RESEARCH ARTICLE

WILEY

OPEC meetings, oil market volatility and herding behaviour in the Saudi Arabia stock market

Dina Gabbori[1] | Basel Awartani[2] | Aktham Maghyereh[3] | Nader Virk[1]

[1]Accounting, Economics and Finance, Plymouth University, Plymouth, UK

[2]Department of Accounting and Finance, University of Westminster Business School, London, UK

[3]Department of Accounting and Finance, United Arab Emirates University, Al Ain, UAE

Correspondence
Nader Virk, Accounting, Economics and Finance, Plymouth University, Plymouth, UK.
Email: nader.virk@plymouth.ac.uk

Abstract

We investigate the influence of oil market volatility and hand-picked OPEC meetings data on herding tendency in the Saudi equity market. Our results show the presence of significant herding behaviour in the Saudi market; surprisingly this herding behaviour is independent of oil market volatility. Importantly, we find herding on and around the OPEC meeting days however this is only limited to a period of high global uncertainty that is, during the Global Financial Crisis period (GFC) of 2008–2010. However, when we filter out factor-based herding in the Saudi equities, we also find persistent herding in the post GFC period. These results are consistent when we assess the impact of OPEC meetings using event windows of one to 5 days before and after the announcement. In consideration of the crucial role of OPEC in determining the oil prices, we explain our results of Saudi market herding on and around OPEC meeting days for the prior announcement ambiguity and corrections before, on and after the announcements on global supply. Our results show that this tendency has originated during the GFC, has persisted in the post-GFC in the Saudi equities and surprisingly, is largely found absent in the periods when the Saudi equity market witnessed bullish market conditions. Our results are robust after accounting for common factor return variations in equity returns, the unconditional and conditional estimates of the volatility in oil prices and several event windows around OPEC meeting days.

KEYWORDS
equity market, global financial crisis, herding, oil market volatility, OPEC meetings

JEL CLASSIFICATION
G15; Q43; Q47

1 | INTRODUCTION

Herding behaviour refers to investors' tendency to ignore their information and to follow the market. In herding markets, asset prices stray from their equilibrium values and market participants' trading activity drives market mispricing. As equities depart from fair values, the increased volatility influences risk-averse investors to refrain from entering the market. Gains and losses under such conditions may have serious effects on financial

institutions and investors. In all, herding tendency is a subjective investor choice, however, in the context of developing equity markets such investor behaviour has the potential to destabilize the financial system, discourage investors, imply market manipulation, and reflect badly on overall market functioning and integrity.

The herding behaviour in a particular financial market may be triggered by trading activity and/or information originating from other related markets. For instance, the study of Galariotis, Rong, and Spyrou (2015) finds that UK equity market herding could be initiated by volatility in the US market, whereas the volatility of UK equities does not instigate cascades in US markets.[1] However, Klein (2013) documents that this transmission is bidirectional between the US and European equity markets: volatility in the European stocks results in herding in the US equity markets as well.[2] The upshot of all this research is that volatility in one market can instigate herding in other related markets with crucial implications for international hedging and diversification.

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 paper 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, Demirer, & Hammoudeh, 2013, 2014; Balcilar, Demirer, & Ulussever, 2017; Rahman, Chowdhury, & Sadique, 2015) is that we differentiate between spurious herding that results from exposures to the common fundamental risk factors and actual herding that ignores these factor variations. An additional contribution of this paper is that it investigates the herding behaviour on and around the OPEC conference meetings using hand-picked data.

In the oil-exporting countries such as Saudi Arabia, the GDP growth is largely funded by government spending, which heavily relies on oil revenues.[3] An increase in the oil price triggers economic expansions while price declines trigger recessions in such economic settings. The uncertainty in the price of oil casts uncertainty on the expected future performance of the economy and the expected cash inflows of operating companies. Potentially, this price variation affect the unsophisticated/ uninformed investors the most and may induce them to follow the crowd instead of trying to see through the smoke screens of the changes in fundamentals. Arguably, this herding is more likely in markets that are dominated by the less savvy individual investors such as the Saudi markets.

