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SAUDI EQUITIES HERDING: THE ROLE OF REGIONAL AND GLOBAL FACTORS

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**UNIVERSITY OF
PLYMOUTH**

**SAUDI EQUITIES HERDING: THE
ROLE OF REGIONAL AND
GLOBAL FACTORS**

by

DINA GABBORI

A thesis submitted to the University of Plymouth in
partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

Plymouth Business School

April 2020

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Dina Gabbori

Dedication

“This thesis is dedicated to my teachers, friends and family”.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

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Abstract

Candidate: Dina Gabbori,

Title: Saudi Equities Herding: The role of Regional and Global Factors

Herding is an important stock market behaviour for investors and policymakers, it may affect market volatility, which investors need to understand to properly assess risks. Financial instability may deter risk-averse investors while benefitting investors seeking profit from market inefficiencies. Policymakers who understand herding impacts are better placed to improve the information available to investors.

Herding behaviour in the Saudi equity market was examined between 2006 and 2016 using the method suggested by Chang et al. (2000), from three related perspectives. Firstly, through its influence on oil market volatility, including during OPEC conference meetings. Results showed significant herding behaviour in most sub-periods. However, cascading was independent of oil market volatility, except during OPEC meetings in the global financial crisis period, 2008 - 2010. Secondly, through the impacts of social attitudes coinciding with Islamic festivals of Ramadan, Eid-ul-Fitr, Ashoura and Eid-ul-Adha. Up- and down-days for both markets and liquidity were considered in domestic and the influential US and oil markets, using appropriate vectors. Movements pre and post the 2008 Global Financial Crisis and the Arab Spring in 2010 were separately assessed. Results showed significant herding during Eid-ul-Fitar, Ashoura and Eid-ul-Adha, but, contrary to some studies, none during Ramadan. Thirdly, through its effects on regionally and culturally adjacent equity markets, particularly in GCC countries, with information spill-over from the US a factor. Results showed pronounced herding in all GCC equity markets affected by significant herding spilled-over from the Saudi market and insignificant spill-over from the US; indicating regional integration of markets with Saudi pre-eminent.

Several findings are novel, including the impacts of Islamic festivals, other than Ramadan and oil price volatility during OPEC meetings, on herding behaviour: both have been largely ignored in most previous studies. Our results provide valuable insights, showing that herding and excess volatility recently observed in the Saudi equity market is not related to risk or information spill-over from oil markets.

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List of Abbreviations

A	Average (normal returns)
ATA	Agricultural Futures Market Amsterdam
AVD	The Average Absolute Value of the Deviation
BL	Big Low Book to Market
CAPM	Capital Asset Pricing Model
CEO	Chief Executive Officer
CH	Christie and Huang (1995)
CK	Chang <i>et al.</i> (2000)
CSAD	Cross-Sectional Standard Deviation of Returns
CSSD	Cross-Sectional Standard Deviation
EMH	Efficient Market Hypothesis
ESM	European Stability Mechanism
ETFs	Exchange Traded Fund
FOX	London Futures and Options Exchange
FSI	St. Louis Fed's Financial Stress Index
GCC	Gulf Cooperation Council
GFC	Global Financial Crisis period
HML	High Minus Low
HS	Hwang and Salmon (2004)
HSCI	Hong Kong's Hang Seng Composite Index
L	loser (low or negative returns)
MATIF	Marche a Terme International de France
MENA	Middle East and North Africa
MOM	Momentum
NYSE	New York Stock Exchange
OLS	Ordinary Least Squares
OPEC	The Organisation of the Petroleum Exporting Countries
OVX	CBOE Crude Oil Volatility Index
SH	Small High Book to Market
SL	Small Low Book to Market
SM	Small Medium Book to Market
SMB	Small Minus Big
STR	Regime-Switching Smooth Transition Regression Model
TVTP-MS	Time-varying Transition Probability Markov Switching model
UAE	United Arab Emirates

UK	United Kingdom of Great Britain and Northern Ireland
US	United States of America
VIX	CBOE Volatility Index
W	Momentum Winner (high returns)
WTI	West Texas Intermediate

Chapter 1: Introduction

This thesis comprises three separate but related empirical studies. This chapter starts with a brief discussion of the underlying motivation to undertake this research. The chapter also defines the research aim and objectives, research questions, conceptual framework, methodological approach, and outlines the gaps in our knowledge that make each study important and novel. At the end of this Chapter, the structure of the thesis is provided.

1.1 The research motivation

Herding in financial markets has serious implications for investors. Herding makes financial markets riskier and, hence, may reduce the suitability of these markets for a wide range of investors with low risk tolerance. Price instability due to herding may discourage individual and institutional participation in financial markets as investors may look to invest in more stable, less volatile markets instead. The outflow of capital from financial markets has serious implications on corporate valuations, funding and economic growth. Therefore, many papers have focused on studying herding in financial markets, including Christie and Huang, 1995; Chang *et al.*, 2000; Hwang and Salmon, 2004; Galariotis *et al.*, 2015; Balcilar, 2013; Sharma *et al.*, 2015; Gavriilidis *et al.*, 2016).

This chapter will now discuss why the Saudi stock market has been chosen as an example for this study. Emerging markets such as the Saudi market are highly controlled by retail investors and hence, there is a greater chance that the trading activities are characterised by herding with serious impact on financial markets' stability. The literature on herding in emerging markets is, however, scant. In the context of herding in Saudi equities, there are four principal studies (Balcilar *et al.*, 2013; Balcilar *et al.*, 2014; Rahman *et al.*, 2015 and Balcilar *et al.*, 2017), all of which found significant herding. Balcilar *et al.* (2013, 2017) employs the cross-sectional absolute deviation of returns (CSAD) in the context of a Markov switching process that changes volatility regime from low to high to an extreme. In the Rahman *et al.* (2015) study, the inference is derived from a simple regression model; but the CSAD is computed differently using a beta dispersion method that employs individual company betas. In the Balcilar *et al.* (2014) model, the market switches from herding to non-herding state according to some transitional probabilities. The transition to the herding state is found to be more likely when volatility is high. The Balcilar *et al.* (2013) research found herding to be more intense during periods of extreme

market movements, while Rahman *et al.* (2015) found evidence of intense herding in an up-market state and when the trading volume was high. Balcilar *et al.* (2017), investigated the influence of speculation in the oil market on equity herding but found less evidence of herding, attributable to speculation associated with more rationality in the oil-producing countries.

It must be noted that there is one common issue with these studies which is important to consider. In all of the studies on Saudi equities, herding is inferred by regressing the cross-section absolute deviation of company returns on the squared returns of the market. A negative and significant relationship is indicative of herding behaviour. However, this type of negative association may also arise due to similar responses of investors to the flow of fundamental information, or because of similar investment styles, as mentioned by Galariotis *et al.* (2015). These factors were not taken into account in all of the studies that discuss Saudi equities. In this thesis we infer the herding behaviour of Saudi equities after accounting for that part of the cross-section absolute deviation that may arise from three styles of investments: small size, high book to market value and momentum. We do that by creating factors of returns that are used to filter the cross-section absolute deviations from any covariance that is due to such factors or similar style investing by market participants. This refinement has been undertaken in many studies of herding in the US and UK, but not in Saudi Arabia.

There are other, geopolitical and religious considerations which motivate this study. Saudi Arabia is one of the largest global oil producers and it produces around 13 % of global oil output and controls 22 % of global reserves. Its economy is not diversified so it depends on oil revenues. This implies that developments in the oil market may influence herding in the Saudi equity market. In addition, Saudi Arabia is considered as one of the most important religious countries in the Islamic world. It contains the holiest places for Muslims and, therefore, it is expected that Saudi markets may herd during Islamic event periods. This issue has been the topic of study by Gavriilidis *et al.* (2016), who found significant herding behaviour during Islamic occasions in a group of Islamic equity markets. However, problematically for our study, Gavriilidis *et al.* (2016) only included Ramadan and they excluded Saudi Arabia from their sample of countries. Finally, Saudi is considered the hub of the Gulf Cooperation Council (GCC), which is a politically and economically collaborative body of six Middle Eastern nations. It was the main mover in setting up the GCC in 1981 (Husain and Naser, 2008). The main objectives of national leaders when joining the GCC were to effect coordination, integration, and

interconnection among the member states in all fields, to achieve unity. As a result, deeper ties among the GCC countries were created. Historically, the GCC countries have common religious, social, and cultural identities and the GCC is a political and economic policy-coordinating forum for its member countries (Husain and Naser, 2008). This makes it interesting to test whether herding in Saudi Arabian equities market impact herding in the GCC equities markets. To the best of our knowledge, this issue has not been investigated in previous research.

1.2 The research aim and objectives

The herding behaviour is particularly relevant in developing markets where herding is likely to be more pronounced due to the dominance of retail investors. These investors are informationally inefficient and they suffer from a multitude of behavioural biases in making their investment decisions. The Saudi equity market is an emerging market that is dominated by retail investors. The market is relatively more volatile than other emerging markets and it is suspected that some of this excess volatility can be attributed to herding. Therefore, the aim of this thesis is to investigate the significance of herding behaviour in the Saudi market. In particular, we examine the herding behaviour in the Saudi equity market from three different but related perspectives:

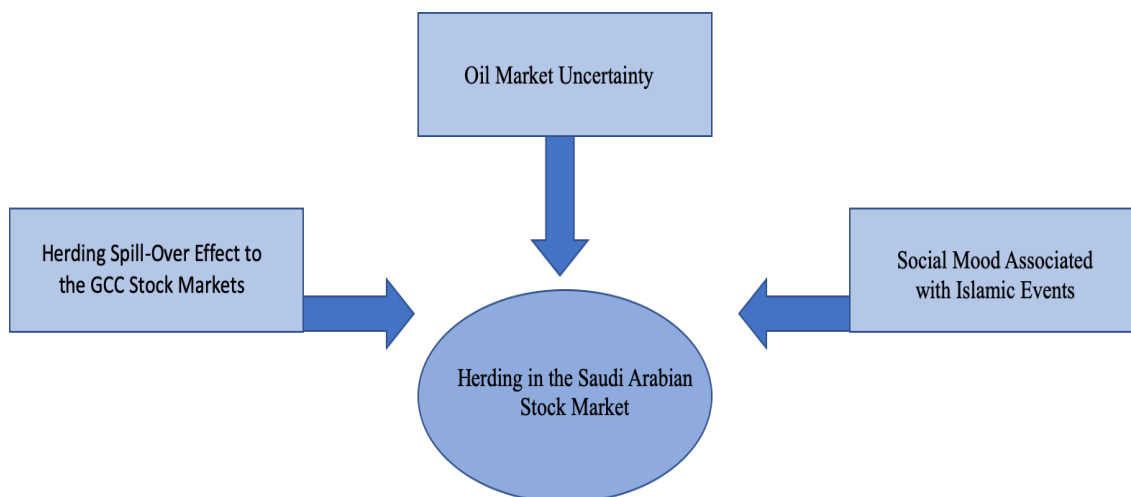
- (a) The first perspective focuses on the influence of oil market uncertainty, including the uncertainty during the OPEC (The Organization of the Petroleum Exporting Countries) conference meeting days on the herding tendency of Saudi equities.
- (b) The second perspective assess the impact of social mood associated with Islamic events on herding of Saudi equities.
- (c) The third perspective focuses on herding spill-over effect from Saudi Arabia equity market to the GCC markets and investigates whether regional or global factors trigger herding in the GCC equity markets.

1.3 Research questions

As discussed, the notion of herding is applied on the Saudi Arabian stock market. Consequently, the following questions have been developed to address the research objectives above. The key question being formulated is: ‘To what extent does herding behaviour impact the Saudi Arabian equity market?’ In order to address a comprehensive answer to this question, numerous questions are asked to formulate the research purpose. The questions include:

- (a) Whether the oil market volatility impacts herding in the Saudi equities?
- (b) Does news from periodic OPEC meetings influence this herding behaviour?
- (c) Whether social mood affecting market activities associated with Islamic events leads to herding behaviour in investors in Saudi Arabia's stock market?
- (d) If herding behaviour does exist in Saudi Arabia, is its existence more significant on festive event days compared to non-event days?
- (e) Whether herding in the Saudi market facilitates herding in the GCC stock markets?
- (f) Is herding tendency in the GCC stock markets regional in design or an outcome of international spill over?

1.4 Conceptual framework



1.5 Methodological approach

This thesis implements a positivist epistemological approach, employing a deductive quantitative data analysis to address the research objectives. We follow Change *et al.* (2000) to capture herding behaviour in the stock market. They measure herding by the cross-sectional absolute deviation of returns (CSAD). The relationship between how assets returns tend to rise or fall with market returns capture herding behaviour in the stock market. The negative association between dispersion and absolute (squared) returns indicate herding behaviour in the stock market. However, when company returns are expected to move with the market according to their betas, the value of CSAD should be

increasing and that indicates anti-herding behaviour in the stock market¹. The observed return on a company and market returns are obtained in Dollars from Thomson-Reuters Datastream database. The number of companies listed in the Saudi market of the Tadawul all-share index is only 175, while the number of companies listed in the financial markets of the Gulf Cooperation Council countries is 623. The research uses data for all active, dead and suspended companies to eliminate any potential survivorship bias.

Investors may follow similar investment decisions as a response to fundamental market information. As a result, the relationships may indicate herding behaviour even when there is no actual herding in the markets. Consequently, we eliminate the part of cross section absolute deviations (CSAD) that response to fundamental information or style investing using Galariotis *et al.* (2015) method. The number of Saudi companies is not very large, so in order to improve the style returns measure, we pooled all the companies in the Gulf Cooperation council Countries², which is the economic block that Saudi Arabia belongs to for the purpose of factor computations.

To investigate the first objective, this thesis is related to the Balcilar *et al.*, (2013), the Balcilar *et al.* (2014), the Rahman *et al.* (2015) and the Balcilar *et al.* (2017) papers, and herding literature. This thesis instead, however, focuses on the influence of oil market uncertainty including the uncertainty during the OPEC conference meeting days on the herding tendency of Saudi equities. The WTI crude oil is obtained from Thomson-Reuters Datastream database, and an OPEC meetings dummy which was constructed manually by looking into OPEC quarterly reports at the OPEC website: www.opec.org. The influence of oil volatility and OPEC meetings are tested over various time periods (e.g. Financial crisis, Arab Spring) to check for significant herding in the Saudi equities and how it is related to different information channels pertaining to oil market.

To test whether herding is different during Islamic event days as opposed to other, non-event, days, the research applied the modified approach suggested by Gavriilidis *et al.*

¹ Standard pricing models such as CAPM assumes an efficient behaviour of the market. Consequently, we avoid the use of CAPM model as the Saudi Arabian stock market and the behaviour of the investors who control it is inefficient. Furthermore, sentiment plays an important role in the market and such behaviour is not covered by CAPM model.

² The GCC companies subject to similar environment and respond to similar risks and regulations.

(2016). We constructed a dummy variable for each Islamic event to capture its effect on herding. The dummy variables included in the research are: Ashoura, Ramadan, Eid-ul-Fitr and Eid-ul-Adha; they are formed manually using data from the Islamic calendar. The corresponding days were taken from the Gregorian calendar. This matching exercise utilised the lunar calendars for the years covered in this study from the website: <https://calendar.zoznam.sk>. We checked also for the robustness of the results with the changes in investment style, changes in variables reflecting Saudi Arabian domestic market conditions, US daily stock market returns, US investor sentiment, the Chicago Board Options Exchange Crude Oil Index, the 2008 Global Financial Crisis and the Arab Spring. The daily time series data such as US daily stock market returns, US investor sentiment, the Chicago Board Options Exchange Crude Oil Index data were obtained in US dollars from the Thomson-Reuters Datastream database.

To test herding spill-over effect from Saudi Arabia to the GCC stock markets, the study applied the same methodology suggested by Chang et al. (2000) with some adjustments in their method. The study added the dispersion of Saudi equities, to detect herding spill-over effect from Saudi Arabian stock market to the rest of the GCC stock markets, the dispersion of Saudi equities should be positive. Herding in the GCC stock markets is also calculated for the purposes of the research. This research also removed the part of dispersion that respond to the same fundamental information. We also check for the robustness of the results with the changes over various time periods to determine what triggers herding behaviour in GCC markets: is the herding tendency regional in design or is it an outcome of international spill over?

1.6 Contribution of the study

This study makes three different contributions to the literature and further contributions in methodology and policy. The first contribution is to the growing literature on herding behaviour in Saudi Arabian equity market. The contribution in this respect is that the study covers a longer period of twelve years from 2005 to 2016. This period includes the 2008/2009 financial crisis and the Arab spring phenomenon that caused financial instability in many financial markets. Previous literature (e.g. Balcilar *et al.*, 2017) covers the impact of the financial crisis period only when investigating herding in Saudi Arabian market. We form our investigation using different data range that covers the periods before, during and after the 2008 financial crisis. These periods also cover the Arab spring

phenomenon, giving a much broader perspective that facilitates the understanding of what influence herding in Saudi equity market.

The study also contributes to the literature by studying the influence of uncertainty in the oil market on the herding behaviour of the Saudi equity markets: this has not been previously studied. Most published literature looks at equity returns and volatilities in oil exporting countries, where oil market returns and volatilities are related (e.g. Park and Ratti, 2008; Filis *et al.*, 2011; Arouri and Nguyen, 2010; Awartani and Maghyereh, 2013). The rationale of these studies is that the increase in oil prices will negatively impact on company costs, cash flows and value. By considering the relationship between oil prices and equity prices, it is logical to assume that uncertainty and volatility in the oil market may trigger herding in equities of the oil exporter countries, such as Saudi Arabia. Thus, our first study investigates the herding behaviour in the Saudi Arabian equity market. It focuses on the impact of the oil market volatility, and the effect of the OPEC meetings, on the herding behaviour of Saudi equities. This has not been previously studied.

Moreover, our study is the first that investigate the impact of Islamic events on herding behaviour in Saudi Arabian equity market. In emerging markets such as Saudi Arabia, previous research has studied the impact of the Islamic calendar on the stock markets only as a seasonal anomaly (e.g., Husain, 1998; Alper and Aruoba 2001; Seyyed *et al.* 2005; Ramezain, 2013). Therefore, in our second study we focus on the impact of social mood on herd behaviour in the Saudi Arabian stock market. It specifically investigates whether the sentiments associated with Islamic events encourage herding around these days more than on non-events days. Investors during Islamic events face the same set of emotional stimuli and social moods correlated with combined levels of optimism or pessimism as the population in general. Such sentiments may influence investor decision making towards herding or reducing their market activities. Gavriilidis *et al.* (2016) research focuses only on the impact of Ramadan and found significant herding in a group of Islamic equity markets. Similarly, Yousaf *et al.* (2018) used Ramadan only when investigated herding in the Pakistani stock market. We added to Gavriilidis *et al.* (2016) and Yousaf *et al.* (2018) research different Islamic events such as Eid-ul-Fitr, Ashoura and Eid-ul-Adha and Ashoura which enables the examination of different moods including happiness, sadness and religious, emotional conflict.

In addition, herding behaviour in one market that can be spilled over to other related markets is the primary objective of the third study. It looks at whether herding in the Saudi

Arabian stock market can be exported to the GCC countries' stock markets. The Saudi Arabian stock market is the largest stock market in the region and no studies have been done on GCC equity markets that investigate any cross herding from the Saudi market to the rest of the region. Furthermore, the literature on cross herding is sparse and mainly focuses on herding spill over between US and European markets. The GCC stock markets, including Saudi Arabia's, are inefficient, have poor corporate governance, and are typically controlled by individual investors. As a result, the presence of herding behaviour in the GCC stock markets is highly likely. The results obtained from this study contribute to the body of knowledge from prior studies that have revealed mixed results on the presence of herding behaviour in the GCC equity markets. Our study shows that the presence of herding across countries is varied and based on different factors such as the market condition and time periods.

The second aspect of the contribution of this study is regarding the methodological approach. The growing literature on herding in Saudi Arabia equity market infer herding by regressing the cross-section absolute deviation (CSAD) of company returns on the squared returns of the market (e.g. Balcilar *et al.*, 2013; Balcilar *et al.*, 2014; Rahman *et al.*, 2015 and Balcilar *et al.*, 2017). They argue that herding is present in the market if a relationship between the CSAD of a company and the squared market return is negative and significant. However, there are some important factors they do not take into account when calculating CSAD. Investors may follow similar investment decisions as a result of following similar fundamental information, or because they apply similar investment styles (Galariotis *et al.*, 2015). That could wrongly consider as herding, even if there is no actual herding behaviour in the market. The contribution in this respect is we take into account these factors and eliminate them from the CSAD measure to avoid any covariance that is due to such factors or similar style investing by market participants. These factors include small size, high book to market value and momentum following as we followed the method suggested by Galariotis *et al.* (2015).

The third aspect connected to the potential practical and policy implications of the results from this study. The Saudi market is controlled by retail investors and the level of information transparency is low, so study of the factors that influence herding in the Saudi market is very important for policy makers. This study considers different key aspects that affect herding behaviour in the Saudi Arabian equity market. These aspects include regional factors (e.g. market conditions, liquidity, Size) and global factors (e.g. the impact of oil volatility and OPEC meetings, Islamic events, CBOE index, S&P 500 Index,

2008/2009 Financial crisis). Our results would help policy makers in understanding what manipulate the market in Saudi Arabia, and hence develop strategies and policies to improve the market.

1.7 Outline of the thesis

This dissertation is organised as follows: This chapter was aimed at introducing the research project. It outlined the motivation of undertaking the research, the research objectives and research questions. Chapter one reviews the research background and summarises previously published research in this field and outlines the overall structure. Chapter two provides a clear definition of herding, sources of herding and herding theories, herding measurement methodology and covers the principal literature on herding behaviour. Chapter three is an empirical analysis, examining whether oil market volatility and OPEC meetings impact on herding behaviour in the Saudi equity market. Chapter three also includes a relevant literature review, methodology, data set and style factor construction, results and discussion and finally the conclusions. Chapter four is another empirical analysis, examining the impact of social mood on the herd behaviour in the Saudi Arabian stock market. This chapter provides a detailed study of the effects of Muslims' mood on herding during Ashoura, Ramadan and the Eids. It summarises the most important, related empirical evidence in the literature and includes a methodology, data, results, and discussion and conclusions. Chapter five is an empirical analysis that examines regional and international herding transmission in the context of GCC countries and the US. Chapter five also includes a related literature review, methodology, data set and style factor construction, results, discussion and conclusions. Chapter six concludes the study, summarising the findings, explains their policy implications and suggesting directions for future research.

Chapter 2: Herding Behaviour

This chapter will discuss herding in the financial markets, it provides a clear definition of herding, sources of herding and herding theories, measurements of herding and provides an overview of the empirical evidence on herding. This chapter helps in understanding the concept of herding and why investors herd. Additionally, a summary of empirical evidence is provided which identifies the research gaps to give a clear image about the scope of this research.

2.1 Historical overview

Behavioural finance can be summarised based on De Bondt *et al.* (2008) in three statements: a) there is a catalogue of biases; b) investor sentiment matters and c) decision processes shape decision outcomes. As a result, three building blocks have been identified: sentiment, behavioural preferences and limits to arbitrage. So, it is important to consider the attitudes and emotions, moods and sentiment, personality traits, perception towards investment making, and feelings of the investors as they play important role in investor's decision making (Boda and Sunitha, 2018). These psychological factors impact on the logical thinking of the investors and are affected by biases as mentioned in Figure 2.1. Behavioural psychology consists of heuristics biases (including representativeness, availability and anchoring,) and cognitive bias (over-confidence, over-reaction and herd effect) which may give explanations and solutions to the market anomalies compared to the traditional form of finance which fail to explain these anomalies.

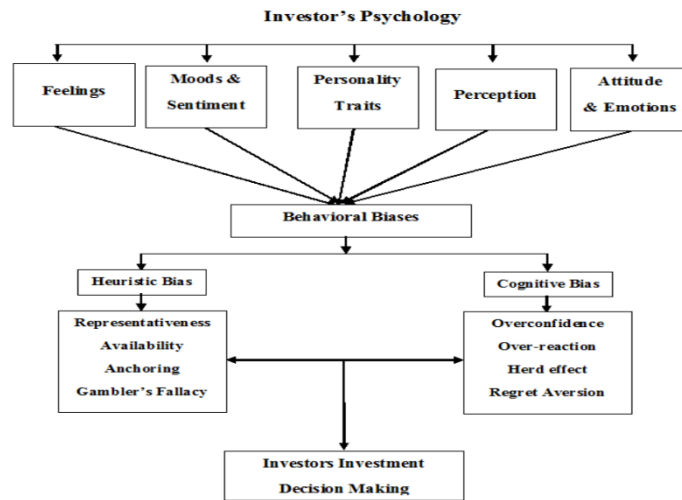


Figure 2.1 Psychological approach to investment decision making

Source: Boda and Sunitha (2018)

Herding behaviour, also known as the “crowd behaviour”, is one example of the cognitive bias in investor’s psychology. At the end of the 19th century, the French psychologist and sociologist Gustave Le Bon looked at the psychology of crowds and noticed that when people become members of a group three characteristics are attributed to them: the *absence of responsibility, contagion, and suggestibility*. The first one means that individual become irresponsible when becoming part of a crowd as an individual performs actions he would otherwise not have chosen to do (Le Bon, 2002:6). The second one implies that individuals suppress their personal beliefs and interests and choose to follow those of the crowd when being a part of a crowd; the formed belief of the crowd spreads contagiously among its members (2002:7). Thirdly, an individual may become an ‘automaton’ and is driven by suggestions and instincts rather than reason because of being in the crowd, and contagion is, finally, an effect of suggestibility (2002:7,8).

2.1.1 Investors’ decision making under uncertainty

Having discussed the various characteristics of herding behaviour, there are elements that might affect the decision-making process from an investor perspective aspect. For example, those hunches or feelings can easily be impacted by behavioural biases (Daniel and Titman, 1999; Wärneryd, 2001). In addition to this, the information available to investors is related to the degree of uncertainty they perceive and how the information is presented. Consequently, herding behaviour is more frequent in high-uncertainty contexts. Investors often base most of their analysis on hunches or feelings as they are

not aware of all the information signals and cannot analyse all the information they receive (Daniel and Titman, 1999; Wärneryd, 2001). Therefore, they apply vague ad hoc rules to translate the information they receive into estimates of cash flows and company valuations.

Looking closely at how these uncertainties cause investors to react irrationally in various situations. It is clear that they would be concerned about the real value of the securities being traded, and about the quality of the information available. As a result, the informational limitations, and cognitive limitations would therefore influence investors' decisions making. Investors may think in uncertain contexts that others have better information than what they have and tend to observe other investors decisions. Investor may put equal weight on private and public signals, if an individual has access to public and private information and they are of equal value in predicting the asset's intrinsic value. Furthermore, he will put more weight on the public signal than on private signal, when the individual knows that others have also observed the same public signal, the public signal is a better predictor of average opinion. As a consequent of this, asset prices will be overweighting public information relative to the private information if willingness to pay for an asset is related to their expectations of average opinion (Allen *et al.*, 2006). Moreover, researchers have found that if private information does not incorporate in asset prices, agent will not act on private information at time they sell the asset (Froot *et al.*, 1992).

Herding behaviour can be a possible cause of the market's bubbles (Galbraith, 1994). An evidence of that is the first "bubbles" in economic history was the "tulip mania" in the Netherlands back in 1637. People contract prices increased rapidly in the first place as a result of the mania of people regarding tulip bulbs, before seeing them eventually collapsing. Furthermore, in 1720 another bubble took place in England and is called the South Seas' bubble. The monopoly of trading between England and its South American colonies is gained by a joint stock company in return for accumulating the debt of England created during the war; extreme speculation on the stock of the company raised its price to extremely high levels before also seeing it collapsing causing severe losses to its shareholders (Gavriilidis, 2013).

Additionally, in 1720 the Mississippi bubble was burst. The Mississippi Company spread its profits to its shareholders in forms of paper money because of speculation on its stock, and the excess supply of banknotes in relation to the gold and silver results in a sharp decrease in the stock price. Finally, in 1929 the level of insanity and poverty increased

among investors as a result of the famous crash euphoria of the previous years which leads to a sharp drop in stock after an enormous rise in stock market prices (Gavriilidis, 2013).

2.1.2 Definition and sources of herding

According to Hwang and Salmon (2004, p.1), “*herding arises when investors decide to imitate the observed decisions of others or movements in the market rather than follow their own beliefs and information*”. Herding can also be defined as a behavioural tendency for an individual to follow the actions of others (Hudson, 2014). It can be also described as ‘*...the phenomenon of individuals deciding to follow others and imitating group behaviours rather than deciding independently and atomistically on the basis of their own, private information.*’ (Baddeley, 2010, p.282).

The convergence of opinions when investors follow other market participants combined with convergence in trades leads to investor herd behaviour (Hudson,2014). Experiments in social psychology prove that individuals’ decision making may abide by the group decision, even when they perceive the group to be wrong (Sherif and Murphy, 1936 and Trade and Parsons, 1903). Moreover, investors may follow wrong trading strategies because they are overwhelmed with large amounts of information about companies so stock markets and other investors’ decisions can easily mislead or manipulate them (Gavriilidis, 2013).

The influence of others on an investor investments decisions and financial transactions could be as a result of the ‘herd instinct’ in the investor’s decision-making, or an emotional response to information (Ibnrubbian, 2012). According to Bikhchandani and Sharma (2001), herding behaviour can be either a rational or irrational form of investors’ behaviour. Moreover, rational herding is fostered by information cascades, reputation concerns and compensation structures (Hudson, 2014). Rational herding follows Bayes’ rule when making sequential decisions and it is based on using information about other’s actions. A cognitive process of information involves at least some part of learning from other's actions. The reputation concerns of herding correspond with what Keynes (1936, quoted in Baddeley,2010, p.282) observed ‘*...it is better to be conventionally wrong than unconventionally right*’. Also, previous research argues that in a fully rational setting some irrational phenomena could actually appear and that what the theoretical work on herding behaviour points out (Hirshleifer and Teoh, 2003). Previous research found that the outcomes generated by Bayesian models can be good or bad based on whether the

predecessors' actions send the investor down the correct or incorrect track (Baddeley, 2010).

In contrast, irrational herding is when sociological, psychological and emotional factors play a role in the decision-making process (Ibnrubbian, 2012). Behavioural finance theory posits that certain psychological biases and heuristics influence investors' behaviour. For instance, Prast (2000) argued that there is strong relationship between herding behaviour and cognitive dissonance; the latter is defined by Festinger (1957, p.13) as being two cognitive elements '*in a dissonant relation if, considering these two alone, the obverse of one element follows from the other*'. Cognitive dissonance³ could demonstrate the herding behaviour of investors in a financial markets. Making the same choice and imitating other investors is more convenient for investors who choose to herd on their peers': instead of being alone when making the wrong choices, they belong to a group that did the same mistake (Gavriilidis, 2013).

Leading on from this, Prast (2000) found that congruity bias induces herding behaviour in investors. Investors choose to adjust their decisions towards the information source or the new information itself if the new information arrived is not match investors' previous beliefs about the information source (this could be a fund manager or an analyst) because investors deal with the new information in a biased way. Practically, analyst choose to disregard new information and pick his good previous choices because a deviating bad choice has a higher cost to the analyst rather than a choice similar to those that performed well in the past, and eventually did not.

Moreover, the contagion of investors' behaviour and decisions is one of the crucial aspects of herding and is often driven by the contagion of media information and the beliefs of other investors. Previous literature describes the phenomenon when investors feel more comfortable observing others and carry out the same actions as they do as conformity (Hirshleifer, 2001). Furthermore, the phenomenon when investors do not adapt quickly towards newly arriving information is called conservatism bias. This phenomenon is an essential characteristic of crowd members and is not met only in herding but in other behaviourally driven patterns of investors such as that of underreaction (Barberis *et al.*, 1998).

³ In the history of Psychology, this phenomenon is one of the most heavily studied, and it describes individuals' psychology when their cognitions—beliefs, attitudes, and behaviours—are at odds (Festinger, 1957).

Another behavioural bias representativeness heuristic (Barberis *et al.*, 1998), which can induce herding in investors' behaviour, is when they extrapolate from limited and recent events to imagine patterns that do not exist.

Home bias may influence investors' behaviour and drive them into similar decisions. Investors may choose to invest in familiar companies in terms of geographical location, and this bias is documented by previous literature. Feng and Seasholes (2004) looked at the link between location and correlated trading. Their research is based on data from China and the findings showed that if investors are in the same location, the correlation among investors' trading is more significant. Furthermore, the findings show that investors who live closer to a firm's headquarters are able to receive more accurate information regarding the company as they recognise an information asymmetry among investors. The authors concluded by putting more weight on the important of public information upon investors' decisions and how the public information is crucial in explaining the trading actions of investors.

Additionally, investors are often influenced by rumours through their interaction with others or through media coverage and rumour-heuristic could also drive herding behaviour, especially during crises (Buckner, 1965). Professionals, being better informed, take advantage during the crises and realise gains from them (Schindler, 2007). The impact of hedge funds' speculative actions on destabilizing role in the markets has been much criticised (Fung and Hsieh, 2000).

Investors pay more attention to more familiar and salient events even when exposed to a large amount of information, and this phenomenon is called limited attention. In particular, investors ignore more critical information when making investment decisions and overweight specific factors such as an analyst's fame (Daniel *et al.*, 2002; Hirshleifer and Teoh, 2003).

2.1.3 Herding theories

According to Welch (2000), different theories show the various incentives to adopt herd behaviour. They include, utility interaction, sanction on deviants, positive payoff externalities, informational externalities, principal-agent payoff externalities, and irrational agent behaviour, but it is difficult to empirically discriminate fine differences between the theories. As a result, empirical studies concentrate on whether similar investment decisions are taking place in financial markets instead.

When investors trade on the same side of the market and it has been described as herding behaviour in the financial markets (Ibnrubbian, 2012). Many academic models outline the rationale for herding, information cascades, or feedback trading. The mechanisms can generally be summarised as information difference, principal- agent relationship, and investors' sentiment based on the forces that drive investors into herding (Ibnrubbian, 2012).

Information is a crucial ingredient for successful investment, especially in the highly competitive context of financial markets. Gathering accurate information is usually both time and money consuming for investors. Instead, investors, when they do not own sufficient information, may choose to copy other investors whom they consider to be better informed. Furthermore, when they feel other investors have better information, they follow other investors even if they possess their information sets. Investors when choosing to free-ride on other investors' decisions would result in a pattern of correlated trading among investors (Gavriilidis, 2013).

According to Welch (2000), the form of herding when investors ignore their information and believe that 'others' may have some important information about the returns is called Information-driven herding behaviour. This form of herding is revealed by investors' actions when they trade based on other investors' informational sets (Banerjee, 1992; Bikhchandani *et al.*, 1992; Shiller, 1995 and Gavriilidis, 2013). Also, according to Gavriilidis (2013), researchers have identified informational asymmetry among investors as a possible source for herd behaviour and defined it as *informational cascading*.

Hirshleifer and Teoh (2003) argued that this phenomenon of informational asymmetry causes information blockages since not all investors' information is conveyed to the market. Herding behaviour occurs as a result of information inefficiency rather than the incentive problems inherent in the principal-agent relationship (Hudson, 2014). Under uncertainty, investors look for useful return information or signals by observing each other's actions, and herding behaviour occurs as a result. Although each investor has private information about the correct course of action, it is not observable under the situation of an uncertainty environment (Hudson, 2014).

Information cascades happen among investors for number reasons. First, investors may choose to ride freely on others' information since he believes his information is not accurate or good enough. Welch (2000) documented how two analysts' recommendations are affected by an analyst recommendation. Moreover, bullish markets

may become more vulnerable to crashes (increased euphoria in the markets eventually leads to sudden drops in prices) as a result of the lower information aggregation and the higher level of herding that prevail in the bullish markets. Second, the cost of following what others do might be less than the cost of gaining accurate information. Calvo and Mendoza (1997, 2000) found that herding on other investors' decision is less costly for investors than acquiring their information when they study investors' diversification. Researchers used the Mexican crisis in 1994 to support their argument where investors' herd behaviour severely impacted similar countries to Mexico such as Chile, Brazil, etc. (Gavriilidis, 2013). Mainly, they assumed that these countries similar to Mexico, i.e., Latin countries, would follow what others do. As a result, after the sharp devaluation of the Mexican peso, the currencies of these countries were also devaluated, instead of the alternative to studying each country's specific characteristics and fundamentals (Gavriilidis, 2013).

The principal-agent relationship-based herding is regarded as 'principal-agent payoff externalities' (Welch, 2000; Hudson, 2014). Concerns may arise from investors and the money managers because of the uncertainties around the stock picking skill and portfolio managing ability of investment managers. Accordingly, the reward scheme and terms of employment provide the incentives for the agents to imitate professionals in the financial market is referred to the fund managers who make investments on behalf of others or analysts who provide analytical information to investors. They do herd based on reputation concerns and the incentives offered by the compensation scheme (Welch, 2000; Hudson, 2014).

On the one hand, fund managers' performance about selecting the 'right' stocks (or analysts' recommendation) are often evaluated by confirming the portfolio with other investment professionals. Thus, managers who want to be considered as high ability managers may be encouraged to create investment portfolios based on others' information because the high ability managers will be considered to the managers who have selected similar stocks as others (Bikhchandani and Sharma, 2001).

On the other hand, investors update their beliefs and take appropriate action in which relative performance evaluation is introduced after they have learned about the ability of the managers (Hudson, 2014). So, writing a relative performance contract to maximise a weighted sum of the principal's and the agent's utility is believed to be beneficial for the principal (i.e., employer of the investment manager) (Hudson, 2014). Investment managers "go with the flow" instead of depending on their information because their

compensation based on his/her investment performance compared with that of other similar professionals (Maug and Naik, 1996).

Previous research (e.g. Maug and Naik, 1996) considers a type of investor whose compensation depends on the performance of his/her investment portfolio relative to the performance of a benchmark and this type of investor is regarded as a risk-averse agent investor. The performance of a separate group of investors or the return of an appropriate index can be the benchmark. By doing this, additional incentives for an agent can be provided by the relative performance compensation contract. If investment portfolio underperforms the benchmark's portfolio, the investment manager's compensation will decrease. One reason that may lead the agent to follow the benchmark could be an inefficient information environment that both the agent and the benchmark face about asset returns. The agent may observe the benchmark's actions and moves his/her optimal investment portfolio closer to it. As a result, the agent would skew the investments even more closely towards the benchmark's portfolio.

