herding behaviour causes market inefficiencies and can lead to bubbles and crashes in financial markets. Understanding how cultural traits and religion influence herding behaviour might bring significant insights to investors and policymakers.

This study enriches the debate on this topic, supporting that financial markets reflect herding behaviour in some countries before and during the pandemic. The uncertainty brought by Covid-19 changed market participants' strategies in some developed countries: Estonia, France, Germany, Netherlands, Spain and Sweden started to mimic other participants' investment decisions. On the other hand, Ireland and Portugal stopped following other investors' strategies and started trading based on their own analysis. Overall, Covid-19 crisis increased the percentage of developed countries that herd from 12% to 28%. In developing countries, the percentage of countries documenting herding behaviour in their markets did not change with the emergence of Covid-19, nevertheless there were some changes within this subgroup: during the pandemic period, Chinese and Taiwanese countries stopped showing evidence of herding behaviour, while Pakistanis and Turkish markets started following their peers.

This dissertation also highlights that cultural traits leverage herding behaviour. Before the pandemic, collectivistic societies with a higher power distance, that is, nations that prioritize the group needs and better accept the unequal distribution of power, were more prone to herd. During the Covid-19 crisis, feminine societies (lower masculinity index) were more willing to herd, showing that societies characterized by modest and caring values tend to trade according to the market consensus in uncertain times. On the other hand, we did not find evidence that religions impact herding behaviour in financial markets.

These findings can be helpful for investors and portfolio managers because they help to design strategies according to the market/country characteristics and their usual market behaviour. When investing in a market where participants tend to herd around the market index, there is a higher correlation between stocks, and the risk is greater. Thus, investors must demand a larger number of stocks to achieve an inferior degree of correlation in the

portfolio to attain the same degree of diversification in a rational market. (Chang, Cheng, & Khorana, 2000) Furthermore, policymakers and regulators can use these insights to analyse which nations are more likely to herd around the market consensus and design more effective regulations and interventions in financial markets.

6. Limitations and future research

In this chapter, we discuss the limitations that are inherent to our study methodology and data sources. Recognizing these limitations is crucial for interpreting the results of our research accurately.

One significant limitation of our study is the assumption that investors exclusively allocate their investments to the domestic market. It is very common to have investors participating in both domestic and foreign markets. Additionally, market participants trade differently in domestic and foreign markets. (Tan, Chiang, Mason, & Nelling, 2008) The exclusion of foreign investments introduces an element of simplification that may impact our findings.

The methodology employed in our study plays a crucial role in shaping our results. It is important to emphasize that variations in methodology can contribute to the diverse outcomes observed between our research and prior literature. Moreover, because we employed an equally-weighted measure when calculating the average return of listed stocks $(R_{i,m,t})$, our results might be impacted by the smaller stocks in each country, because small stock portfolios have different reactions relative to large stock portfolio, being that "small stocks respond slowly to good news, and this slowness could result in extra dispersion in up markets, and bias against detecting evidence of herding" (McQueen, Pinegar, & Thorley, 1996 as cited in Chang, Cheng, & Khorana, 2000, p.1668)

Another limitation is the fact that we may miss some control variables when studying the influence of cultural dimensions and religions. We chose not to include more control variables because the dependent and explanatory variables in equation 3 and 4 are fixed variables that do not vary over time, and most control variables used in previous studies change daily or monthly. Moreover, we could not only include a few variables because our sample has limited observations in the second part of the study (we only have 44 countries). However, including more control variables in future research would be interesting.

Furthermore, the fact that we account for the most common religion, ignoring the fact that sometimes a significant percentage of the population is not religious, can be one of the reasons for our non-significant these results; for instance, Vietnam, South Korea, and Estonia, in which 81,80%, 56,90%, and 54,10% of the population assumed they were not religious, respectively.

Finally, our approach identifies herding in financial markets without offering insights into the motives behind these behaviours, that said, an inherent limitation pertains to the inability to differentiate between intentional and spurious herding.