The volatility spikes in the oil price are not uncommon. During the pronounced oil volatility periods, the fundamental signals are expected to be unclear for naive investors and the potential for herding is high. There are many reasons that cause the oil price to exhibit a relatively higher volatility compared to other financial assets. The global daily consumption and production of oil are around 100 million barrels. Each day the world consumes roughly the same amount of oil that it produces. The narrow gap between the demand and the supply makes the oil price extremely sensitive to news regarding global oil production and consumption. This also makes the oil price to fluctuate profoundly during short periods of time. For instance, in 2018, oil has fluctuated between $85 and $50 per barrel. The oil price response to the recent supply shock of the shale oil production technology took the oil prices from $110 per barrel in May 2014 to $36 per barrel in January 2016.

The geopolitics, particularly in the Middle East, threatens energy supplies and influence oil prices.[4] Other examples resulting in outages in global oil supply stem from embargoes in different forms and shapes: US sanctions on Venezuela and Iran are on-going episodes that have contributed to oil market returns and volatility in recent periods. Moreover, interventions by OPEC are another contributory that introduce fluctuation in the oil price. To this account, OPEC policy to cut production to avoid global oversupply until March 2020 is one recent example.[5]

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 slower 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 have recently started to grow at a relatively higher rate. Therefore, the growth in these regions plays a pivotal role in determining the current global demand for oil. The recovery of oil prices in the aftermath of the global financial crisis in 2008 was due to the continued growth and demand coming from these markets. During the period, the oil price recovered from $50 in January 2009 to $116 by May 2011.

The oil market volatility is not limited to variations in global supply and demand shocks (Kilian, 2009) but also reflects the intense speculative activity in the market (Balcilar et al., 2017). As argued earlier, this uncertainty in energy prices influences business cycle conditions and 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 influence herding in a related market is narrow and it mainly focuses on the US and the European equity markets. A notable omission is studied tracing the impact of OPEC meetings on herding in stock markets. Guidi, Russell, and Tarbert (2006) document evidence on the effect of OPEC meetings on the US and the 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 transmission from oil to equities,[6] 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. These tests have implications for global diversification and asset allocation between oil and the equities of oil exporter countries.

Saudi Arabia is a natural choice to test the proposed assertions. It is one of the biggest global oil producers, providing 13% of global oil demand and controls 22% of the verified global oil reserves. Moreover, the dependence of Saudi market capitalization on energy is substantial and this largely explains the information transmission 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.[7] Therefore, we aim to investigate two important questions, first, a novel cross-market information transmission that is, 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 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.[8] 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 and 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, money/portfolio managers may devise their investment strategies underpinned by same fundamentals. 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 behaviours 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 has not 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 the actual herding behaviour in the market.[9]

In the context of Saudi equity herding, we find four studies: Balcilar et al. (2013, 2014), Rahman et al. (2015), and Balcilar et al. (2017). Balcilar et al. (2013) and Balcilar et al. (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 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 upmarket and when trading volume is high. Balcilar et al. (2017) go 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 paper is related to these papers and the rest of the literature on herding, but our focus on the influence of oil volatility and OPEC meetings on the herding in Saudi equities distinguishes this work from earlier reported evidence. Moreover, unlike the rest of the literature on herding, we draw inference 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 investment style-ridden free herding in the Saudi equities is related to oil market uncertainty.

Our results indicate that while the non-fundamental herding in the Saudi equities is significant, the fundamental herding is not. This highlights the importance of filtering style covariation in revealing significant herding in financial markets. The results are uniform and valid across all of the time periods investigated.

The similar co-movement of individual equities is likely to result from herding and imitating rather than from following similar investment styles and responding to fundamentals. With the exception of investing in small companies, the rest of the styles were found to be unprofitable during the sample period. The performance of the value style, the momentum style and the market oriented style was negative over the sample period. This indicate that these styles were out of favour and hence, may not be followed by individual investors in Saudi Arabia.

The herding behaviour of Saudi equities is found to be independent of the uncertainty in the oil market. This remains valid even when we examine the relationship between herding and the oil volatility during the OPEC conference meeting days or when we use conditional approximation of oil market volatility. However, we find that there is significant non-fundamental herding of Saudi equities on the OPEC conference meeting days during and after the global financial crisis (GFC) period (2008–2010). The fundamental herding during the GFC period is also significant but only at the 10% level. The Saudi equities co-move during these periods reflect the influence of the OPEC interventions in the oil market on the Saudi equities. There is neither fundamental nor non-fundamental herding on the OPEC conference meeting days in the pre GFC period.