Furthermore, reputational considerations give another reason for professional to herd, and that is also relevant to agency-concerns (Hudson, 2014). Strong and weak reputational professional herd for some different reasons. For example, a strong reputational professional herds to preserve his/her reputation. Also, the weak reputational professional may herd as a means of free riding on the reputation of better-reputed peers. As a result, professionals tend to exhibit similarities by adhering to the line of the 'opinion leaders' or the perceived majority. Trueman (1994) argues that the forecasts that are released by analysts are like those previously announced by other analysts, even when their information does not justify this. Moreover, Welch (2000) reveals that there is a considerable positive impact of an analyst's recommendations revision on the next two analyst's revisions. When the revision accurately predicts short-run ex-post stock returns, and if the most recent revision has occurred more recently, the influence is even stronger.

Another approach explaining the mechanism of intentional herding is called the sentiment based approach: intentional herding based on individuals who are not fully rational. Previous research (e.g., DeLong *et al.*, 1990; Froot *et al.*, 1992; Hirshleifer *et al.*, 1994; Grinblatt *et al.*, 1995 and Lux and Marchesi, 1999) modelled herding based on noise trader theory assumptions and arbitrage. Firstly, noise trader theory assumptions based on investors who are not fully rational who are sentiment driven. Secondly, arbitrage is risky and hence limited. Froot *et al.* (1992), FSS henceforth, argue that investors have exogenous short horizons. They trade based on other information instead of the

fundamental value information of the asset and herd on a subset of information because information spill over is positive in the short horizon. This means traders tend to trade on the same information as others when fundamental information has not been incorporated into prices. The model explains that when speculators liquidate their holding before the fundamental information is realised, the marginal return from trading increases.

As a result, the news about the same part of fundamental information that speculators trade on is priced in the market (Hudson, 2014). Instead of timing market liquidity as in FSS model, Hirshleifer *et al.* (1994) reveal that the sequential nature of the arrival of private information impacts the trading decisions, and the types of information being collected. This private information is assumed to be received by investors either early or later. Furthermore, before the private information arrives to the late informed traders, Hirshleifer *et al.* (1994) assume a positive correlation between the trades of early informed traders and the private information. This correlation is considered to be negative after it arrives to the late- informed traders. Also, there is a positive correlation between the trades of the late-informed traders and the previous period trades of the early-informed traders. Furthermore, the risky asset price moves are positively correlated with the private information (Hirshleifer *et al.*, 1994). These show that profit can be made by the early-informed traders by reversing their position when late-informed traders start to trade on the same information, and it becomes more pronounced as the proportion of late-informed traders increases.

1.2.1.3 Positive feedback models

Herding on private information, or noise traders' systematic sentiment, would benefit investors as they can profit from that and that is what the time-variation of information and market liquidity suggests (Hudson, 2014). DeLong *et al.* (1990) states that depending on their anticipation of the positive feedback trader trades of noise investors, the speculative investors tacitly coordinate their trades. The way that the positive feedback traders trade is by chasing the price trend. When the price trends raise, feedback traders buy the securities and they sell securities if they fall (i.e. momentum).

As shown in Figure 2.2, in anticipation of such price herd behaviour, the prices will increase as a result of speculator buying more today, which reflects good news (Hudson, 2014). When the price increases the positive feedback traders buy the securities. For instance, the price overreacts to the news and deviates from the fundamentals. As a result, speculators sell out the securities and make a profit as the price may remain above the fundamentals. So, instead of asset fundamentals, speculators bet on positive feedback traders' trend-chasing behaviour. Speculators can increase their overall profits by taking advantage of the short-horizon extrapolation of positive feedback traders. (Hudson, 2014).

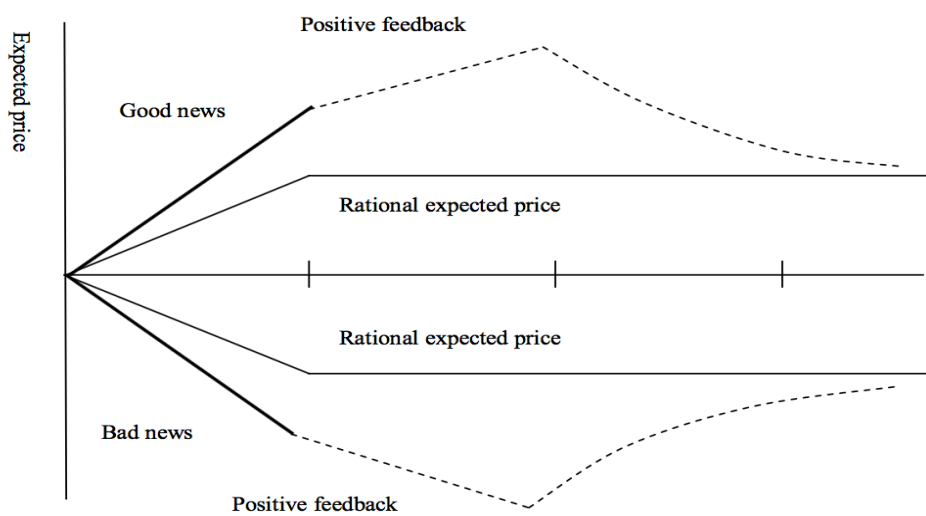


Figure 2.2 Price effect with positive feedback traders

Source: Hudson (2014)

Previous research (e.g. Boco *et al.*, 2010) looks at how overconfident traders exploit the presence of feedback traders by introducing informed overconfident traders into DeLong *et al.*, (1990)'s model. The four-period model shows that, neither rational informed nor overconfident informed traders can stabilise security prices while they exploit the positive feedback traders present in the market and this finding is consistent with DeLong *et al.*, (1990). Also, overconfident traders are not the primary cause of excess volatility (Boco *et al.*, 2010). The model indicates that the volatility mainly caused by the trading from feedback traders and depends critically on the number of feedback traders in the market (Hudson, 2014).

2.2 Empirical evidence

Investors rationally follow the actions of the market and ignore their own beliefs when they choose to follow the herd behaviour. Mimicking other market participants' actions or the market consensus is an investment strategy, and the consequences of this strategy will be reflected either in an aggregate level in asset returns or a micro level in investors' accounts, or both (Hudson, 2014). The main idea behind the return base strategy is that herding behaviour can be detected by examining the cross-sectional dispersion of returns when the individual stock returns tend to cluster around the average market return. The measurement of herding under this level can be done in two ways. First, the dispersion of individual asset returns to those of the overall market portfolio; the other is the deviation of the asset biases' betas from the CAPM betas (Hudson, 2014).

Cross-section dispersion measures are regarded as indirect measures and are usually used as a method to test herding behaviour in the market. These measures concentrate on the price implication of herding and is based on financial theories. The stock returns data can be found widely and in higher frequencies such as daily and weekly. However, the links between theories and the measures can be quite weak and subject to different interpretations (Hudson, 2014). There is no discrimination between one group of investors and the other when using these measurements of herding as it generally measures the collective behaviour of all participants in the markets (Hudson, 2014).

Furthermore, the micro-level of herding suggests that herding investors trade on the same stock (or same group of stocks) in the same direction at the same period (Hudson, 2014). So, herding behaviour can be detected directly by examining the trade order imbalance where the number of buyers and sellers active or the monetary value of the trades during a given period is measured. Compared to the return base strategy, under the micro level of herding investigation, it is possible to investigate herding by groups categories, such as institutional and individual investors (Hudson, 2014).

Moreover, there could be a significant order imbalance resulting from stock fundamentals which causes investors to buy or sell the same stock (group of stocks) at the same time. This order imbalance can be introduced as evidence of herding. However, using this measure it is not easy to distinguish the source of herding by using this measure. Also, this measure requires detailed investors' trading or holding data which is limited in availability in practice and perhaps in very low frequency, such as quarterly and/or half-year data (Hudson, 2014).

2.2.1 Micro-level accounts-based herding

Researchers apply individual account data when they study herding behaviour in the micro-level. For instance, Lakonishok *et al.* (1992), henceforth LSV, research underline the standard order imbalance measures, which are calculated based on the number of institutional buyers related to the number of institutional sellers of a given stock or industry group at the same time. Their research uses a sample of 769 US equity funds from the 1985-1989 period and they calculate the order imbalance for each equity quarter. Their finding shows an inverse relationship between fund herding and stock-size in US market; that is, that funds herd to a greater degree in smaller capitalisation stocks.

Furthermore, Grinblatt *et al.* (1995) do not find strong evidence of funds tending to buy and sell the same stocks at the same time when investigating US mutual funds between 1974 and 1984. Their finding also shows that the majority of mutual funds tend to buy past ‘winners’ but do not systematically sell past ‘losers.’ Also, Warmers (1999) also uses US mutual fund data and test 20 years (1975-1994) and found a fairly low but slightly higher level herding in pension fund than on average stocks.

Choe *et al.* (1999) and Hong and Yi (2006) use different frequencies of data: daily versus monthly and LSV measure for the Korean equity market and noticed various levels of herding. Compared to the normal period, Choe *et al.* (1999) found that foreign funds herded less during the Asian Crisis. However, Hong and Yi (2006) noticed that the concurrent relationship between the degree of the herding of fund managers and equity returns is positive from the buy side of trades and is negative from the sell side of trades.

Wylie (2005) also used LSV measures and noticed evidence of herding in U K equity mutual funds. He also looked at the positive-feedback trading by examining the relationship between the demand of a stock and the past performance of it, and the finding shows some proof of positive-feedback trading in small shares, but not in large stocks. However, Barber *et al.* (2009) extend the studies by employing eighteen years (1983-2001) US security markets and two brokerages’ data. The results showed evidence of the imbalance of buyer and seller initiated small trades, suggesting strong herding by individual investors.

2.2.2 Institutional herding vs individual herding

Compared to institutional investors, it is expected that individual investors may have more tendency to herd as a result of their limited access to information and of the costs of gathering and processing the information (both financial and non-financial), Individual

investors based their trading decisions on the actions of the crowd and that would be prudent and perhaps even rational for them. Individual investors often influence and get attracted by other people's opinions as a result of the lack of information picking and analysis skills. Intuition, feeling and mood, and psychological biases may impact their decisions and amplify existing herding intentions among them (Hudson, 2014).

They may also herd as a result of inferring information from the prior actions of peer group agents (Shiller and Pound, 1989; Banerjee, 1992; Bikhchandani *et al.*, 1992). It is more likely that correlated private information such as analysts' recommendations reaches institutions than reach individuals. As a result, institutional fund managers may trade on the same side of the market because they end up favouring the same indicator (Froot *et al.*, 1992; Hirshleifer *et al.*, 1994). The hypotheses above result in two primary streams of empirical herding study. The first stream investigates individual investor herding. The second stream focuses on the behaviour of institutional investors. Measuring the imbalance in the number of buyers to sellers in one particular stock (or group stocks) is the primary focus of the studies that look at the institutional herding.

Empirical studies have been found evidence of herding by fund managers in developed stock markets such as the US, UK, and Japan, and in emerging equity markets such as Korea, Taiwan, and China (e.g. Lakonishok *et al.*, 1992; Grinblatt *et al.*, 1995; Wermers, 1999; Wylie, 2005; Choe *et al.*, 1999; Chang *et al.*, 2000; Liao *et al.*, 2011). Lakonishok *et al.* (1992) found little evidence of herding in large stocks by the US pension funds compared to herding in smaller stocks. Also, Grinblatt *et al.* (1995) found very weak evidence of herding when studied the US mutual funds. Furthermore, Wermers (1999) research found fairly low but slightly higher level of herding than pension funds on average stocks. Also, previous research noticed a various level of herding the Korean equity market (Choe *et al.*, 1999 and Hong and Yi, 2006). Furthermore, studies such as Wylie (2005) Agudo *et al.* (2008) noticed proof of herding in the UK and Spanish equity funds respectively. Previous studies such as Claudio and Schmukler (2012) also saw evidence of institutional herding by looking at Chile's pension funds.

Institutional investors usually participate in similar transactions to other institutions. Hirshleifer *et al.* (1994) noticed that institutional investors trading is based on buying or selling the same stocks at roughly the same time. The institutional investors' transactions may have a significant impact on stock price, volatility and return as a result of the increasing number of and volume traded by institutional investors (Campbell *et al.*, 2001; Bennett *et al.*, 2003).

For instance, Nofsinger and Sias's (1999) research looks at the association between stock returns and the fraction of shares held by institutional investors by applying US NYSE 20 year's data (1977-1996). The findings show evidence that the stocks which institutional investors purchase subsequently outperform those they sell and institutional herding is positively associated with lag return and appears to be related to stock return momentum. There is also a positive association between annual changes in institutional ownership and returns, which indicates that institutional investors engage in a higher level of positive feedback trading than individual investors, and their herding has a more significant influence on price.

Individual investors are different to institutional investors as they are often referred to as ignorant and uninformed investors trading on sentiment. They have limited access to information and their trading more likely affected by people's opinions, such as brokerage house recommendations, popular market gurus, and forecasters. Especially, individual investors are more likely to engage in irrational positive feedback trading (Lakonishok *et al.* 1994). Jackson (2003) applied Australian data for the period 1991-2002 and tested the patterns in the trades of investors, both in aggregate market level and cross-sectional level, by using an order imbalance measure based on net flows into or out of the equity market. The finding proves herding by individual investors at both levels, systematic associations hold for both the trade number and the trade volume of individual investors, and the relationship is consistent over the observation period. Barber *et al.*'s (2009) study also show evidence of herding by individual investors, who predominantly buy (or sell) the same stocks as each other during the same period. Their research also shows that the stocks heavily bought by individual investors one week earn strong returns in the same and the subsequent week, and vice versa.

2.2.3 Return-based herding

The first studies test herding using aggregate market data are conducted by Christie and Huang (1995) (CH) and Chang *et al.* (2000) (CCK). Their studies find evidence of herd behaviour in various advanced and developing market except for the US. CH study, test the presence of herd behaviour at the industry-level and the market consensus in the US. They use monthly returns data from (December 1925 to December 1988) and daily returns data from (July 1962 to December 1988) to capture the herd behaviour and use dispersions as a measure of herding. Dispersions are the Cross-Sectional Standard Deviation of Returns (CSAD) which is expected to be low when individual performances are herding around the market.

Furthermore, by using the linear regression, the finding shows no evidence of herd behaviour in the US market irrespective of the market stress period when herding behaviour was expected to be present. Also, during up markets dispersions increase more compared to down markets. These results support the assets pricing model which indicate that during market stress herding is not the primary determinant of equity returns. The, CCK improves CH model by incorporating nonlinearities and asymmetry of direction to find evidence for herd behaviour. The study uses daily stock price data for the US from (January 1963 to December 1997), Hong Kong (January 1981 to December 1995), Japan (January 1976 to December 1995), South Korea (January 1976 to December 1995), and Taiwan (January 1976 to December 1995). The main finding indicates the presence of herding behaviour in the two emerging markets, South Korea and Taiwan. In contrast, the study finds no evidence of herding in the US and Hong Kong markets.

However, in the Japanese market, the study finds partial evidence of herding. The study also examines the effects of market capitalization on the presence of herding. The result shows that herding behaviour is not driven by the size of the portfolios. However, macroeconomic information tends to have a substantial impact on herding compared to firm-specific information. The finding also shows that in the US, Hong Kong, Japan, South Korea and Taiwan during the period of up market days, the dispersion of the security return increases relative to the down market days.

Similarly, Gleason *et al.* (2003) use the CH method to detect herding behaviour. The study uses daily data of thirteen commodity futures contracts traded on three European exchanges, FOX: London Futures and Options Exchange MATIF: Marche a Terme International De France, and the ATA: Agricultural Futures Market Amsterdam, and use the cross-section return dispersion as a measure of herding. The study also includes the extreme up and down market periods to capture their effect on the presence of herding behaviour. In the case of herding, investors and traders ignore their beliefs and follow the market consensus. So, it may be expected that return dispersion of individual stocks will be small. The study shows that dispersion, in general, increases during the period of extreme price movement. Thus, there is no evidence of herding behaviour in futures markets.

Gleason *et al.* (2004) use intraday data of nine sectors ETFs traded on the American Stock Exchange to test for herd behaviour and apply CH and CCK methods. Their finding also documents an absence of herding behaviour during extreme market movements. This is

because of the cross-section return dispersion increases during up markets as well as down markets.

Caporale *et al.* (2008) use daily, weekly and monthly stock returns traded on the Athens Stock Exchange to find evidence of herd behaviour. The study applies CH and CCK measures to detect herding. Their finding shows evidence of herding over the whole sample period (1998-2007) for daily, weekly and monthly time intervals. Also, the evidence of herd behaviour is weak over weekly and monthly time intervals compared to the regular time intervals. This result indicates that herding is a short-term phenomenon. The study also divides the sample into semi-annual sub-periods to investigate the presence of herd behaviour during the market crisis period. The result indicates that herding behaviour occurred during the market crisis. Moreover, investors' behaviour changed to be more rational since 2002. This change in the investor behaviour could be attributed to the characteristics of the Greek equity market and the presence of foreign institutional investors. The finding also shows that herding is more present during up market than down market phases.

Munkh-Ulzii *et al.* (2018) also uses CCK model to investigate financial herding behaviour by examining index returns from the stock markets in China and Taiwan. The study applies daily data from 1 January 1999 to 31 December 2014. The findings show evidence of herding behaviour regardless of whether they were emerging or frontier markets. The study also finds evidence of herding under up and down market conditions, but herding is greater in up markets than in down markets. Herding is also greater during low trading volume states than during high trading volumes.

Prior research extends the herd behaviour investigation and utilises different factors that are not used in CH and CCK approaches. One study was conducted by Hwang and Salmon (2004) (HS). Their study uses data from the US and the South Korean stock markets. Also, the study applies a new measure of herding that was based on the cross-sectional dispersion of the factor sensitivity of assets within a given market. The factors include the size (small minus big, SMB), value (book-to-market high minus low, HML), and they include elements that introduced by Fama and French (1993). The finding does not support CH and CCK results regarding the absence of herding behaviour in the US market. HS's findings indicate herd behaviour in both US and South Korean stock markets. They also find factor herd behaviour in both markets.

The HS model is the first model that considers the time-variant pattern of beta. This approach is now widely used in literature. For instance, Demirer *et al.* (2010) adopt CH, CCK and HS herding methods to the Taiwan equity markets. The result proves the invalidity of CH method as they found no evidence of herd behaviour using this method even though they find evidence of herd behaviour in Taiwan Market by using CCK and HS models. Xie *et al.* (2015) argue that although HS_method provides instructive insight, by taking the time-variant pattern of beta into consideration, it may be difficult to find an efficient way to estimate time-variant beta which makes this model difficult to apply in practice.

Lam and Qiao (2015) investigate herding at both the whole market level and the individual industry level in a method similar to the CH and CCK approaches but also, they investigate herding behaviour on fundamental factors under different market statuses. Their study uses the Hong Kong stock market (April 1, 1986, to December 31, 2007), taking into account different crisis period such as the Asian financial crisis and the Russian crisis. The finding proves herding behaviour in both the first and second sub-periods sample. The study also indicates market herding in the up market of the first sub-period. However, industrial herding illustrated in the up market for the two sub-periods. Furthermore, Lam and Qiao (2015) also find evidence of herding behaviour in the up market, high trading volume, and low trading volatility status. The finding also indicates that the return dispersion CSAD is well explained by CSAD volatility and there is a weak relationship between herding and size. Finally, their study also indicates that herding is affected by size in the up market of the first sub-period.

Zhou and Lai (2009) finds a higher frequency of herding on the sell-side compared to the buy-side when investigating herding behaviour in the Hong Kong stock market. The study applies intraday data on Hong Kong's Hang Seng Composite Index (HSCI) from January 2003 to December 2004. Sharma *et al.* (2015) also find substantial evidence of herding behaviour on the Chinese stock market. The study also reports evidence of asymmetric herding behaviour with stronger herding behaviour in up markets than in down markets. Their study also finds that herding is sector-specific and predominant in the industrial and properties sectors. Finally, their study reports that herding behaviour is time-varying and time-varying herding is more likely to be prevalent in some sectors than others.

Houda and Mohamed (2013) investigate asymmetric herding behaviour in 28 stock markets. First, the study applies CH and CCK measures to capture herding behaviour over the period from January 2006 to 2009. The findings report no evidence of herding

behaviour. Second, the study investigates the asymmetric response of investors to good and bad news by separating the sample into the upturns and downturns. The study reports evidence of asymmetric herding behaviour, and this is more prevalent in the upstream than in the downstream. The study also develops a new herding measure which considers the asymmetric reaction to good and bad news using E GARCH (1,1). The findings indicate the validity of this measure to capture the cross-section of stock returns.

Yousaf et al. (2018) find no evidence of herding during up and down market as well as during high and low volatility in the Pakistani stock market. They use CH and CCK methods based on daily stock data from 2004 to 2014. However, they prove evidence of herding during low trading volume days. Also, there is no evidence of herding during Ramadan. Also, herding behaviour is absent during the financial crisis of 2007-008, but herding existed during 2005, 2006 and 2007. They conclude that Pakistani Stock Market exhibits herding behaviour due to higher uncertainty and information asymmetry.

Galariotis *et al.* (2015), find that during different crises periods, US investors herd due to both fundamentals and non-fundamentals. The study also finds that there is a herding spill-over effect from the US to the UK. UK investors only herded due to fundamentals when the Dotcom bubble burst. Thus, UK herding seems to be weaker than the US herding. Since there is a little evidence of herding behaviour in the UK market compared to the US and it is only occurring on fundamentals this study drives to the main conclusion that herding behaviour is period and country specific.

2.3 Herding in the GCC countries

The six member states of the Gulf Cooperation Council (GCC) financial market involve Saudi Arabia, Qatar, Bahrain, Oman, United Arab Emirates (i.e. Dubai and Abu Dhabi) and Kuwait. These markets are different from both developed and other emerging ones in being segmented from global equity markets, and in their sensitivity to politics in the region. Bahrain, Kuwait and Qatar now all allow foreigners to own stock, whereas in Saudi Arabia they can do so only indirectly, by investing in mutual funds. The GCC economies are dependent on oil and their stocks may be affected by short-term movements of prices in other US exchanges. GCC exchange rates, monetary policies and short-term interest rates are also tied in practice to those of the US (Karam, 2001).

The effective linking of GCC exchange rates with the US dollar implies changes in American stock market indices and oil prices may be interesting potential influencers of

GCC herd behaviour. The GCC's vast petroleum reserves, almost half of the global total, also give their markets the potential for strong gains (Hammoudeh and Choi, 2007). Also, in emerging markets such as Saudi Arabia, where individuals dominate the markets, herding behaviour maybe common because, individuals in these markets are inexperienced and their decisions making based on rumours and information publically circulated (internet websites, text messages, friend's advice, etc.) (Ibnrubbian, 2012). Herd behaviour can impact the market and drives the market from one extreme side to the other and may cause the market to overreact (Ibnrubbian, 2012).

A growing strand in the GCC literature focuses only on the effect of global shocks on herd behaviour. For instance, the study conducted by Balcilar *et al.* (2014) examines the effect of market volatility on herding behaviour in the GCC stock markets. The study uses a regime-switching smooth transition regression model (STR). The study controls for some global factors such as the U.S. stock market performance, the price of oil, and the US interest rate. Furthermore, the study includes the risk indexes such as CBOE Volatility Index (VIX) and the St. Louis Fed's Financial Stress Index (FSI). The study report evidence of herd behaviour in all GCC countries and the global factors are important factors that govern the transition to herding states.

Another study conducted by Balcilar *et al.* (2013), tests the dynamic association between global factors and herding behaviour in the GCC markets. The sample includes Abu Dhabi, Dubai, Kuwait, Qatar and Saudi Arabia markets, and covers the time series for each stock market until March 2012. The study applies a time-varying transition probability Markov Switching model (TVTP-MS). The results show evidence of herding in the GCC markets and that global factors such as the U.S. market performance and the price of oil, contribute to herding behaviour in the GCC markets (Balcilar *et al.*, 2013). Moreover, the study shows that the GCC markets are highly integrated with the world's global markets although they have put some barriers to entry to reduce the effect of foreign investors.

Rahman *et al.* (2015) study investigate the herd behaviour in the Saudi Arabia context. The focus of their study is to conduct a comprehensive analysis of market-wide herd behaviour in Saudi financial market where retail investors dominate trading. The study examines herding by estimating the CH, CCK and HS approaches over the period from January 2002 to March 2012. Their findings report evidence of herding behaviour in the Saudi context irrespective of the market conditions. The study also finds that Saudi investors herding behaviour is not drives by fundamental and this finding support the

previous literatures which suggests that individual investors are more likely to be noise traders.

Güvercin (2016), also investigates the presence of herding behaviour in both Saudi and Egyptian stock markets. The study uses state-space methodology suggested by HS. This research uses daily data for both markets for Saudi Arabia it starts March 2001 and ends in June of 2014, while for Egypt the daily data is from July 2002 to May 2014. The study uses the ordinary least squares (OLS) to investigate the effect of regional and global shocks on herding behaviour for both markets. The study finds no evidence for the presence herding in the Saudi market but it reports evidence of herd and adverse herd behaviour in the Egyptian stock market. Moreover, the mortgage crisis and Egyptian military takeover are found to be significant determinants of herding behaviour in the market consensus.

Youssef and Mokni (2018) also test the presence of herding over the period from 2003 to 2007 using both static, and regime-switching framework that is suggested by Demirer et al. (2015). In the static analysis of herding in GCC stock markets countries, the results prove herding behaviour among investors in Qatar, Oman and Abu Dhabi markets only. However, in a regime-switching framework, the results are different. There is herding behaviour among Saudi market investors during normal conditions (low volatility). However, herding is detected in the Qatari market during stress periods (high volatility). Also, herding behaviour is verified in the Omani market during both low and high volatility regimes. No evidence of herding behaviour is found in Abu Dhabi, Bahrain and Kuwaiti markets. The effect of herding among investors on the dependence structure is also examined in GCC stock markets. Herding behaviour is found to affect positively the dynamic conditional correlations for most GCC markets pairs in the static framework. In the switching regime regression results, a negative effect in low herding regimes and positive impact in high herding condition are found.

Chaffai and Medhioub (2018) paper investigate the presence of herd behaviour in five Islamic GCC stock markets. The study applies the methodology given by Chiang and Zheng (2010). They use generalized auto regressive conditional heteroskedasticity (GARCH)-type models and quantile regression analysis and applied to daily data ranging from 3 January 2010 to 28 July 2016. The study considers the GCC markets to be an aggregated market. The findings prove evidence of herd behaviour in the GCC stock markets. The data also divided into down and up market periods to account for the

differences in market conditions; the findings show evidence of herding during upward market periods only.

2.4 Methods to measure herding

This section provides the most common methods that are used in the literature to measure herding behaviour in the market. CH applies two methods to quantify the dispersion of asset returns, the Cross-Sectional Standard Deviation (CSSD)⁴ and CSAD⁵. The rationale for their model is that in the presence of herding behaviour, the dispersion of returns will decline. CH argues that different factors, such as the lack of new information in the market, can explain the low dispersion of asset returns. Furthermore, they argue that during periods of market stress (e.g., the price movements are more extreme), herding is more likely to be present. Christies and Huang (1995) isolated the level of dispersion of stock returns, in the extreme tails of the distribution of market returns S_t , applying the time series model:

$$S_t = \alpha + \beta_1 D_t^L + \beta_2 D_t^U + \epsilon_t \quad (1)$$

S_t is CSSD or CSAD. D_t^L D_t^U are dummy variables explained as follows: if the market return on day t lies in the extreme lower tail of the distribution D_t^L otherwise it is equal to zero. If the market return on day t lies in the extreme upper tail of the distribution D_t^U ; otherwise it is equal to zero. Statistically, the negative and significant values of β_1 and β_2 show the presence of herding behaviour α and denotes the average dispersion of the sample excluding the regions covered by the two dummy variables.

To test the relationship between CSAD and the market portfolio return, Chang *et al.* (2000), CCK henceforth, adjusted the CH model to examine the relationship between CSAD and the market portfolio return R_m , to study herd behaviour. They define the average Absolute Value of the Deviation (AVD) by applying a conditional version of

$$AVD_{it} = |\beta_i - \beta_m| E(R_m - y_0) \quad (2)$$

⁴ CSSD = $\frac{\sqrt{\sum_{i=1}^n (r_i - r)^2}}{n-1}$, where r_i is the observed return on stock i , r is the cross-sectional average return of the portfolio, and n is the number of stocks in the portfolio.

⁵ CSAD = $\frac{\sqrt{\sum_{i=1}^n |r_i - r|}}{n-1}$, where r_i is the observed return on stock i , r is the cross-sectional average return of the portfolio, and n is the number of stocks in the portfolio.

(y_0) is the return on zero-beta portfolio, β_i is the systematic risk of asset i , and β_m is the systematic risk of an equally-weighted market portfolio, i.e. $\beta_m = \frac{1}{n} \sum_{i=1}^n \beta_i$. The expected CSAD is:

$$ECSAD = \frac{1}{n} \sum_{i=1}^n |\beta_i - \beta_m| E(R_m - y_0) \quad (3)$$

CSAD and R_m then used as proxies for the unobservable expected CSAD and return of market portfolio respectively. The increasing and linear relation between dispersion and the market expected returns can be revealed by deriving first and second order differentiation⁶.

Dispersions are an increasing function of the market return, and the relation is linear and that what the rational asset pricing models predict. The linear and the increasing relation between dispersion and market return will no longer hold if individual participants choose to follow aggregate market behaviour. Therefore, the model is:

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t \quad (4)$$

Since CSAD is the absolute value of dispersion of return, the absolute term of market returns, $R_{m,t}^2$, are also used to examine the positive linear relation. The square power of $R_{m,t}^2$ examines the non-linear relation.

The model is also modified to incorporate the possibility of nonlinearities in the market as well as directional asymmetry, i.e. different degree responses of herding in up- versus down markets:

$$CSAD_t^{DOWN} = \beta_0 + \beta_1 D |R_{m,t}| + \beta_2 D (R_{m,t})^2 + \varepsilon_t \quad R_{m,t} < 0 \quad (5)$$

$$CSAD_t^{UP} = \beta_0 + \beta_1 U |R_{m,t}| + \beta_2 U (R_{m,t})^2 + \varepsilon_t \quad R_{m,t} > 0 \quad (6)$$

Where $R < 0$ refers to the “down” days, the days when the market portfolio correlated with negative return and $R > 0$ refers to the “Up” days, the days when the market portfolio associated with positive return. If there is herd behaviour during market stress periods, the investors' expected return would be a less than proportional increase (or decrease) in the CSAD measure. The return dispersions change at a decreasing rate with an increase

⁶ First order differentiating equation: $\frac{\partial ECSAD}{\partial E(R_m)} = \frac{1}{n} \sum_{i=1}^n |\beta_i - \beta_m| > 0$. The second order differentiating of equation is: $\frac{\partial^2 ECSAD}{\partial^2 E(R_m)} = \frac{1}{n} \sum_{i=1}^n |\beta_i - \beta_m| = 0$.

in market return if there is a presence of herding behaviour. The negative and statically significant indicate herding behaviour in the market as during the market stress periods, herd behaviour would result in a non-linear relation between CSAD and the average market return.

The CH and CCK methods do not include any device to control for movements in fundamentals, HS argued that it is impossible to identify whether the causes of the decrease in return dispersions are herding behaviours or just the adjustment to fundamentals. Investors may be prone to behavioural biases. Thus, the perception of risk-return relationship of assets may be distorted and that leads to the betas of the stocks to deviate from their equilibrium values. The beta of a stock is influenced by investors' sentiment, its changes with the fluctuation of investors' sentiment. It is expected that the cross-sectional dispersion of betas will be smaller in the presence of herd behaviour. So, the HS method test herding based on the cross-sectional dispersion of the factor-sensitivity of assets.

A herding parameter is developed to capture the presence of herding behaviour in the market. Furthermore, it depends on the CAPM equilibrium risk-return relationship and is biased by investors herding towards the performance of the market portfolio.

$$E_t(r_{it}) = \beta_{imt} E_t(r_{mt}) \quad (7)$$

Where r_{it} is the return on asset i at time t , r_{mt} is the market return at time t , and β_{imt} is the systematic risk measure.

The biased expected asset return will be

$$E_t^b(r_{it}) = \beta_{imt}^b E_t(r_{mt}) \quad (8)$$

Where $E_t^b(r_{it})$ is the biased short run conditional expectation on the excess returns of asset i and β_{imt}^b is the market's biased beta of asset at time t .

Equation (9) is suggested by Hwang and Salmon, (2004) instead of (4) when investors herd towards the return of market portfolio:

$$\frac{E_t^b(r_{it})}{E_t(r_{mt})} = \beta_{imt}^b = \beta_{imt} - h_{mt}(\beta_{imt} - 1) \quad (9)$$

where h_{mt} is a latent herding parameter that changes over time. $h_{mt} = 1$ suggests the individual assets move in the same direction with the same magnitude as the market

portfolio, and indicating a perfect herding, and $h_{mt} = 0$ suggests there is no herding, and the equilibrium CAPM applies $0 < h_{mt} < 1$ means that some degree of herding exists in the market.

Herding behaviour according to the HS method attempts to explore is market-wide rather than a single asset. Equation (previous one), therefore, is assumed to hold for all assets, and the cross-sectional mean of β_{imt}^b or β_{imt} is always 1. Standard deviation of β_{imt}^b is:

$$Std_c \beta_{imt}^b = \sqrt{E_c((\beta_{imt} - h_{mt}(\beta_{mt} - 1) - 1)^2)} = \sqrt{E_c((\beta_{imt} - 1)^2)}(1 - h_{mt}) = Std_c(\beta_{imt})1 - \quad (10)$$

where Std_c is standard deviation of β_{imt}^b or β_{imt} and E_c the cross-section of is the cross-sectional expectation β_{imt}^b or β_{imt}

HS establish the state space model by taking logarithms of the cross-sectional mean of β_{imt}^b to measure resulting h_{mt} in:

$$\log[Std_c(\beta_{imt}^b)] = \mu_m + H_{mt} + v_{mt} \quad (11)$$

where $Std_c(\cdot)$ represent the cross sectional standard deviation, $H_{mt} = \log(1 - h_{mt})$, and $\log[Std_c(\beta_{imt}^b)] = \mu_m + v_{mt}$, $\mu_m = E(\log(Std_c(\beta_{imt})))$ and $v_{mt} \sim iid(0, \sigma_v^2)$. Assuming the mean zero AR (1) process, this gives:

$$H_{mt} = \phi_m H_{mt-1} + n_{mt} \quad (12)$$

Where $n_{mt} \sim iid(0, \sigma_{mn}^2)$, and the model can be estimated using the Kalman filter. When $\sigma_{mn}^2 = 0$, the model becomes $\log[Std_c(\beta_{imt}^b)] = \mu_m + v_{mt}$, meaning that herding does not exist, indicating $H_{mt} = 0$ for all t. The significant value of σ_{mn}^2 meaning that herding presents in the market. CH method also accounts for different variables such as market volatility and returns, size and book to market factors, and macroeconomic factors.

2.5 Conclusion

Herding can be defined as when a group of individuals ignoring their own information and trading in the same direction. Lack of information is one of the main drivers of herding behaviour in the stock market, especially under uncertainty. There are many reasons behind herding of professional investors and fund managers. For example, professional investors herd because of the separation of ownership and management; fund

managers get incentives from the reward scheme, principal- agent mechanism herding suggests the term of employment to ‘learn’ the investment decisions of others.

The noise trader theories state that some investors based their investment decision by sentiment. Sentiment investors seek information held by others, and they ignore fundamental information which leads to the investment decisions being made based on the same information as others. DeLong *et al.* (1990) and Boco *et al.* (2010) found that speculators take advantage of herding behaviour of positive feedback traders and that results in the asset price being driven away from its fundamental value. This result was found when they studied the price effect with trend tracing positive feedback investors.

Two major methods are used by the literature to investigate herding. One way is to test the level of individual stock returns clustering around the average market return. So, herding in the market can be measured by the cross-section of return dispersions. The main idea behind this approach is if the relation between market return and cross-section return dispersion is not negative, which is suggested by a rational asset price model, there is no herding behaviour in the market. Christie and Huang (1995) look at herding behaviour under extreme market conditions. Also, Chang *et al.* (2000) test the possibility of negative linear or non-linear relation of return dispersion and the absolute market returns.

Using these methods, previous research has found little evidence of herding in either the US or UK markets and results from other countries are mixed. Herding was found, for instance, by Hwang and Salmon (2004), using the cross-section dispersion of systematic risk (beta) of stocks, in both the US and South Korean markets. Within the GCC countries, Rahman *et al.* (2015) used the three approaches described above and tested herding using the Saudi Arabia stock market. Their findings suggest evidence of herding in the Saudi context, irrespective of market conditions. Three methods of detecting herding, CH, CCK and HS, are widely used for investigating herding behaviour in market level, they test the market consensus and do not discriminate between groups of investors, such as individual and institutional. Given this evidence, albeit limited, of herding in developing markets, and the availability of widely used and proven methods for detecting herding, we constructed a series of analyses to test for this behaviour in the Saudi Arabia developing market and looked for spill-over to and from other emerging markets in the GCC and from global markets, specifically the US market. Our investigation considers two rarely considered influences on herding in the Saudi market. Firstly, the effects of the oil markets, because we expected to find a link, given the dependency of the Saudi economy

on this commodity and, secondly, OPEC conference meeting dates, for the same reason and because these are short duration events which are widely publicised and impact upon oil market policy and are consequently likely to lead to measurable herding, if it occurs.

Chapter 3: OPEC meetings, Oil Market volatility and Herding Behaviour in the Saudi Arabia Stock Market

We investigate the influence of oil market volatility and OPEC meetings on herding tendency in the equity market of largest global oil producer country. We document the presence of significant herding behaviour in Saudi market, surprisingly this herding behaviour is independent of oil market volatility. Importantly, we provide conclusive evidence for the herding on and after OPEC meeting days but only during the Global Financial Crisis period (GFC) of 2008 and 2009. The persistence effect of OPEC meetings on the Saudi market herding behaviour during GFC period potentially reflects the prior announcement ambiguity and subsequent adjustments following the announcement considering the crucial role of OPEC in determining oil price. Overall, our results show that herding in Saudi equity market is not influenced by uncertainties emanating from global demand as captured by oil market volatility rather is an outcome of changes in global supply of crude oil.