In the context of this dissertation, the potential future research in the field of herding behaviour in financial markets can focus on broadening the geographical scope of the sample, including more countries, which would enhance the comprehensiveness of the analysis. Moreover, distinguishing between spurious herding and intentional herding and analysing the impact of cultures only in intentional herding would be a significant step forward. Lastly, it would be interesting to explore in future research the impact of foreign investors on national markets, elucidating how the participation of these investors influences herding behaviour.

7. Appendix

Appendix 1 - Augmented Dickey-Fuller test statistic and significance

Country	Series	ADF test
USA	CSAD	-7,9399***
	Rm	-19,5124***
Argentina	CSAD	-14,8071***
	Rm	-47, 6837***
Australia	CSAD	-8,0009***
	Rm	-34,0871***
Austria	CSAD	-11,0567***
	Rm	-31,1894***
Bangladesh	CSAD	-16,1006***
		-15,9132***
Belgium	CSAD	-9,3877***
	Rm	-32,2596***
Brazil	CSAD	-8,6853***
	Rm	-18,6028***
Canada	CSAD	-7,9361***
	Rm	-17,3087***
Chile	CSAD	-10,6856***
	Rm	-30,0160***
China	CSAD	-6,9662***
	Rm	-48,2418***
Denmark	CSAD	-9,3287***
	Rm	-46,6721***
Estonia	CSAD	-16,7424***
	Rm	-51,4099***
Finland	CSAD	-10,8809***
	Rm	-47,7068***
France	CSAD	-8,0766***
	Rm	-32,0170***
Germany	CSAD	-9,3452***
	Rm	-46,8127***
Great Britain	CSAD	-8,1953***
	Rm	-46,8170***
Greece	CSAD	-21.1528***
	Rm	-48,9451***
Hong-Kong	CSAD	-7,2269***
	Rm	-46,9594***
Hungary	CSAD	-14,1849***
	Rm	-49,9438***
India	CSAD	-9,1214***
	Rm	-16,6284***
Indonesia	CSAD	-7,1870***
	Rm	-47,2714***

Ireland	CSAD	-7,4810***
	Rm	-52,1544***
Italy	CSAD	-9,2920***
	Rm	-32,2800***
Japan	CSAD	-11,2823***
	Rm	-46,7634***
Korea South	CSAD	-6,4422***
	Rm	-45,1279***
Malaysia	CSAD	-10,9043***
	Rm	-24,6583***
Mexico	CSAD	-9,5136***
	Rm	-48,2000***
Netherlands	CSAD	-9,2286***
	Rm	-33,8391***
New Zealand	CSAD	-10,5473***
	Rm	-32,6810***
Norway	CSAD	-7,6758***
	Rm	-33,6840***
Pakistan	CSAD	-11,8257***
	Rm	-44,5985***
Philippines	CSAD	-9,4931***
	Rm	-47,0689***
Poland	CSAD	-8,4781***
	Rm	-44,0953***
Portugal	CSAD	-12,8980***
	Rm	-33,5930***
Romenia	CSAD	-14,9453***
	Rm	-32,7609***
Russia	CSAD	-9,3600***
	Rm	-47,5699***
Singapore	CSAD	-10,9094***
	Rm	-20,1868***
Spain	CSAD	-10,2135***
	Rm	-33,3874***
Sweden	CSAD	-10,8813***
	Rm	-32,3483***
Switzerland	CSAD	-9,0227***
	Rm	-45,5798***
Taiwan	CSAD	-8,2584***
	Rm	-31,9138***
Thailand	CSAD	-11,6297***
	Rm	-33,1856***
Turkey	CSAD	-9,3354***
	Rm	-33,0662***
USA	CSAD	-7,9399***
	Rm	-19,5124***
Vietnam	CSAD	-12,0113***
	Rm	-46,6389***