In the periods that surrounds the OPEC conference meetings, we find significant non-fundamental herding in 1, 2, 3, 4, and 5 days windows around the OPEC conference meetings. However, the results are insignificant in the pre GFC period that is, the 2005 to 2008 period. The herding in the Saudi equities is found significant during and after the GFC periods that is, 2008–2010 and 2011–2019, respectively.

These results conform to the evidence in Guidi et al. (2006) that shows that during stressed times oil markets require more time to incorporate the OPEC decisions. Given the strong influence of variations in oil prices on the returns in the equity markets of the oil-producing countries, the inference also applies to continued herding behaviour in the Saudi market when international markets were stressed/uncertain during/after the GFC. In the pre-crisis period, herding is insignificant in the Saudi equity market and vindicates our approach to approximate herding in the Saudi equities using an adjusted CSAD measure that is clear of co-movements coming from Fama–French–Carhart investment styles/ risk factors.

Hence, Saudi equities herd on and around the days of the OPEC conference meeting particularly during the GFC period. 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 the news during stress, the ambiguity of the outcome of OPEC meetings during the crisis, and by the expectations that the decisions taken by OPEC will be crucial in determining the future stability of the oil market over the course of the GFC. The non-availability of information and resultant uncertainties may have induced market participants to copy the market on these days.

The rest of the paper is organized as follows: Section 2 contains a synopsis of the literature on herding. In Section 3, we describe the methodology. Section 4 contains a description of the data set and samples. The empirical findings of the model, the analysis of herding including the influence of oil market uncertainty can be found in Section 5. Finally, Section 6 contains some concluding remarks.

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 finds that they herd in buying /selling small companies' shares after positive/ negative returns. He also finds that herding in large-cap shares is less likely. The same results for US funds are recorded by Lakonishok, Shleifer, and Vishny (1992) and Grinblatt, Titman, and Wermers (1995).

The inference about herding in equities or equity markets is mainly driven by examining 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 the

significance of cascades in US industries during extreme market movements. The paper finds that US investors in various industries do not blindly follow other investors and that herding has no role to play in pricing US assets. Many other studies find similar results in other developed equity markets and the US. 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. Their work shows that herding behaviour can be inferred if there is a negative nonlinear relationship between the cross-sectional deviation measure of herding and average market return. Gleason et al. (2003) use the continuous record of nine ETFs traded in the US stock market, and they find that there is an 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.

In contrast to the previous studies, Hwang and Salmon (2004) detect herding using 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, market betas on all stocks go to one. This convergence is assumed to depend on some latent herding parameter that is retrieved using the Kalman filter. The method also allows for testing return dispersions net of the components of fundamental factors and those that are pure market sentiment.

Many researchers think that investors are more likely to ignore their own information and herd when they are under stress. Thus, in herding literature, many studies investigate market behaviour during extreme market conditions and crises. For instance, Lam and Qiao (2015) study 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 calm periods. Caporale et al. (2008) provide evidence on herding during periods of high fluctuations in the Athens Stock Exchange. The Markov Switching model of Balcilar et al. (2013) shows that herding is more pronounced during periods of excess volatility states in the Gulf Cooperation Council (GCC) countries. Finally, Güvercin (2016) finds that there was significant herding in the Egyptian stock market during the period of the Egyptian military takeover of the country by the Army in 2013.

Interestingly, herding is more widespread during market upturns as opposed to market downturns. The study of Caporale et al. (2008) of the Athens equity market shows that herding is more obvious during market rallies than in market falls. Lam and Qiao (2015) find similar results in the Hong Kong stock market as do Sharma et al. (2015) and Tan, Chiang, Mason, and Nelling (2008) in the Chinese equity markets. The study by Houda and Mohammed (2013) shows 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.

Information asymmetry is one of the key determinants for herding to take place in financial markets. Several studies document that investors in countries with a lower level of information transparency are more likely to herd (Bikhchandani & Sharma, 2000; K. A. Kim & Nofsinger, 2005; Wermers, 1999). 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. Other drivers of herding are based on reputational reasons, style herding and/or fads. Trueman (1994) suggests that equity analyst herd in making their forecasts even at the expense of their private information. Another form of non-informational herding may occur if the investors in a particular market are attracted to the same characteristics of companies, which promotes herding for different stock characteristics in the market (Bennett, Sias, & Laura, 2003; Nofsinger & Sias, 1999; Sias, 2004).