3.1 Introduction

It is well known that the performance of the Saudi economy is heavily dependent on oil and therefore, it would be interesting to see whether uncertainty in the oil market has any influence on the herding behaviour of Saudi equities. Hence, this study aims to investigate the influence of oil market uncertainty on the herding of equities in Saudi Arabia. The distinguishing feature of this study compared to the related literature (See for instance, Balcilar *et al.*, 2013; Balcilar *et al.*, 2014; Rahman *et al.*, 2015; Balcilar *et al.*, 2017) is that we differentiate between spurious herding that results from exposures to the common fundamental risk factors and actual herding which emanates from ignoring these factors and following the market. An additional contribution of this paper is that it investigates the herding behavior on and around the OPEC conference meetings.

In oil exporting countries such as Saudi Arabia, the GDP growth is largely funded by government spending which depends heavily on oil revenues.⁷ An increase in the oil price triggers economic expansions while its decreases trigger recessions. The uncertainty in

⁷ Government spending constitutes around 50% of aggregate spending.

the price of oil casts uncertainty not only on the expected future performance of the economy but also on the expected cashflows of operating companies. Therefore, the oil market volatility influences equity markets' trading activity and prices.

The oil price is volatile. In 2018, oil has fluctuated between \$85 and \$50 per barrel. The global daily consumption and production of oil is a round 100 million barrels, and this means that each day the world consumes roughly the same oil that it produces. This narrow gap between the demand and the supply has made the oil price very sensitive to news regarding global oil production and consumption. For instance, a well-known and recent supply shock is the shale oil production technology. Following the start of shale oil production, the oil price fell from \$110 in May 2014 to \$36 in January 2016.

The geopolitics particularly in the Middle East threatens energy supplies and influence prices.⁸ The recent outages due to US sanctions on Venezuela and Iran affect global oil supplies and returns. Moreover, the OPEC interventions is another factor that introduces fluctuation into oil. This year OPEC cuts production to avoid oversupply, but it brought volume back thereafter.

On the demand side, the demand for oil depends on global economic growth. Until recently, the growth prospects of the US and Western Europe used to be the main source of demand for oil. However, due to the slow economic growth in Europe and the US, the main increases in global demand for oil stem from China, India, the Middle East and other emerging economies that has started to grow at a relatively higher rate. Therefore, the growth of these regions plays the pivotal role in determining the demand for oil. For instance, following the global financial crisis in 2008, the oil price was not affected due to the continued growth and to the demand which emanates from these markets. The oil price has dropped from around \$164 in June 2008 to \$50 in January 2009; but it has recovered quickly to \$116 by May 2011.

The oil market is volatile not only because of varying demand and supply, but also due to the intense speculation activity in the market. The uncertainty in energy prices introduce uncertainty in the economic prospects of oil producing countries and its financial markets. Therefore, it is interesting to see whether uncertainty in the oil market may instigate volatility and herding in the equity market of an oil producing country such as Saudi Arabia. The existing research on how herding and volatility in one market may

⁸ The oil price had jumped from \$47 in July to \$67 in August 1990 after the Iraq invasion of Kuwait.

influence herding in a related market is narrow and it mainly focuses on the US and the European equity markets. A notable omission are studies tracing the impact of OPEC meetings on herding in stock markets. Guidi *et al.* (2006) document evidence on effect of OPEC meetings on US and UK stock markets however they do not account for herding behaviour in these markets. Essentially, we have not found a study analyzing the herding behaviour in equity markets, developing or developed, in relation to OPEC meetings. Thus, our analysis fills an important research gap.

There is extensive empirical evidence on the information spill-over from oil to equities⁹, but no research has addressed the question of how oil volatility and OPEC news influence herding in these markets. In oil producing countries, oil market fluctuations are news for domestic equity market investors and hence the oil market is monitored. Oil price hikes are expected to start business cycles with significant implications on equity prices and returns. Therefore, it is important to see if news and volatility in the oil market can start herding in the equity markets of oil producing countries. This is important as it has crucial implications for global diversification and asset allocation between oil and the equities of oil exporter countries.

Saudi Arabia is a natural choice to test this. It is one of the biggest global oil producers, providing 13% of global oil demand and controls 22% of the verified total reserves. Moreover, the dependence of Saudi market capitalization on energy is substantial and this largely explains the information spill-over between Saudi equities and changes in oil prices. The Saudi equity market is an emerging market and, as such, is expected to be informationally inefficient and a market rich with herding.¹⁰ Therefore, we aim to investigate two important questions, first, a novel cross-market information spill-over i.e. whether the oil market volatility impacts herding in the Saudi equities and second, if the news coming from periodic OPEC meetings influences herding behaviour. To the best of our knowledge, this work is the first to assess if herding in a major oil producing equity market changes with oil market volatility and announcements coming out of OPEC

⁹ For more on oil equity linkages see Park and Ratti (2008), Filis *et al.* (2011), Arouri and Nguyen (2010), Awartani and Maghyereh (2013) and references therein. The increase in oil prices increases costs and reduces company cash flows and value. However, if the rise is due to the rise in global demand for oil, then it is associated with higher equity prices. Oil price volatility also influences share values in energy companies.

¹⁰ Historically Saudi equity market has been a frontier market, however, as per the MSCI 2018 market classification review its status is elevated to emerging market status from June 2019.

meetings. These empirical exercises will shed light on how the herding of Saudi equities is associated with different sources of uncertainty emanating from the oil market.

In the literature, herding behaviour is inferred from the interaction of the cross-deviation measure of equity returns with the squared value of the market returns. The cross-deviation assesses the extent of co-movements of equities around the average market.¹¹ Where individual equities in herding markets move alongside the average market they do not move by their betas, instead the cross dispersion is expected to be negatively non-linearly related to the square of market returns. The shrinkage of the dispersion measure is not a direct measure of herding but can be interpreted as potential herding.

However, market investors could also take, independently and individually, similar investment decisions as a response to fundamental market information, for example if managers follow similar investment styles or strategies. Hence, observers can see relationships that indicate herding without actual herding in the markets. Therefore, precise herding estimates should be inferred and tested once procedures in the estimation of herding behaviour have accounted for similar investment styles and responses to fundamental news in the markets. Alternatively, market co-movement of similar style investors may be wrongly construed as herding. Unfortunately, this aspect in prior research does not have been accounted for and this may possibly result in over reporting of herding tendency in financial markets by the reported inferences on herding.

Therefore, before making any inferences about herding of Saudi equities, we eliminate the part of cross section absolute deviations (CSAD); an empirical measure to approximate herding proposed by Chang *et al.*, (2000), that is common with, and related to, fundamental or style investing. To do this, we subtract the part explained by the Fama-French-Carhart investment styles / risk factors from the CSAD. The expectation is that the relation between squared market returns with the remaining dispersion is representative of herding behaviour in the market.¹²

¹¹ See for instance, Christie and Huang (1995), Chang *et al.* (2000), Caporale *et al.* (2008), Gleason *et al.* (2003), Hwang and Salmon (2004) and Demirer and Kutan (2006).

¹² The same method is used by Galariotis *et al.*, (2015). The number of companies in Saudi Arabia are not large enough to get diversified portfolios to construct reliable estimate of style returns. Therefore, we pooled all companies in the Gulf Cooperation Council countries, which is the economic block that Saudi Arabia belongs to, for the purpose of factor computations. All companies within the block live under similar environment and are subject to similar risks and regulations. This has increased the number of companies by three-fold and has improved style returns measurement.

In the context of Saudi equity herding, we find four studies: Balcilar *et al.*, (2013), Balcilar *et al.* (2014), Rahman *et al.* (2015) and Balcilar *et al.* (2017). Balcilar *et al.* (2013, 2017) model the CSAD as a Markov switching process in low, high and extreme volatility regimes while the Rahman *et al.* (2015) paper infers, from a simple regression, an expected CSAD that is computed based on a beta dispersion method. The herding state is modelled as transitional in the Balcilar *et al.* (2014) study. All papers find significant herding, and in Balcilar *et al.* (2013) herding is found to be more intense during periods of extreme market movements. The Rahman *et al.* (2015) paper finds that herding is more intense in an up market and when trading volume is high. Balcilar *et al.* (2017) goes one step further and investigates the role of speculation in the oil market on equity herding. It finds that speculation is associated with more rationality and less herding in the equity markets of the oil producing countries.

Our study is related to these papers and the rest of the literature on herding, but it is distinctive in our focus on the influence of oil volatility on the herding of Saudi equities. Moreover, unlike the rest of the literature on herding, our inference is drawn from the remainder of deviations after accounting for the covariance risk that can be explained by the Fama-French-Carhart investment styles. This provides new perspectives on how herding of Saudi equities is related to oil market uncertainty.

Our results conform to the previous studies in that we find significant herding in the Saudi equities. The herding is found to be more intense during the Global Financial Crisis period (2008 – 2010) than afterwards (2010-2016). Moreover, we find significant and persistent effect of the OPEC meetings on herding in Saudi market during the Global Financial Crisis period. This result in conformity with the evidence in Guidi *et al.* (2006) that shows during stressed times oil markets require more time to incorporate OPEC decisions. Given the strong influence of oil returns on the returns in the equity markets in oil producing countries, we infer this also applies to continuation in herding behaviour in the Saudi market when international markets were stressed during Global Financial Crisis period of 2008 and 2009. In the pre-crisis period, herding is insignificant in the Saudi equity market and vindicates our approach in estimation of CSAD that is clear of co-movements coming for following Fama-French-Carhart investment styles / risk factors.

Furthermore, we find that herding in Saudi equities is independent of oil market volatility. This remains valid when we also consider the relationship of herding and oil volatility during the days of the OPEC conference meetings. Hence, Saudi equities herd on the days of the OPEC conference meeting and afterwards. However, this herding is independent

of the volatility of the oil market. These results can be explained by the sensitivity of the equity market to news during stress, the ambiguity of the outcome of OPEC meetings during the crisis, and by the expectations that decisions taken by OPEC will be crucial in determining the future stability of the oil market over the course of the global financial crisis period. The unavailability of information may have induced market participants to copy the market on these days.

The rest of the chapter is organised as follows: Section 3.2 contains a synopsis of the literature on herding. In Section 3.3, we go over the methodology used in inference. Section 3.4 contains a description of the data set and samples. Also, in this section we present the way in which we construct the four styles used in the analysis. The empirical findings of the model and the analysis of herding and the influence of oil market uncertainty can be found in section 3.5. Finally, section 3.6 contains some concluding remarks.

3.2 Literature Review

Herding behaviour in financial markets has been extensively studied. The first group of studies in the subject infers herding by tracking the changes in equity holdings and transactions of institutional investors such as mutual and pension funds. For instance, Wermers (1999) investigates the behaviour of growth oriented US mutual funds and find that they herd in buying /selling small companies' shares after positive/ negative returns. He finds also that herding in large cap shares is less likely. The same results on US funds are recorded by Lakonishok *et al.* (1992) and Grinblatt *et al.* (1995).

In the literature that follows, the inference on herding is mainly derived by looking into the behaviour of equities with respect to the average market / industry. The study of Christie and Huang (1995) uses the cross -sectional standard deviation as a measure to test significance of cascades in US industries during extreme market movements. The paper finds that US investors in various industries do not follow blindly other investors and that herding has no role to play in pricing US assets. Same results on other developed equity markets and the US are found by many other studies. For example, in a recent study, Galariotis *et al.* (2015) find that herding behaviour is insignificant in both the US and the UK equity markets.

In Chang *et al.* (2000) significant herding is found in many developing and developed markets.¹³ Their work shows that for herding behaviour to be present, it suffices to have a negative nonlinear relationship between the cross-sectional deviation measure of herding and average market returns. Gleason *et al.* (2004) use the continuous record of nine ETFs that are traded in the American Stock and they find increase in equity return dispersion during extreme market moves and thus conclude that there is no evidence of herding behaviour in the US ETF markets.¹⁴

In contrast to the previous studies, Hwang and Salmon's (2004) find significant cascades in the US using a new approach. Their approach to detect herding relies on the betas of companies with respect to the market and/or other risk factors. Herding in their model occurs when all companies' returns and market returns are equivalent. This means that when there is cascading all shares betas in the market go to one. This convergence is assumed to depend on some latent herding parameter that is subsequently estimated by Kalman filtering the implied state space model. The method also allows for testing return dispersions net of the components of fundamental factors and that are pure market sentiment.

Many researchers think that ignoring own information and herding is more likely under stress. Thus, in the herding literature many studies investigate market behaviour during extreme market conditions and crises. For instance, Lam and Qiao (2015) studies the Hong Kong equity market and they find significant herding evidence during the Asian crisis in 1997, the Russian crisis in 1998 and the dot com technology bubble in 2003. Similarly, Prosad *et al.* (2012) find herding in the Indian equity market during periods of excess volatility and stress and no herding in clam periods. The evidence on herding during periods of high fluctuations in the Athens Stock Exchange is provided by Caporale *et al.* (2008). The Markov Switching model of Balcilar (2013) shows that herding is more pronounced during the excess volatility state in the Gulf Cooperation Council Countries.¹⁵ Finally, Güvercin (2016) finds that there is significant herding in the Egyptian stock

¹³ In their study herding is significant in two emerging markets which are South Korea and Taiwan. It is partially significant in Japan and there is no evidence of herding in either of Hong Kong or the US.

¹⁴ Gleason *et al.* (2003) have also investigated herding in thirteen commodity futures contracts. They show that return dispersion in these contracts increases during periods of extreme price movement and that there is no evidence of herding behaviour in the commodity markets.

¹⁵ The Gulf Cooperation Council is an economic block that includes a group of oil producing countries in the Arab peninsula. These countries are: Saudi Arabia, Oman, United Arab Emirates, Kuwait, Qatar and Bahrain.

market during the period of Egyptian Military takeover of the country by the Army in 2013.

To the surprise of many who think that markets are more likely to herd in a market fall than rise, many studies find the opposite. Herding is more widespread during market up turns as opposed to market downturns.¹⁶ The study of Caporale *et al.* (2008) of the Athens equity market shows that herding is more obvious in market rallies than in market falls. Similar results are found by Lam and Qiao (2015) in the Hong Kong stock market and by Sharma *et al.* (2015) in the Chinese market. The same regarding herding asymmetry in the A share Chinese market is provided by Tan *et al.* (2008). The study by Houda and Mohammed (2013) show herding of market indexes around the MSCI global index in 35 equity markets. They show that these markets herd more during upturns than during downturns.¹⁷ A recent study has done by Chaffai and Medhioub (2018) in the GCC markets show evidence of herding behaviour during upward market only, when they divided the data into down and up market periods. Munkhnet *et al.* (2018) also found greater evidence of herding during up market compared to down market when investigating herding in China and Taiwan markets.

The price information in one market is observed by investors in other markets and hence these investors may ignore their own information and follow external markets. In today's increasingly integrated financial markets, cross herding is a possibility (stands a greater chance). The cross herding among markets has been the subject of Galariotis *et al.* (2015) who focus on herding spill-over between the US and the UK and finds that there is herding spill over from the US to the UK markets and not the other way around. The herding in the UK market is found to be beyond the movement that is required by fundamental changes in the US markets. In this study, we follow Galariotis to investigate cross herding from oil to equities in order to see the role of oil volatility and information in herding formation of Saudi shares.

The information flow to less developed markets such as the Saudi stock exchange is not very well organised and some investors are always believed to have more information than other investors. The Saudi market is also dominated by individuals who are more

¹⁶ Herding asymmetry refers to financial markets that herd more/less in a bull market than in a bear market.

¹⁷ Their sample of countries include the US, UK, Germany, Brazil, Mexico, Argentina, France, Indonesia, China and India among many other countries.

driven by emotions in comparison to institutional investors. Therefore, herding behaviour is well expected in the Saudi market. In terms of herding in the Saudi market, we find four studies. Balcilar *et al.* (2013), Balcilar *et al.* (2014), Balcilar *et al.* (2017) and Rahman *et al.* (2015).

Rahman *et al.* (2015) examine the period from 2002 to 2012 and find significant herding in all periods. Balcilar *et al.* (2014) use a regime switching model of volatility and show that herding is more and cross dispersions are less when the regime switches to the high volatility state. In their study, the market switching to a herding state depends on a latent herding parameter that takes a value between 0 and 1. The conditional mean in their study controls for many variables including oil, US interest rates and the VIX index and all are found to be significant factors in influencing the herding parameter and thus the transition to a herding state. Balcilar *et al.* (2013) model cross deviations using a regime switching specification and find that oil market movements significantly influence herding in the Saudi market. Finally, in a recent study, Balcilar *et al.* (2017) model the herding parameters in the conditional mean as a Markov Switching and time varying and then link them to the speculation activity in the oil market. They find that while oil returns and volatility are not influencing the dynamics of herding in Saudi equities, speculation in the oil market does and in a positive way. Surprisingly, high speculation in the oil market is positively associated with less herding in the Saudi equity market. They explained this by saying that speculation on oil is high when oil is expected to rally, and that this is positive news leads to more rationality and less herding in the Saudi domestic markets.

Our study is related to these studies in the assessment of oil equity herding relationship. However, our inference is drawn from the component of the dispersion of equity returns that remains after accounting for the covariance with similar styles investing. Therefore, we believe that our results are purely linked to the market sentiment which is the main cause of herding as opposed to market moves due to similar but independently taken investment decisions.

3.3 Methodology

We follow Chang *et al.*, (2000) and regress the cross-sectional absolute deviation of returns on absolute and squared market returns. Specifically, the dispersion of equity returns in day t is measured by the following expression:

$$CSAD_t = \frac{1}{N} \sum_{i=1}^N |R_{i,t} - R_{m,t}| \quad (1)$$

where $R_{i,t}$ is the observed return on company i and $R_{m,t}$ is the market returns.¹⁸ As can be seen, the CSAD is a quantity that describes how asset returns tend to rise and fall with market returns and hence its relationship with the market returns is suitable to capture herding behaviour. When markets herd, dispersions are predicted to be low despite a possible big change in the market and this will be reflected in a negative association between dispersion and absolute (squared) returns. However, in normal conditions company returns are expected to move with the market according to their betas and hence the value of the CSAD should be increasing linearly with market returns.¹⁹ Chang *et al.* (2000) argues that under the herding state, the linearity of the relationship is violated and that a non-linear increase at a decreasing rate with market returns of the dispersion measure is indicative of herding. Therefore, a suitable specification that may be used to detect the herding behaviour in financial markets can be written as:

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t \quad (2)$$

A negative and significant β_2 is indicative of herding behaviour in the market.

The influence of volatility spill-over from the oil market on the herding of Saudi equities is checked by estimating the following regression:

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{o,t}^2 + e_t \quad (3)$$

Where $R_{o,t}^2$ is the squared returns of WTI²⁰ crude oil. A negative and significant β_3 coefficient would indicate that the oil volatility is associated with less dispersion and follow

To check whether investors tend to herd on days when OPEC meetings are held we use the following equation:

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 DUM_t R_{m,t}^2 + e_t \quad (4)$$

Where DUM_t denotes a dummy variable that takes the value of 1 on the days of OPEC members conference meetings and zero otherwise. These days are collected from the quarterly reports issued by OPEC and published online in the OPEC website. If the Saudi

¹⁸ The results are not different when we use the cross-sectional average of the N company returns instead of market returns. The market returns are computed as the continuously compounded returns of the broad market index.

¹⁹ This measure is built on the basis of a zero beta CAPM model. In this model it can be shown that the expected CSAD is the market returns above the zero beta returns multiplied by the difference between the beta of individual companies and the beta of the equally weighted market portfolio of the N companies. Hence, the measure should increase linearly with market returns.

²⁰ This variable is used as a proxy for the changes in oil prices in previous studies (e.g. Balcailar *et al.*, 2014).

market herds on these days then β_3 coefficient will be negative and statistically significant at conventional levels.

Any significant oil volatility influence on the herding of Saudi equities on the days of OPEC meetings is captured by the following regression

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 DUM_t R_{o,t}^2 + e_t \quad (4a)$$

A negative and significant β_3 indicates that the oil market uncertainty on the days of OPEC conference meetings may cause herding in the Saudi market.

As mentioned previously in the introduction, spurious herding may arise due to similar styles or responses of investors to fundamentals which is not herding.²¹ In order to filter the part of the CSAD that is not herding and related to styles we regress it on four risk/style factors as follows:

$$CSAD_t = \beta_0 + \beta_1 (R_{m,t} - R_F) + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 MOM_t + e_t \quad (5)$$

The first three style factors in the model are the Fama and French (1993) style (risk) factors. The $R_{m,t} - R_F$ is a market oriented investment style which establish exposure to the general market.²² The HML_t factor is the return on the portfolio that longs the high book to market value stocks and shorts the low book to market companies. The portfolio represents a value investment style. The SMB_t factor is the return on the portfolio that invests in small companies and sells large ones. The factor is expected to capture small cap investment style. The last factor is the Carhart (1997) momentum factor MOM_t , which represents the return on a portfolio that buys previous winners and sells previous losers.²³ The portfolio mimics the returns of growth investors who follows momentum strategies.

It is worth to mention here that these styles have been seen to be able to capture fundamental information by the literature. For instance, Liew and Vassalou (2000) find that the HML and SMB factors are informative of GDP and the economic growth of

²¹ In the language of Bikhchandani and Sharma (2000) this is termed as spurious herding and in the language of Galariotis et al., (2015) it is termed as fundamental herding. We use both terms throughout the paper to describe the part of the measure which is not related to our measure for herding.

²² We assume that the daily risk-free rate is zero for simplicity.

²³ More details about the construction of these factors can be found in the next section.

countries. Similar results on the positive correlation between growth and the HML factors are arrived at by Gregory *et al.*, (2003). Substantial relationship between momentum and the economy is reported by Kessler and Scherer (2010). All these studies provide a justification of using these styles to filter that part of the CSAD that stems from investors' similar reaction due to same fundamental information.

The assumption that these factors are capturing similar styles co-movement is crucial for our analysis to be valid and for the decomposition of the CSAD. On each day, the conditional CSAD on these factors represents the part of the deviation that emanates from same styles or similar investor responses to the same information filters. The rest of the CSAD can be attributed to pure market sentiment and herding. Hence, to find that part of the CSAD that is likely to be herding we first regress the CSAD on the styles and then we subtract the actual CSAD from the fitted CSAD. Hence, the herding measure is the estimate of the error term in the above equation. We term this as non-fundamental CSAD

$$CSAD_{NONFUND,t} = e_t$$

The rest of the CSAD is spurious and it is termed as fundamental and it is estimated as

$$CSAD_{FUND,t} = CSAD_t - CSAD_{NONFUND,t}$$

Hence, our actual testing of significant herding in the previous equations is all based on $CSAD_{NONFUND,t}$ and not on the total CSAD as represented before. Therefore, we test for significant herding using

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t \quad (6)$$

And for the influence of oil volatility on herding we regress

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{o,t}^2 + e_t \quad (7)$$

And for the tendency to herd on OPEC meeting days we estimate

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 DUM_t R_{m,t}^2 + e_t \quad (8)$$

And finally, the effect of oil volatility during the days of the OPEC meetings, we regress

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 DUM_t R_{o,t}^2 + e_t \quad (8a)$$

These tests are estimated over various time periods to check for significant herding in the Saudi equities and how it is related to different information channels pertaining to oil market.²⁴

In the next section we discuss the data set and how we construct the factors that represent common styles for the computation of non-fundamental CSAD.

We collect data that includes all listed companies in the Saudi market from the 5th of October 2005 to the 25th of February 2016 for a total of 2667 days. The number of listed companies by the end of the sample is 175 companies.²⁵ The time series of the corresponding Saudi market index and the WTI crude oil prices is also retrieved for the same period.²⁶ All data is obtained in Dollars from Thomson-Reuters Datastream database. The dummy that represents the days of OPEC meetings during the period is constructed manually by looking into OPEC quarterly reports. These are available at the OPEC website: www.opec.org. Table 3.1 shows the dates of OPEC meetings and the decisions that were taken in each meeting over the study period:

²⁴ We have also estimated another version of (8) that reads as $CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 DUM_t |R_{m,t}| + \beta_4 DUM_t R_{m,t}^2 + e_t$ but the results are not any different. Therefore, we keep the simpler specification in the exposition.

²⁵ The study uses data for all active, dead and suspended companies to eliminate any potential survivorship bias.

²⁶ The name of the Saudi broad market index is the Tadawul all-share index. Its symbol in Datastream is TDWTASI.

Table 3.1 OPEC meetings dates and the decisions were taken in each meeting

The OPEC meetings controlled in the study are shown

Year	OPEC Decisions		
	Increase Production	Decrease Production	Unchanged Production
2002		15/03/2002 26/06/2002 19/09/2002 12/12/2002	
2003		24/04/2003 24/09/2003	11/03/2003 11/06/2003 31/07/2003 04/12/2003
2004	03/06/2004 15/09/2004	10/02/2004 10/12/2004	31/03/2004
2005	16/03/2005 15/06/2005 19/09/2005		30/01/2005 12/12/2005
2006		19/09/2006 14/12/2006	31/01/2006 08/03/2006 01/06/2006 11/09/2006
2007	11/09/2007		15/03/2007 05/12/2007
2008			01/02/2008 05/03/2008
2009			15/03/2009 28/05/2009 09/09/2009 22/12/2009
2010			17/03/2010 14/10/2010 11/12/2010
2011			08/06/2011 14/12/2011
2012			14/06 2012 12/12 2012
2013			31/05/2013 04/12/2013
2014			11/06/2014 27/11/2014
2015			05/06/2015 04/12/2015

To investigate herding in various time periods the whole sample is divided into three subsamples. First subsample covers pre global financial crisis period that extends from the 5th of October 2005 to the 1st of January 2008 for a total of 574 days, second is global financial crisis period but pre Arab spring sample and covers the period from the 2nd of January 2008 to the 17th of December 2010. Second sample period contains 760 days;

and finally a post global financial crisis and Arab spring sample that contains 1332 days and runs from the 20th of December 2010 to the 25th of February 2016.²⁷

The style factors used to compute the conditional CSAD and to extract the herding dispersion are constructed by pooling all companies listed in the Gulf Cooperation Council countries. The computation of regional factors increases the reliability of factors' returns as they will be based on a larger number of companies operating in the same economic block.²⁸

In the construction of style factors, we include dead firms in the universe of regional stocks to avoid survivorship bias. But we exclude non-common equity companies and companies with unreported dollar capitalization. Out of the 623 companies in the sample 25 non-equity firms are removed.²⁹

For the remaining companies we correct for extreme return reversals in Datastream by setting daily returns for day t and $t+1$ to be missing when daily return is more than 100 % but reverses the following day. Daily returns are also considered missing if the return of the two subsequent days is less than 0.5 and/or the daily gross return is greater than 2.³⁰ From the filtered data of the rest of companies we construct three factors: size (SMB: small minus big), value (HML: high minus low) and momentum (MOM).

The returns on the style factors are computed as averages of value weighted returns of the relevant company portfolios. Specifically, to construct the size and value factors we divide companies into big and small using the median capitalization firm. The two groups are further divided into high, medium, and low book to market using the third and the seventh decile breakpoints of firms' book to market value. These style portfolios are constructed and rebalanced at the end of June every year. As a result, six portfolios are established: small low book to market (SL), small medium book to market (SM), small

²⁷ The Arab spring refers to the political change of regimes by national revolutions in the Middle East which started in Tunis by the end of 2010.

²⁸ The number of companies listed in the Saudi market is only 175, while the number of companies listed in the financial markets of the Gulf Cooperation Council countries is 623. Therefore, we opt to compute regional factors to get more accurate estimates of factor returns. Since all companies run in the same economic block these factors are expected to be informative for all countries including Saudi Arabia.

²⁹ The number of listed companies in the Gulf Cooperation Councils countries is 175 in Saudi Arabia, 150 in Oman, 68 in Kuwait, 47 in Bahrain, 46 Qatar, 69 in Dubai, and 68 in Abu Dhabi.

³⁰ We follow Ince and Porter (2006) and Griffin et al (2010) in their industry codes to remove non-equity securities and to filter the equity data.

high book to market (SH), big low book to market (BL), big medium book to market (BM), and big high book to market (BH). The size style factor (small-minus-big SMB) is then generated by subtracting the average value weighted returns of the big portfolios (BL, BM, BH) from the average returns of the small portfolios (SL, SM, SH). Similarly, the HML style factor is computed by offsetting returns of the average of the two value portfolios (SL, BL) and the two growth portfolios (SH, BH).

A similar procedure is adopted to build the momentum style factor: we form three momentum portfolios i.e. momentum winner (high returns, W), average (normal returns, A) and loser (low or negative returns, L) portfolios. These portfolios are rebalanced monthly on the basis of the previous year performance of companies. The WML factor is then calculated as the difference between the averages of the two winner portfolios (SW, BW) and the two loser portfolios (SL, BL).

3.4 Results and Discussion

In Table 3.2 we present summary statistics of the CSAD as well as of the style factors that are computed in this study. As can be seen in the table, the Saudi market returns are marginally negative during the sample period. Moreover, the average returns of investing in the style factor portfolios are slightly positive on average with the momentum style being the lowest returning strategy. The HML strategy is the riskiest with the highest standard deviation and range of returns, while the MOM strategy is the lowest risk with a narrow range of returns.

The table shows that the Saudi equities' daily average dispersion around the market is relatively low (around 0.7 %).³¹ The CSAD ranges wide from around zero in certain days to 5.7 % in others. This shows that in certain days, movement around the market shrinks significantly and that Saudi companies could be potentially herding during these days. The rest of the statistics indicate that the CSAD is positively skewed and leptokurtic and therefore the null hypothesis of normality is rejected by the Jarque-Bera statistics.

³¹ The average daily reported CSAD in similar studies ranges from 0.5 % to 3 %. See Rahman et al. (2015) and Gavriilidis et al., (2016) as they report CSAD values in a range of countries. If the Saudi daily dispersion is transposed to monthly using the square root rule then it will translate to 3.4 %, which is also low compared to the monthly US equity return dispersion reported by Christie and Huang (1995).

Table 3.2 Descriptive Statistics for the Saudi Arabian and GCC Stock Markets

Descriptive statistics for the Saudi Arabian Stock Market including Cross-Sectional Absolute Deviation (CSAD) as proxy for equity market herding, and for the GCC region markets showing Fama-French-Carhart Factors.

	Sample Mean	Std. Error	t-Statistic (Mean=0)	Skewness	Kurtosis (excess)	Jarque-Bera	Minimum	Maximum
CSAD	0.007	0.005	76.849	3.365	20.847	53306.563	0.000	0.057
Market Factor	0.000	0.007	-1.028	-0.646	11.354	14505.543	-0.051	0.070
SMB Factor	0.000	0.009	1.837	0.597	17.663	34815.567	-0.089	0.119
HML Factor	0.000	0.012	1.979	2.641	34.999	139165.225	-0.060	0.189
MOM Factor	0.000	0.004	1.085	0.202	14.509	23403.394	-0.035	0.043

Note: CSAD is estimated using the following expression:

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

CSAD and Market Factors are constructed using stocks from the Saudi Arabian markets, Size factor (SMB), value factor (HML) and momentum factor (MOM) are regional, constructed using stocks from the GCC markets.

To check the dynamics of dispersion across time, Figure 3.1 plots a time series of the CSAD statistics during the sample period. It also plots the average of the CSAD to help create a point of reference. In the figure, dispersions around the market are high and above average in the period that precedes the global financial crisis from 2005 to 2008. Following 2008, dispersion starts to shrink and companies tend to move closely with the market consensus. In most of the days after 2009 the CSAD is below its average and therefore, we expect herding to be significant during this period.

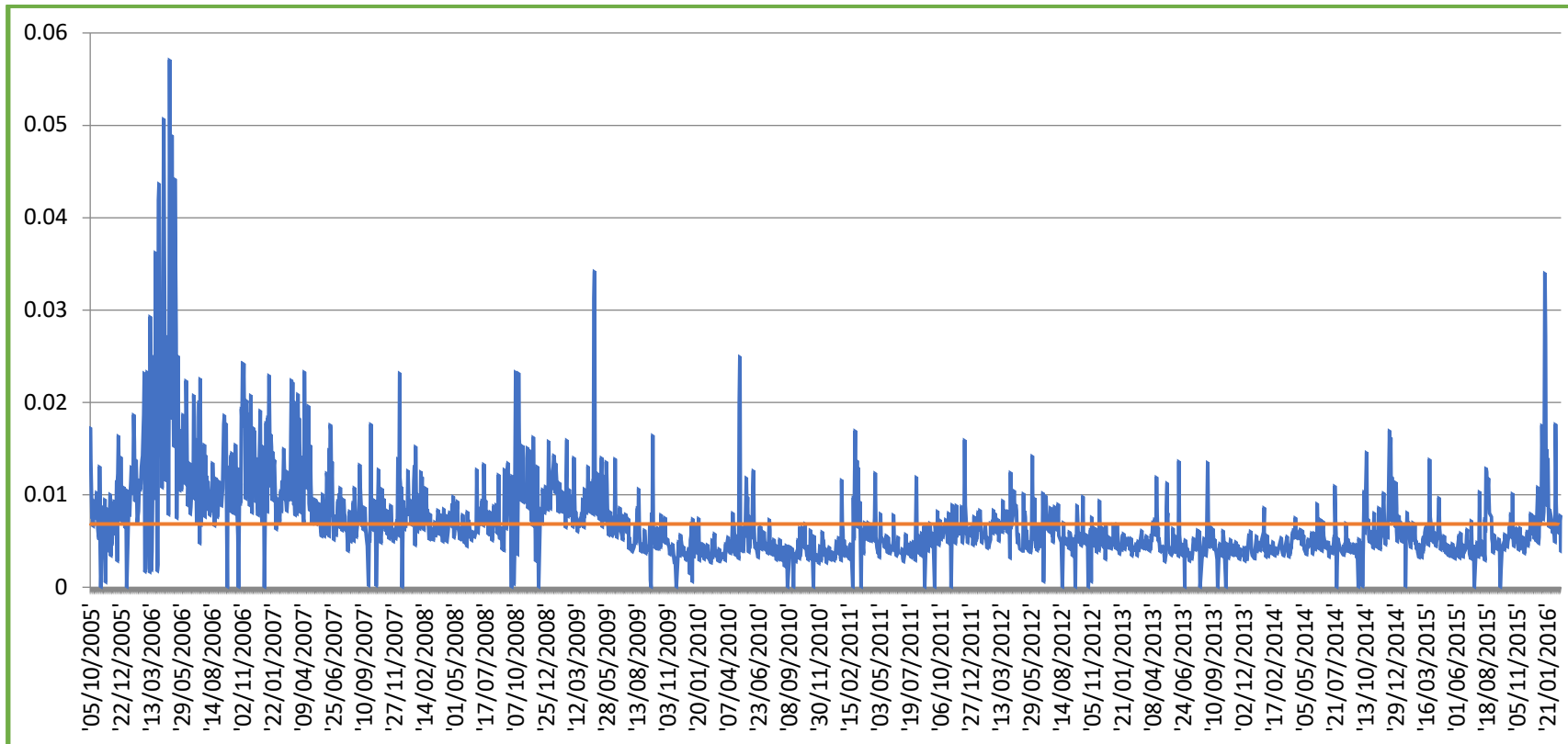


Figure 3.1 CSAD Time Series Plot

The blue line represents results for the CSAD over time for the duration of the sample (2005 – 2016), the red line is average CSAD.

To see how dispersion moves with market returns, Figure 3.2 scatter the CSAD against market returns. The figure shows that dispersion increases with market returns albeit at a decreasing rate. The concavity of the scattered diagram is clear and hence, we expect to find significant negative non-linearity and herding behaviour in the Saudi market.

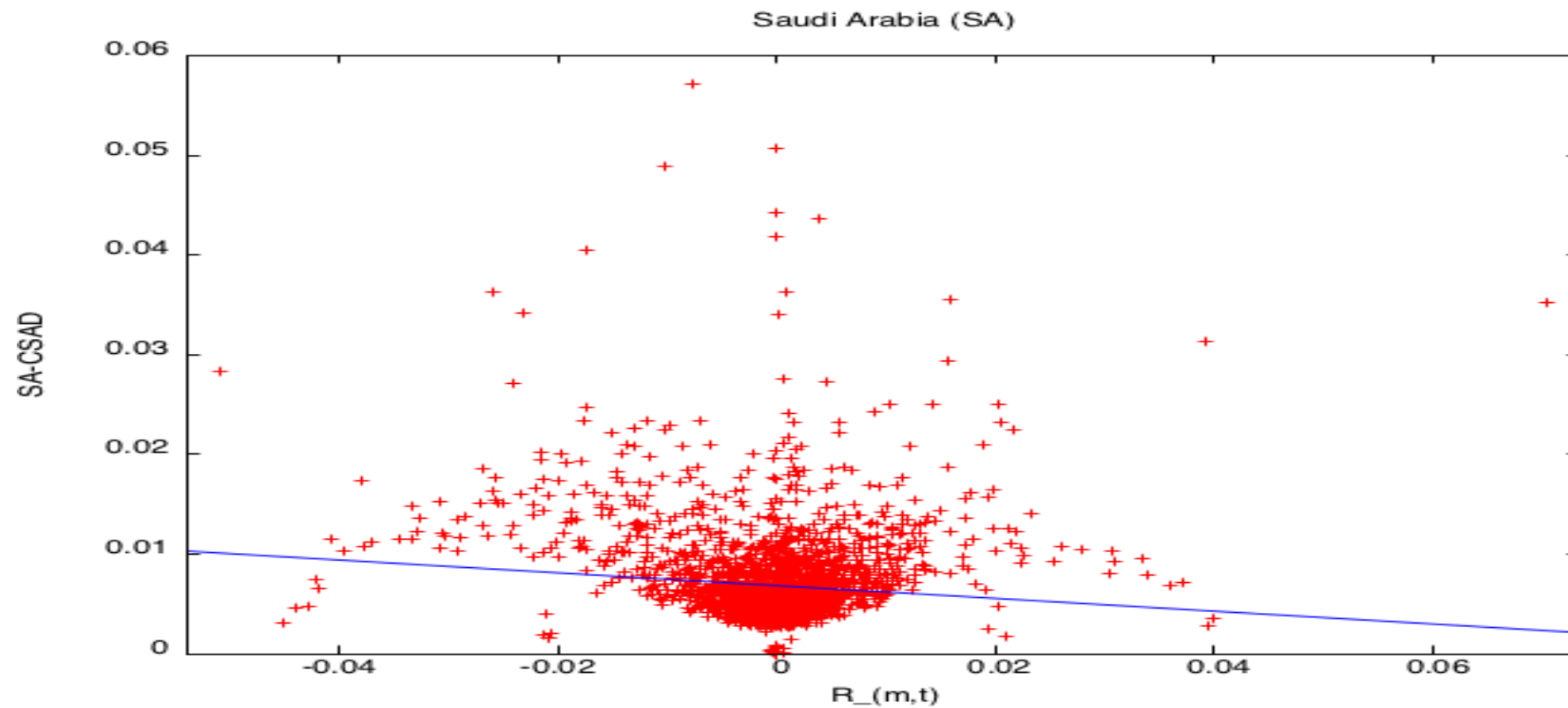


Figure 3.2 CSAD Scatter Plot of CSAD against Market Returns

The blue line represents the average CSAD.