*** P<0,01 ; ** P<0,05 ; * P<0,1

Appendix 2 - Results of t test (p-value) to decide the value of $D_{\gamma_{i,4}}$ during Pandemic COVID-19 Period

Country	t test	Coefficient´s value
Argentina	2,4386*** (0,0074)	-1
Australia	3,2810*** (0,0005)	-1
Austria	-0,2718 (0,3929)	0
Belgium	-1,0837 (0,1393)	0
Brazil	1,5248* (0,0637)	-1
Canada	2,3229** (0,0102)	-1
Chile	0,3759 (0,3535)	0
China	0,1922 (0,4593)	0
Denmark	0,2943 (0,3843)	0
Estonia	-1,4522* (0,0733)	1
Finland	-0,6191 (0,2680)	0
France	-1,4226* (0,0775)	1
Germany	-1,9371** (0,0264)	1
Great Britain	3,1376*** (0,0009)	-1
Greece	1,2518 (0,1054)	0
Hong-Kong	2,0501** (0,0203)	-1
Hungary	1,6886** (0,0457)	-1
India	2,8079*** (0,0025)	-1
Indonesia	3,2487*** (0,0006)	-1
Ireland	-0,2735 (0,3923)	0
Italy	-0,3586 (0,3600)	0
Japan	1,0667 (0,1431)	0
Korea South	3,2185*** (0,0007)	-1
Malaysia	0,1450	0

	(0,4424)	
Mexico	0,2257 (0,4108)	0
Netherlands	-1,7244 (0,0424)	1
New Zealand	1,0986 (0,1360)	0
Norway	0,4583 (0,3234)	0
Pakistan	-6,6695 (0,0000)	1
Philippines	0,1138 (0,4547)	0
Poland	1,3362* (0,0908)	1
Portugal	-1,176193 (0,1198)	0
Romania	-0,4686 (0,3197)	0
Russia	-0,3796 (0,3521)	0
Singapore	-0,1405 (0,4441)	0
Spain	-1,8823** (0,0299)	1
Sweden	-1,3226* (0,0930)	1
Switzerland	-3,7200*** (0,0001)	1
Taiwan	-0,9752 (0,1648)	0
Thailand	-2,8808*** (0,0020)	1
Turkey	-1,4836* (0,0690)	1
USA	1,8098** (0,0352)	-1
Vietnam	-3,7944*** (0,0001)	1

*** P<0,01 ; ** P<0,05 ; * P<0,1

Appendix 3 – Countries classification table and percentage of countries with evidences of herding/no herding before and during COVID-19

	Before	During	
Country	D_{g3}	D_{g4}	Classification
Argentina	-1	-1	developing economy
Australia	-1	-1	developed economy
Austria	0	0	developed economy
Bangladesh		-1	developing economy
Belgium	-1	0	developed economy
Brazil	-1	-1	developing economy
Canada	0	-1	developed economy
Chile	0	0	developing economy
China	1	0	developing economy
Denmark	0	0	developed economy
Estonia	-1	1	developed economy
Finland	-1	0	developed economy
France	-1	1	developed economy
Germany	0	1	developed economy
Great Britain	-1	-1	developed economy
Greece	0	0	developed economy
Hong-Kong	-1	-1	developing economy
Hungary	0	-1	developed economy
India	-1	-1	developing economy
Indonesia	-1	-1	developing economy
Ireland	1	0	developed economy
Italy	-1	0	developed economy
Japan	-1	0	developed economy
Korea South	-1	-1	developing economy
Malaysia	-1	0	developing economy
Mexico	0	0	developing economy
Netherlands	0	1	developed economy
New Zealand	0	0	developed economy
Norway	-1	0	developed economy
Pakistan	0	1	developing economy
Philippines	0	0	developing economy
Poland	0	0	developed economy
Portugal	1	0	developed economy
Romania	0	0	developed economy
Russia	0	0	economy in transition