Herding is found to be more pronounced in emerging markets than in developed markets (Borensztein & Gelos, 2003). Other studies on developing equity markets include, Economou, Gavriilidis, Kallinterakis, and Yordanov (2015) which examine herding in frontier markets; Chang et al. (2000) and Demirer, Kutan, and Chen (2010) in Taiwan financial market; Tan et al. (2008) and Chiang and Zheng (2010)) investigate herding in Chinese equity markets; and Rahman et al. (2015) and many other assess herding in the GCC equity markets.[10] Our study is related to these studies but we are distinguished by accounting for fundamental and style co-movements in return premia before drawing our inferences on herding in Saudi equities.

Investors in one market can observe price information 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 stands a greater chance. The cross-herding among markets has been the subject of Galariotis, Rong, and Spyrou (2015) who focus on herding transmission between the US and the UK and find that there is herding spillover from the US to the UK markets but not

the other way around. Herding in the UK market is found to be beyond the movement that is required by fundamental changes in the US markets. In this paper, we follow Galariotis et al. (2015) to investigate cross herding from oil to equities to assess the role of oil volatility and information in herding formation in the Saudi market.

Herding behaviour is predicted in the Saudi market because, first, the information flows in the less developed markets such as the Saudi stock exchange are not very well organized and concentration of information is assumed to be informationally advantageous for few investors only. Second, the Saudi market is potentially dominated by individuals who are driven by emotions compared to institutional investors. In terms of herding in the Saudi market, Balcilar et al. (2013, 2014, 2017) and Rahman et al. (2015) provide important evidence while using a range of empirical methods.

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 greater and cross dispersions reduced when the regime switches to the high volatility state. In their study, the market switching to one with herding 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. Whereas, Balcilar et al. (2017) investigate herding in the conditional mean by a Markov State Switching and time-varying parameter. They link it to the speculation activity in the oil market and find that oil returns and volatility do not influence the dynamics of herding in Saudi equities, but speculation in the oil market positively influences herding. Surprisingly, this result implies that high levels of speculation in the oil market is positively associated with reduced herding in the Saudi equity market. They explain that speculation on oil is high when oil is expected to rally and that this positive news leads to more rationality and less herding in the Saudi domestic markets.

Our study is related to these studies in assessing the 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 from similar investing styles. 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. We turn now to discuss the methodology that we follow in our study.

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.[11] As can be seen, 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 can capture herding behaviour. When markets herd, dispersions are predicted to be low despite a big possible 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 linearly increase with market returns.[12] Chang et al. (2000) argue that herding violates the linearity of the relationship and that herding is indicated if the dispersion measure increases with market returns in a non-linear way at a decreasing rate. 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 transmission 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 WTI crude oil. A negative and significant β_3 coefficient would indicate that oil volatility is associated with less dispersion and herding in equity markets.

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

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

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 market herds on these days then the 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:

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

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 the introduction mentioned, spurious herding may arise as investors may respond similarly to fundamentals.[13] In order to filter the part of the CSAD that related to investor 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 establishes exposure to the general market.[14] 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.[15] The portfolio mimics the returns of growth investors who follow momentum strategies.

It is worth to mention here that literature has shown that these styles have been seen to capture fundamental information e. 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, Harris, and Michou (2003). Kessler and Scherer (2010) report a substantial relationship between momentum and the economy. All these studies provide a justification for using these styles to filter that part of the CSAD that stems from investors' similar reactions due to the same fundamental information.

The assumption that these factors capture returns on four prominent and robust stylized investment strategies is crucial if our analysis is 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 identical investment strategies or similar investor responses to the same information filters. The rest or most 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 so that 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 not herding 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

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

For the influence of oil volatility on herding we regress

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

For the tendency to herd on OPEC meeting days we estimate

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

Finally, for the effect of oil volatility during the days of the OPEC meetings, we regress

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

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 the oil market.[16]

4 | DATA SET AND STYLE FACTOR CONSTRUCTION

We collect data that includes all listed companies in the Saudi market from the January 4, 2005 to the September 30, 2019, for a total of 3,845 days. The number of listed companies by the end of the sample is 175 companies.[17] The time series of the corresponding Saudi market index and the WTI crude oil prices is also retrieved for the same period.[18] All data is obtained in US Dollars from the 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.