We proceed to test formally for significant herding by regressing CSAD on market absolute returns and market squared returns as mentioned previously. The herding test results are presented in Table 3.3. Every Panel of the table corresponds to a particular sample period and in each panel, we run three regressions: the first regression includes all days and all market conditions (results are in all markets row). Then we separate the days of a bull market from the days of a bear market and run two additional regressions³². The results of the regression that run over bull days are presented in the up-market row while the results of the bear days are presented in the down-market row.

³² The bull and bear days are separated based on the Saudi market index returns.

Table 3.3 Herding Test Results

The Time series regression analysis retains both fundamental and non-fundamental components in the Cross-Sectional Absolute Deviation (CSAD) for the Saudi equity market herding and provides estimates for linear and non-linear herding parameters β_1 and β_2 , respectively. Panel A – entire date range; Panel B – 2005 - 2008; Panel C - 2008–2010 (global financial crisis period); Panel D – 2010 - 2016 (post crisis period).

	β_0	t-statistic	β_1	t-statistic	β_2	t-statistic	R^2
Panel A: 2005 to 2016							
In all markets	0.005***	43.206	0.549***	20.423	-6.995***	-8.644	0.224
Up market	0.005***	37.147	0.391***	11.364	-2.239**	-2.334	0.168
Down market	0.004***	23.906	0.724***	17.068	-12.986***	-9.897	0.289
Panel B: 2005 to 2008							
In all markets	0.008 ***	11.570	0.383 ***	2.821	-3.440	-0.893	0.098
Up market	0.009 ***	11.090	0.267 **	2.358	0.329	0.157	0.095
Down market	0.008 ***	8.388	0.654 ***	3.439	-12.405 **	-2.288	0.122
Panel C: 2008 to 2010							
In all markets	0.004 ***	18.250	0.599 ***	11.18	-11.188 ***	-4.526	0.347
Up market	0.004 ***	12.180	0.428 ***	3.954	-6.29	-1.033	0.224
Down market	0.003 ***	15.190	0.727 ***	10.760	-14.538 ***	-7.891	0.482
Panel D: 2010 to 2016							
In all markets	0.004 ***	30.670	0.434 ***	8.668	-5.55 4**	-2.240	0.303
Up market	0.004 ***	26.17	0.362 ***	7.227	-6.61 ***	-4.130	0.163
Down market	0.004 ***	25.41	0.477 ***	8.333	-5.12 *	-1.860	0.422

A two-tailed test was conducted: *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R2 (coefficient of determination) indicates proximity to the fitted regression line. CSAD_t was obtained from calculations using the following equation; data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t.$$

Panel A shows the loadings when the regressions are run over the whole sample that extends from 2005 to 2016. As can be seen in the panel, the linear parameter of absolute market return is positive while the parameter associated with squared returns is negative and significant. This indicates that there exists significant herding in Saudi equities during the sample period. This is expected as trading in it. Hence, we conform very well to the significant herding results findings in the Saudi market by Balcilar *et al.* (2013), Balcilar *et al.* (2014), Rahman *et al.* (2015) and Balcilar *et al.* (2017).

These results carry on in all subsamples with the exception of the sample that directly precedes the global financial crisis in 2008 (See Panel B). In this particular sample the relation between cross deviation and average returns is non-linear and negative, but insignificant pointing out to weak cascades in the market. This is surprising as the sample period covers the Saudi market rally in 2005 and 2006 and the crash that follows in December 2006.³³ The oil price during this period is increasing and the country is awash with money that finds its way through retail investors to equities and therefore share prices have decoupled from their fundamental value in a classic example of a bubble which bursts afterwards. Hence, herding is expected in the up and the down turn market during this period.

However, as can be seen in Panel B of Table 3.3, there is a strong and significant herding behaviour only in the downturn of the market, but unexpectedly no significant cascades are found in the upturn market. To see more closely, we regressed using a sample that contains only 2005 and 2006 and we find significant herding even in the upturn market as expected.³⁴

In all Panels and across all periods, the parameters associated with the up- market and the down- market regressions are also negative and significant and point to herding in either state: a market rally or a market fall. The loadings of the parameters clearly show that the shrinkage in the dispersion measure is more intense and significant in bearish markets. In The parameters linked to squared returns in Panel A indicate that for every 10 % change in market returns, the dispersion decreases by around 13 % in a downturn market, but by only 2.5 % in an upturn market. These results are not fully replicated in two subsamples as pointed out by Panels B and C of Table 3.3. In the period from 2010 to 2016, herding

³³ By January 2007 the Saudi market index lost more than half of its value since its all-time high recorded in February 2006.

³⁴ Results for these two years are not displayed and they are only available from the author upon request.

is stronger in the upturn market compared to the down turn market. Hence, we may conclude that while herding in general is stronger and more significant in a market fall, there are periods when market cascades in a rally are more pronounced. These results are generally in line with the literature that finds that herding is more pronounced in crisis and downturn market than it is in an upturn market.

As mentioned before results based on CSAD do not distinguish between co-movement due to ignoring individual information (herding) and co-movement that result from following the same styles and/or same reaction to information. We follow Galariotis *et al.* (2015) and term the first co-movement as non-fundamental herding and the second as fundamental.

Table 3.4 displays results when we filter the conditional CSAD from the computed CSAD and regress on absolute returns and squared returns. Panel A of the table shows that the parameter associated with squared returns is still negative and significant. This shows that even when the shrinkage in dispersion due to styles is accounted for in the CSAD measure, there is still evidence of negative non-linearity between cross sectional absolute dispersion and squared returns. Hence the shrinkage of dispersion in the Saudi equities is more likely to be linked to the herding behaviour of investors rather than to similar styles or the market reacting to the same information disclosure. In Panels B, C and D, we regress over various time periods. In all the panels, except Panel B, the parameters are negative and significant and they all point to the fact that there is some sort of cascading behaviour in Saudi equities.³⁵

³⁵ The 2005 and 2006 regressions show significant herding. These are available from the authors upon request.

Table 3.4 Testing Results for Non-Fundamental Herding

Time series regression analysis was conducted for non-fundamental CSAD – CSAD with the return co-movements arising from Fama-French-Carhart factors eliminated – for the Saudi equity market. Estimates are shown for linear and non-linear herding parameters β_1 and β_2 , respectively. Panel A – entire date range; Panel B – 2005 - 2008; Panel C – 2008 - 2010 (global financial crisis period); Panel D – 2010 - 2016 (post crisis period).

	β_0	t-statistic	β_1	t-statistic	β_2	t-statistic	R^2
Panel A: 2005 to 2016							
Non-Fund	-0.002***	-16.555	0.519***	19.198	-6.735***	-8.278	0.201
Panel B: 2005 to 2008							
Non-Fund	0.002 ***	2.728	0.330 **	2.162	-2.705	-0.598	0.079
Panel C: 2008 to 2010							
Non-Fund	-0.002 ***	-10.390	0.590***	10.770	-11.437 ***	-4.372	0.322
Panel D: 2010 to 2016							
Non-Fund	-0.002 ***	-20.350	0.418 ***	10.060	-6.236 ***	-3.210	0.271

A two-tailed test was conducted: *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R^2 (coefficient of determination) indicates proximity to the fitted regression line. CSADt was obtained from calculations using the following equation; data was sourced as described in methods.

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t.$$

Columns two and three of Table 3.5 present the influence of oil volatility on herding of Saudi equities. In column two, we display the non-linear parameter of the CSAD associated with the oil market and in column three we show its t-statistics. We run two regressions: the first regresses the full CSAD on the squared of oil returns (the all deviation row) and the second regresses the non-fundamental CSAD on the squared oil returns (the non-fundamental row).

The parameters in column two show that there is non-linear negative relationship between oil volatility and cross deviations and hence dispersion and herding in Saudi equities is more likely when the oil market uncertainty is high. However, the relationship is insignificant and the parameters are not statistically different from zero. This is true in all investigated samples and therefore, we conclude that there is no evidence of cross interaction between the Saudi market herding and the volatility in the oil market. The results using only the component of the CSAD that is pure market sentiment is not different and they show that herding in Saudi equities is independent of the oil market variance.

This result contradicts with Balcilar *et al.* (2013) who find that oil is an important factor in affecting market switching from herd to no herd state and vice versa. However, this result conforms to the recent work of Balcilar *et al.* (2017) who find that oil returns and volatility has no role to play in the Saudi equity herding and that only speculation in the oil market matters which they find it to be positively related to the no herd state of the market.

In order to check if there is herding on the days of the OPEC meetings, we run a regression on the multiplication of the squared returns of the market and a dummy that takes a value of 1 on the day of OPEC meeting and zero otherwise. The parameters associated with the dummy with its t-statistics are reported in columns four and five of Table 3.5.

As can be seen in column four, the parameter associated with the dummy is negative over the full sample period and across sub-samples as well, with the exception of the 2010-2016 sample in which the herding parameter is positive. The table shows clearly that the parameters are negative and significant only in the financial crisis period that is defined in the study as the period covering 2008 to 2010. In the regression of the full CSAD, the non-linearity parameter is only significant at the 10 % level (see all deviation row in Table 3.4). However, when we use the dispersion after accounting for similar styles, the parameter becomes significant at the 1.0 % level and its value increases from -63 to -83.

This shows a high level of negative non-linearity between CSAD and market returns on the days of OPEC meetings during the global financial crisis period.

Table 3.5 Cross Herding from Oil Markets Oil and OPEC Meetings

Results from two time series regression analyses of the influence of oil volatility on herding in Saudi equities. Full CSAD against oil returns (squared) are shown in the "All Deviations" rows and Non-Fundamental CSAD against oil returns (squared) is in the "Non-fundamental" rows. Column two is the non-linear parameter of the CSAD associated with the oil market and column three is its t-statistic; column four is the linear parameter. Co-movements arising from Fama-French-Carhart systematic GCC regional factors have been eliminated. **Oil Market β_3** - is the Saudi oil market returns squared, i.e. $R_{o,t}^2$; **OPEC β_3** is the interactions of market returns on OPEC meeting dates, represented by a dummy variable, with the Saudi oil market returns, squared, i.e. $DUM_t R_{m,t}^2$. Panel A – entire date range; Panel B – 2005 - 2008; Panel C – 2008 - 2010 (global financial crisis period); Panel D – 2010 - 2016 (post crisis period).

	Oil Market β_3	t-statistic	OPEC β_3	t-statistic
Panel A: 2005 to 2016				
All Deviations	-0.016	-0.279	-7.877	-1.034
Non-Fundamental	0.441	1.204	-7.957	-0.474
Panel B: 2005 to 2008				
All Deviations	-0.251	-0.668	-16.180	-1.242
Non-Fundamental	2.132	0.750	-15.775	-1.070
Panel C: 2008 to 2010				
All Deviations	-0.018	-0.287	-63.449 *	-1.749
Non-Fundamental	0.894 **	2.084	-83.049 ***	-3.287
Panel D: 2010 to 2016				
All Deviations	0.080	1.005	60.405	1.116
Non-Fundamental	1.338*	1.773	43.133	0.662

A two-tailed test was conducted: *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. CSAD_t was obtained from calculations using the following equations; data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

We explain these results by the greater sensitivity of the Saudi market during stress to news regarding the future prospects of oil that comes out from the OPEC meetings. Following the global financial crisis in 2008, the Saudi equities has dropped by more than 50 % and as the country is mainly dependent on oil, investors become more interested to look out for oil news. Moreover, out of the financial crisis OPEC members have various directions regarding quotas and energy policies. This may have introduced ambiguities regarding potential outcomes and information asymmetries from OPEC meetings. The equity market stress and the increased sensitivity to oil news coupled with misinformation and ambiguity of OPEC meeting outcomes may have led to herding in the Saudi equity market.

On the contrary, over the 2005-2008 period oil demand and oil prices were high. Oil producers were producing with full capacity and daily global production is very close to daily global consumption. Moreover, with the exception of the crash in late 2006, the Saudi equity market has not been in stress during the period. Considering, in this period global oil production was almost equivalent to global oil consumption and hence any disruptions to supplies or changes in demand would have created short term shortages and price volatility. Under these conditions, oil producing countries have a consolidated objective of stabilizing the oil market and the outcome of OPEC meetings, though uncertain, would have had a big influence on the oil market but as shown by our results not on equity markets of oil producing countries. This is probably because when the equity market is not in distress and oil prices are relatively high, markets participants are less interested in oil news and OPEC meetings. Perhaps high oil prices in this period are presumably so assuring that the future Saudi Government revenues and spending will continue, equity investors did not pay much heed to information flows from the oil market.

There is a chance that herding lags the signal in the oil market due to non-synchronous trading and / or illiquidity.³⁶ To check whether the herding signal is taken from previous oil volatility, we regress the cross deviations on lagged squared returns of oil and then subsequently on the lagged dummy of the OPEC conference meetings. Column 2 of Table 3.6 displays the parameters that describe whether oil market volatility is related to future herding of Saudi equities. The t statistics and significance are displayed in

³⁶ Taking the positive/negative signal from previous returns is known as feedback trading in the literature. See Nofsinger et al. (1999) and reference therein.

Column 3. As can be seen in the columns, the herding of Saudi equities is independent from lagged volatility in the oil market. On the contrary, oil volatility and Saudi market herding are significantly negatively correlated, thus indicating that volatility in the oil market is associated with rational behaviour of investors and less cascading in the Saudi market.³⁷

Column 4 of Table 3.6 presents the parameter that shows whether herding is significant on the day that follows the OPEC conference meeting or not. Column 5 contains the t statistics. The columns show clearly that OPEC meeting induce irrational behaviour and feedback trading but only during and after the Global Financial Crisis from 2008 to 2010. For the rest of time periods, the equity market behaviour varies. For instance, there is no significant herding or feedback trading during the 2010-2016 period. OPEC meeting has no influence on future herding of Saudi equities. In the period from 2005 to 2008, herding is less likely the day after the meeting. The parameter estimates show more equity return dispersion and less herding on the following day of the OPEC conference meeting. Hence during this period and in the day after the meeting, there is more information available and equity markets are less uncertain regarding the developments in the oil market. As the results of lagged oil information persist we may conclude that herding in Saudi equities is independent of oil volatility despite their tendency to cascade on the days of the OPEC conference meetings during the global financial crisis.

³⁷ The parameters in Column 2 and 3 of table 3.6 show that the CSAD is positively correlated with the squared of oil returns and its lag during the 2008-2010 and the 2010-2016 periods. Hence, increase in oil volatility is associated with increases in cross deviations and less herding of Saudi equities.

Table 3.6 Cross Herding with Oil and OPEC Feedback Trading Results

This time series regression analysis retains both fundamental and non-fundamental components of the Cross-Sectional Absolute Deviation (CSAD) for the Saudi equity market, representing herding behaviour after excluding the return co-movements arising from Fama-French-Carhart systematic GCC regional factors. **Oil Feedback β_3** - is the Saudi oil market returns squared, i.e. $R_{o,t}^2$; **OPEC Feedback β_3** is the interactions of market returns on OPEC meeting dates, represented by a dummy variable, with the Saudi oil market returns, squared, i.e. $DUM_t R_{m,t}^2$. Panel A – entire date range; Panel B – 2005 - 2008; Panel C – 2008 - 2010 (global financial crisis period); Panel D – 2010 - 2016 (post crisis period).

	Oil Feedback β_3	t-statistic	OPEC Feedback β_3	t-statistic
Panel A: 2005 to 2016				
All Deviations	0.032	0.627	31.702***	4.186
Non-Fundamental	0.058	1.120	35.623***	5.140
Panel B: 2005 to 2008				
All Deviations	0.601	1.084	22.897*	1.874
Non-Fundamental	0.566	0.457	25.859***	2.797
Panel C: 2008 to 2010				
All Deviations	0.117***	2.731	-98.356	-1.161
Non-Fundamental	0.134	2.251	-94.132**	-2.132
Panel D: 2010 to 2016				
All Deviations	0.195	4.104	27.559	0.408
Non-Fundamental	0.241	3.581	53.326	0.661

A two-tailed test was conducted: *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. CSAD_t was obtained from calculations using the following equations; data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

Table 3.7 uses the GARCH oil volatility instead of oil squared returns in order to check the relationship between oil volatility and herding on equities in the Saudi market. In Column 2 and Column 3 we present the results when we regress on the contemporaneous volatility and in column 4 and Column 5 we regress on lagged volatilities. As can be seen in the table, the oil GARCH volatility and lag volatility are associated with higher cross dispersion and less herding in the equity market. Hence, we conclude by saying that oil does not trigger herding in Saudi equities. On the contrary, the volatility in the oil market is associated with more rationality and less herding of Saudi equities. This result sits very well with the findings of Balcilar *et al.* (2017) who pointed out that volatility and speculation in the oil market is associated with less herding Saudi equities.

Table 3.7 Cross Herding with Oil GARCH Volatility

This time series regression analysis retains both fundamental and non-fundamental components of the Cross-Sectional Absolute Deviation (CSAD) for the Saudi equity market, representing herding behaviour after excluding the return co-movements arising from Fama-French-Carhart systematic GCC regional factors. **Contemporaneous Volatility β_3** – is contemporaneous fitted oil GARCH volatility estimates; **Lagged Volatility β_3** – is lagged oil GARCH estimates. Panel A – entire date range; Panel B - 2005–2008; Panel C - 2008–2010 (global financial crisis period); Panel D – 2010-2016 (post crisis period).

	Contemporaneous Volatility β_3	t-statistic	Lagged Volatility β_3	t-statistic
Panel A: 2005 to 2016				
All Deviations	0.400***	3.522	0.402***	3.541
Non-Fundamental	0.456***	3.996	0.456***	3.995
Panel B: 2005 to 2008				
All Deviations	9.117***	4.143	8.293***	3.769
Non-Fundamental	9.581***	4.368	8.638***	3.936
Panel C: 2008 to 2010				
All Deviations	1.074***	11.802	1.078***	11.881
Non-Fundamental	1.072***	11.774	1.074***	11.825
Panel D: 2010 to 2016				
All Deviations	0.541***	4.056	0.516***	3.848
Non-Fundamental	0.632***	4.964	0.632***	4.737

A two-tailed test was conducted: *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. CSADt was obtained from calculations using the following equations; Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

In Table 3.8, we check the influence of current and previous oil volatility on equity herding but only on the days of OPEC conference meeting. Column 2 and column 3 of the table reports the parameter value and the t statistics that are associated by the cross product of oil squared returns and the dummy that represents the OPEC meetings. Column 4 and column 5 display the parameters associated with lagged oil squared returns. As can be seen in the table, all parameters are insignificant at all time periods indicating that although the Saudi market herds around the OPEC conference meeting, this herding is still independent of the oil market volatility.

Table 3.8 Cross Herding (Feedback Effect) from Oil Volatility on OPEC Conference Meeting Days

This time series regression analysis retains both fundamental and non-fundamental components of the Cross-Sectional Absolute Deviation (CSAD) for the Saudi equity market, representing herding behaviour after excluding the return co-movements arising from Fama-French-Carhart systematic GCC regional factors. OPEC/OIL Market β_3 – is oil market return estimates squared i.e. $R_{o,t}^2$; Lagged OPEC/OIL Market β_3 is the lagged interaction of OPEC meeting days, represented by a dummy variable dummy variable and the squared Saudi market returns, squared i.e. $DUM_t R_{m,t}^2$. Panel A – entire date range; Panel B – 2005 - 2008; Panel C – 2008- 2010 (global financial crisis period); Panel D – 2010 - 2016 (post crisis period).

	OPEC/Oil Market β_3	t-statistic	Lagged OPEC/OIL Market β_3	t-statistic
Panel A: 2005 to 2016				
All Deviations	1.512	1.564	0.890	0.921
Non-Fundamental	1.688	1.738	1.643	2.451
Panel B: 2005 to 2008				
All Deviations	0.264	0.069	-0.198	-0.051
Non-Fundamental	0.286	0.074	0.265	0.069
Panel C: 2008 to 2010				
All Deviations	1.695	1.371	-0.308	-0.249
Non-Fundamental	1.633	1.325	-0.475	-0.385
Panel D: 2010 to 2016				
All Deviations	1.145	1.711	1.222	1.826
Non-Fundamental	1.510	2.251	1.643	2.451

A two-tailed test was conducted: *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. CSADt was obtained from calculations using the following equations; data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

$$CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 R_{x,t}^2 + e_t.$$

3.5 Conclusions

In this essay, we study the herding behaviour in the Saudi equity market. The main tests include analysing the influence of the oil market volatility and effect of OPEC meetings on herding behaviour in Saudi equity market. The investigation covers various periods between 2005 and 2016. In particular, we look into the pre and post the financial crisis samples along with the Global Financial Crisis period (2008-2009).

Unlike previous studies (e.g., Balcilar *et al.*, 2013; the Balcilar *et al.*, 2014; the Rahman *et al.*, 2015; Balcilar *et al.*, 2017), we draw our herding inference by accounting for potential spurious herding that may arise from same styles or response to fundamental information. Before detecting any non-linearity of the cross-sectional dispersion with average squared returns, we covary dispersion with style and only use the rest of dispersions to infer. For this purpose, we construct four investment styles that popular in the finance literature: market oriented, value, growth and small style investing.

Our results indicate significant herding behaviour in Saudi equities that is independent of oil volatility but not of OPEC conference meetings. This finding is consistent with previous research (e.g., Balcilar *et al.*, 2013; the Balcilar *et al.*, 2014; the Rahman *et al.*, 201) which finds significant herding in the Saudi Arabian equity market, but is inconsistent with Balcilar *et al.* (2014) in terms of the impact of oil on the Saudi stock market. Equities herd on the days of OPEC meeting, but only during the global financial crisis period.

The herding on the days of OPEC meeting days has disappeared with the start of global recovery in 2010. It is worth to mention here that equity herding on the days of the OPEC conference meetings is independent of the oil market volatility whose influence remained insignificant even during days when OPEC meetings are held.

Overall, our results show that herding in Saudi equity market is not influenced by uncertainties emanating from global demand as captured by oil market volatility rather is an outcome of changes in global supply of crude oil. This finding is inconsistent with previous research (e.g., Balcilar *et al.* 2014). These are new results and illuminate existing research on behavioural decision biases for equity markets in natural resource abundant countries as well as emerging equity markets.

These results are important for policy makers as there is room for improving the quality of the Saudi market and reducing its volatility by disclosing more information and

educating retail investors. The results are also important for active funds; as our results reveal that there are exploitable inefficiencies and room to improve performance by investing in Saudi equities particularly around the OPEC conference meetings.

The absence of influence of oil volatility on the herding of equity markets in oil producing countries has important implications on the asset allocation decision, portfolio hedging and diversification. Nonetheless, the key implication of our work is that subjective trading and market inefficiencies for a market that underlies changes in oil prices is strongly and persistently related to the decisions undertaken at the OPEC during stressed global times.

Defined events such as OPEC conference meetings were shown here to have an impact on the herding measured in the Saudi equities market, likely through affecting the potential supply levels, whereas ongoing oil market volatility arising from fluctuating global demands for oil were shown have few discernible effects on herding behaviour. Therefore, the next investigation considered other events for their importance to herding, in particular religious events. We summarise the evidence for behavioural modification derived from the frame of mind of particular social groups, which shows that mood amongst groups of people is important in a variety of ways and therefore might reasonably be expected to affect herding. The events we analyse in this context are Islamic religious festivals, Ramadan has been studied previously, but is not the only significant event in the Islamic calendar and the moods amongst Muslims engendered by them are not equivalent. To improve the likelihood of finding significant results highly correlated with Islamic events and because, for example, domestic factors require added emphasis given the absence of strong effects from international markets, we included several other factors likely to effect herding into the regression models in order to eliminate their potential effects. These factors included the size, economically, of investors, since smaller investors may be more prone to herding for reasons explained below, and domestic and international (US) market returns and liquidity, since both are potential sources of information to investors. We also included some major global and regional events as factors to be controlled during the investigation, including the 2008 global financial crisis and the 2010 Arab Spring.

Chapter 4: The impact of Islamic Events on Herding Behaviour in the Saudi Arabia Stock Market

The effects of social mood, as influenced by Islamic events, on herd behaviour in the Saudi Arabian stock market are investigated. The impacts of different religious events are compared using Saudi equity market settings for the period October, 2005 → February 2016. Methodology follows Gavriilidis et al. (2016). Results support the suggestion that investors' mood during the Islamic events of Eid-ul-Fitr, Ashoura and Eid-ul-Adha affects herding behaviour and contrasts with existing evidence of herding in Ramadan month. Moreover, when the study controlled for variables reflecting market states, both domestically (market returns, liquidity) and internationally (US market returns, US investor's sentiment, CBOE Crude oil index, the global financial crisis and the Arab Spring), herding significance within, compared to outside, religious days, exhibited variation compared to expected levels across the market.

4.1 Introduction

4.1.1 Stock Markets During Islamic Calendar Events

Various studies have investigated the impact of Islamic calendar events on financial markets in Muslim countries, with the premise that any effects are the results of these seasonal periods. Thus, it is assumed, Islamic events may influence social mood, which may transfer into investment decisions.

Studies that have reported market effects arising from the influence of Ramadan include Al-Ississ (2010) who found positive effects on the trading volumes and daily returns of 17 Muslim countries. Al-Ississ argued that cultural and religious festivals may lead to changes in equity market returns because either, investors who follow a particular religion will be absent from stock markets on religious and cultural festival days or, if these religious investors share the same attitude towards investment decisions, they can cause a one-sided effect.

Ramadan, in the Islamic calendar, has received most attention from market impact researchers, however, typically studies fail to detect evidence of its impact on financial markets. Alper and Aruoba (2001), for example, failed to find any significant evidence of the impact of Ramadan in the Istanbul stock market. Husain, (1998), investigated

Pakistan's stock exchange and found evidence that Ramadan caused stock volatility, notably a market decline, but no substantial evidence of any impact on normal or average returns. Bialkowski *et al.* (2012) investigated 14 Muslim countries' stock returns and found higher stock returns during Ramadan compared to non-Ramadan months. Al-Khazali (2014) also found evidence from 15 Muslim countries, across differing time periods, that stock returns were higher in Ramadan, an affect that dissipated after the global financial crisis period (2007–2012). Seyyed *et al.* (2005) found seasonal behaviour in volatility and trading activity disappeared in Saudi Arabia's stock market during Ramadan, having analysed several sectoral indices.

Another stream of research extends the scope of Islamic events investigated to include the Eid festivals and Ashoura holy days amongst others. For instance, Wong *et al.* (1990) considered the influences of multiple seasonal affects, such as the "January" effect, a widely reported, abnormal, increase stock prices in January, the Chinese New Year and the Muslim festival of Eid-ul-Fitr. They found a negative effect of Eid-ul-Fitr on Malaysian-stock market returns. Conversely, however, Chan *et al.* (1996), did not find any impact of Eid-ul-Fitr in the Malaysian-stock market. McGowan and Jakob (2010) also found no effect from Eid-ul-Fitr on the Syariah Index of the Kuala Lumpur Stock Exchange return between 2000 and 2003. Ali *et al.* (2017) also failed to find any significant influence of Ashoura, Eid Milad-un-Nabi, Ramadan or Eid-ul-Adha on Asian financial markets, the only religious day they found that had a significant positive impact was Eid-ul-Fitr. Chowdhury and Mostari (2015) and others examined if Eid-ul-Adha affects the Dhaka market returns and found that before and after this event there is a higher mean index return and an anomaly index return. Akhter *et al.*'s (2015), study examined Eid-ul-Adha effects in the stock markets of six Islamic countries. They found a negative impact in Malaysian stock market returns but no effects on equity markets returns in any other countries they sampled. Stock market volatility was affected by Eid-ul-Adha in the Turkish, Moroccan and Egyptian markets, but nowhere else they sampled. Majeed *et al.* (2015) did not find an effect from Eid-ul-Adha on Pakistani stock market returns using daily data from the KSE-100 Index from 2001 to 2012; but the festivals of Ramadan, Ashoura, Rabiul Awal and Eid-ul-Fitr all had significant effects. Al-Ississ (2010) who reported that Ramadan had a positive effect on market returns, also found that Ashoura had a negative impact, in 17 Muslim countries. Many studies have investigated the impacts of Islamic calendar events on the stock markets of Muslim countries, such as Saudi Arabia, Turkey and Pakistan (e.g., Husain, 1998; Alper and Aruoba 2001; Seyyed *et al.*, 2005; Ramezain, 2013).

4.1.2 Saudi observance of Islamic religious events

The Islamic, Muslim, or Hijri calendar consists twelve months³⁸ in a year of 354 or 355 days. It is a lunar calendar and used by many Muslim countries, including, Saudi Arabia. Muslims depend on the Islamic calendar to determine the date of occurrence of Islamic holidays and rituals such as the annual periods of fasting and Hajj. This study specifically focuses on four main Muslim events: Ramadan, Ashoura, Eid-ul-Fitr and Eid-ul-Adha because of their cultural importance.

Ramadan is the ninth month in the Islamic calendar and it is the fourth of the five pillars of Islam, its observance is mandatory (Seyyed *et al.*, 2005) for Muslims. It is described as “better than a thousand months” in the Qur’an³⁹. Eating, drinking, smoking and having other sensual pleasures are prohibited during Ramadan days, from dawn until sunset. In Ramadan, there are two daily meals, Muslims break their daily fast with Iftar⁴⁰ and before it starts (Imsak) they take Shoor. Muslims acquire self-restraint from fasting because it is a spiritual act intended to turn the heart towards Allah and away from worldly concerns, as stated in the Qur’an (Al-Qur’an 2:183) (Seyyed *et al.*, 2005). Muslims particularly refrain from participating in religiously prohibited “haram” activities during Ramadan. During Ramadan, Muslims are motivated to do special prayers such as Tarawih and Qiyam in mosques almost every night and reading the Qur’an and performing good acts like feeding a fasting person or donating to a charity are popular activities, this leads to marked spiritual orientation among average Muslims. Muslims believe that performing good acts during Ramadan merits twice the typical reward achieved from similar on non-Ramadan days. Muslim behaviour during Ramadan is correlated with low levels of anxiety and increased levels of euphoria and social interactions (Daradkeh ,1992; Knerr and Pearl, 2008).

Many Muslims consider speculative trading in securities is a form of gambling. Gambling is prohibited by Islam and one of the "haram" activities, therefore, securities trading is particularly avoided by Muslims during Ramadan and the volume of trading declines. There is also a prohibition against the accumulation of interest or “Riba”, so the leverage

³⁸The twelve months of the Islamic calendar, in order, are: Muḥarram, Şafar, RabiI, RabiII, JumadaI, JumadaII, Rajab, Sha’ban, Ramaḍan, Shawwal, Dhu al-Qa’da and Dhu al-Ḥijja.

³⁹ Muslim holy book (Surah al-Qadr: 3)

⁴⁰ The Iftar meal is often taken after Maghrib (around sunset); people gather then to break their fast together, so Iftar is one of the religious observances of Ramadan and is predominately a family and/or communal activity.

(margin trading) or trading in interest-based securities may also decline during this period (Seyyed *et al.*, 2005). There is also a reduction of the working hours in all sectors in Ramadan and that in turn leads to a slow down in business activities (Seyyed *et al.*, 2005). Shah and Ahmed (2014) investigated the consequences of Ramadan on the Karachi Stock Exchange. Their study assumed that the Islamic calendar, specifically, Muharram and Ramadan, may impact business life due to their influence on Muslims, because, during these months, Muslims may pay more attention towards rituals and faith and less to business activities. Their results, however, showed that the Karachi financial market remained the same during Ramadan as in any other month of the year.

After a month of fasting and religious practices in Ramadan, comes the month of Shawwal, which includes two great festivals of Eid. Firstly, the three days of Eid-ul-Fitr which mark the end of Ramadan. The word Eid is Arabic and means "festivity," while Fitr means "to break fast." Muslims often celebrate Eid-ul-Fitr with family and friends and it is a time of increased charity towards those in need (Al-Hajieh *et al.*, 2011).

The twelfth month is known as Dhu al-Hijjah, it is when many Muslims around the world come to Saudi Arabia to perform Hajj, another of the five pillars of Islam. Muslims during this month seek to imbibe piety and self-righteousness⁴¹. Secondly comes Eid ul-Adha, a single day which celebrates the willingness of Abraham to sacrifice his son Ishmael as an act of obedience to Allah. Eid-ul-Adha is the 10th of Dhu al-Hijjah and it is one of the crucial festivals in the Islamic calendar, a notable day of prayer and of donning new clothes to visit family and friends.

Ashoura is the tenth⁴² day of the first Hijri month of Muharram and marks the death of Hussein Ibn Ali. Sunni and Shi'a Muslims treat this event differently. Shi'a in Saudi Arabia treat it as a day of great remorse whereas the Sunni majority instead regard it as a day of relief and happiness (Al-Ississ, 2010), celebrating by fasting in respect of the Prophet Moses' (Moosa) fast on this day. Moses and the Israelites are believed to have been saved by Allah from the Pharaoh of Egypt and his army on Ashoura.

⁴¹ The common halal sacrifice, on this date, of the best domestic animal, such as a camel, goat, cow or sheep, is an act of obedience to God. Allah appeared to Abraham in a dream and asked him to sacrifice his son Ismael and, when he attempted to kill his son, Allah asked him to kill a lamb instead (Chowdhury and Mostari, 2015).

⁴² Ashra in the Arabic language is ten. Ashoura is named thus because it is the tenth day of Muharram.

During Muslim events the level of social interaction increases compared to non-festival days. Many researchers have argued that social interaction generally and social mood specifically are important factors driving behaviour which affects financial markets (see Prechter, 2001; Hong *et al.*, 2004; Parker and Prechter, 2005; Olsen, 2006; Liao *et al.*, 2011; Blasco *et al.*, 2012). Since the late 1990s, Islamic financial markets have experienced strong growth, and Islamic calendar⁴³ anomalies have received attention from many researchers. Muslims, during festive months, become more sociable, healthy and spiritually oriented (Bialkowski *et al.*, 2012). Moreover, the level of social support Muslims received during festive months may encourage optimistic beliefs, as people become more satisfied and happy and this optimism may extend to investment decisions (Beit-Hallahmi and Argyle, 1997; Gavriilidis *et al.*, 2016).

Saudi Arabia is one of the major Islamic nations and 100 %⁴⁴ of Saudi citizens are Muslim. It has adopted the most austere puritanical form of Islam, so is a conservative society. The Saudi stock exchange lists some non Shariah-compliant stocks because although the Islamic finance services industry is expanding, there are as yet no legal restrictions when it comes to portfolio selection. Portfolio selection is therefore based on the ethical attitude of investors and their preferences. Any influence of religious events on behaviour or mood are therefore likely to be more observable in Saudi, compared to less strictly observant Islamic societies.

4.1.3 Mood effects - general decision making

Schwarz and Clore (1983) formalised the mood-as-information theory, which holds that people's decision making across many unrelated aspects of their lives has a dependency on their mood. Their assessment of their life satisfaction can, for example, depend on transitory fluctuations in the weather: a phone survey provided evidence that greater life satisfaction was reported when the weather was good than when the weather was rainy and overcast. The mood-as-information hypothesis argues that people sometimes let their feelings be affected by variations in environmental factors, such as weather, with consequences for unrelated decisions, especially if these decisions are complex and involve risk and uncertainty (Lucey and Dowling, 2005). General impacts of mood on decision making can be summarised as follows: *“Negative affective states, which inform*

⁴³ Muslims in more than fifty countries in the world follow Islamic calendar and celebrate religious months such as Ramadan and Ashoura and days such as Eid-ul-Fitr and Eid-ul-Azha (Akhter *et al.*, 2015).

⁴⁴ <https://nosharia.wordpress.com/list-of-muslim-majority-countries-with-sectstategovernment/>

the organism that its current situation is problematic, foster the use of effortful, detail-orientated, analytical processing, whereas positive affective states foster the use of less effortful heuristic strategies” Schwarz (1990, p.527).

Other studies have corroborated this theory. Isen *et al.* (1978) gave a small gift to one group of people at the start of their experiment and found that these people enjoyed a shopping experience more than those who did not receive the gift; they attributed this to improved mood in the favoured group. Kamstra *et al.* (2003) found that in fall (autumn) and winter periods, the medical condition caused by the lack of sunlight (seasonal affective disorder - SAD) resulted in more risk averse behaviour.

The phenomenon of mood misattribution is a key element of the mood-as-information hypothesis and states that mood can inform decisions even when the cause of the mood is entirely unrelated to the decision being made (Lucey and Dowling, 2005). Johnson and Tversky (1983) found evidence of this in risk assessments. They undertook two complimentary experiments, in the first they found low mood induced by asking half of their trial subjects to read negative news led to higher ratings of the risk of death from various possible causes, compared to the group who did not read the negative news. In the second experiment, the subjects who read positive news stories rated the risk of death from various causes as lower, compared to the other group.

4.1.4 Mood effects - financial decision making, herding

Mood-as-information theory and its associated phenomenon of misattribution have led behavioural finance researchers to look at the influence of mood and irrelevant feelings on decision making in the equity markets (Lucey and Dowling, 2005). They found evidence that good weather associated good moods encourage people to make more optimistic judgments about equities and that in bad weather associated with bad moods people will make pessimistic judgments about equities.

This theory has been widely supported in other research. Edmans *et al.* (2007) showed that the wave of mood deterioration associated with the loss of an international soccer game reduced next-day stock returns in the losing country. Also investigating football, positive abnormal returns in the UK stock market were detected after wins by the England national team (Ashton *et al.*, 2003) which was attributed to the happy mood encouraging individuals to invest in risky assets.

Kaustia and Rantapuska (2016) also investigated if investors' mood influenced trading behaviour in Finland and found that sunny weather had a positive influence on demand for stocks and that the full moon had a negative one. The weather was also implicated in Saunders' (1993) results: he found that cloud cover in New York caused a negative mood which translated into lower New York equity prices while the positive mood induced by good weather, in this case, clear and bright days, resulted in higher equity prices. Hirshleifer and Shumway (2003) reported that the good mood induced by sunshine led people to be more risk-prone and/or to evaluate future prospects more optimistically. Kamstra *et al.* (2000) reported significantly negative market returns for Mondays following Daylight Savings Time Changes, both in Spring and Autumn, compared with other Monday and weekend returns. They linked this effect to the disruptions in sleeping patterns that in turn led to anxiety, depression, and illness (Coren, 1996, Kamstra *et al.* 2000).