Singapore	0	0	developing economy
Spain	-1	1	developed economy
Sweden	-1	1	developed economy
Switzerland	1	1	developed economy
Taiwan	1	0	developing economy
Thailand	1	1	developing economy
Turkey	0	1	developing economy
USA	-1	-1	developed economy
Vietnam	1	1	developing economy

Developed Economy		
	Before COVID-19	During COVID-19
Herding	12%	28%
No herding	48%	20%

Developing Economy		
	Before COVID-19	During COVID-19
Herding	24%	22%
No herding	41%	39%

8. References

Almeida Ferreira Maio, J. M. (2014). *Herding around the world: Do cultural differences influence investors' behavior?* Retrieved from repositorio-aberto.up.pt

Amirhosseini, Z., & Okere, V. O. (2012). Effect of cultural dimensions on stock exchange investment decisions in Iran. *Journal of Business & Economics Research (JBER)*, 10(12), 681-688.

Aziz, S., Jalan, A., Matkovskyy, R., & Bouraoui, T. (2021). Does Shariah compliance affect investor behaviour in the COVID-19 times: evidence from herding in the global energy market. *Applied Economics*, 1-12.

Bikhchandani, S., & Sharma, S. (2000). Herd behavior in financial markets. *IMF Staff papers, 47(3)*, 279-310.

Bogdan, S., Suštar, N., & Draženović, B. O. (2022). Herding behavior in developed, emerging, and frontier European stock markets during COVID-19 pandemic. *Journal of Risk and Financial Management*, 15(9), 400.

Chang, C. H., & Lin, S. J. (2015). The effects of national culture and behavioral pitfalls on investors' decision-making: Herding behavior in international stock markets. *International Review of Economics & Finance*, 37, 380-392.

Chang, E. C., Cheng, J. W., & Khorana, A. (2000). An examination of herd behavior in equity markets: An international perspective. *Journal of Banking & Finance*, 24(10), 1651-1679.

Chatjuthamard, P., Jindahra, P., Sarajoti, P., & Treepongkaruna, S. (2021). The effect of COVID-19 on the global stock market. *Accounting & Finance, 61*, 4923 - 4953.

Chiang, T. C., & Zheng, D. (2010). An empirical analysis of herd behaviour in global stock markets. *Journal of Banking and Finance*, 34, 1911-1921.

Christie, W. G., & Huang, R. D. (1995). Following the pied piper: Do individual returns herd around the market? *Financial Analysts Journal*, 51(4), 31-37.

Chui, A. C., Titman, S., & Wei, K. J. (2010). Individualism and momentum around the world. *The Journal of Finance*, 65(1), 361-392.

Devenow, A., & Welch, I. (1996). Rational herding in financial economics. *European economic review*, 40(3-5), 603-615.

Díez-Esteban, J. M., Farinha, J. B., & García-Gómez, C. D. (2019). Are religion and culture relevant for corporate risk-taking? International evidence. *BRQ Business Research Quarterly*, 22(1), 36-55.

Espinosa-Méndez, C., & Arias, J. (2020). COVID-19 effect on herding behaviour in European capital markets. *Finance Research Letters, 38*, 101787 - 101787.

Ferreruela, S., & Mallor, T. (2021). Herding in the bad times: The 2008 and COVID-19 crises. *The North American Journal of Economics and Finance*, 58, 101531.

Fischer, P., Ai, A. L., Aydin, N., Frey, D., & Haslam, S. A. (2010). The relationship between religious identity and preferred coping strategies: An examination of the relative importance of interpersonal and intrapersonal coping in Muslim and Christian faiths. *Review of General Psychology, 14(4)*, 365-381.

Hilary, G., & Hui, K. W. (2009). Does religion matter in corporate decision making in America? *Journal of financial economics*, 93(3), 455-473.

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online readings in psychology and culture*, 2(1), 2307-0919.

Hong, H., Bian, Z., & Lee, C.-C. (2021). COVID-19 and instability of stock market performance: evidence from the US. *Financial Innovation*, 7(1), 1-18.