To investigate herding in various time periods the whole sample is divided into three subsamples. The first subsample covers the pre-GFC period that extends from the January 4, 2005 to January 1, 2008 for a total of 781 days. The second is the GFC period but pre-Arab spring sample and covers the period from the January 2, 2008 to December 17, 2010. It contains 774 days. The third and final period is the post GFC and Arab Spring sample that contains 2,291 days and runs from the December 20, 2010 to September 30, 2019.[19]

The style factors used to compute the conditional CSAD and extract the herding dispersion are constructed by pooling all companies listed in the GCC 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 an economic block that is underpinned by similar fundamentals.[20]

When constructing 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.[21]

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 the 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.[22] From the filtered data for 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 weighed to the capitalization of the companies in each portfolio. 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, we establish six portfolios: 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 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 that is, 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's 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 | RESULTS AND DISCUSSION

In Table 1, we present summary statistics of the CSAD and the regional Fama–French–Carhart style factors, The Saudi market returns are marginally negative during the sample period. Moreover, the average returns of investing in the factor portfolios are typically slightly negative with the exception of SMB strategy. The SMB portfolio has positive average returns that are significant at 1% critical t-values. The MOM strategy is the riskiest with the largest standard deviation and range of returns among all factors. While the SMB strategy is the lowest risk with a narrow range of returns.

Figure 1 compares the performance of $1 invested in each of the factor portfolios. As can be seen in the figure, a $1 dollar invested in the SMB portfolio has ended with a value of around $3.5, while a $1 invested in the market has lost almost half of its value at the end of the sample period in our work. The investments in the HML and the MOM portfolios are also underperforming. The investment in the MOM has lost more than half of its value and the investment in the HML has lost almost all of its value at the end of the sample. This indicates that the most ubiquitous anomalies that is, value and momentum factors are out of favour in the GCC region. For the fact that the returns on the style factors are capitalized weighted, this also applies to the Saudi market and shows

TABLE 1 Descriptive statistics: Factors and cross section absolute deviation

	Sample mean	*SE*	t-statistic (mean = 0)	Skewness	Kurtosis (excess)	Jarque–Bera	Minimum	Maximum
CSAD	0.01463	0.01012	89.5	3.33	21.02	77,958.3	0.000	0.132
Market factor	−0.000002	0.0152	−0.0078	−0.642	12.7	26,235.3	−0.116	0.162
SMB factor	0.000353	0.00702	3.11	0.999	29.17	137,036	−0.072	0.114
HML factor	−0.001023	0.010703	−5.92	−2.633	31.9	167,504	−0.179	0.0682
MOM factor	−0.000151	0.010879	−0.858	1.277	83.9	1,131,003	−0.144	0.243

Notes: This table presents descriptive statistics on the cross-sectional absolute deviation measure to proxy equity market herding. It is estimated using the following expression: $CSAD_t = \frac{1}{N} \sum_{j=1}^{N} |R_{i,t} - R_{m,t}|$. We also provide summary statistics on the market factor for the Saudi equity market and regional Fama–French–Carhart factors which are constructed using stocks from the Gulf Cooperation Council (GCC) markets. These factors are size factor (SMB), value factor (HML) and momentum factor (MOM).
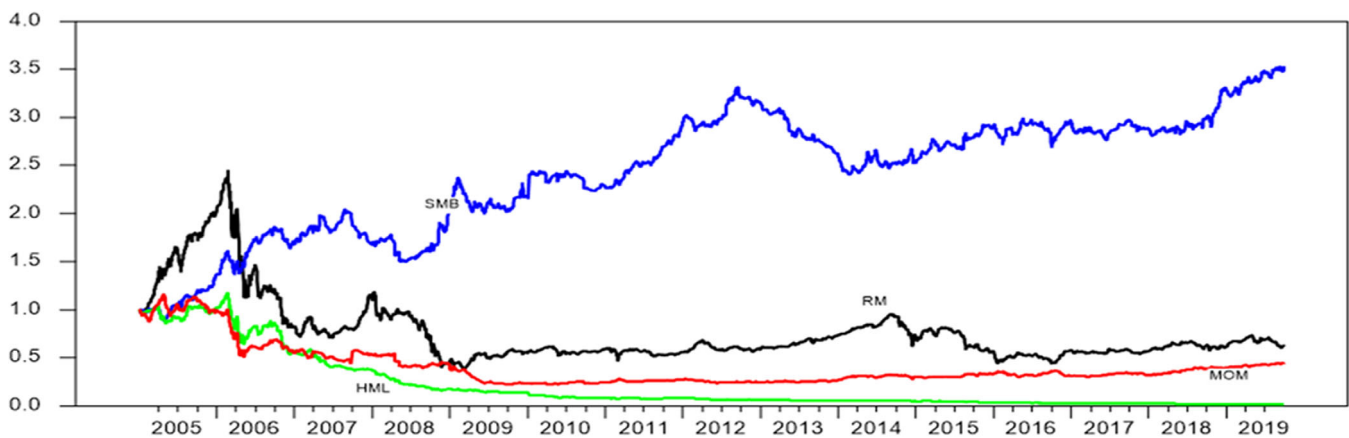
FIGURE 1 The growth of a 1 USD invested in Gulf Cooperation Council (GCC) factor portfolios (2005–2019) [Colour figure can be viewed at wileyonlinelibrary.com]