Weather is not the only mood-changer to influence financial decision making. Investors were found to make riskier investment decisions, being willing to accept exposure to higher risk investments when their mood was positive (Shu, 2010). In a controlled study of risk taking, investors in a good mood displayed more risk-prone behaviour than those in a bad-mood (Au *et al.*, 2003). Several reviews of behavioural finance studies have confirmed a strong relationship between mood and investment decisions, notably Hirshleifer (2001), Daniel *et al.* (2002), Nofsinger (2005) and Dowling and Lucey (2005). They concluded that mood plays a significant role in changing investors' preferences, risk assessments and rationalisations and eventually, their investment decision making. Nofsinger (2003) argued that fluctuations in social moods influenced equity returns and also report that optimism and good moods are associated with higher equity pricing and pessimistic and negative feelings with lower returns. Being in positive mood makes individuals less likely to be aware of the potential negative consequences of their decisions, the lack of careful and rational thought may intensify their risk-prone responses (Leith and Baumeister, 1996; Forgas, 1998). Gabbi and Zanotti (2010) tracked subjects' mood states through daily surveys over a six-week period which showed that individuals in good mood are more likely to enter long positions and increase their financial leverage in a virtual stock market game.

In traditional understandings of finance, investors' behaviour has been assumed to be rational. For example, Fama (1970) describes investors under the efficient market theory as profit maximizing individuals who compete with each other to predict the future market

values of individual securities. It has also been assumed that information is available freely to all investors and that pricing reflected this situation. However, investors are not always rational and instead may follow cognitive and emotional biases (Aduda *et al.*, 2012). When uncertain, investors' decision making may deviate from market rationality towards specific behavioural biases (Lo, 2005). This behaviour, when the stocks deviate from the assumptions of the Efficient Market Hypotheses (EMH), is called a financial market anomaly⁴⁵..

Personal emotions often impinge on market stability, when behaviour is driven by emotions and this may result in financial losses and failures to achieve financial goals. Research has clearly shown that investors' behaviour may disturb market equilibrium due to its impact on stock prices and returns. Higher stock prices can be correlated with better mood and vice versa, hence, to help investors make the right decisions and avoid mistakes and behavioural driven biases, it may be crucial to better understand the factors that impact on investors' decision making. (Shu, 2010).

Herding is an example of a behavioural bias observable in the financial market. Herding happens when investors follow other investors, assuming their decisions are based on better information or processing, so accept those decisions to govern their own assessments, evaluations and ultimately investments. While behavioural finance theory has identified herding as a human trait which, under uncertain conditions, is a basis for investment behaviour (Christie and Huang, 1995; Saxena *et al.*, 2016), herding is not consistent with EMH, which disapproves of such effects on asset prices.

One definition of herding is: "*the phenomenon of individuals deciding to follow others and imitating group behaviours rather than deciding independently and atomistically on the basis of their own, private information.*" (Baddeley, 2010, p.282); for further definitions see Chapter 2. Within the context of behavioural finance, heuristics are defined as the rules of thumb used when decision making is undertaken in a situation of complex uncertainty, or as extrapolation from limited and recent events to imagine

⁴⁵ The literature in finance especially related to capital markets divides anomalies into three main categories calendar, technical and, fundamental (Latif *et al.*, 2012; Akhter *et al.*, 2015). There are many examples of these anomalies and they have been investigated by previous research (Kiymaz and Berument, 2003; Rasugu, 2005; Dodd and Gakhovich, 2011). These examples include the day of the week effect, holiday effect.

patterns that do not exist. It can result, therefore, in herding in investors' behaviour (Barberis *et al.*, 1998).

Herding behaviour is addressed in more detail in Chapter 2.

4.1.5 Mood affected by religion – effects on financial decision making

Investors' mood may be influenced by different factors such as weather and social events and these factors have been considered in previous research (e.g. Saunders, 1993; Kamstra *et al.*, 2000; Nofsinger, 2003; Frieder and Subrahmanyam, 2004 and Pantzalis and Ucar, 2014), but also by religion. Investors' mood may be specific to their own religious calendar, as each community celebrates its own religious months and days according to these religious calendars. (Akhter *et al.*, 2015).

Frieder and Subrahmanyam (2004) found a significant impact of Jewish High Holy days (i.e. Rosh Hashanah and Yom Kippur⁴⁶) on US investors' mood, return patterns were consistent with the notion that sentiment plays a role. Dollar volume – market trading – deteriorated on both holy days. They linked the decrease in trading activity on these days to the non-financial opportunity cost of trading which appears to be large for many investors on the holy days and so found a significant impact of both days on stock returns. Around Rosh Hashanah, stock returns were significantly up while around Yom Kippur they were significantly down.

Pantzalis and Ucar (2014) found that Easter week holiday distracts US investors which causes a delayed response to earnings news in the form of a post-earnings announcement drift. Their research expected investors to be rational in processing and incorporating this type of information into stock prices, both completely and timely. Behavioural literature suggests that incomplete and or delayed information processing may often happen because of distraction, because people have limited information processing capabilities and finite attention.

⁴⁶ Rosh Hashanah and Yom Kippur are religious occasions celebrated by Jewish communities. Rosh Hashanah is a joyous occasion similar to the secular New Year's Day. It is the Jewish new year and signifies God's creation of the world. Rosh Hashanah is a day spent in prayer for a good year (Frieder and Subrahmanyam, 2004). Yom Kippur happens nine days after Rosh Hashanah and in contrast is a solemn occasion and regarded as the most austere holy day in the Jewish canon. It is also the day of Atonement, the time to reflect on one's sins (often in worship) and the time to ask God's forgiveness so as to begin the next year with a "clean slate" (Frieder and Subrahmanyam, 2004).

Islamic events have been identified as triggers for herding behaviour. Investors during Islamic events face equivalent stimuli and social moods, to those in non-Muslim countries, and the corresponding levels of optimism or pessimism, may affect investors' decision-making including through herding responses (Prechter, 1985, 1999; Al-Hajieh *et al.*, 2011; Gavriilidis *et al.*, 2016).

As with seasonal anomalies, Ramadan, the biggest Muslim festival globally, has been the focus of most investigations. Positive mood associated with Ramadan was linked to abnormal market returns in most Middle Eastern countries, during the period from 1992-2007 Al-Hajieh *et al.* (2011). While Hussain (1998) found no significant changes in mean returns during Ramadan, volatility declined significantly in the Pakistani equity market.

During Eid-ul-Fitr and Eid-ul-Adha, most Muslims are more optimistic and feel a sense of social identity and solidarity which may impact their decision-making facilitating enhanced trading activities and increasing the risk of herding. As Frieder and Subrahmanyam (2004) found with Jewish events, joyous festivals facilitate trading in risky assets as a result of the prevailing optimism reduces risk aversion among investors. Ashoura, according to Al-Ississ (2010), is dominated by negativity, especially for Shi'a Muslims.

A study by Gavriilidis *et al.* (2016) was the first to look at the influence of Islamic events from a behavioural perspective. They examined seven countries where Islam is the majority religion (Bangladesh, Egypt, Indonesia, Malaysia, Morocco, Pakistan, and Turkey) and attempted to link market fluctuations with the effects of herding during Ramadan. They found that herding effects were greater on Ramadan days compared to non-Ramadan days in most of the sample markets, an outcome they linked to the prevalent social mood. No other religious festivals were studied and results from the Saudi Arabian stock market were not reported. Yousaf *et al.* (2018) also looked at the impact of Ramadan on herding behaviour in the Pakistani stock market and found no evidence of herding during Ramadan, up and down market, as well as during the 2007-2008 financial crisis. Evidence of herding is found during low trading volume days and the 2005, 2006 and 2007 periods.

4.1.6 Domestic and international market conditions

While seasonal anomalies and religious mood effects have been shown to influence investor behaviour, clearly there are many other factors which might potentially do the same and lead to skewed decision making. To understand religious effects it is important,

therefore, to statistically eliminate known effects of any likely significant scale. Domestic and international market conditions and events are known to affect investor behaviour, but very few studies have investigated the integration between herding behaviour and global factors in the Gulf Cooperation Council (GCC) countries which include Saudi Arabia.

Numerous studies have attempted to explain the integration of the GCC financial markets with world markets, but generally from the perspective of portfolio diversification. For instance, Hammoudeh and Li (2008) investigated the impact of local, regional and global events on the changes in volatility on five Arabian Gulf stock markets contributing evidence that most GCC financial markets were more affected by major global factors than by local and regional factors. Global factors, such as the 1997 Asian crisis, the collapse of oil prices in 1998 after the crisis, the adoption of the price band mechanism by OPEC in 2000, and the "9/11" attacks on the US consistently impacted the Gulf markets. Sedik and Williams (2011) also tested the impact of global and regional spillovers to GCC financial markets, and their results also suggest that global and regional shocks influence GCC equity markets. Oil prices and the GCC stock markets are integrated, as Arouri and Rault (2012) showed through long-term links between oil prices and the equity markets and Ravichandran and Alkhatlan (2010) through market returns.

Global variables comprised of US stock market performance, the price of oil, the Chicago Board Options Exchange Volatility Index (CBOEVIX), market volatility and crash volatility were found to be important factors that drove herding behaviour in the GCC stock markets including Saudi Arabia. (Balcilar *et al.*, 2013; Balcilar *et al.*, 2014; Balcilar *et al.*, 2017). Thus, it is to be expected that such global market factors may influence the relationship between herding and Islamic events, a situation exacerbated because Saudi Arabia's economy depends heavily on oil and has numerous characteristics which make it unique among emerging market bourses.

4.1.7 Aims and objectives

This essay aims to investigate whether social mood affecting market activities associated with Islamic events leads to herding behaviour in investors in Saudi Arabia's stock market. If herding behaviour does exist in Saudi Arabia, its existence may be more significant on festive event days compared to non-event days, both because communal moods associated with religious festivals have been demonstrated to lead to equivalence

in decision making and thus market anomalies and because Saudi society is more religiously observant than many other Muslim societies.

This study investigates the impact of Ramadan on herding using the same methods, with different objectives and expectations, as Gavriilidis *et al.*, (2016). It includes other Islamic festivals, with different characteristics, specifically Eid-ul-Fitr, Eid-ul-Adha, and Ashoura, which facilitates the investigation of different moods including happiness, sadness and religious, emotional conflict. These religious events are correlated with high levels of social interaction in most Muslim countries, but particularly in Saudi Arabia and previously published work has shown that these events impact investors' mood which may result in herding behaviour.

Since Hussain (1998), investigating the Pakistan stock market, found no significant change in mean returns during Ramadan, but significant declines in volatility, we expect to observe herding during the Eids and on Ashoura and anti-herding during Ramadan. Saunders, 1993, Kamstra *et al.*, 2000 and Lucy and Dowling, 2005 found that negative feelings among investors led to pessimistic judgments about equities which was reflected in negative returns and low equity prices. As a result, we expect little herding during Ashoura compared to Eid's' festivals. Studying the influence of religious experience on herding behaviour in Saudi stock market during Ramadan, Eid-ul-Fitr, Eid-ul-Adha, and Ashoura, with their quite different moods, may be ground breaking, since these occasions may generate different, previously unrecognised impacts on the Saudi stock market. It is to be expected that the extent and nature of herding behaviour would change based on the mood of the Islamic event and the level of trading activities associated with it. Thus, this research expects more herding during the Eids compared to Ashoura. During Eid's days, most Muslims are celebrating and they are more optimistic and happy which may enhance market activities and enhance herding. However, Ashoura days cause some mood depression for Shia⁴⁷ Muslims which leads to negative outlooks and may reduce trading activities in the stock market.

We also expect herding to be absent or reduced during Ramadan, because then investors may be distracted by religious devotion and compulsory practices such as fasting and

⁴⁷ Shi'a Muslims consider this day as a day of sorrow, it is the anniversary of the martyrdom of Hussein Ibn Ali, the grandson of Prophet, at the Battle of Karbala.

forming special prayers. Further, in Ramadan, working hours for employees are decreased thus, market activities are slowed, which will also contribute to reduced herding.

We also investigate whether domestic and international market states have an impact on the association between herding and festive occasions, given the sensitivity of herding to market conditions (see Chang *et al.*, 2000). Hence we statistically control for various international factors and events, such as the Arab Spring and the 2008/2009 financial crisis period, both periods of considerable political instability in the Middle East. We also control for global factors, specifically US investors' sentiment, US market returns and the price of oil and differences in behaviour between large and small stocks portfolios. Domestic market states controlled are the liquidity of the market and market returns. The remainder of this Chapter is organised as follows: Section 4.2 presents the Methods. Section 4.3 presents results and discussion. Finally, Section 4.4 provides the conclusion.

4.2 Methodology

To calculate herding, this study is underpinned by a quantitative approach following Chang *et al.* (2000) (CCK) who improved the Christie and Huang (1995) (CH) method. This method is simple and widely used. It measures herding based on returns dispersion in a portfolio of assets with similar characteristics. Christies and Huang (1995) estimated herding by the Cross-Sectional Standard Deviation of returns (CSSD). They argue that dispersion of returns will be low when herding behaviour exists around the market consensus.

Chang *et al.* (2000) argue that during periods of market stress, the linear association between cross-sectional dispersion of stock returns may no longer hold if investors choose to follow the aggregate market. Thus, there may be non-linear increases or decreases between dispersion and market return. To capture herding, they calculated a measurement of herding based upon the cross-sectional absolute deviation (CSAD) of returns, specified as:

$$CSAD_t = \beta_0 + \beta_i |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t \quad (1)$$

CSAD is calculated as:

$$CSAD_t = \frac{1}{N} \sum_{i=1}^N |R_{i,t} - R_{m,t}| \quad (2)$$

Where: N is the total number of stocks traded on day t in the Saudi Arabian market; $R_{i,t}$ is the entire stock return from individual stocks i on day t ; $R_{m,t}$ is the market average return on day t (an average of the returns of all securities for day t).

The modified approach proposed by Gavriilidis *et al.* (2016) was followed to calculate herding and to test our hypothesis that herding is different during Islamic event days, as opposed to other, non-event, days. First, a dummy variable ($D_{event_Day_{i,t}}$) was constructed and given the value of one during event days and zero during non-event days, then the following calculation was made for each tested event in the Islamic calendar:

$$CSAD_t = \beta_0 + \beta_1 D_{event_Day_{i,t}} |r_{m,t}| + \beta_2 (1 - D_{event_Day_{i,t}}) R_{m,t} + \beta_3 D_{event_Day_{i,t}} r_{m,t}^2 + \beta_4 (1 - D_{event_Day_{i,t}}) R_{m,t}^2 + \varepsilon_3 \quad (3)$$

Where $R_{m,t}$ is the average Saudi Arabian market return on day t (an average of the returns of all securities for day t); $D_{event_Day_{i,t}}$ is dummy a variable that takes the value of 1 during a given Islamic event day and 0 otherwise. Each Islamic event day was tested individually ($D_{Ramadan_1-30_{i,t}}$, $D_{Eid-ul-Fitr_1-14_{i,t}}$, $D_{Eid-ul-Adha_8-20_{i,t}}$ and $D_{Ashoura_1-14_{i,t}}$).

Negative and significant values of β_3 (β_4) indicate herding behaviour within (outside) Islamic event days.

Robustness of the results with the changes in investment style (large vs. small) was tested. Differences may arise due to small traders following the recommendation of analysts' since they may lack access to appropriate experience and be unable to access and process the reliable and relevant information available to large investors. Investment style portfolios were controlled by calculations using the following equations:

$$CSAD_{large,t} = \beta_0 + \beta_1 D_{event_Day_{i,t}} |r_{m,t}| + \beta_2 (1 - D_{event_Day_{i,t}}) R_{m,t} + \beta_3 D_{event_Day_{i,t}} r_{m,t}^2 + \beta_4 (1 - D_{event_Day_{i,t}}) R_{m,t}^2 + \varepsilon_3 \quad (4)$$

$$CSAD_{small,t} = \beta_0 + \beta_1 D_{event_Day_{i,t}} |r_{m,t}| + \beta_2 (1 - D_{event_Day_{i,t}}) R_{m,t} + \beta_3 D_{event_Day_{i,t}} r_{m,t}^2 + \beta_4 (1 - D_{event_Day_{i,t}}) R_{m,t}^2 + \varepsilon_3 \quad (5)$$

Variables are defined as above.

The study then assessed whether the results are robust to changes in variables reflecting Saudi Arabian domestic market conditions. Each domestic factor was measured through a proxy variable as shown in Table 4.1

Table 4.1 Domestic Factors affecting Herding on Islamic Event Days, and proxies

The domestic factors and the proxy variables controlled in this study are shown.

Domestic Factor	Proxy Variable
Market Returns	$R_{m,t}$
Market Liquidity	Price impact measure, using equal weights for all stocks available in a given day. Following Amihud (2002)

Separate calculations of herding were carried out for each domestic factor, the equations for positive and negative (market up or market down) conditions, were as follows:

$$CSAD_t = \beta_0 + \beta_1^{UP} D |R_{m,t}| + \beta_2^{UP} (1 - D) |R_{m,t}| + \beta_3^{UP} D R_{m,t}^2 + \beta_4^{UP} (1 - D) R_{m,t}^2 + \varepsilon_3 \quad (6)$$

$$CSAD_t = \beta_0 + \beta_1^{DOWN} D |R_{m,t}| + \beta_2^{DOWN} (1 - D) |R_{m,t}| + \beta_3^{DOWN} D R_{m,t}^2 + \beta_4^{DOWN} (1 - D) R_{m,t}^2 + \varepsilon_3 \quad (7)$$

The superscripts UP and DOWN represent the market increase or decrease respectively, as measured by the appropriate proxy variable (Table 4.1) for the factor. Other variables are defined as above.

The study then controlled for the effects on differences in herding on Islamic event days of global factors, each global factor was measured through a proxy variable as shown in Table 4.2

Table 4.2 Global Factors affecting Herding on Islamic Event Days

The global factors and the proxy variables controlled in this study are shown.

Global Factor	Proxy Variable
US daily stock market returns	Daily returns of the S&P500 index
US investor sentiment	Chicago Board Options Exchange Volatility Index (CBOEVIX)
The Chicago Board Options Exchange Crude Oil Index	The Chicago Board Options Exchange Crude Oil Index (CBOEOILVIX)
The 2008 Global Financial Crisis	Market returns was calculated before and after the outbreak of the 2008 global financial crisis (i.e. after September 2008)
The Arab Spring	Market returns was calculated before and after the outbreak of the Arab Spring crisis period (from 17 December 2010).

Separate calculations of herding were carried out for each global factor, the equations for positive and negative (market up or market down) conditions, or prior or post the 2008 global Financial Crisis and Arab Spring events were as follows:

$$CSAD_t = \beta_0 + \beta_1^{PROXYUP} D |R_{m,t}| + \beta_2^{PROXYUP} (1 - D) |R_{m,t}| + \beta_3^{PROXYUP} D R_{m,t}^2 + \beta_4^{PROXYUP} (1 - D) R_{m,t}^2 + e_t \quad (8)$$

$$CSAD_t = \beta_0 + \beta_1^{PROXYDOWN} D |R_{m,t}| + \beta_2^{PROXYDOWN} (1 - D) |R_{m,t}| + \beta_3^{PROXYDOWN} D R_{m,t}^2 + \beta_4^{PROXYDOWN} (1 - D) R_{m,t}^2 + e_t \quad (9)$$

The superscripts PROXYUP and PROXYDOWN represent the market increase or decrease (or pre- and post-event) respectively, as measured by the appropriate proxy variable (Table 4.2) for the factor. Other variables defined as above.

Research data was obtained from all listed equities⁴⁸ in the Saudi Tadawul all-share index⁴⁹. The total number of stocks is 175. The Ashoura, Ramadan, Eid-ul-Fitr⁵⁰ and Eid-ul-Adha⁵¹ dummies were created manually using data from the Islamic calendar and the corresponding days were taken from the Gregorian calendar. This matching exercise utilised the lunar calendars for the years covered in this study from the website:

⁴⁸ To avoid any potential survivorship bias, the Saudi companies include all active, dead and suspended companies.

⁴⁹ The Saudi Tadawul all-share index symbol in Datastream is TDWTASI.

⁵⁰ In the Islamic calendar Eid-ul-Fitr is in the month of Shawwal; we include the first two weeks of Shawwal starting from 1st to the 14th.

⁵¹ In the Islamic calendar Eid-ul-Adha is in the month of Dhu al Hijjah, we include two weeks between the 8th and the 20th.

<https://calendar.zoznam.sk>.⁵² The daily equities data were obtained in US dollars from the Thomson-Reuters Datastream database. Data start from 5th October 2005 and continue until 25th February 2016. The daily time series data for the S&P500 index, the CBOEVIX, and the CBOEOILVIX were also obtained from the Thomson-Reuter Datastream database.

4.3 Results and Discussion

Descriptive statistics on the Cross-Sectional Absolute Deviations (CSAD) of returns averaged across days within and outside Islamic events for the Saudi Arabian stock market, during the survey period, are presented in Table 4.3.

The total mean value of CSAD, without controlling for Islamic events is (0.007). The mean value of CSAD on Islamic events days decreases for Ramadan, Eid-ul-Adha, and Eid-ul-Fitr and remains the same during Ashoura. This may be unexpected, since Ashoura is the only event to be considered unambiguously associated with positive emotional responses amongst Muslims. Ashoura CSAD has the highest mean value (0.007), while Ramadan and Eid-ul-Adha have the smallest (0.005).

Annualised mean return values overall are negative (-0.037) and lower during Islamic events days, compared to non-event days, again, except in the case of Ramadan. Ramadan has the highest annualised average return per day at -0.018, and Ashoura the lowest at -0.209. Ashoura is an event which causes negative emotions for some Muslims, particularly Shia's, and that may be reflected in this negative and lowest annualised return (Al-Ississ,2010).

Compared to the mean value of 0.805 for the whole period and all events, the mean liquidity value during Eid-ul-Fitr and Ramadan is higher, at 1.082 and 0.877 respectively (Table 4.3). Liquidity, however, decreases during Eid-ul-Adha and Ashoura to 0.556 and 0.683 respectively.

During the sample period the market seems illiquid during Ramadan. However, Ramadan has the lowest annualised average daily losses at -0.018 and shows an increase in

⁵² We depend on the Islamic calendar dates for the Ramadan, Eid-ul-Fitr and Eid-ul-Adha dates. The Islamic calendar involve twelve lunar Months in a year, and it is used to locate the Islamic events concurrently with the Gregorian calendar. Islamic events are not fixed in the Gregorian calendar as they are lunar (Lee and Hamzah, 2010).

liquidity. Gavriilidis *et al.* (2016) found that trading volumes in some sample countries decreases on Ramadan days. However, based on the relationship between stock returns and stock liquidity, Amihud and Mendelson (1986) report that returns increase in periods of illiquidity. Our results show differences between event and non-event days, and confirm, albeit insignificant, decreases in annual returns on event days for the Saudi market. In Ramadan and on Eid-ul-Fitr days, liquidity is higher but during Ashoura (with the difference being significant at the 5 % level). It is lower. In Eid-ul-Adha, liquidity increases with the difference significant at the 10 % level).

Table 4.3 Descriptive statistics for Domestic Market factors during and outside of Saudi Arabian festivals

Total stock market returns, average stock market returns (represented by $R_{m,t}$), and liquidity were used to represent domestic market factors affected by herding during the Saudi Arabian events of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD) for these factors, in the Saudi Arabian Stock Market between October 2005 - February 2016, are presented.

	Mean	Median	Minimum	Maximum	SD	Observations	Test of differences
CSAD							
Whole Sample	0.007	0.005	0.000	0.057	0.005	2667	
Ashoura	0.007 (0.006)	0.006 (0.005)	0.001 (0.000)	0.015 (0.057)	0.003 (0.004)	114 (2553)	
Ramadan	0.005 (0.006)	0.004 (0.005)	0.000 (0.000)	0.017 (0.057)	0.003 (0.004)	228 (2439)	
Eid ul-Fitr	0.006 (0.006)	0.004 (0.005)	0.000 (0.000)	0.024 (0.057)	0.005 (0.004)	97 (2570)	
Eid-ul-Adha	0.005 (0.006)	0.004 (0.005)	0.000 (0.000)	0.018 (0.057)	0.004 (0.004)	91 (2576)	
$R_{m,t}$							
Whole Sample	-0.037	0.060	-0.051	0.070	0.117	2667	
Ashoura	-0.209 (-0.036)	0.126 (-0.075)	-0.043 (-0.050)	0.019 (0.070)	0.118 (0.118)	114 (2553)	
Ramadan	-0.018 (-0.039)	0.017 (-0.073)	-0.029 (-0.050)	0.027 (0.070)	0.095 (0.119)	228 (2439)	
Eid ul-Fitr	-0.086 (-0.035)	0.006 (-0.062)	-0.045 (-0.050)	0.039 (0.070)	0.158 (0.115)	97 (2570)	
Eid ul-Adha	-0.075 (-0.036)	0.000 (-0.075)	-0.029 (-0.050)	0.017 (0.070)	0.092 (0.118)	91 (2576)	
Liquidity							
Whole Sample	0.805	0.473	0.000	34.3	1.953	2667	
Ashoura	0.683 (0.811)	0.618 (0.467)	0.000 (0.000)	3.621 (34.3)	0.583 (1.992)	114 (2553)	0.000 (0.059)
Ramadan	0.877 (0.799)	0.577 (0.467)	0.000 (0.000)	5.749 (34.3)	0.959 (2.021)	228 (2439)	0.000 (0.299)
Eid-ul-Fitr	1.082 (0.795)	0.417 (0.476)	0.000 (0.000)	30.357 (34.3)	3.198 (1.8904)	98 (2570)	0.000 (0.382)
Eid-ul-Adha	0.556 (0.814)	0.198 (0.479)	0.000 (0.000)	2.686 (34.3)	0.682 (1.982)	91 (2576)	0.000 (0.002)

CSAD is the cross-sectional absolute deviation of returns within (outside) event days. $R_{m,t}$ is the annualised average market return per day within (outside) events days and liquidity is the market liquidity within (outside) events days.

To test for evidence of herding behaviour in the Saudi equity markets during the Islamic events of Ashoura, Ramadan, Eid-ul-Fitr, and Eid-ul-Adha, we calculated differences in market returns on and outside event days using Gavriilidis *et al.* (2016) method, as shown in Equation 3. This calculation was carried out without controlling for any variables reflective of market states either domestically or internationally, to present an overall picture of the impact of Islamic events on herding. Results are shown in Table 4.4.

Table 4.4 shows evidence of herding outside of Ramadan in significantly negative β_4 values. No herding was detected during Ramadan days. Trading activities decreased during the days of Ramadan, compared to non-Ramadan days. This finding is inconsistent with previous research (e.g. Gavriilidis *et al.*, 2016). During Ramadan, trading activities may slow down because Muslim investors may be influenced by Islamic judgments on some of their trading activities. They may also be distracted by religious practices, such as fasting, prayer and otherwise strengthening their relationship with Allah. Table 4.3 shows that the mean liquidity within compared to outside Ramadan days is 0.877 and 0.799 respectively, indicating that there is an impact of Ramadan on trading activities in the Saudi Arabian stock market.

During Eid-ul-Fitr, Eid-ul-Adha, and Ashoura, the results show evidence of herding, however there is also evidence of this behaviour outside of these days, as reflected in significantly negative β_3 and β_4 values). The absolute term β_3 is always larger than β_4 , which indicates that herding in Saudi Arabia is stronger during and not outside Ashoura, Eid-ul-Fitr and Eid-ul-Adha. Previous research which has considered the effects of Eid-ul-Fitr as a seasonal anomaly on several other Muslim countries (e.g. Wong *et al.*, 1990; Ali *et al.*, 2017) has found positive evidence of its impact. Our findings are consistent with research (e.g. Akhter *et al.*, 2015; Majeed *et al.*, 2015) which found either negative or an absence of effects of Eid-ul-Adha on the stock exchanges of some Muslim countries.

Unlike our results, some research (e.g. Chan *et al.*, 1996; McGowan and Jakob, 2010) has, however, failed to detect any evidence for the influence of Eid-ul-Fitr on the Islamic countries' stock markets under consideration. Chowdhury and Mostari (2015) did notice a positive impact of Eid-ul-Adha in the Dhaka stock exchange, but generally research has focussed on the effect of Ashoura on Muslim stock exchanges only as a seasonal anomaly. For example, Al-Ississ (2010) found negative returns when investigating the impact of Ramadan and Ashoura on seventeen Muslim countries and Majeed *et al.* (2015) found abnormal returns in the pre-period of Ashoura when investigating the influence of Islamic calendar events on the Pakistan stock market.

Table 4.4 Estimates of Herding from average Saudi Arabian Market Returns on Event versus Non-event Days

Regression analyses were used to test the differences in values for $CSAD_t$ within / outside Islamic events. Analyses was carried for each Islamic event separately, Results are shown for the Saudi Arabian events of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation ($CSAD_t$) for these events were undertaken for the Saudi Arabian Stock Market during October 2005 - February 2016.

Islamic Event	β_0	t-stat-istic	β_1	t- stat-istic	β_2	t- stat-istic	β_3	t-stat-istic	β_4	t-stat-istic	R ² (%)
Ramadan	0.004 ***	18.66	0.441 ***	3.021	0.556 ***	6.433	-4.907	-0.887	-7.131 **	-1.980	22.48
Eid-ul-Fitr	0.005**	23.17	0.348 *	1.706	0.459 ***	7.366	-18.925 ***	-3.482	-3.837 *	-1.875	20.58
Eid-ul-Adha	0.004 ***	18.66	0.636 ***	2.920	0.551 ***	6.444	-17.009 *	-1.872	-6.996 **	-1.965	22.48
Ashoura	0.004 ***	19.11	0.642 ***	5.404	0.544 ***	6.521	-14.229 ***	-4.718	-6.638 *	-1.896	22.63

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-value measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

$CSAD_t$ was obtained from calculations using the following equation; data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1 D_{event_Day_{i,t}} |r_{m,t}| + \beta_2 (1 - D_{event_Day_{i,t}}) R_{m,t} + \beta_3 D_{event_Day_{i,t}} r_{m,t}^2 + \beta_4 (1 - D_{event_Day_{i,t}}) r_{m,t}^2 + \varepsilon_3.$$

The negative and significant coefficients β_3 (β_4) indicate herding behaviour during (outside) event days.

Previous research has reported that herding may be more pronounced in smaller capitalisation stocks (e.g. Lakonishok *et al.*, 1992; Wermers, 1999). However, our results, shown in Table 4.5, indicate the presence of herding behaviour within Islamic events for both large and small stock portfolios. The coefficient β_3 is negative and significant for Ashoura, Eid-ul-Fitr and Eid-ul-Adha for all investment style portfolios, but not for Ramadan. One possible explanation for greater herding for both small and large stock portfolios during events may be attributable to the cognitive and emotional responses that all investors exhibit during event days, whether they are positive or negative: Baddeley (2010) argues that herd behaviour could be the result of an interaction of cognitive and emotional factors. Intentional herding may just occur in conditions of very limited information (Banerjee, 1992). The results may also be a consequence of unintentional herding during Islamic events days or all stock movements could arise from responses to the same issue, for example if investors sell shares which have lost value to window-dress their portfolios (Lakonishok *et al.*, 1992).

Table 4.5 Estimates of Herding for different Investment Styles (Large and Small Investors)

Regression analyses were used to test if herding values were robust when investment styles varied. Large and small investors were compared. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian events of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD_t) for these events were undertaken for the Saudi Arabian Stock Market during October 2005 - February 2016.

Islamic Event	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_3	t-stat-istic	β_4	t-stat-istic	R2 (%)
Large Investors.											
Ramadan	0.003 ***	17.60	0.322 ***	3.470	0.447 ***	5.771	-1.924	-0.548	-4.257	-1.298	24.37
Eid-ul-Fitr	0.003 ***	18.77	0.705 ***	4.181	0.429 ***	6.173	-16.208 ***	-3.483	-3.347	-1.130	25.02
Eid-ul-Adha	0.003 ***	17.55	0.463 ***	(3.935)	0.442 ***	5.766	-10.909 **	-2.317	-4.134	-1.273	24.32
Ashoura	0.003 ***	18.10	0.470 ***	5.648	0.437 ***	5.875	-10.051 ***	-4.638	-3.795	-1.195	24.58
Small Investors											
Ramadan	0.005 ***	17.89	0.566 ***	2.679	0.674 ***	0.000	-7.209	-0.913	-9.645 **	-2.549	8.44
Eid-ul-Fitr	0.005 ***	21.10	0.387	1.271	0.560 ***	7.916	-22.087 ***	-2.783	-5.829 **	-2.267	16.60
Eid-ul-Adha	0.005 ***	17.96	0.814 **	2.423	0.670 ***	7.238	-24.126 *	-1.668	-9.511 **	-2.546	18.49
Ashoura	0.005 ***	18.24	0.807 ***	4.875	0.662 ***	7.253	-17.302 ***	-4.177	-9.156 **	-2.473	18.53

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

CSAD_t was obtained from calculations using the following equations, where "small" represents market variation arising from small investors and "large" from large investors. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_{large,t} = \beta_0 + \beta_1 D_{event_Day_{i,t}} |r_{m,t}| + \beta_2 (1 - D_{event_Day_{i,t}}) R_{m,t} + \beta_3 D_{event_Day_{i,t}} r_{m,t}^2 + \beta_4 (1 - D_{event_Day_{i,t}}) r_{m,t}^2 + \varepsilon_3.$$

$$CSAD_{small,t} = \beta_0 + \beta_1 D_{event_Day_{i,t}} |r_{m,t}| + \beta_2 (1 - D_{event_Day_{i,t}}) R_{m,t} + \beta_3 D_{event_Day_{i,t}} r_{m,t}^2 + \beta_4 (1 - D_{event_Day_{i,t}}) r_{m,t}^2 + \varepsilon_3.$$

The negative and significant coefficients β_3 (β_4) indicate herding behaviour during (outside) event days.

Results for the impact of domestic factors on market returns exhibited in the association between herding and Islamic events (calculated using Equations (6) and (7)) are reported in Table 4.6.

Interestingly, stronger herding, as shown by the absolute term β_4 larger than β_3 , is observed both during and outside of Ramadan during down-market days. Significant herding is also found on Eid-ul-Fitr and Eid-ul-Adha during both up- and down-market days but is stronger inside Eid festival days as the value in absolute term of β_3 is larger than that of β_4 .

There is an association between herding and overall positive market returns. Gavriilidis *et al.*, (2016) argue that herding would be strong during days that are correlated with positive mood, such as up market days. Our finding supports Gavriilidis *et al.* for Eid-ul-Adha. Herding during Eid-ul-Adha occurs on days of both up and down market returns, but the values of β_3 are larger in absolute terms on up- compared to down-market days.

There is also herding during and outside of Ashoura on down-market days only, but herding is stronger during Ashoura as the value in absolute term of β_3 is larger than that of β_4 . The results show strong evidence of herding especially during down-market days, however, previous research (e.g. Christie and Huang, 1995; Change *et al.*, 2000; Gleason, Mathur and Peterson, 2004), found that dispersions of security return increases in up-markets more than in down-markets. Our results are consistent with Houda and Mohamed (2013) and Sharma *et al.* (2015) who found evidence of asymmetric herding with strong herding behaviour in down markets.

Table 4.6 Estimates of Herding with Domestic Market Returns Controlled

Regression analyses were used to test if herding values were robust when variation from market returns is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD_t) for these events were undertaken for the Saudi Arabian Stock Market during October 2005 - February 2016.

	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_3	t-stat-istic	β_4	t-stat-istic	R2 (%)
Market Returns Up											
Ramadan	0.005 ***	25.14	0.346 ***	3.56	0.420 ***	5.396	-4.671	-1.266	-2.789	-1.222	16.93
Eid-ul-Fitr	0.005	28.95	0.291	1.407	0.353 ***	5.474	-16.331 ***	-3.029	-0.530	-0.332	15.72
Eid-ul-Adha	0.005 ***	24.91	0.930 ***	0.000	0.412 ***	5.324	-46.550 ***	-2.775	-2.641	-0.243	17.02
Ashoura	0.005 ***	24.95	0.407***	2.719	0.408 ***	5.238	7.803	0.883	-2.595	-1.137	16.90
Market Returns Down											
Ramadan	0.004 ***	22.97	0.573 ***	4.666	0.743 ***	11.10	-8.344 *	-1.788	-13.448 ***	-6.341	28.99
Eid-ul-Fitr	0.004 ***	22.46	0.331 *	1.760	0.589 ***	7.401	-20.821 ***	-4.492	-8.337 ***	-3.014	25.64
Eid-ul-Adha	0.004 ***	23.07	0.583 ***	0.000	0.742 ***	0.000	-13.181 ***	-3.037	-13.371 ***	-6.287	29.04
Ashoura	0.004 ***	23.02	0.686 ***	8.683	0.729 ***	10.74	-15.291 ***	-8.004	-12.791 ***	-5.623	29.10

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

CSAD_t was obtained from calculations using the following equations, where "UP" represents variation arising from domestic market gains and "Down" from market losses. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{UP} D |R_{m,t}| + \beta_2^{UP} (1 - D) |R_{m,t}| + \beta_3^{UP} D R_{m,t}^2 + \beta_4^{UP} (1 - D) R_{m,t}^2 + \varepsilon_3$$

$$CSAD_t = \beta_0 + \beta_1^{Down} D |R_{m,t}| + \beta_2^{Down} (1 - D) |R_{m,t}| + \beta_3^{Down} D R_{m,t}^2 + \beta_4^{Down} (1 - D) R_{m,t}^2 + \varepsilon_3$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

Table 4.7 also presents results calculated using Equations (6) and (7) but shows the outcome of controlling domestic variation in market liquidity on the association between herding in Ramadan, Ashoura, Eid-ul-Fitr, and Eid-ul-Adha.

During decreased market liquidity, herding is detected outside Eid-ul-Fitr only, but both during and outside Eid-ul-Adha. It appears stronger on Eid-ul-Adha days, β_3 in absolute terms is significantly greater than β_4 . For the remaining Islamic events, herding is only detected outside events days during decreasing market liquidity.