Jlassi, M., & Bensaida, A. (2014). Herding behavior and trading volume: Evidence from the American indexes. *International Review of Management and Business Research*, 3(2), 705-722.

Khan, M. A., Gu, L. K., & Meyer, N. (2022). The effects of national culture on financial sector development: Evidence from emerging and developing economies. . *Borsa Istanbul Review, 22(1)*, 103-112.

Kizys, R., Tzouvanas, P., & Donadelli, M. (2021). From COVID-19 herd immunity to investor herding in international stock markets: The role of government and regulatory restrictions. *International Review of Financial Analysis*, 74, 101663.

Kristjánsdóttir, H., Guðlaugsson, Þ. Ö., Guðmundsdóttir, S., & Aðalsteinsson, G. D. (2017). Hofstede national culture and international trade. *Applied Economics*, 49(57), 5792-5801.

Lobão, J. (2020). Culture, learning and rational decision-making: evidence from a TV show. *Decyzje*, (34), 5-27.

Lobão, J. (2022). "Herding Behavior in the Market for Green Cryptocurrencies: Evidence from CSSD and CSAD Approaches. *Sustainability, 14(19)*, 12542.

Lobao, J., & Serra, A. P. (2007). Herding behavior: Evidence from portuguese mutual funds. *Diversification and portfolio management of mutual funds*, 167-197.

Luong, H. T., & LUU, Q. T. (2020). Herding Behavior in Emerging and Frontier Stock Markets During Pandemic Influenza Panics. *Journal of Asian Finance, Economics and Business Vol 7 No 9*, pp. 147-158.

Matters, C. R. (2008). Countries and culture in behavioral finance. *CFA Institute Conference Proceedings Quarterly*, Vol. 25, No. 3, pp. 38-44.

McQueen, G., Pinegar, M., & Thorley, S. (1996). Delayed reaction to good news and the cross-autocorrelation of portfolio returns. *Journal of Finance, 51*, 889-919.

Meier-Pesti, K., & Penz, E. (2008). Sex or gender? Expanding the sex-based view by introducing masculinity and femininity as predictors of financial risk taking. *Journal of Economic Psychology 29*, 180-196.

Minkov, M., & Hofstede, G. (2014). Nations versus religions: Which has a stronger effect on societal values? *Management International Review*, 54(6), 801-824.

Mobarek, A., Mollah, S., & Keasey, K. (2014). A cross-country analysis of herd behavior in Europe. *Journal of International Financial Markets, Institutions and Money, 32*, pp. 107-127.

Newey, W., & West, K. (1987). A Simple, Positive Semi-Definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica, 55*, pp. 703-708.

Nofsinger, J. R., & Sias, R. W. (1999). Herding and feedback trading by institutional and individual investors. *The Journal of finance*, 54(6), 2263-2295.

Stulz, R. M., & Williamson, R. (2001, April). Culture, Openness, and Finance. *NBER Working Paper Series*.

Tan, L., Chiang, T., Mason, J., & Nelling, E. (2008). Herding behavior in Chinese stock markets: An examination of A and B shares. *Pacific-Basin finance journal, 16(1-2)*, 61-77.

Vieira, E. F., & Pereira, M. S. (2015). Herding behaviour and sentiment: Evidence in a small European market. *Revista de Contabilidad*, 18(1), 78-86.

Vo, X. V., & Phan, D. B. (2019). Herding and equity market liquidity in emerging market. Evidence from Vietnam. *Journal of Behavioral and Experimental Finance, 24*, 100189.

World Health Organization. (2020, March 11). Virtual press conference on COVID-19 – 11 March 2020. Retrieved from https://www.who.int/docs/default-source/coronaviruse/transcripts/who-audio-emergencies-coronavirus-press-conference-full-and-final-11mar2020.pdf?sfvrsn=cb432bb3_2

Zhou, R. T., & Lai, R. N. (2009). Herding and information based trading. *Journal of Empirical Finance, 16(3)*, 388-393.