This finding contradicts Gavriilidis *et al.*, (2016) as there is no evidence of herding within or outside of Ramadan on days of either increasing or decreasing market liquidity. Moreover, market liquidity does not seem to play an important role on the relationship between herding and Islamic events, however this may be because different sample and time-periods were used. Our sample included only the stocks listed on the Saudi Arabian stock market, however, Gavriilidis *et al.* (2016) used data from Bangladesh, Egypt, Indonesia, Malaysia, Morocco, Pakistan and Turkey and this diversity may have been influential. Investors in these countries will have different characteristics and be impacted by different factors compared to the Saudi investors and not just by market liquidity. We used the method proposed by Amihud (2002) to control for market liquidity, however, Gavriilidis *et al.* (2016) used trading volume and its expression across thousands of stocks: the differences in method may also, therefore, be influential.

Table 4.7 Estimate of Herding with Domestic Market Liquidity Controlled

Regression analyses were used to test if herding values were robust when variation from market liquidity is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD_t) for these events were undertaken for the Saudi Arabian Stock Market during October 2005 - February 2016.

	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_3	t-stat-istic	β_4	t-stat-istic	R2 (%)
Liquidity Up											
Ramadan	0.004 ***	18.56	0.152	1.453	0.401 ***	4.414	5.556	1.336	-3.764	-1.077	19.85
Eid-ul-Fitr	0.005 ***	24.47	0.399 **	2.512	0.324 ***	5.025	0.324 ***	5.025	-16.799 ***	-4.261	19.12
Eid-ul-Adha	0.004 ***	18.57	0.290 *	1.848	0.399 ***	4.457	-3.305	-0.572	-3.665	-1.064	19.68
Ashoura	0.004 ***	19.45	0.533 ***	6.523	0.389 ***	4.617	-11.467	-0.406	-3.152	-0.963	20.02
Liquidity Down											
Ramadan	0.004 ***	16.63	0.802 ***	5.047	0.874 ***	9.743	-4.940	-0.373	-14.260	-3.410	31.50
Eid-ul-Fitr	0.004 ***	17.07	0.289	0.661	0.749 ***	8.619	-27.329	-1.126	-9.887 ***	-2.710	27.19
Eid-ul-Adha	0.004 ***	16.72	2.135 ***	4.054	0.878 ***	9.902	-155.524 **	-2.571	-14.290 ***	-3.437	31.18
Ashoura	0.004 ***	16.54	1.034 ***	3.357	0.880 ***	9.853	-36.747	-1.307	-14.369 ***	-3.439	31.51

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

CSAD_t was obtained from calculations using the following equations, where "UP" represents variation arising from domestic market liquidity gains and "Down" from market liquidity losses. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{UP} D |R_{m,t}| + \beta_2^{UP} (1 - D) |R_{m,t}| + \beta_3^{UP} D R_{m,t}^2 + \beta_4^{UP} (1 - D) R_{m,t}^2 + \varepsilon_3$$

$$CSAD_t = \beta_0 + \beta_1^{Down} D |R_{m,t}| + \beta_2^{Down} (1 - D) |R_{m,t}| + \beta_3^{Down} D R_{m,t}^2 + \beta_4^{Down} (1 - D) R_{m,t}^2 + \varepsilon_3$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

Table 4.8 presents results calculated using Equations (8) and (9) but shows outcomes following controlling for the daily movements of the US market (indicated by the S&P500 index) on the association between herding in Ramadan, Ashoura, Eid-ul-Fitr, and Eid-ul-Adha.

Evidence is shown of herding during and outside Ramadan (reflected in significantly negative β_3 and β_4 values). The absolute value of β_3 is larger than β_4 , which suggests that herding grows stronger in Ramadan during positive US market days. We also show that herding is more intense during within Eid-ul-Fitr, this is the case on both up and down US market days. Significant herding occurs outside Eid-ul-Adha days when the US market is up. Herding is also significant outside Ashoura during up US market days but during Ashoura on down US market days. Gavriilidis *et al.*, (2016) also tested the impact of the US market on the relationship between Ramadan and herding and found evidence of herding within Ramadan for most of their sample markets. They found herding significance during both up- and down-market days in Bangladesh, Morocco and Turkey, in just down-market days for Egypt and Malaysia and in just up-market days for Indonesia. Although they also found evidence of herding outside Ramadan for some markets, it was always more intense during Ramadan.

Table 4.8 Estimate of Herding with US Market Returns Controlled

Regression analyses were used to test if herding values were robust when variation from US Market Returns, a global market factor, is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation ($CSAD_t$) for these events were undertaken for the US Stock Market during October 2005 - February 2016. The model is estimated for days of positive (“up US market days”) and negative (“down US market days”) US market returns.

	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_3	t-stat-istic	β_4	t-stat-istic	R2 (%)
US Market Returns Up											
Ramadan	0.004 ***	22.93	0.561 ***	5.356	0.626 ***	6.765	-10.102 **	-2.109	-9.983 **	-2.571	22.74
Eid-ul-Fitr	0.005 ***	29.45	0.240	1.165	0.505 ***	6.709	-19.222 ***	-3.656	-5.498 *	-1.850	20.40
Eid-ul-Adha	0.004 ***	22.50	0.689 ***	4.430	0.614 ***	6.743	0.019	0.117	-9.682 **	-2.536	22.71
Ashoura	0.004 ***	22.67	0.406 **	2.414	0.618 ***	6.673	15.167	1.025	-9.830 **	-2.540	22.71
US Market Returns Down											
Ramadan	0.005 ***	18.59	0.309 **	2.570	0.489 ***	4.804	0.288	0.064	-5.291	-1.362	21.21
Eid-ul-Fitr	0.005 ***	24.06	0.441 **	2.418	0.410 ***	5.637	-19.390 ***	-4.464	-2.731	-1.025	20.21
Eid-ul-Adha	0.005 ***	18.46	0.353 **	2.505	0.491 ***	4.856	-5.830	-1.121	-5.275	-1.368	21.12
Ashoura	0.005 ***	19.69	0.593 ***	6.021	0.480 ***	5.093	-13.506 ***	-5.727	-4.659	-1.256	21.77

*, **, *** indicate the result is significant at $P = 0.1, 0.05,$ and $0.01,$ respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R^2 (coefficient of determination) indicates how close the data are to the fitted regression line.

$CSAD_t$ was obtained from calculations using the following equations, where "UP" represents variation arising from US market return gains and "Down" from US market return losses. $R_{m,t}$ refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{UP} D |R_{m,t}| + \beta_2^{UP} (1 - D) |R_{m,t}| + \beta_3^{UP} D R_{m,t}^2 + \beta_4^{UP} (1 - D) R_{m,t}^2 + \varepsilon_3$$

$$CSAD_t = \beta_0 + \beta_1^{Down} D |R_{m,t}| + \beta_2^{Down} (1 - D) |R_{m,t}| + \beta_3^{Down} D R_{m,t}^2 + \beta_4^{Down} (1 - D) R_{m,t}^2 + \varepsilon_3$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

Table 4.9 presents results calculated using Equations (8) and (9) but shows outcomes following controlling for the daily movements of daily changes of the US investors' sentiment index (CBOEVIX) on the association between herding in Ramadan, Ashoura, Eid-ul-Fitr, and Eid-ul-Adha.

Herding occurred outside Ramadan on days when the CBOEVIX increased or decreased. There is also intense herding during Eid-ul-Fitr, reflected in the larger absolute term of β_3 compared to β_4), during increasing CBOEVIX days. Herding outside Eid-ul-Fitr is found only on decreasing CBOEVIX days. Herding is observed both on and outside Ashoura days, on increasing CBOEVIX-days, but was stronger on Ashoura days because the absolute term of β_3 is larger than β_4 . Herding is also indicated, to a lesser extent, inside and outside Ashoura during decreasing VIX-days. This finding contradicts Gavriilidis *et al.*, (2016) who found strong evidence of herding outside of Islamic events but no evidence for it in Ramadan on up-VIX⁵³ days. When VIX is up, there is a rise in “fear” among investors in the US. Strong evidence of herding also is found during Eid-ul-Fitr and Eid-ul-Adha. Previous research (Chiang *et al.*, 2013; Philippae *et al.*, 2013; Gavriilidis *et al.*, 2016) also provide evidence for the importance of increasing VIX values for motivating herding intentionally.

⁵³ Up-VIX predicts higher volatility during the next 30 days.

Table 4.9 Estimate of Herding with US Market CBOEVIX Controlled

Regression analyses were used to test if herding values were robust when variation from US Market Chicago Board Options Exchange Volatility Index (CBOEVIX), a global market factor, is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD_t) for these events were undertaken for the US Stock Market during October 2005 - February 2016. The model is estimated for days of positive and negative US Market CBOEVIX returns.

	β_0	t-stat- istic	β_1	t-stat- istic	β_2	t-stat- istic	β_3	t-stat- istic	β_4	t-stat- istic	R2 (%)
CBOEVIX Up											
Ramadan	0.004 ***	30.36	0.276 ***	3.838	0.617 ***	13.41	0.653	0.221	-11.936 ***	-6.075	33.40
Eid-ul-Fitr	0.004 ***	30.24	0.387 **	2.276	0.414 ***	0.414	-18.972 ***	-4.226	-4.639 *	-1.782	26.73
Eid-ul-Adha	0.004 ***	30.80	0.288 ***	6.777	0.611 ***	13.25	0.062	1.579	-11.707 ***	-5.948	33.06
Ashoura	0.004 ***	29.54	0.834 ***	11.65	0.588 ***	11.65	-18.685 ***	-10.45	-10.891 ***	-4.869	33.01
CBOEVIX Down											
Ramadan	0.005 ***	22.46	0.647 ***	5.223	0.601 ***	7.110	-6.523	-1.022	-5.687 *	-1.784	21.43
Eid-ul-Fitr	0.005 ***	23.73	0.072	0.165	0.552 ***	7.300	-6.428	-0.328	-4.464 *	-1.661	19.86
Eid-ul-Adha	0.005 ***	22.50	2.078 ***	3.740	0.600 ***	7.188	-144.619 **	-2.569	-5.636 *	-1.788	21.81
Ashoura	0.005 ***	22.23	0.557 ***	3.121	0.612 ***	7.142	-16.781	-1.054	-5.923	-1.823	21.54

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

CSAD_t was obtained from calculations using the following equations, where "UP" represents variation arising from US CBOEVIX gains and "Down" from US CBOEVIX losses. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{UP} D |R_{m,t}| + \beta_2^{UP} (1 - D) |R_{m,t}| + \beta_3^{UP} D R_{m,t}^2 + \beta_4^{UP} (1 - D) R_{m,t}^2 + \varepsilon_3$$

$$CSAD_t = \beta_0 + \beta_1^{Down} D |R_{m,t}| + \beta_2^{Down} (1 - D) |R_{m,t}| + \beta_3^{Down} D R_{m,t}^2 + \beta_4^{Down} (1 - D) R_{m,t}^2 + \varepsilon_3$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

Table 4.10 presents results calculated using Equations (8) and (9) but shows outcomes following controlling for the daily movements of daily changes of the US investors' crude oil index (CBOEOILVIX) on the association between herding in Ramadan, Ashoura, Eid-ul-Fitr, and Eid-ul-Adha.

Herding is significant outside Ramadan when the CBOEOILVIX is increasing. It is observed during and outside Ramadan when the CBOEOILVIX is decreasing but is stronger during Ramadan because the value in absolute terms of β_3 is larger than that of β_4 . Our findings indicate that herding during Eid-ul-Fitr is only related to a rising CBOEOILVIX but that during Ashoura it occurs when the CBOEOILVIX is both increasing and decreasing. However, no herding is evidenced during Eid-ul-Adha and it is only found outside Eid-ul-Adha when the CBOEOILVIX is increasing.

This research is the first that controls for the effects of variation in the CBOEOILVIX on the relationship between herding and Islamic events in the Saudi Arabian stock market. The Saudi Arabian economy depends on oil and so an impact of oil on investor's behaviour is to be expected. Previous research such as Gavriilidis *et al.* (2016) only considers the CBOEVIX when treating global factors, since it focuses on non or small oil exporting economies, despite finding that the CBOEVIX plays a critical role in initiating herding behaviour during Ramadan in some Islamic stock markets.

Table 4.10 Estimate of Herding with US Market CBOEOILVIX Controlled

Regression analyses were used to test if herding values were robust when variation from US Market Chicago Board Options Exchange Volatility Crude Oil Index (CBOEOILVIX), a global market factor, is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD_t) for these events were undertaken for the US Stock Market during October 2005 - February 2016. The model is estimated for days of positive market days and negative market days for the US Market CBOE Crude Oil returns.

	β_0	t-stat- istic	β_1	t-stat- istic	β_2	t-stat- istic	β_3	t-stat- istic	β_4	t-stat- istic	R2 (%)
CBOEOILVIX Up											
Ramadan	0.004 ***	32.39	0.205 ***	2.660	0.531 ***	11.81	3.283	0.962	-9.389 ***	-4.413	30.90
Eid-ul-Fitr	0.005 ***	30.01	0.392 **	2.105	0.355 ***	5.713	-17.667 ***	-3.745	-2.723	-0.912	26.01
Eid-ul-Adha	0.004 ***	31.92	0.255 *	1.724	0.524 ***	11.57	0.380	0.042	-9.141 ***	-4.311	30.51
Ashoura	0.004 ***	31.38	0.653 ***	7.539	0.502 ***	10.28	-14.707 ***	-7.701	-8.225 ***	-3.464	30.60
CBOEOILVIX Down											
Ramadan	0.003 ***	40.47	0.470 ***	2.638	0.483 ***	12.76	-10.427 ***	-3.389	-5.544 **	-2.353	30.33
Eid-ul-Fitr	0.004 ***	38.13	-0.404 ***	-3.125	0.235 ***	4.262	78.954 ***	3.932	8.475 *	1.942	23.57
Eid-ul-Adha	0.003 ***	40.54	0.334 ***	2.865	0.474 ***	11.02	-4.125	-1.031	-4.344	-1.422	30.64
Ashoura	0.004 ***	40.07	0.421 ***	4.702	0.465 ***	10.20	-4.027**	-2.165	-3.780	-1.034	30.48

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

CSAD_t was obtained from calculations using the following equations, where "UP" represents variation arising from US CBOEOILVIX gains and "Down" from US CBOEOILVIX losses. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{UP} D |R_{m,t}| + \beta_2^{UP} (1 - D) |R_{m,t}| + \beta_3^{UP} D R_{m,t}^2 + \beta_4^{UP} (1 - D) R_{m,t}^2 + \varepsilon_3$$

$$CSAD_t = \beta_0 + \beta_1^{Down} D |R_{m,t}| + \beta_2^{Down} (1 - D) |R_{m,t}| + \beta_3^{Down} D R_{m,t}^2 + \beta_4^{Down} (1 - D) R_{m,t}^2 + \varepsilon_3$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

Table 4.11 presents results calculated using Equations (8) and (9) but shows outcomes following controlling for the effect of the global financial crisis, that began in September 2008, on the association between herding in Ramadan, Ashoura, Eid-ul-Fitr, and Eid-ul-Adha.

There is significant herding during and outside Eid-ul-Adha pre-2008, herding is stronger during Eid-ul-Adha because the value in absolute terms of β_3 is larger than that of β_4 . Herding is also observed during Ashoura only pre-2008, as shown in a significant negative β_3 value. Herding is not observed during Islamic events post the 2008 crisis period, only outside events days.

Evidence of herding is, however, pronounced outside Islamic events days and Gavriilidis *et al.* (2016) also found evidence of significant herding only outside Ramadan in the Egyptian, Malaysian and Pakistani markets. This finding may be attributable to a lower level of trading activity during Islamic events, Al-Khazali (2014) found that after the 2008 financial crisis the Ramadan effect on stock return scaled back substantially in a majority of Muslim markets for the same reason.

Table 4.11 Estimate of Herding with effects of the 2008 Global Financial Crisis Controlled

Regression analyses were used to test if herding values were robust when variation before and after the 2008 Global Financial Crisis, a global market factor, is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSAD_t) for these events were undertaken for the US Stock Market during October 2005 - February 2016. The model estimates for variability between market returns before (pre-) and after (post-) the crisis.

	β_0	t-stat- istic	β_1	t-stat- istic	β_2	t-stat- istic	β_3	t-stat- istic	β_4	t-stat- istic	R2 (%)
Pre-crisis											
Ramadan	0.008 ***	13.19	0.306	1.465	0.373 ***	3.106	2.612	0.281	-3.368	-0.912	10.26
Eid-ul-Fitr	0.008 ***	15.66	0.202	0.419	0.289 ***	2.850	-6.594	-0.312	-1.401	-0.484	8.7
Eid-ul-Adha	0.008 ***	13.19	1.030 *	1.906	0.377 ***	3.140	-71.833 ***	-1.449	-3.404 ***	-0.922	10.33
Ashoura	0.008 ***	13.74	0.469 ***	2.991	0.375 ***	3.367	-12.168 ***	-3.254	-2.863	-0.860	11.02
Post-crisis											
Ramadan	0.003 ***	31.91	0.240 ***	2.960	0.455 ***	9.351	3.993	1.218	-5.711 **	-2.406	31.82
Eid-ul-Fitr	0.004 ***	30.23	-0.335 ***	-3.857	0.358 ***	5.464	28.783 ***	6.760	-1.249 **	-2.365	29.92
Eid-ul-Adha	0.003 ***	31.43	0.186 ***	2.795	0.450 ***	8.993	0.960	0.394	-5.317 **	-2.097	31.84
Ashoura	0.003 ***	31.67	0.367 ***	2.914	0.448 ***	9.106	-2.994	-0.248	-5.391 **	-2.249	31.52

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

CSAD_t was obtained from calculations using the following equations, where "PRIOROUTBREAK" represents variation arising from US markets prior to the 2008 Global Financial Crisis and " PRIOROUTBREAK " from variation after the crisis. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{PRIOROUTBREAK} D |R_{m,t}| + \beta_2^{PRIOROUTBREAK} (1 - D) |R_{m,t}| + \beta_3^{PRIOROUTBREAK} D R_{m,t}^2 + \beta_4^{PRIOROUTBREAK} (1 - D) R_{m,t}^2 + e_t$$

$$CSAD_t = \beta_0 + \beta_1^{POSTOUTBREAK} D |R_{m,t}| + \beta_2^{POSTOUTBREAK} (1 - D) |R_{m,t}| + \beta_3^{POSTOUTBREAK} D R_{m,t}^2 + \beta_4^{POSTOUTBREAK} (1 - D) R_{m,t}^2 + e_t$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

Table 4.12 presents results calculated using Equations (8) and (9) but shows outcomes following controlling for the effect of the Arab Spring uprising that began in on 17 December 2010, on the association between herding in Ramadan, Ashoura, Eid-ul-Fitr, and Eid-ul-Adha. It is not just in the field of business finance that insufficient research has been conducted to clarify the complex phenomenon of the Arab Spring, its associated political uncertainty and the economic consequences for stock market volatility and depressed confidence among foreign investors. Our study seeks to partially fill that gap by shedding light on the effects of the Arab Spring on herding behaviour in the Saudi Arabian stock market.

Herding was pronounced and significant during Eid-ul-Fitr only prior to the outbreak of the Arab Spring crisis, as shown by a significantly negative β_3 value. There is, conversely, herding during Ashoura but only prior to the Arab Spring. Outside of Ramadan, Eid-ul-Adha, and Ashoura there is herding, but only after the Arab Spring period.

Table 4.12 Estimate of Herding with effects of the 2010 Arab Spring Controlled

Regression analyses were used to test if herding values were robust when variation from before and after the 2010 Arab Spring, a global market factor, is controlled. Analysis was carried for each Islamic event separately, Results are shown for the Saudi Arabian festivals of Ashoura, Ramadan, Eid-ul-Fitr and Eid ul-Adha. Calculations of Cross-sectional Absolute Deviation (CSADt) for these events were undertaken for the US Stock Market during October 2005 - February 2016. The model is estimated for variability between market returns before (pre-) and after (post-) the Arab Spring.

	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_3	t-stat-istic	β_4	t-stat-istic	R ² (%)
Pre-Arab Spring											
Ramadan	0.006***	13.06	0.343***	1.818	0.511***	4.511	-2.839	-0.403	-6.553	-1.604	16.51
Eid-ul-Fitr	0.006***	16.02	0.518***	2.784	0.410***	4.863	-23.240***	-4.779	-3.392	-1.188	15.46
Eid-ul-Adha	0.006***	13.04	0.750**	2.196	0.505***	4.478	-31.545	-1.517	-6.412	-1.579	16.34
Ashoura	0.006***	13.43	0.675***	5.541	0.496***	4.598	-15.858***	-5.207	-5.937	-1.517	16.73
Post-Arab Spring											
Ramadan	0.004***	30.85	0.259***	2.600	0.442***	8.812	2.869	0.723	-5.895**	-2.390	30.53
Eid-ul-Fitr	0.004***	28.80	-0.325***	-3.131	0.341***	4.832	25.248***	3.178	-1.168	-0.317	28.03
Eid-ul-Adha	0.004***	30.33	0.192**	2.193	0.439***	8.409	0.485	0.152	-5.576**	-2.101	30.61
Ashoura	0.004***	30.60	0.410***	3.571	0.438***	8.562	-7.391	-0.669	-5.673**	-2.269	30.35

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R2 (coefficient of determination) indicates how close the data are to the fitted regression line.

CSADt was obtained from calculations using the following equations, where "PRIOROUTBREAK" represents variation arising from US markets prior to the 2010 Arab Spring and " PRIOROUTBREAK " from variation after the Arab Spring. R_{m,t} refers to the market's average return. Data was sourced as described in methods.

$$CSAD_t = \beta_0 + \beta_1^{PRIOROUTBREAK} D |R_{m,t}| + \beta_2^{PRIOROUTBREAK} (1 - D) |R_{m,t}| + \beta_3^{PRIOROUTBREAK} D R_{m,t}^2 + \beta_4^{PRIOROUTBREAK} (1 - D) R_{m,t}^2 + e_t$$

$$CSAD_t = \beta_0 + \beta_1^{POSTOUTBREAK} D |R_{m,t}| + \beta_2^{POSTOUTBREAK} (1 - D) |R_{m,t}| + \beta_3^{POSTOUTBREAK} D R_{m,t}^2 + \beta_4^{POSTOUTBREAK} (1 - D) R_{m,t}^2 + e_t$$

The negative and significant coefficient β_3 (β_4) indicate herding behaviour during (outside) event days.

4.4 Conclusions

This research considers the Saudi Arabian stock market as a useful research setting for this study for the following reasons. First, no study has examined the impact of Islamic events on herding behaviour in the Saudi context. Second, Saudi Arabia is one of the major Islamic countries and the faith is prominent here.

Festive months in the Islamic calendar are identified (e.g. Prechter, 1999 and Al-Hajieh *et al.*, 2011) as environments that may potentially facilitate herding behaviour in the stock market. This may be the case because investors' behaviour during such events is associated with optimism or pessimism which may extend to investment decision making.

This study is the first to consider the effects of short Islamic events, from the behavioural perspective, on the Saudi Arabian stock market. Saudi Arabia is a publicly devout nation and, during festivals, levels of social interaction increase and the popular mood may be either positive or negative: it is such phenomena that may facilitate herding. We explicitly examine if Eid-ul-Fitr, Eid-ul-Adha and Ashoura, in comparison to Ramadan, impact on Saudi investors' behaviour and thereby encourage herding in the stock market. Most previous research has concentrated instead on the impact of the Islamic calendar on stock returns and volume as seasonal anomalies (e.g. Husain, 1998; Alper and Aruoba, 2001; Seyyed *et al.*, 2005 and Ramezain, 2013).

Our findings contrast those of Gavriilidis *et al.* (2016), as we observed herding behaviour during Eid-al-Fitr, Eid-al-Adha and Ashoura but found no evidence of herding during Ramadan. This result is consistent with Yousaf *et al.* (2018). The evidence we found for herding during these event days was observed following inclusion of several controls for variables widely considered as reflective of market status. Variables controlled relevant to domestic market status included liquidity, market returns and investment style and those relevant to international market status were US market returns, US investors' sentiment, Crude Oil CBOE index, the global financial crisis and the Arab Spring. The strongest evidence of herding was observed when domestic market returns, especially down-market returns, were controlled.

Overall, the impacts of international effects on Saudi investors tended to lead to herding outside of the studied event days. However, herding significance during the Islamic holy days did show some variable dependent influence, for example, when US market returns were controlled, herding was observed during both Ramadan and Eid-al-Fitr, leading to

higher US market returns. Furthermore, during Eid-al-Fitr and Ashoura, US market returns were down. When controls for the effects of the CBOEVIX were included in our model, herding during Eid-al-Fitr and Ashoura occurred on days when the CBOEVIX rose but herding during Eid-al-Adha decreased on days when the CBOEVIX fell.

This research is the first to control for variables associated with the international equities market on the relationship between all of the Muslim holy days and herding behaviour in the Saudi Arabian stock market, as effected by investor mood. Controlling for the post-2008 financial crisis and the Arab Spring period also resulted in strong evidence for herding at times outside of the Islamic holy days. These findings support previous studies (e.g. Galariotis *et al.*, 2015; Gavriilidis *et al.*, 2016) which report that herding is both country and period specific and like Gavriilidis *et al.* (2016) found it to be mood related.

It may be difficult to determine exactly what influences investors' mood, because their national characteristics are not equal. Some investors may be influenced by religious occasions while others are not. They might also be variously impacted by other factors, such as weather and holidays. This may explain why our findings contradict those of Gavriilidis *et al.* (2016) in regard to Ramadan. Future research might, therefore, use different samples, such as from MENA countries or the GCC. There is also a gap in the literature when considering herding behaviour in western countries, such as the UK and US, from cultural perspectives. It is necessary to consider culture to fully understand the effects of different moods associated with dissimilar cultural events on behavioural biases such as herding. Our understanding would be further enhanced by more research into the effects of other financial anomalies, such as weather and holidays. Future research may also usefully consider testing the role of Islamic events in driving non-fundamental herding. To the best of our knowledge, this study is the first that covers all major Muslim events and studies their impact on herding behaviour in the Saudi stock market. These findings are in line with the social norm theory with a focus on religious social norms. Akerlof (1980) and Romer (1984) argued that under the social norm theory, individuals follow the behavioural norms, beliefs and or/ actions of other community members.

These results make a useful contribution to understanding the role of Islamic events on Islamic stock market behaviour and may be of interest to market regulators seeking to understand the main contributors to market instability in Saudi Arabia, a major Islamic country. Thus, it might enable regulators to form expectations about market direction during these Islamic events days, to inform their right decision making. By providing evidence of the consequences of the Islamic calendar on the Saudi Arabia equity market,

investors in Saudi Arabia may also be helped in forming effective investment decisions and creating optimal investment portfolios.

Since we found inconclusive evidence for herding in the Saudi markets when global factors were included in these analyses, notably US market returns, US investors' sentiment, Crude Oil CBOE index, in the next Chapter we consider in greater detail the presence of spill-over effects, both regionally, using data from the GCC countries and globally using data from US markets. It is important to understand if there are interactions between markets and, if so, which are the most influential. Firstly, therefore, we looked at how herding in individual GCC countries varied during three notable events, the 2008 global financial crisis, the 2010 Arab Spring and the recent oil crisis of 2014 and secondly we looked at spill-over between these countries and into these countries from the US markets, using the same notable global and regional market events as previously, in order to obtain corroborative as well as more detailed analysis.

Chapter 5: Herding spill-over effect from the Saudi Arabian Stock Market to the GCC Stock Markets.

We investigate regional and global herding spill-over in the Gulf Cooperation Council (GCC) equity markets. We focus on herding spill-over effect from Saudi Arabian stock market to the GCC stock markets. In order to investigate this relationship, we measure herding behaviour for all the GCC stock markets. It is also interesting to test whether herding in the GCC equity markets is regionally dominated by the Saudi equity market or is internationally integrated, so some international factors are covered as a result in this study (e.g. WTI AND S&P500). Our results show significant and uniform herding behaviour that, in all the GCC markets, persists across various independent time periods. This persistence stays even if we control well known factor structures in stock returns. Importantly, we find that the cross-market herding spill overs originate from the Saudi market and transfer to the rest of neighbouring regional stock markets, whereas the role of the US market on herding in GCC markets is found to be negligible and insignificant. Therefore, we conclude that behavioural inefficiencies in the GCC equity markets are regional in nature and sentiment-based trading in US has essentially no effect on it.

5.1 Introduction

Herding markets in finance refer to market swings that arise from investors' correlated decisions, while ignoring their own information, following others assumed to more informed investors/institutions. As a result, equity prices deviate from their fair values, exhibit price momentum and excess volatility. These trends reduce market quality, give rise to speculative trading, compromise the integrity of financial markets and discourage risk averse investors including arbitrageurs.⁵⁴

The herding behaviour in a financial market can be the result of trade flows and/or information that originate in the same market and/or in other related markets. For instance, Galariotis *et al.* (2015) find that herding behaviour in UK equity market is

⁵⁴ There are many explanations for herding in the economic literature. For instance, reputational herding occurs when fund managers who are concerned with protecting their reputation choose to follow other managers (Trueman, 1994). The characteristics herding occurs when investors agree on preferred stocks characteristics (Falkenstein, 1996) or when there are fads in financial markets (Friedman, 1984)

triggered by contemporaneous herding in the US but not the other way around. However, Klein (2013) shows that herding spill-over with the US is bi-directional when taken a European perspective: herding in European equities also instigates herding in the US. Other prominent evidence analysing cross-market herding spill-over show that herding across equity markets can be regionally influenced (Chiang *et al.*, 2013), advanced equity markets may herd with the US market i.e. can be of global in nature (Chiang and Zheng 2010) and different global sectoral indices may herd uninfluenced of the global or the US stock market (Gębka and Wohar 2013).

The evidence in Gębka and Wohar is imperative as they report herding in oil and gas global indices. This evidence links up well with the notion that herding is most severe when the quality and quantity of information is poor.⁵⁵ Hamilton (1983) shows that a majority of the US recession post- World War II can be attributed to unexpected changes in oil prices. This reinforces the general consensus that oil and stock markets are often intertwined with the global economic activity. However, recent evidence shows that changes in US stock returns are more responsive to global oil-demand shocks than oil-supply shocks (Killian and Park 2009).⁵⁶

The existing research on herding spill-over is rare and it mainly focuses on the herding transfer between the US and the European/developed markets. For the reported shift in the response of US stock market to global oil supply shocks (Kilian and Park 2009), we aim to add to herding literature from the opposite end. We assess if the dominant oil exporting countries in the of Gulf Cooperation Council Countries (the GCC hereinafter) equity markets herd towards these changes in global dynamics or are regionally influenced. To do so, we use the largest equity market in the region i.e. Saudi Arabia equity market as the benchmark to examine if herding crosses from the benchmark equity

⁵⁵ The level of influence in the determination of oil prices and stability in them as well played by The Organization of the Petroleum Exporting Countries (OPEC) is no secret given these countries generate approximately 44 percent of the world's total crude oil production, and more than 20 percent of the world's natural gas production. Even more importantly, together the output from these countries makes up 60 percent of the total petroleum traded internationally. The inclusion of Russia, an observer of OPEC cartel, adds an additional 10 % both in terms of global crude oil production and export of it. For further details on these statistics, see <https://www.statista.com/topics/1830/opec/>.

⁵⁶ The oil production from the US, as a result of innovations and new technologies in the extraction of crude oil i.e. so called “Shale revolution”, have witnessed enormous transformation: in 2015 the Energy Information Agency reported that US oil production has almost doubled relative to production levels recorded in only five and six years earlier.

market to the rest of equity markets during various time periods. Furthermore, for completeness, we assess the impact of the US equity market and proxy estimates for herding in the US to uncover influence of changing global dynamics on herding in GCC equity markets.

The existence of herding behaviour, a testament of market inefficiency, in GCC equity markets including the Saudi market is highly likely. Potentially, trading in these markets is dominated by individual investors and institutional presence and trading is weak. This is further exacerbated by entrenched ownership and poor corporate governance mechanisms (Abdallah and Ismail, 2017) that rise informational asymmetries in the trading activities. Thus, in these markets investors access to information is limited due to weak regulatory regime, lack of corporate transparency and financial analyst industry and concentrated ownership structure in the firms. In these markets trades of other investors are watched closely to get information and therefore herding is expected to be widespread.

For all these reasons herding in GCC markets has recently attracted the attention of many researchers. For instance, Rahman *et al.* (2015) find that herding is significant in the Saudi equity market irrespective of equity characteristics or even market conditions.⁵⁷ However, they find that herding intensifies when the market rallies and when trading volumes are high. Another recent study on herding in the GCC countries is the Balcilar *et al.* (2014) which finds that herding is significant in GCC markets and that equity volatility is the main trigger that switches the equity market from a non-herding state to a herding state. The other factors such as the VIX, the SP500 returns, the US interest rates are all important in the switch but to a lower degree.

The final study that we find on GCC equity market herding is the Balcilar *et al.* (2017) which focuses on whether the speculation and the volatility in the oil market can trigger herding in the GCC markets.⁵⁸ The study finds that speculation in the oil market is taken as a positive news by market participants and that it encourages trading against the market in domestic equity markets and therefore herding is unlikely. However, they find that this

⁵⁷ They find herding in small, medium, large, value and growth stock portfolios. They also find herding in high, medium and low volatility samples.

⁵⁸ Note that GCC countries are major oil producers and together they control substantial proportion of global oil reserves.

is only true in low volatility regimes and that herding is still significant despite speculation in energy markets when equity volatility is high.

The three studies on GCC have used the relationship between the absolute cross section deviation and market squared returns, in addition to other methods, to draw inferences on herding behaviour. In the Rahman *et al.* (2015) study, the authors have additionally used a beta dispersion measure which assumes the validity of the CAPM model as a pricing model in the GCC markets.⁵⁹ To avoid the detection of a spurious herding in case of a common equity movement due to fundamentals, the three studies have controlled for the oil prices, the US short term interest rates, the S&P500 index returns and the VIX index.

However, it is still entirely possible that the significant herding that is observed in these studies is unintentional and/or driven by similar investment styles that are followed by investors in financial markets. For instance, if investors tend to buy winners and sell losers, then a momentum strategy can be wrongly construed as herding when it is not. Similarly, if market participants prefer growth over value or small over large company investments then the following of similar styles and same characteristics investments may cause trends that may be wrongly judged as herding.

Another potential reason why observed herding might be at least partially not genuine is when it is driven by fundamental information. Investors receive and investigate the same information and as they use the same methods they arrive at similar fundamental values of assets and implement similar trades accordingly. The market may appear herding in such cases, however, in this case, herding is not bad as it helps market stability, price discovery and market efficiency.

Therefore, before making any inference on herding, the covariance of the cross absolute deviation with style and fundamental factors should be removed and this is what we do in this study. Our contribution in this study is to investigate herding in GCC markets by using the relationship between the squared market return and cross section absolute deviation that does not covary with market styles and/or fundamentals. In order to do that we follow Galariotis *et al.* (2015) and account for four styles: market oriented, small cap,

⁵⁹ The Balcilar *et al* studies have used two states for the volatility process in the context of a Markovian switching regime models.

value and momentum.⁶⁰ As these factors have been shown to be associated with economic fundamentals, filtering the covariance of deviation with these factors is expected to remove the style and the fundamental herding influence on the value of dispersion.⁶¹

Another contribution of our study is to investigate any cross herding from the Saudi market to the rest of markets in the area. The previous literature on GCC equity market herding is silent on this issue and it is typically restricted to the level of the single market. The degree of market integration in economic blocks such as the GCC is expected to be high and news and developments in important and big markets are likely to influence other smaller markets. Therefore, in this study we investigate whether herding in the biggest and most important GCC country which is Saudi Arabia triggers herding in the rest of smaller markets in the region. A comparison with the role of the US is also conducted to infer the relative importance of regional versus global factors in instigating a herd behaviour in GCC equities.

Our results indicate that there is significant herding behaviour in all the GCC countries with the exception of the Abu Dhabi stock exchange where no evidence for herding tendency is found. The Kuwaiti market is found to herd only when the market is trending down. Moreover, there is some variation in herding significance when we consider various subsamples. For instance, significant herding is found during the Global Financial Crisis and during the big drawdown in oil prices after 2014 in all countries except for Kuwait. During the Global Financial Crisis herding is insignificant in Abu Dhabi while during the fall of oil market after 2014 herding is insignificant in Bahrain as well. Surprisingly herding around the Saudi market crash in February 2006 is significant in most countries except the Saudi market.

There is significant cross herding from the Saudi market to all markets in the GCC countries. The herding spill-over is consistent across various time periods. The only exceptions are the cross herding to Qatar during the Saudi market crash and to Bahrain

⁶⁰ The same method is used by Galariotis *et al.*, (2015). The number of companies in Saudi Arabia is not large to get reliable risk factors. Therefore, we pooled all companies in the Gulf Cooperation council Countries which is the economic block that Saudi Arabia belongs to for the purpose of factor computations. All companies within the block lives under similar environment and subject to similar risks and regulations. This has increased the number of companies by three folds and has improved factors measurement.

⁶¹ See Liew and Vassalou (2000), Gregory *et al.*, (2003) and Kessler and Scherer (2010) for more information on how these factors are related to the economy.

during the drop-in oil prices after 2014 where herding cross over is found to be insignificant. To compare with herding cross over from global markets we investigate herding spill-over from the US market. Surprisingly, we find that herding in the US market does not influence herding in the GCC market. Therefore, we conclude that in the context of GCC countries the regional factors are more than global factors.

The rest of the essay is organised as follows: Section 5.2 contains a synopsis of the literature on herding and cross herding. In Section 5.3 we go over the methodology used in inference. Section 5.4 contains a description of the data set and samples. We also present the way in which we construct the four factors used to obtain the herding measure. The empirical findings of the model and the analysis of herding measure and cross herding with the Saudi and the US market can be found in section 5.5. Finally, section 5.6 contains some concluding remarks.

5.2 Literature Review

The literature on herding focuses on whether herding occurs in a particular financial market, its explanation and influence on market stability and efficiency. Most studies examine the US market but recently international research on herding has started to increase. For instance, there are the studies by Kim and Nofsinger (2005); Kim and Wei (2002); Chen and Hong (2006); Kremer and Nautz (2013); Lakshman *et al.* (2013) and Zhou and Lai (2009). These works provide a single country evidence on herding from Japan, Korea, Taiwan, Germany, India and Hong Kong respectively.

Other studies investigate herding of investors in multiple markets. Studies such as Chiang and Zheng (2010), Chang *et al.* (2000), Blasco and Ferreruela (2008) and Borensztein and Gelos (2003) investigate herding behaviour in multiple markets. In the Chang *et al.* (2000) study it is shown that herding is not a behavioural pattern of the US and other developed markets, but it is in emerging markets such as South Korea and Taiwan. On the contrary Chiang and Zheng (2010) find some evidence of herding in developed markets when herding propensity is computed from aggregate market index. The study of Blasco and Ferreruela (2008) test the herding behaviour using a cross section standard deviation of returns in seven markets and find that herding is only pronounced in the Spanish equity market. The herding behaviour of 400 emerging markets mutual funds is studied by Borensztein and Gelos (2003). They find that herding is significant in all

market conditions and in stressful markets. Their results are stronger for open ended funds.

The drivers behind herding has been studied by many researchers and much debate is still ongoing as to why investors follow others' trades. For instance, herding may occur due to lack of information or due to information asymmetry. The investors in the countries with lower level of information transparency are more likely to herd (Wermers, 1999; Kim and Nofsinger, 2005; Bikhchandani and Sharma, 2000). The informational cascade in the market occurs when these investors ignore their own information and make decisions based on their observation of the decisions of other investors. Wermers (1999) points out that herding in the shares of small growth companies is common due to information asymmetry. Similarly, Sias (2004) shows that institutional investors in the US market are more likely to herd buying and selling small company securities.

The non-informational causes for herding are based on reputational reasons, style herding and / or fads. Fund managers mimic the trades of other managers because for them underperforming with the crowd is less painful than underperforming alone. Scharfstein and Stein (1990) show that these decisions are rational as the blame due to errors is shared. Trueman (1994) suggest that analyst do herd and report predictions that are different than what their private information suggest and this is another example of reputational herding. Another form of non-informational herd may occur if the investors in a particular market are attracted to the same characteristics of companies. In this case we may observe a characteristic or style herding in the market (Gompers and Metrick, 2001; Bennett *et al.*, 2003; Nofsinger and Sias, 1999; Sias, 2004).

Herding can be spurious, unintentional or driven by the flow of fundamental market information. If investors analyse relevant information in the same way and arrive to the same equilibrium values of assets then they will buy the securities until its market price adjusts to fundamental value. Hence, this unintentional herding may help security prices to reflect information and it promotes market efficiency (Bikhchandani and Sharma, 2000; Froot *et al.*, 1992). Even in the particular case where herding is intentional it still helps market stability as long as it is based on informational cascades (Sias, 2004).

In today's increasingly integrated financial markets investors in one market may ignore their own information and follow investors in other markets. The herding literature that tackles cross herding in multi-market context is not as large as the literature that is concerned in a single market setting. From the few studies that exist there is the study of

Chiang and Zheng (2010) who have looked at the interaction of herding behaviour beyond national borders in the US and 18 countries in Asia and Latin America. They find that US dispersion plays a central role in explaining the herding behaviour in the rest of markets. They also find that markets in crisis countries herd and trigger herding in other markets and in this way the crisis is exported to other countries. The recent global financial crisis is an example of the global nature of herding and crisis spill-over.

In the same direction is the study of Galariotis *et al.* (2015) which investigates the cross herding between the US and the UK. The authors find that there is herding spill over from the US to the UK equities and not the other way around. The co-movement of herding among markets is also the subject of Chiang *et al.* (2013) who find a correlated herding behaviour in the Pacific Basin region. Moreover, they find that the dynamics of herding is time varying and that it significantly relates to stock market returns. Surprisingly, they find that herding is insignificant under uncertainty and when the conditional volatility of domestic or global markets are high.

In the context of the GCC countries, Rahman *et al.* (2015) examine the period from 2002 to 2012 and find significant herding during the period. Balcilar *et al.* (2014) use a regime switching model of volatility and show that herding is more and cross dispersions are less when the regime switches to the high volatility state. In a recent study Balcilar *et al.* (2017) find that when speculation in the oil market is high, herding is less likely in the Saudi market. They explained this by saying that when the speculation on oil is high and when the oil market is strong and healthy then this would in turn encourage rationality in investors behaviour of the Saudi market.

Our study is related to these studies but we contribute by studying the herding spill-over from the Saudi market to the rest of markets in the GCC countries. In terms of methodology we are also different and we account for fundamental and similar style co-movement before inference on herding is obtained.

5.3 Methodology

We follow Chang *et al.*, (2000) and infer herding by looking at the relationship between cross section absolute dispersion and the square of market returns. The cross-sectional absolute deviation of returns (the CSAD hereafter) in day t is measured by the following equation:

$$CSAD_t = \frac{1}{N} \sum_{i=1}^N |R_{i,t} - R_{m,t}| \quad (1)$$

where $R_{i,t}$ is the observed return on company i and $R_{m,t}$ is the market returns.⁶² As can be seen, the dispersion quantity captures return variations in excess of market returns and hence it is suitable to capture co-movement in equities. When shares co-move at the same pace, aggregated dispersions are narrowed and this will be reflected in the CSAD measure. However, in normal conditions shares move differently than the market as it changes value as the firm level fundamentals change. Hence, the aggregated value of the CSAD measure during such times is relatively larger. Because equities are expected to move linearly with the market according to their betas, the CSAD quantity is expected to increase linearly with market returns.⁶³

Chang *et al.* (2000) argues when markets are herding, the linearity of the measure is violated and it is predicted to increase non-linearly at a decreasing rate with average market returns. Therefore, a suitable specification that may be used to detect herding behaviour in financial markets can be written as:

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t \quad (2)$$

A negative and significant β_2 is indicative of herding behaviour in the market.

Significant herding spill-over from the Saudi market to the rest of GCC equities is estimated using the following regression:

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 CSAD_{Saudi,t} + e_t \quad (3)$$

⁶² The results are not different when we use the cross-sectional average of the N company returns instead of market returns. The market returns are computed as the continuously compounded returns of the broad market index.

⁶³ This measure is built on the basis of a zero beta CAPM model. In this model it can be shown that the expected CSAD is the market returns above the zero beta returns multiplied by the difference between the beta of individual companies and the beta of the equally weighted market portfolio of the N companies. Hence, the measure should increase linearly with market returns.

The $CSAD_{Saudi,t}$ is the dispersion of Saudi equities. A positive and significant β_3 coefficient would reveal that Saudi market co-movement significantly influence equity co-movement in the GCC countries. In this respect, we expect that β_3 should be positive to capture cross-herding in the GCC equity markets relative to Saudi stock market. A positive relationship will display the widening and narrowing of CSAD in Saudi market is followed by other GCC markets.

However, the co-movement of shares in a single market or across markets may arise from the same response to the flow of fundamental information or because of similar investment styles as mentioned previously. Therefore, the significant influence of the Saudi market dispersion on the dispersion of other markets may not be herding spill-over.⁶⁴ Therefore, it is important to remove the influence of identifiable, systematic and stylistic co-movement from the CSAD before making any inference on cross herding between markets. In order to filter the part of the CSAD that does not describe herding tendency, we follow Galariotis *et al.* (2015) and regress on four risk/style factors as follows:

$$CSAD_t = \beta_0 + \beta_1(R_{m,t} - R_F) + \beta_2HML_t + \beta_3SMB_t + \beta_4MOM_t + e_t \quad (4)$$

The four style factors in the equation are: the market oriented, the value, the small company and finally the momentum style factor.⁶⁵ It is worth to mention here that these styles have been seen to be able to capture fundamental information by the literature. For instance, Liew and Vassalou (2000) find that the HML and SMB factors are informative of GDP and the economic growth of countries. Similar results on the positive correlation between growth and the HML factors are arrived at by Gregory *et al.*, (2003). Substantial relationship between momentum and the economy is reported by Kessler and Scherer

⁶⁴ In the language of Bikhchandani and Sharma (2000) this is termed as spurious herding and in the language of Galariotis *et al.*, (2015) it is termed as fundamental herding. We use the term throughout the paper to describe the part of the measure which is not herding. The rest of it we term as adjusted dispersion or adjusted CSAD.

⁶⁵ Note that the market, the value and the size factors are the Fama and French (1993) factors while the momentum factor is proposed as an additional factor by Carhart (1997). The market-oriented strategy is the returns on a passive investment in the market index that is financed at the risk-free rate which assumed to be zero in this study. The value factor represents the returns on the portfolio that longs high book to market equities and shorts low book to market equities. The size factor is the return on the portfolio that longs small companies and shorts large companies. Finally, the momentum factor is the return on the portfolio that buy winners and short losers.

(2010). All these studies provide a justification of filtering out risk/style factor based covariations in the approximate measure to describe herding behaviour.

The assumption that these factors are capturing fundamental and similar style co-movement is crucial for our analysis to be valid. On each day, the conditional CSAD on these factors represents the part of the deviation that emanates from same styles or similar investor responses to the same information filters. The rest of the CSAD can be attributed to herding. Hence, to find that part of the CSAD that is likely to be herding, we first regress the CSAD on the risk/style factors and then we get the adjusted herding measure that is the estimate of the error term in equation (4). We term this as adjusted CSAD:

$$CSAD_{adjusted,t} = e_t.$$

The rest of the CSAD is considered spurious and it is termed as fundamental part of herding behaviour i.e.

$$CSAD_{FUND,t} = CSAD_t - CSAD_{adjusted,t}$$

Hence, our actual testing of significant herding in the previous equations is all based on $CSAD_{adjusted,t}$ and not on the total CSAD as represented before. Therefore, we test for significant herding using

$$CSAD_{adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t \quad (5)$$

And for herding spill-over we regress

$$CSAD_{adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 CSAD_{adjusted,Saudi,t} + e_t \quad (6)$$

These regressions are estimated over various time periods to determine what triggers herding behaviour in GCC markets: is the herding tendency is regional in design or is an outcome of international spill over. Furthermore, we also test the same in down and up market periods to relate the herding patterns in GCC markets to available evidence on

In the next section, we discuss the data set and how we construct the factors that represent common styles for the computation of adjusted CSAD.

We collect data that includes all listed companies in GCC markets from the 5th of October 2005 to the 25th of February 2016 for a total of 2667 days. The number of all listed

companies at the end of the sample is around 623 companies.⁶⁶ The time series of the Saudi market index and the indexes of other GCC markets are retrieved for the same period.⁶⁷ All data is obtained in Dollars from Thomson-Reuters Datastream database.

The sample period includes three interesting periods that may influence herding and cross herding in GCC countries. The first is the Saudi market crash period in 2006. The Saudi market index reached its all- times high in February 2006. However, the market started skidding after that. In two weeks after the 28th of October, the index lost more than 20 % of its value and by the end of the year it closes at 50 % of its end of year level in 2005.⁶⁸ The second period is from 2007 to 2012 includes the Global Financial crisis. The third period from 2012 to 2016 have witnessed the big drawdowns in oil prices in 2014 and in 2016 and as the GCC countries are net oil producers it is possible that the drop-in oil market influences herding and cross herding in the region.

Therefore, to investigate herding in various time periods, the whole sample is divided into three corresponding sub- samples: a Saudi market crash sample that extends from the 5th of October 2005 to the 28th of December 2006 for a total of 316 days; a global financial crisis sample that covers the period from the 2nd of January 2007 to the 30th of March 2012 and contains 1347 days; and finally a sever drop in oil prices sample that contains 1003 days and runs from the 2nd of April 2012 to the 25th of February 2016.

The number of listed companies in GCC countries is small and therefore the estimation of country factors would be devoid of diversification axiom that is the bedrock element in the construction of these factors and there is a strong chance that these factors for low number of firms in the portfolios will mimic the large firm return variation. For instance, the number of companies listed in the biggest market which is the Saudi market is only 175. Therefore, we opt to compute regional factors on the basis of all of the 623 companies in the GCC equity market universe to get more accurate estimates of factor returns. Although the GCC capital markets do not trade on the same platform, they are still sufficiently integrated and equity investment is open for investors in all member

⁶⁶ The study uses data for all active, dead and suspended companies to eliminate any potential survivorship bias.

⁶⁷ The name of the Saudi broad market index is the Tadawul all-share index. Its symbol in Datastream is TDWTASI.

⁶⁸ Between February and December, the index dropped from around 20,000 to 8000.

countries.⁶⁹ Therefore, for the noted reasons, the choice regional factors instead of country factors is larger benefits and is used in the analysis.

In the construction of factors, we include dead firms in the universe of regional stocks to avoid survivorship bias. But we exclude non-common equity companies and companies with unreported dollar capitalization. Out of the 623 companies in the sample 25 non-equity firms are removed.⁷⁰

For the remaining companies we correct for extreme return reversals in Datastream by setting daily returns for day t and $t+1$ to be missing when daily returns is more than 100 % but reversed the following day. Daily returns are also considered missing if the return of the two subsequent days is less than 0.5 and/or the daily gross return is greater than 2.⁷¹ From the filtered data of the rest of companies we construct three factors: size (SMB: small minus big), value (HML: high minus low) and momentum (MOM).

The returns on the factors are computed as averages of value weighted returns of the relevant company portfolios. Specifically, to construct the size and value factors we divide companies into big and small using the median capitalization firm. The two groups are further divided into high, medium, and low book to market using the third and the seventh decile breakpoints of firms' book to market value. These portfolios are constructed and rebalanced at the end of June every year. As a result, six portfolios are established: small low book to market (SL), small medium book to market (SM), small high book to market (SH), big low book to market (BL), big medium book to market (BM), and big high book to market (BH). The size risk factor (small-minus-big SMB) is then generated by subtracting the average value weighted returns of the big portfolios (BL, BM, BH) from the average returns of the small portfolios (SL, SM, SH). Similarly, the HML factor is computed by offsetting returns of the average of the two value portfolios (SL, BL) and the two growth portfolios (SH, BH).

A similar procedure is adopted to build the momentum factor: we form three momentum portfolios i.e. momentum winner (high returns, W), average (normal returns, A) and loser (low or negative returns, L) portfolios. These portfolios are rebalanced monthly on the

⁶⁹ Note that foreigners are not allowed to invest. They may only do that through domestic funds.

⁷⁰ The number of listed companies in the Gulf Cooperation Councils countries is 175 in Saudi Arabia, 150 in Oman, 68 in Kuwait, 47 in Bahrain, 46 Qatar, 69 in Dubai, and 68 in Abu Dhabi.

⁷¹ We follow Ince and Porter (2006) and Griffin *et al* (2010) in their industry codes to remove non-equity securities and to filter the returns series.

basis of the previous year performance of companies. The WML factor is then calculated as the difference between the averages of the two winner portfolios (SW, BW) and the two loser portfolios (SL, BL).

5.4 Results and Discussion

Table 5.1 presents summary statistics of the CSAD, the market indexes as well as for the computed regional factors. The bottom of the table presents the simple correlation coefficient between the CSADs of individual GCC countries and that of the Saudi market. As can be seen in the table, the correlation between the CSADs of the GCC markets with the Saudi market are positive yet at a moderate level. Surprisingly the lowest correlation of the CSAD is around 12 % with the closer and the more connected Bahraini market while the highest dispersion correlation is around 35 % with the Qatari market. The rest of correlation are in the order of 20 % which indicate moderation dispersion association across countries.

The table also shows that the average growth rate of all indexes is marginal and negative during the sample period. The only market which managed to achieve a slight growth in the value of its market is the Omani market with an average daily growth rate of 0.0007 %. The rest of markets' capitalization is slightly less at the end of the sample than at its beginning. The standard error computation shows that volatility of the Dubai Financial Market is the highest at a daily volatility of around 0.8 %⁷². The range portrays a different picture than the standard error as a measure of risk. To display this, the biggest daily draw down of 15.8 % is experienced by the Abu Dhabi exchange. The rest of daily drawdowns in other countries are lower and range from 2 % to 5 %. The Abu Dhabi Stock Exchange has also witnessed the biggest daily rally in equity prices of around 17.2 %. The biggest daily increase in value in the rest of countries ranges from an increase of 1.5 % in the value of the Bahraini market to 7 % in the value of the Saudi market. As expected, daily returns of equity indexes are negatively skewed and leptokurtosis is more than what is expected from a normally distributed data. Therefore, the null hypothesis of normality in returns is rejected by the Jarque-Bera test statistics for all the GCC equity market returns.

⁷² Note that under certain assumptions, the 0.0007 % of daily returns translates to 17.6 % annually and the 0.8 % daily volatility translates to around 12.6 % of annual volatility.

In contrast to the GCC market portfolios' performance which is negative, the factor returns are all positive. Figure 5.1 shows the value of \$1 invested in the strategy at the beginning of the sample. As can be seen in the figure, the momentum (MOM) strategy is dominated by the HML and SMB investment strategies. The SMB strategy has underperformed the HML and MOM strategies around the Global Financial Crisis in 2008.



Figure 5.1 The growth of a \$1 US invested in GCC factor portfolios (2005-2016)

As can be seen in Table 5.1, the returns of the momentum strategy are the lowest with an average annual return of 2.4 %. The returns of HML strategy is highest at around an average annual growth rate of 11.2 % in the portfolio that buys high book to market equity (BM) ratio stocks and shorts the low BM ratio stocks. The performance of SML strategy that invests in small companies is moderate and its average annual returns is around 8.1 %. The annualised standard deviation of the SML, HML and MOM strategies is 14.5 %, 19.2 % and 6.5 % respectively.⁷³ The Sharpe Ratio of the SML, HML and MOM strategies is 0.56, 0.6 and 0.35 respectively. Therefore, in terms of risk adjusted performance buying value stocks in the most remunerating strategy in the region.

Moreover, it can be seen in the table that the maximum daily drawdown of HML strategy is around 6 % which is lower than the 8 % maximum daily loss of the SMB portfolio. The highest daily increase in the value of the HML portfolio is 18 % compared to 11 % and 4 % of the SML and MOM strategies respectively. The lowest daily drawdown is experienced by the momentum strategy with a maximum daily drop of 3 %.

The table also shows that daily average dispersion around the market is relatively low in all countries. For instance, it is around 0.7 % in Dubai, Abu Dhabi, Kuwait and the Saudi market.⁷⁴ The CSAD ranges wide from around zero in certain days to around 6 % in most of the countries and to 16 % in Abu Dhabi. The rest of the statistics indicate that the CSAD is positively skewed and leptokurtic and therefore the null of normality is rejected by the Jarque-Bera statistics.

⁷³ The daily average return of the strategies is multiplied by 252 to get the annualised returns. The daily standard deviation is multiplied by the square root of 252 in order to obtain annualised volatility.

⁷⁴ The average daily reported CSAD in similar studies ranges from 0.5 % to 3 %. See Rahman et al. (2015) and Gavriilidis et al., (2016) as they report CSAD values in a range of countries. If the Saudi daily dispersion is transposed to monthly using the square root rule then it will translate to 3.4 % which is also low compared to the monthly US equity return dispersion reported by Christie and Huang (1995).

Table 5.1 Descriptive Statistics: Factors and Cross-Sectional Absolute Deviation for Individual GCC Markets

This table presents descriptive statistics on the cross-sectional absolute deviation measure to proxy GCC equity markets herding.

Country	Mean	Std. Error	t-Statistic (Mean = 0)	Skewness	Kurtosis (excess)	Jarque-Bera	Minimum	Maximum
CSAD								
Saudi Arabia	0.007	0.005	76.849	3.365	20.847	53306.563	0.000	0.057
Oman	0.004	0.003	66.127	3.441	25.999	80345.702	0.000	0.055
Qatar	0.006	0.003	95.425	1.536	4.999	3824.473	0.000	0.033
Dubai	0.007	0.004	86.477	1.798	5.229	4474.992	0.000	0.034
Abu Dhabi	0.007	0.006	67.559	16.935	465.993	24249163.970	0.000	0.166
Bahrain	0.003	0.003	53.404	5.962	69.666	554924.856	0.000	0.057
Kuwait	0.007	0.003	109.974	3.915	51.612	302717.561	0.000	0.057
Market Returns								
Saudi Arabia	-0.000147	0.007	-1.028	-0.646	11.354	14505.543	-0.051	0.070
Oman	0.000007	0.004	0.077	-0.877	15.324	26428.324	-0.039	0.034
Qatar	-0.000037	0.006	-0.300	-0.440	8.070	7319.705	-0.041	0.041
Dubai	-0.000140	0.008	-0.890	-0.176	5.830	3788.946	-0.053	0.053
Abu Dhabi	-0.000034	0.007	-0.253	1.178	242.346	6524706.022	-0.159	0.173
Bahrain	-0.000099	0.002	-2.038	-0.648	6.784	5298.235	-0.021	0.016
Kuwait	-0.000119	0.004	-1.737	-1.347	11.342	15094.666	-0.040	0.022
SMB Factor	0.000323	0.009	1.837	0.597	17.663	34815.567	-0.089	0.119
HML Factor	0.000469	0.012	1.979	2.641	34.999	139165.225	-0.060	0.189
MOM Factor	0.000085	0.004	1.085	0.202	14.509	23403.394	-0.035	0.043
CSAD Simple Correlation	Saudi Arabia	Oman	Qatar	Dubai	Abu Dhabi	Bahrain	Kuwait	
	1.000	0.257	0.357	0.213	0.215	0.125	0.245	

Note: It is estimated using the following expression: $CSAD_t = \frac{1}{N} \sum_{i=1}^N |R_{i,t} - R_{m,t}|$. We also provide summary statistics of the market returns for the GCC stock markets. The market factor and regional Fama-French-Carhart factors are also provided which are constructed using stocks from the GCC markets. These factors are size factor (SMB), value factor (HML) and momentum factor (MOM).

To check the dynamics of dispersion across time, Figure 5.2 plots a time series of the CSAD statistics during the sample period. It also plots the average of CSAD to help create a point of reference. In the figure, dispersions around the market are high and above average during the global financial crisis from 2007 to 2009 and in all countries. The dispersion of the Saudi market is also high at the start of the sample and in 2006 which is a period that witnessed the Saudi market crash as mentioned previously.

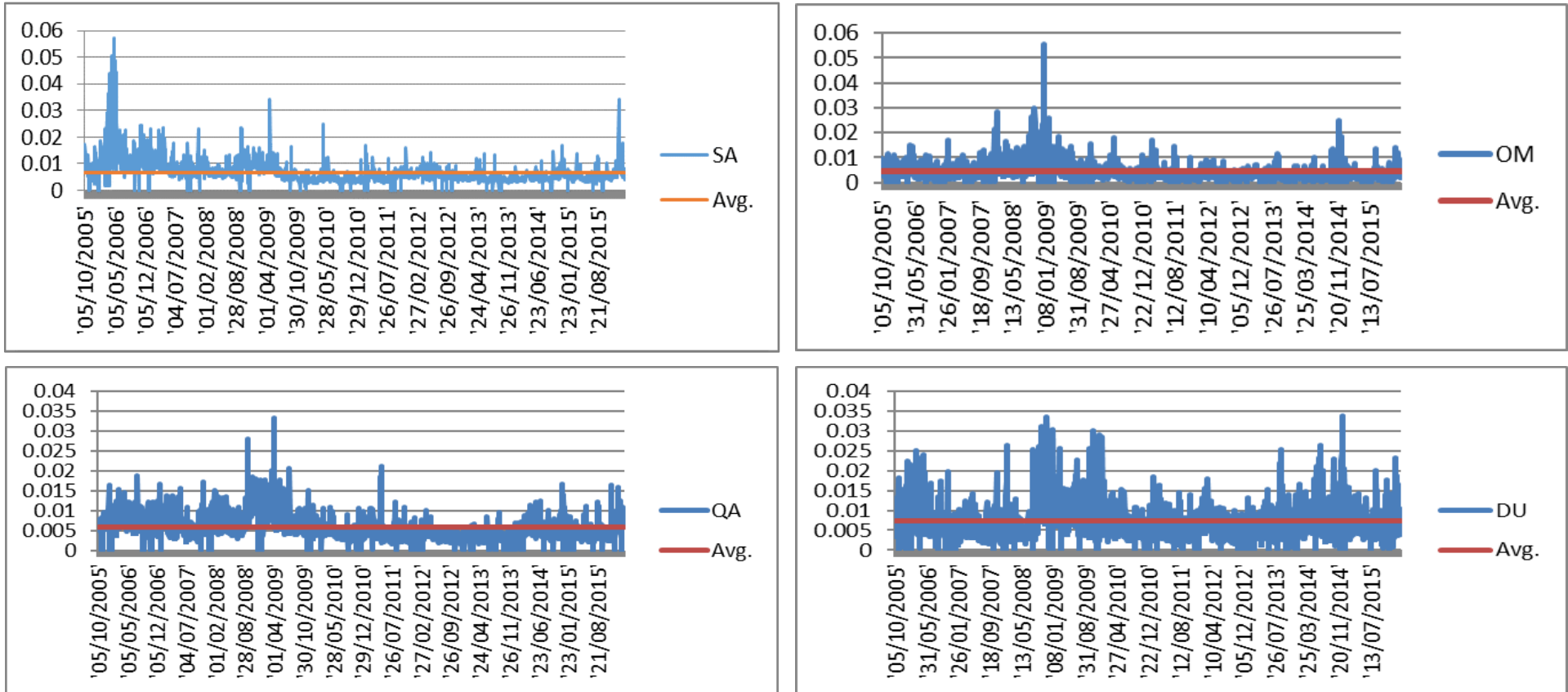


Figure 5.2 Time Series of the CSAD statistics by GCC Country

SA - Saudi Arabia; OM - Oman; QA – Qatar; DU – Dubai; AD - Abu Dhabi; BA – Bahrain; KU - Kuwait

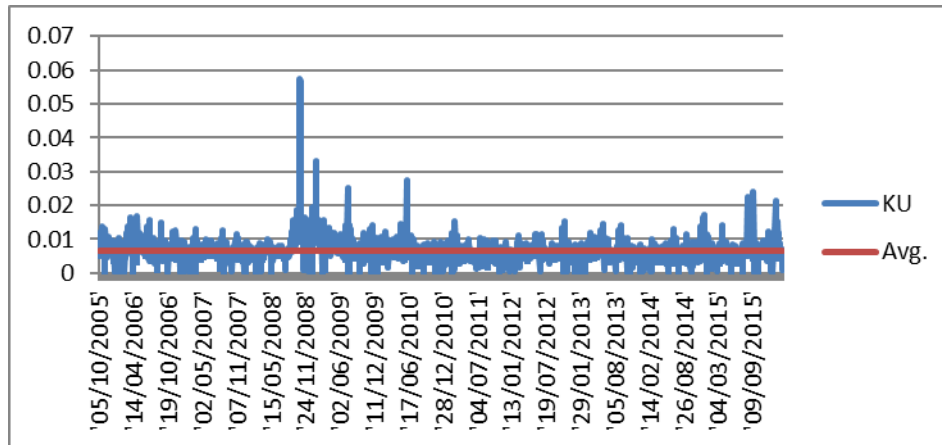
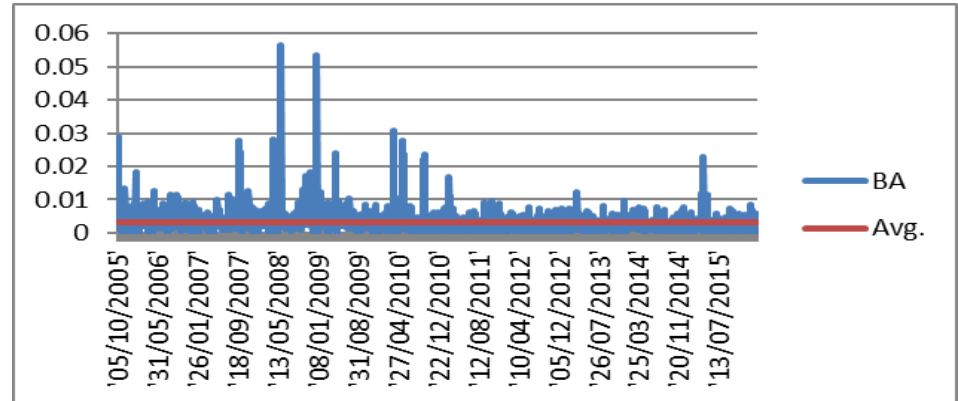
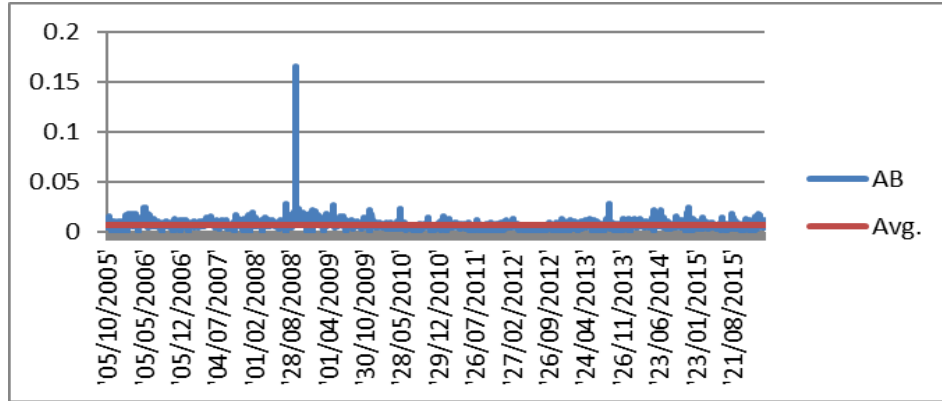


Figure 5.2 Time Series of the CSAD statistics by GCC Country

SA - Saudi Arabia; OM - Oman; QA – Qatar; DU – Dubai; AD - Abu Dhabi; BA – Bahrain; KU - Kuwait

To see how the herd measure moves with market returns, Figure 5.3 scatter the CSAD measure against market returns. The figure shows that dispersion increases with market returns in all sample countries. However, for some countries such as Saudi Arabia, Qatar, Kuwait and Oman the increase in dispersion increases at a decreasing rate thus indicating a negative relationship between CSAD and absolute market returns. For these markets herding is expected to be significant. The concavity of the scattered diagram is clear and hence, we expect to find significant negative non-linearity and herding behaviour in these markets.

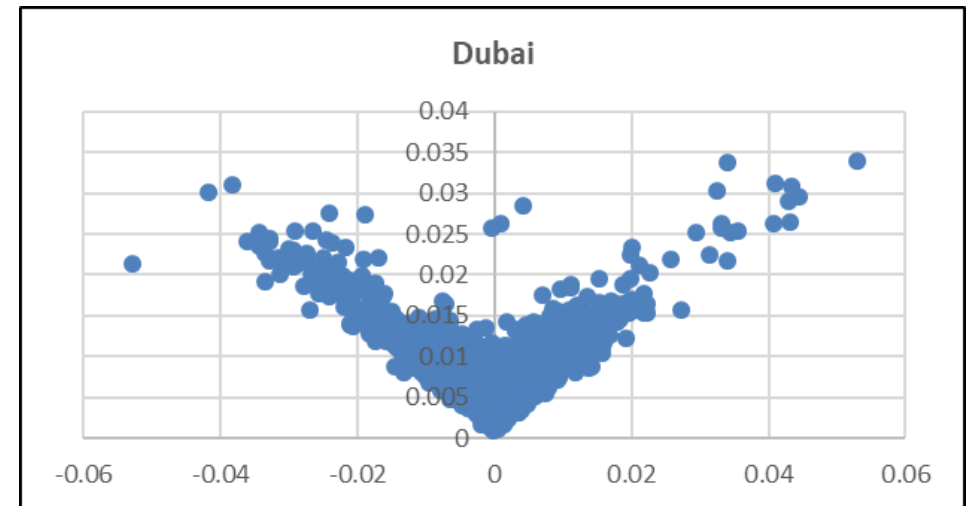
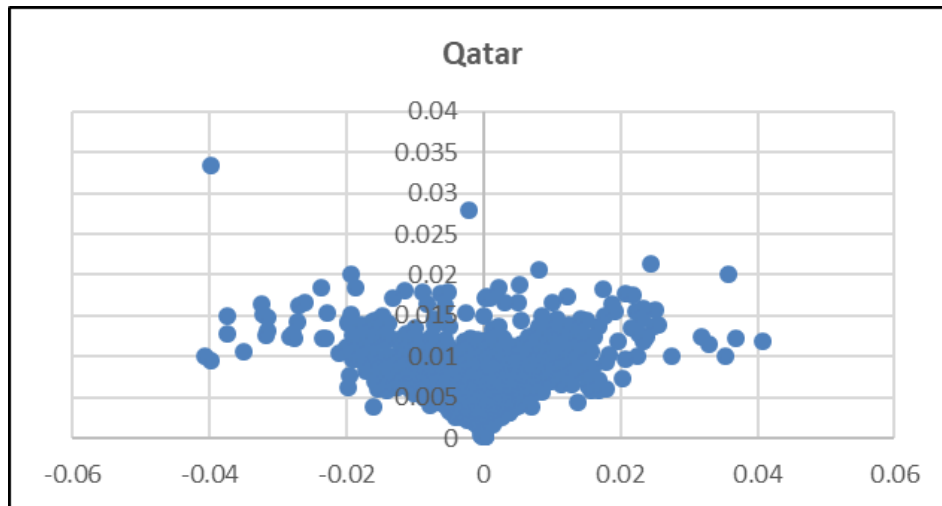
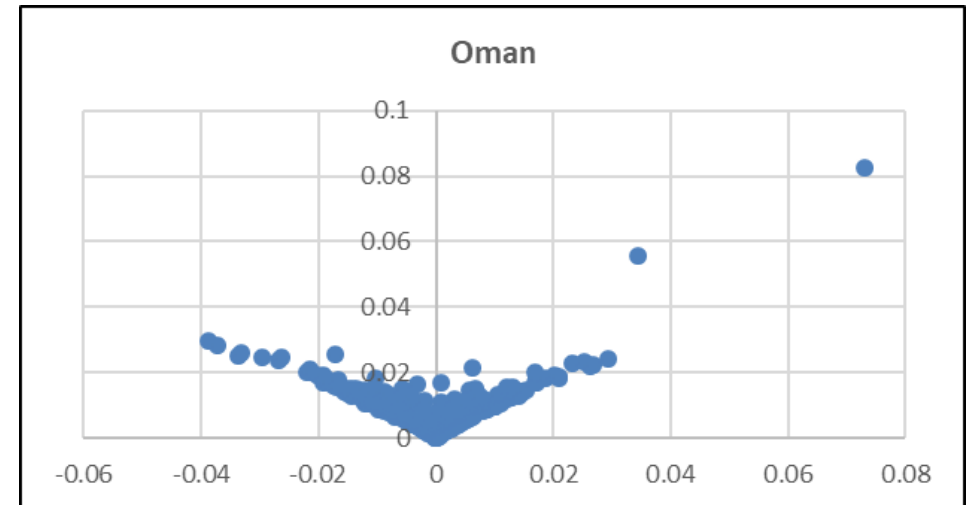
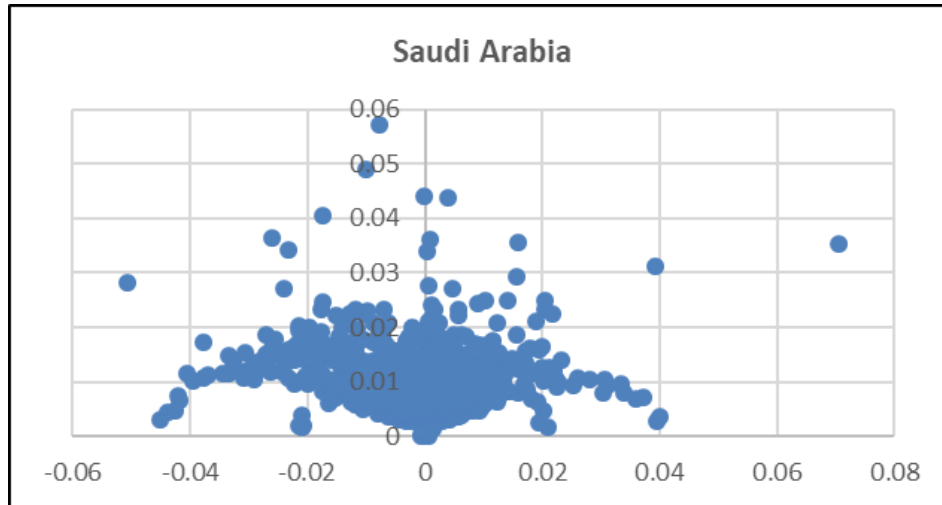


Figure 5.3 Scatter Plots of the CSAD measured against Market Returns

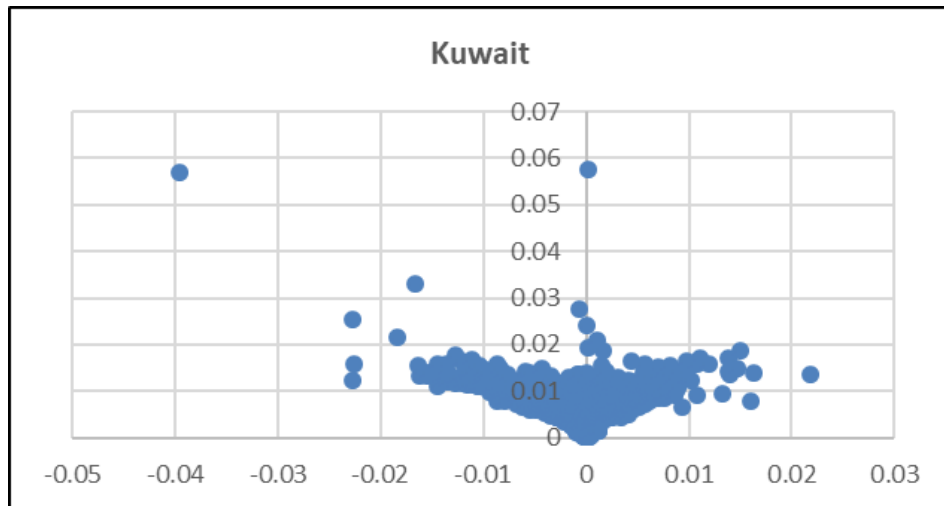
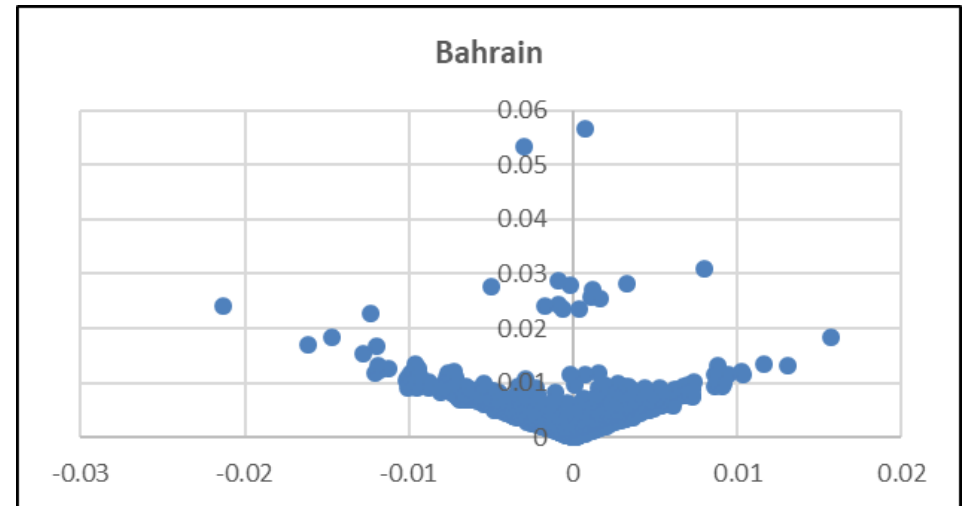
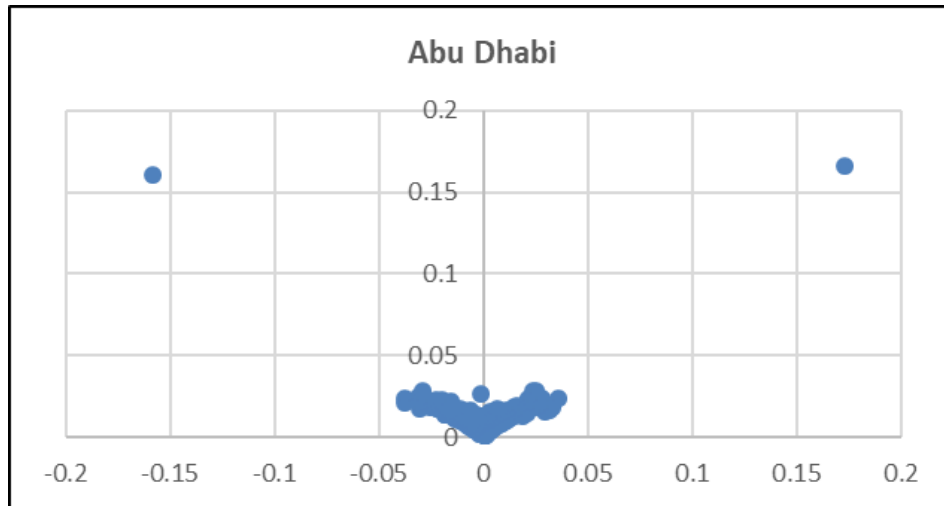


Figure 5.3 Scatter Plots of the CSAD measure against Market Returns

We proceed to test formally for significant herding by regressing the CSAD on market absolute returns and country specific market squared returns as mentioned previously. The herding test results are presented in Table 5.2. Panel A of the table presents results for the full sample. As can be seen in the panel, there is a negative and significant relationship between squared returns and dispersion in Saudi Arabia, Oman, Qatar, Dubai, and Bahrain. This clearly shows that there is evidence of herding in the GCC equity markets.⁷⁵ To compare the extent of herding in these markets we adjusted the herding parameter for the different scales in the regression variables.⁷⁶ The loadings of the herding parameters are -0.08, -0.03, -0.06, -0.19 and -0.04 for Saudi Arabia, Oman, Qatar, Dubai, and Bahrain respectively. Hence, herding in the Dubai Financial Market is the most pronounced and it is followed by level of herding in the market of Saudi Arabia.

Panel B of Table 5.2 presents the regression results of three sub-samples that span various periods. In particular, the first part of the panel shows the results in the period before and after the Saudi market crash in 2006. The second sample covers the 2008 Financial Crisis period and finally the third sample contains the period that witnessed sever drops in the oil price after 2014.

As can be seen in the panel, the herding evidence in the first and the second subsample is similar to the whole sample. This points out that neither the Saudi market crash in 2006 nor the Financial market crisis in 2008 has changed the herding behaviour in the GCC countries. In the recent sample that witnessed the drop in the oil prices, the Abu Dhabi stock exchange which didn't herd previously started to herd. Similarly, the Kuwaiti market has shown some negative nonlinearity of dispersion with squared returns, but the parameter is still not significant at conventional levels.

⁷⁵ The evidence of herding from the Abu Dhabi and the Kuwaiti markets is weak as the parameter associated with herding in these markets is positive and significant.

⁷⁶ We multiplied the parameter by the ratio of the standard error of the dependent variable to the standard error of the independent variable. It can also be done by running a regression with standardised variables and then compare the loadings.

Table 5.2 Herding in Individual GCC Markets

Time series regression analysis of cross-sectional absolute deviation (CSAD) in markets of individual Gulf Cooperation Council (GCC) countries. This specification retains both fundamental and adjusted components of CSAD for herding in GCC equity markets and provides estimates for linear and non-linear herding parameters β_1 and β_2 , respectively. Panel A - full sample; Panel B - 2006 (Saudi Crash Period); Panel C - 2008 (Financial Crisis period) in panel C; Panel D - the 2014 Oil Crisis.

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Country	β_0	t-statistic	β_1	t-statistic	β_2	t-statistic	R ²
Panel A: Full Sample							
Saudi Arabia	0.005***	43.206	0.549***	20.423	-6.995***	-8.645	0.224
Oman	0.002***	51.030	1.005***	67.139	-5.933***	-8.886	0.844
Qatar	0.004***	54.935	0.597***	30.202	-8.316***	-10.806	0.444
Dubai	0.004***	55.065	0.754***	52.634	-4.252***	-8.992	0.786
Abu Dhabi	0.005***	89.461	0.690***	62.023	1.534***	17.342	0.860
Bahrain	0.001***	19.134	1.163***	23.954	-9.527*	-1.944	0.417
Kuwait	0.005***	75.789	0.642***	21.574	8.181***	4.626	0.427
Panel B: Saudi Crash 2006							
Saudi Arabia	0.005***	42.231	0.544***	20.035	-6.835***	-8.391	0.226
Oman	0.002***	50.075	1.009***	66.047	-6.070***	-8.960	0.845
Qatar	0.004***	53.911	0.614***	30.534	-8.620***	-11.151	0.455
Dubai	0.004***	54.187	0.766***	53.479	-4.428***	-9.400	0.793
Abu Dhabi	0.005***	88.302	0.694***	61.743	1.510***	16.981	0.864
Bahrain	0.001***	18.896	1.154***	23.532	-8.744*	-1.720	0.414
Kuwait	0.005***	75.020	0.639***	21.326	8.454***	4.787	0.435

Table 5.2 Herding in Individual GCC Markets

Results of analysis of cross-sectional absolute deviation (CSAD)

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Country	β_0	t-statistic	β_1	t-statistic	β_2	t-statistic	R ²
Panel C: Global Financial Crisis 2008							
Saudi Arabia	0.004***	54.007	0.542***	24.577	-9.312***	-11.986	0.343
Oman	0.002***	43.594	1.028***	62.615	-6.530***	-9.236	0.863
Qatar	0.003***	46.269	0.686***	33.111	-10.115***	-13.344	0.541
Dubai	0.004***	50.448	0.778***	48.925	-4.244***	-8.094	0.810
Abu Dhabi	0.004***	75.239	0.744***	58.312	1.234***	12.907	0.884
Bahrain	0.001***	15.218	1.178***	21.435	-8.589	-1.562	0.413
Kuwait	0.005***	65.485	0.658***	19.130	9.695***	5.027	0.437
Panel D: Oil Crisis 2014							
Saudi Arabia	0.004***	18.757	0.451***	7.928***	-5.896***	-2.665	0.295
Oman	0.001***	27.558	1.111***	52.751***	-11.406***	-10.011	0.952
Qatar	0.003***	24.933	0.573***	14.947***	-5.843***	-3.436	0.654
Dubai	0.004***	28.749	0.739***	29.427***	-3.168***	-4.190	0.876
Abu Dhabi	0.004***	33.313	0.852***	21.635***	-5.043***	-2.673	0.812
Bahrain	0.001***	14.629	0.832***	11.175***	56.554***	5.456	0.701
Kuwait	0.005***	30.645	0.843***	8.404	-0.195	-0.023	0.458

*, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. This table presents the estimates of the model specification in equation (2): $CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t$.

Table 5.3 presents regression outputs using equation 5 to understand broader herding dynamics at country level. This is used to adjust for the co-movement that arise from similar response to fundamental news and style investments. Table 5.4 presents the parameter estimates, using the same specification, from the three sub-samples that are investigated in this study.

Table 5.3 shows that the adjustment did not change the results of the full sample. The evidence still shows insignificant herding in Abu Dhabi and Kuwait and significant herding in the rest of GCC equity markets. However, the adjustment reveals different results in the sub-sample estimates. For instance, Table 5.4 shows significant herding in the Abu Dhabi securities exchange and the Kuwaiti financial market in the sample around the Saudi market crash. Surprisingly, the herding evidence from the Saudi market itself is insignificant in this particular sample. Hence, we may conclude that there is significant herding of equities in GCC markets around the Saudi market crash. The results from the rest of sub-samples are very similar to the evidence retrieved from the unadjusted CSAD.

Table 5.3 Adjusted herd testing Results in GCC Markets

Time series regression analysis was conducted for adjusted CSAD – purged of the return co-movements arising from Fama-French-Carhart factors – for herding in the Gulf Cooperation Council (GCC) equity markets. It provides estimates for linear and non-linear herding parameters β_1 and β_2 , respectively. This analysis is estimated for the full sample period .

Country	β_0	t-statistic	β_1	t-statistic	β_2	t-statistic	R ²
Saudi Arabia	-0.002***	-16.556	0.519***	19.199	-6.735***	-8.278	0.201
Oman	-0.002***	-60.410	1.010***	63.979	-7.066***	-10.032	0.824
Qatar	-0.002***	-29.013	0.598***	30.158	-8.433***	-10.933	0.441
Dubai	-0.004***	-56.850	0.746***	51.165	-4.137***	-8.592	0.777
Abu Dhabi	-0.002***	-46.323	0.690***	62.110	1.539***	17.433	0.861
Bahrain	-0.002***	-25.539	1.186***	24.458	-15.839***	-3.234	0.404
Kuwait	-0.001***	-20.696	0.638***	20.670	2.890	1.576	0.356

A two-tailed test of significance was conducted. *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R2 (coefficient of determination) indicates how close the data are to the fitted regression line.

Note: This table presents the estimates of the model specification in equation (5):

$$CSAD_{Adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t.$$

Table 5.4 Adjustment subsample Testing Results of Herding in GCC Markets

Time series regression analysis was conducted for adjusted CSAD – purged of the return co-movements arising from Fama-French-Carhart factors – for herding in the Gulf Cooperation Council (GCC) equity markets. It provides estimates for linear and non-linear herding parameters β_1 and β_2 , respectively. This analysis is estimated for the 2006 Saudi Market Crash in Panel A, for 2008 global financial crisis period in Panel B, and for 2014 (the drop-in oil prices) in Panel C.

Country	Panel A: Saudi Market Crash 2006				Panel B: Global Financial Crisis 2008				Panel C: Recent Drop in Oil Prices 2014			
	β_1	t-stat-istic	β_2	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic
Saudi Arabia	-0.019	-0.161	2.390	0.917	0.591***	17.015	-11.516***	-10.307	0.366***	6.520	-5.444**	-2.492
Oman	0.851***	10.334	-1.588	-0.200	0.944***	31.387	-5.255***	-4.454	1.103***	33.964	-16.112***	-9.165
Qatar	0.313***	3.548	-8.206	-1.673	0.605***	17.362	-9.084***	-7.916	0.549***	13.823	-5.634***	-3.195
Dubai	0.752***	15.831	-7.320***	-5.336	0.692***	21.861	-2.391**	-2.415	0.727***	26.180	-3.716***	-4.446
Abu Dhabi	0.661***	12.514	-6.246***	-3.178	0.660***	33.071	1.704***	12.379	0.841***	18.838	-7.359***	-3.440
Bahrain	1.243***	9.757	-39.477***	-2.370	1.104***	10.097	-20.839**	-2.195	0.884***	10.534	21.545*	1.844
Kuwait	0.791***	9.004	-16.715***	-2.798	0.479***	7.819	6.121**	2.072	0.798***	7.459	-10.156	-1.132

A two-tailed test of significance was conducted. *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line.

Note: This table presents the estimates of the model specification in equation (5):

$$CSAD_{Adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t.$$

Table 5.5 displays the regression results of the relationship between dispersion and squared returns in bull and bear markets in panels A and B, respectively. For each country, the first line of the table shows the parameter estimates of the regression of CSAD on the market squared returns while the second line presents the estimates when the CSAD is cleared of with the style factor covariates. The days of a bull market from the days of a bear market are classified according to whether the value of index of the particular country has increased or decreased. The results of the regression that runs over the bull days are presented in the up-market panel of the table while the results of the bear market days are presented in the down-market panel of the table.

Table 5.5 Testing Results for Herding in Up and Down Markets

Time series regression analysis was conducted, differentiating the days of bull and bear markets, determined by whether the value of the index of the particular country increased or decreased.

Panel A - bull market ((down); Panel B - bear market (up). For each country we provide results for both CSAD and adjusted CSAD.

Country	Panel A: Down Market						Panel B: Up Market					
	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic	β_0	t-stat-istic	β_1	t-stat-istic	β_2	t-stat-istic
Saudi Arabia	0.004***	23.907	0.724***	17.068	-12.986***	-9.897	0.005***	37.147	0.391***	11.364	-2.239**	-2.335
	-0.001***	-5.653	0.379***	9.106	-12.852***	-9.981	0.000	-1.421	0.079**	2.326	-2.662***	-2.807
Oman	0.002***	39.378	0.997***	54.275	-7.728***	-10.240	0.002***	41.412	0.882***	53.704	2.995***	7.849
	0.000***	-5.657	0.167***	9.124	-7.807***	-10.368	0.000***	3.576	-0.095***	-5.780	2.835***	7.441
Qatar	0.004***	39.044	0.514***	18.835	-5.525***	-5.495	0.004***	38.486	0.629***	21.492	-9.838***	-8.271
	0.000***	-3.053	0.132***	4.841	-5.432***	-5.401	0.000***	-5.016	0.223***	7.684	-10.217***	-8.652
Dubai	0.004***	40.340	0.715***	34.570	-3.872***	-5.496	0.004***	39.087	0.728***	35.551	-2.966***	-4.699
	0.000***	-3.343	0.103***	4.977	-3.834***	-5.454	0.000***	-2.970	0.088***	4.299	-3.073***	-4.889
Abu Dhabi	0.005***	66.208	0.644***	44.132	2.072***	16.492	0.005***	67.188	0.672***	42.310	1.470***	12.705
	0.000***	7.960	-0.185***	-12.653	2.015***	16.032	0.000***	6.827	-0.163***	-10.335	1.438***	12.476
Bahrain	0.001***	13.781	1.105***	16.583	-4.819	-0.811	0.002***	12.065	1.046***	11.115	-1.892	-0.170
	0.000	-0.468	0.048***	0.717	-4.873	-0.821	0.000	-0.235	0.033	0.351	-4.352	-0.398
Kuwait	0.005***	60.173	0.520***	15.700	14.717***	8.573	0.005***	43.300	0.900***	13.925	-19.651***	-3.566
	0.000***	4.177	-0.237***	-7.155	14.747***	8.598	0.000**	-2.080	0.199***	3.085	-19.460***	-3.534

A two-tailed test of significance was conducted. *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line. This table presents the estimates of the model specification in equation (2):

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t$$

and equation (5):

$$CSAD_{Adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t.$$

The table shows that while some markets are likely in herd in both directions, others are not. For instance, the Kuwaiti market is likely to herd in an up market while the Omani market herds in a down market. The markets of Saudi Arabia, Qatar and Dubai herd in both directions of the market. It is worth mentioning here that the extent of negative non-linearity and the significance of the parameters is different in bull and bear markets. For instance, the estimated herding parameter of the Saudi market in a down market state is -12.8 and its t-statistics is -9.8. This can be compared to a parameter value of -2.2 and a t-statistics of -2.3 in a bull market. Hence, the herding evidence is stronger when the market is falling than when it is rising. The same does not apply to the rest of countries. In the Qatari market the bear market herding parameter is -5.4 and its t-statistics is -5.4. The value of these parameters in a bull market is -10.2 and -8.6 respectively and hence, herding is more pronounced during so called bullish conditions. The results are not different when we use the adjusted CSAD as our dependent variable and hence the additional value of correcting the dispersion measure is marginal in this case.

A round 50 % of capital traded in GCC markets is listed in the Saudi market.⁷⁷ Hence, the Saudi equities are expected to play an important role in the spill-over of information to other GCC markets. Hence, herding may start in Saudi Arabia and then crosses to other markets. To investigate this pattern of spill-over, we add the adjusted CSAD of the Saudi market as an additional explanatory variable and estimate equation 6. If the parameter associated with the Saudi CSAD is positive and significant, then the dispersion of Saudi equities influences the dispersion of the other country. If both countries are herding, then it is likely that there is a herding spill-over from the Saudi market to the other country's market.

Table 5.6 shows the parameter estimates together with the associated t- statistics. For each country we estimated two regressions: one with CSAD and the other with the adjusted CSAD. The results are not much different.

As can be seen in the table, the Saudi CSAD positively influence the CSAD in all of GCC countries. A relatively high co-movement in the Saudi equities that is not related to styles induce a high co-movement in other GCC countries. The herding spill-over from the Saudi market is significant in Oman, Qatar, Bahrain and Dubai. The evidence on herding

⁷⁷ There is around 1 trillion dollars of investments that are listed in the GCC markets as a whole.

in Abu Dhabi and Kuwait is not significant and hence we do not conclude a herding spill-over despite the dispersion influence.

In order to compare the regional and global influence on herding in the GCC countries we computed the CSAD of the US market.⁷⁸ Panel B of table 5.6 display the parameter that describe the influence of the US CSAD on the GCC country CSAD over the sample period: this specification replaces $CSAD_{Saudi,t}$ with $CSAD_{US,t}$ in equations 3 and 6. As can be seen from the panel, the parameters associated with US CSAD are all negative. This indicates that in the particular case of herding in the US market it is not transmitted to the GCC markets. This applies to all countries except Saudi Arabia where the influence is found to be positive and significant at the 10 % level. Therefore, we may say that the herding behaviour in GCC countries' takes influence from regional factors such as Saudi market, downward fluctuations in oil prices etc. and the information flows depicting herding in US, or for that matter global markets, have not impact on the herding tendency in GCC markets. Only exception is the Saudi market, which is susceptible to herding crosses from US equities. Table 5.7 shows the dispersion influence in the three samples under investigation. The table presents only the parameter associate with the Saudi (US) markets CSAD and its t- statistics. As before, for each country there is two rows one for the full CSAD and the other for the adjusted CSAD and the results are not different.

The table shows that there is a positive influence of the Saudi market CSAD on the other country CSAD which is robust across the three sample. The only market's dispersion which is not influenced by the Saudi market dispersion is the Qatari market during the period around the Saudi market crash and the Bahraini market in the sample that covers the drop of oil price after 2014.

Similarly, the negative influence of the US CSAD is also consistent across the three samples. The only exception is the positive and significant influence on the Dubai Financial Market and the Abu Dhabi stock exchange in the first sample around the Saudi market crash. The influence of the US CSAD on the Saudi market is found to be insignificant in the three samples.

⁷⁸The US CSAD is computed from all companies that are listed in the NYSE. The data is obtained from CRSP files only for firms with share codes of 10 and 11.

The point to take from these findings is that the co-movement and dispersion of Saudi equities influence the co-movement and dispersion of other GCC equities and there is a herding spill-over from the Saudi market to other markets in the GCC. The role that the US plays in the herding of GCC equities is not as important and, in that sense, we may say that GCC markets are regionally integrated even in their herding tendency than receiving influences from similar global spill overs.

This may be explained by the geographic proximity and the close trade and economic ties between GCC countries. Moreover, there is a lack of transparency in the markets and economies of these countries that cause investors to take correlated decisions.

Table 5.6 Cross Herding with the Saudi and the US Markets Full-Period Results

Time series regression analysis of cross herding between the Saudi and regional, Gulf Cooperation Council (GCC), markets was conducted. To compare global influences on herding in the GCC countries, we replaced Saudi estimates of CSAD, both adjusted and unadjusted, in equations 3 and 6 with US CSAD estimates. All estimates are for the full sample period. For each country, we provide results for both CSAD (first row) and adjusted CSAD (second row).

Panel A - spill-over from the Saudi equity market to the other GCC stock markets; Panel B - herding spill-over from the US equity market to the GCC equity markets

Country	Panel A: Saudi Market						Panel B: US Market					
	B ₁	t-stat-istic	B ₂	t-stat-istic	B ₃	t-stat-istic	B ₁	t-stat-istic	B ₂	t-stat-istic	B ₃	t-stat-istic
Saudi Arabia							0.558***	20.390	-7.951***	-8.076	1.328*	1.703
							0.527***	19.172	-7.656***	-7.734	1.279	1.632
Oman	0.979***	65.748	-5.348***	-8.141	0.060***	10.445	0.976***	62.071	-3.451***	-4.318	-2525.189***	-5.576
	0.984***	62.548	-6.452***	-9.290	0.061***	9.950	0.970***	58.729	-3.574***	-4.257	-3553.901***	-7.472
Qatar	0.555***	28.885	-7.811***	-10.551	0.145***	14.897	0.592***	29.653	-7.926***	-9.949	-1263350*	-1.882
	0.556***	28.900	-7.932***	-10.688	0.146***	14.855	0.592***	29.606	-8.036***	-10.064	-1286555*	-1.912
Dubai	0.745***	51.807	-4.147***	-8.798	0.042***	4.856	0.753***	52.375	-4.190***	-8.714	-3.9e+008	-0.718
	0.738***	50.362	-4.029***	-8.390	0.042***	4.708	0.745***	50.914	-4.076***	-8.324	-3.8e+008	-0.698
Abu Dhabi	0.662***	59.035	1.691***	19.251	0.095***	10.788	0.706***	63.003	1.450***	16.426	-4.3e+012***	-7.572
	0.662***	59.251	1.691***	19.320	0.096***	10.858	0.705***	63.137	1.453***	16.507	-4.4e+012***	-7.705
Bahrain	1.149***	23.654	-9.062**	-1.853	0.038***	3.767	1.162***	23.929	-9.558**	-1.950	4.22e+015	0.356
	1.173***	24.183	-15.500***	-3.172	0.039***	3.763	1.185***	24.416	-15.931***	-3.253	1.27e+016	1.079
Kuwait	0.607***	20.437	8.635***	4.939	0.082***	8.067	0.643***	21.609	8.289***	4.684	-4.3e+020	-1.435
	0.604***	19.582	3.408**	1.878	0.085***	7.962	0.640***	20.735	3.060*	1.668	-6.8e+020**	-2.178

A two-tailed test of significance was conducted. *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R² (coefficient of determination) indicates how close the data are to the fitted regression line. Note: This table presents the estimates of the model specification in equation (3):

$$CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 CSAD_{Saudi,t} + e_t$$

and equation (6): $CSAD_{adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 CSAD_{adjusted,Saudi,t} + e_t$

Table 5.7 Cross Herding with the Saudi and the US Markets, Subsamples of Market Events Testing Results

Time series regression analysis was conducted to investigate herding spill-over from the Saudi market to Gulf Cooperation Council (GCC) markets. To compare global influences on herding in the GCC countries, we replaced Saudi estimates of CSAD, both adjusted and unadjusted. Estimates are for subsample periods when there were significant market events. For each country and subsample, we provide results for both CSAD (first row) and adjusted CSAD (second row).

Panel A - spill-over from the Saudi equity market and US to the other GCC stock markets during the Saudi Market Crash, 2006; Panel B spill-over during the Global Financial Crisis, 2008; Panel C – spill-over during the Recent Drop in Oil Prices (see text).

Country	Panel A: Saudi Market Crash 2006				Panel B: Global Financial Crisis, 2008				Panel C: Recent Drop in Oil Prices			
	Saudi Market		US Market		Saudi Market		US Market		Saudi Market		US Market	
	β_3	t-stat-istic	β_3	t-stat-istic	β_3	t-stat-istic	β_3	t-stat-istic	β_3	t-stat-istic	β_3	t-stat-istic
Saudi Arabia			1.823	0.792			-1.441	-1.614			-1.397	-0.759
			1.556	0.681			-2.768***	-3.106			-7.185***	-7.185
Oman	0.044***	5.048	19823.130	0.560	0.114***	6.013	-3009.070***	-4.939	0.067***	6.164	7044.088***	2.918
	0.044***	4.956	19929.000	0.556	0.118***	5.691	-4139.710***	-6.291	0.093***	5.248	-10266.230**	-2.753
Qatar	0.008	0.357	3e+080	1.096	0.226***	8.240	-1.3e050*	-1.758	0.177***	6.791	-10130265.000	-1.064
	0.007	0.358	35e+070	1.275	0.221***	7.981	-1.4e050*	-1.820	0.222***	8.028	-23756151.000**	-2.419
Dubai	0.073***	4.059	4e+0120***	3.328	0.138***	5.532	-8.0e+080	-1.287	0.205***	8.580	-2.9e+010**	-2.042
	0.078***	4.167	5e+0120***	4.018	0.126***	4.759	-7e+008	-0.989	0.232***	8.184	-5.8e+010***	-3.667
Abu Dhabi	0.040**	2.681	1e+016	1.411	0.223***	9.156	-4e+012***	-6.548	0.148***	6.431	-6.8e+013*	-1.861
	0.045***	2.865	2.4e+016**	2.467	0.223***	8.993	-4e+012***	-6.529	0.189***	6.918	-1e+014**	-2.426
Bahrain	0.020*	1.870	-4e+019	-0.029	0.069*	1.892	3e+015	0.206	-0.004	-0.250	9.2e+018	1.258
	0.018*	1.679	1.2e+0210	0.774	0.071*	1.917	2e+016	1.210	-0.010	-0.498	9.79e+018	1.186
Kuwait	0.048***	3.366	9e+025	1.246	0.254***	8.059	-4.e+020	-1.179	0.185***	5.207	-9.6e+022	-0.811
	0.050***	3.410	1e+026	1.527	0.244***	7.171	-7e+020*	-1.720	0.216***	5.428	-1.8e+023	-1.435

A two-tailed test of significance was conducted. *, **, *** indicate the result is significant at P = 0.1, 0.05, and 0.01, respectively. The t-statistic measures the size of the difference relative to the variation in the sample data. R2 (coefficient of determination) indicates how close the data are to the fitted regression line.

Note: This table presents the estimates of the model specification in equation (3): $CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 CSAD_{saudi,t} + e_t$ and equation (6): $CSAD_{adjusted,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + \beta_3 CSAD_{adjusted,saudi,t} + e_t$

5.5 Conclusions

In this chapter we studied herding behaviour and cross herding in GCC countries from 2005 to 2016. In particular, we test for herding in individual countries and then investigate the external influence of the Saudi market's dispersion to infer herding spill-over.

The herding inference is drawn by investigating the relationship between the CSAD and the square of market returns. Under the herding scenario, the relationship should be negative and significant. But as co-movement occur due to same styles, we filter the CSAD from its covariation with four style factors: market oriented, small cap, value and momentum. These style factors are also shown to be linked to the macroeconomic fundamentals of countries and hence, co-movement due to same response to fundamental news is a by-product that accounted for by these factors.

Our results indicate that there is substantial herding in GCC equities that differs in its characteristics across countries and samples. This result is consistent with Rahman *et al.*'s (2015) findings. For instance, the Kuwaiti equities herds in market rallies and during the Saudi market crash while the Omani equities herds only in market falls but during all times. The Abu Dhabi stock exchange herds only during the period that witnessed a fall in oil prices after 2014. This finding is consistent with Balcilar *et al.*'s findings (2013).

The extent of the strength of the relationship between dispersions and squared returns or the herding evidence also differs across herding countries. This finding is consistent with Galariotis *et al.*'s (2015) findings. The relationship in the whole sample is strongest for the Dubai Financial Market followed by the Saudi market. Moreover, the strength of the relationship changes for the same country over different sub-samples. For the Saudi market it is stronger during the sample around Global Financial Crisis than in other sub-samples.

There is a positive and significant influence of the Saudi co-movement and dispersion on other markets dispersion. The influence is consistent across sub-samples and this indicates that there is herding cross-over from the Saudi market to other GCC countries. The same relationship is not found with the relationship with the US market. Hence, the GCC countries seems to be more integrated within the region than globally. This is explained by the closely integrated economies of the GCC countries, the similar cultural backgrounds and the lack of public information. All may result in herding and cross herding behaviour within the region than the influences from global changes.

Our evidence is important for fund managers as herding poses additional short-term risks that has to be accounted for or exploited. It also creates buying and selling opportunities that may result in enhanced performance.

For policy makers there is a room for improving the quality of the GCC markets by encouraging transparency and the disclosure of more information. This is expected to reduce herding and short-term volatility and to create markets that is more stable and attractive for capital.

Chapter 6: Conclusions

This chapter summarises the findings of the thesis dissertation, main contributions, the policy implications/ recommendation, and highlights the weaknesses of each study.

6.1 Overview of research process

Herding refers to the market movements that happen when investors imitate others rather than following their own beliefs and information. Herding in markets negatively influences liquidity and investments with serious implications for resource mobilisation and economic growth. It increases the risk in financial markets by decreasing the level of market stability which discourages investors with low risk tolerance from investing, disrupting the outflow of capital from financial markets. This, in turn, has severe consequences on funding, corporate valuations and economic growth.

In this study, we empirically test for the existence of herding behaviour in the Gulf Cooperation Council countries which includes: Saudi Arabia, UAE, Bahrain, Qatar, Oman and Kuwait. In order to do this, we used several models that are suitable to test for any symptoms of herding under various market conditions. The same models have also been used to assess the possibility of herding spill-over from oil, regional markets and international markets to the GCC equity markets.

We show in this study that there is significant herding in the equity markets of GCC countries. A possible explanation for this finding is the strong presence of individual investors in these markets as opposed to institutional investors. These investors ignore their private information to imitate other investors, and they are less likely to use fundamental analysis compared to institutions.

6.2 Key findings

The first part studies the influence of uncertainty in the oil market on the potential of herding in the Saudi equity market. The study is motivated by the role that Saudi Arabia plays in the global energy markets. Globally, Saudi Arabia is one of the main exporters of oil and controls a large proportion of the world's oil reserves.

In this study we correct for any potential spurious herding that result from similar investment styles or responses to fundamental information, by filtering the covariance

with fundamental factors before making any inference. We have also inferred herding from different subsamples. Herding is found to be significant in the Saudi equity market even after spurious herding was filtered out.

The herding spill-over from oil market uncertainty to Saudi equities is found to be negligible in most of the time periods considered in this study. This identifies weak or no influence of oil market uncertainty on the herding behaviour of investors in the Saudi market. This result is inconsistent with previous research (e.g., Balcilar *et al.*, 2014).

To further investigate the influence of the oil market, we have also studied the impact of oil volatility on equity herding during the OPEC meetings days. Our results show that there is significant irrational behaviour and cascading of Saudi investors on the days of OPEC meetings during the period surrounding the Global Financial Crisis in 2008. We conclude that there is some evidence that the information spill-over around OPEC meeting days may drive Saudi investors to herd particularly during periods of stress.

The second part of our study investigates the impact of mood swings on the herding behaviour of the Saudi Arabian equity market. The study examines whether Islamic events, such as Ramadan, Eid-ul-Fitr, Eid-ul-Adha, and Ashoura, impact on the behaviour of Saudi investors and encourage them to take similar investment decisions.

The motivation of this work is to see whether the same emotional mood during religious festive triggers similar investment decisions in the equity market. In drawing inference on herding, our study controls for liquidity, market returns, US market returns, US investors' sentiment, Crude oil CBOE index, global financial crisis, and the Arab Spring. Our results show that similar investment decisions and herding are more pronounced during Eid-ul-Fitr, Eid-ul-Adha and Ashoura but not during Ramadan. This finding is consistent with Yousaf *et al.*'s findings (2018).

These results contradict the research of Gavriilidis *et al.* (2016) who found that herding is significantly stronger during Ramadan than other days. Gavriilidis *et al.* (2016) and Yousaf *et al.* (2018) are the only study that we found which considered herding during Ramadan. However, this study did not cover herding during other Islamic occasions and it did not account for the liquidity factor. Moreover, the study has excluded the Saudi equity market from the sample.

Our findings in this study are novel in the sense that they are the first to look at the impact of the Islamic calendar events on similar investment decisions and herding in the Saudi

market. We found strong evidence of herding during these event days, especially when markets are falling. This study also accounts for international factors, such as US investors returns, US investors' sentiment and the global financial crisis that facilitate herding outside of event's days.

The results on the lack of cascading during Ramadan are explained by the slowdown of market activity, monitoring and trading during the holy month. This result contradicts the findings of Gavriilidis *et al.* (2016) who did not correct for illiquidity and low trading activity during Ramadan as we did.

The third study expands the sample of countries and investigates herding in the rest of GCC equities during the period that extends from 2005 to 2016. In this study, we investigate herding in market rallies as well as in market falls. We have also filtered the covariance with fundamental factors before making any inference to eliminate potential spurious herding that result from same styles or responses to fundamental information. There are substantial yet differing herding in GCC equities across the samples and countries. This result is consistent with previous research (e.g., Galariotis *et al.*, 2015). For example, during all times, Omani equities herd only in market falls but the Kuwaiti equities herd in market rallies and during the Saudi market crash. Moreover, the correlation between dispersions and squared returns is strongest for the Dubai Financial Market followed by the Saudi market, whereas the strength of the relationship changes for the same country over different sub-samples. Another motivation in this study is to examine herding spill-over from the regional Saudi equity market and from the international US market to the rest of equity markets in the GCC countries. The GCC countries are influenced by both Saudi market and the US market in terms of trade and capital flows. From this research, it can be concluded that the GCC markets are insignificantly influenced by US spill-over. However, regional factors such as the herding spill-over from Saudi market highly impacts the GCC financial markets and plays a central role. These results match our expectation as the GGC countries have correlating factors among each other such as the cultural backgrounds, legal frameworks, trade relations and geographical locations.

6.3 Contribution to Knowledge

The results of our study provide important evidence that is useful to academics, researchers, investors and market regulators. We provide fresh evidence to scholars that

substantiate the presence of herding behaviour in the equity markets of the Gulf Cooperation Council countries. The extent of herding and its presence varies across countries, market conditions, and time periods. Furthermore, we found significant equity market herding during the periods of Islamic calendar events. We have explained that with similar investment decisions that are driven by common emotional dispositions during these event periods.

There is significant spill-over of cascading from the Saudi equity market to the neighbouring equity markets of the GCC countries. The impact of the herding behaviour in Saudi equities transmits to other markets and in that sense, the Saudi market plays a central role in the spill-over of information across the markets in the region. We have also checked a possible similar role that could have been played by the US markets and found little and insignificant herding spill over to GCC equities. Therefore, we concluded that the regional factors are more important than the international factors in instigating herd behaviour in GCC countries. The weak role of oil mentioned previously also substantiate this result.

6.4 Implications for policy and practice

These empirical findings are useful for policymakers who aim at preventing market manipulation to preserve the integrity of financial markets. The main cause of herding is the dominance of retail investors' trades that are not triggered by information and that cause the markets to be volatile. Policy makers in Saudi Arabia should disclose more information to aid investors so they do not rely on other investors' trades. This will definitely improve the quality of equity markets. Providing training programs for retail investors on how investment decisions are taken before allowing them to trade may also help. Short term transactions and turnover should not be encouraged through the imposition of higher market fees and taxes. This will reduce returns on short term trading and will discourage herding behaviour.

For investors in Saudi Arabia, this study has also some implications. Investors should be aware that short term irrational behaviour may cause short term losses and therefore, they should have a longer perspective when investing in GCC markets.

Portfolio managers should be aware that the correlation of GCC equities can be higher in the short term due to common market herding in both directions. As the US market does not play an important role in triggering herd behaviour, it is a good hedge in GCC equity

portfolios. The role that oil plays is similar as it is independent from the herd behaviour of equities, particularly during normal conditions. Therefore, some allocations to oil and US equities in a portfolio of GCC equities are good for hedging the short-term fluctuations instigated by herding.

The results have also important implications for active funds who aim to enhance their performance by exploiting market inefficiencies especially during stress periods. These funds may trade with the market in order to improve their return performance.

6.5 Research limitations

The implications and the results of this study are drawn conditional on the sample that has been investigated. They are also subject to some limitations. Firstly, this research focuses only on quantitative methods to investigate investors' herding in the stock market. However, qualitative methods, such as questionnaires, can add depth to an understanding of investors' herding and why they behave like this. Due to time limits, it is difficult to undertake qualitative methods. Secondly, there are many important behavioural biases that influence investors' decision-making that could not be possible investigated in this study. These include overconfidence, overreaction and regret aversion. Thirdly, this thesis focuses on GCC equity markets, so the results are limited only to this population but still can be used to make an inference for similar countries. Fourthly, this study applies the method suggested by Chang *et al.* (2000) to measure herding behaviour in the stock market and there are other methods in the literature to measure herding. Some methods require complex calculations to determine herding, the ease of employing Chang *et al.* (2000) enables better initial understanding. This study has also not differentiated between practicing and non-practicing Muslims, which could be difficult to identify while studying the consequences of religious events.

6.6. Future research

Future research could examine these objectives using samples from developed countries such as the US and the UK and compare the results to demonstrate differences. Also, it could include other Middle East and North Africa (MENA) countries to improve the reliability of results and to increase the generalisability, whilst considering cultural, national, and social events of these countries and not just the Islamic calendar. Future research could study this association using different potential causes of financial

anomalies such as weather, national holidays and seasons. Future research may also use different herding behaviour measures such as the method suggested by Hwang and Salmon (2004). Moreover, it could gather data using personal interview technique and identify different biases such as overconfidence, availability bias, and representativeness. Finally, future research can test how market risk varies over time instead of market returns.

However, areas of study concerning mood and various events in the Islamic calendar, OPEC meetings, and comparing herding spill-over from Saudi and the US to the GCC, were imperative. These prior factors had not been considered in such detail in previous literature, therefore opening a gap in the field to determine the relationship between herding, general investor behaviour in decision making processes, the improvements to be made in policy making, and the scholarship surrounding this area.

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