the increased information asymmetry whether that comes from company books or market trends, respectively.

Table 1 shows that the Saudi equities' daily average dispersion around the market is within the range reported in the literature (around 1.4%).[23] The CSAD ranges from around zero to 13.2%. This shows that in certain days movement around the market shrinks significantly and potentially Saudi investors could be herding. 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.

To check the dynamics of dispersion across time, Figure 1 plots a time series of the CSAD during the sample period of our study. It also plots the average of the CSAD to help create a point of reference. Figure 1 shows dispersions around the market are high and above average in the period that precedes the GFC from 2005 to 2008. Following 2008, dispersion starts to shrink and company equities tend to move closely with the market consensus

(Figure 2). Most of the days after 2009 the CSAD is below its average and, therefore, we expect herding to be significant during this period.

To see how dispersion moves with market returns, Figure 3 scatters the CSAD against market returns. It 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.

We proceed to test formally for significant herding by regressing CSAD on market absolute returns and squared market returns. The herding test results are presented in Table 2. Every Panel of Table 2 corresponds to a particular sample period and we run three regressions in each panel. The first regression includes all days and all market conditions (results are in the "all markets" row). Then we include in the regression a dummy for a bull and a bear market days and run two additional regressions.[24] The results of the regression that run over upmarket dummy are presented in the "up-market" row,
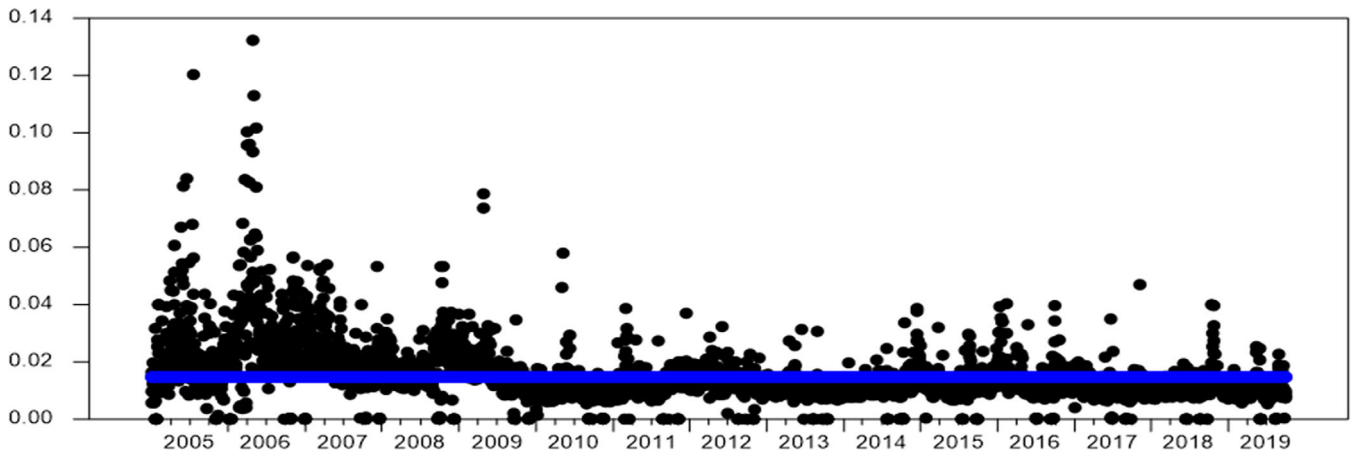
FIGURE 2 CSAD time series variation (2005–2019). *Notes*: black points are the CSAD over time, and the blue line is the average of CSAD [Colour figure can be viewed at wileyonlinelibrary.com]
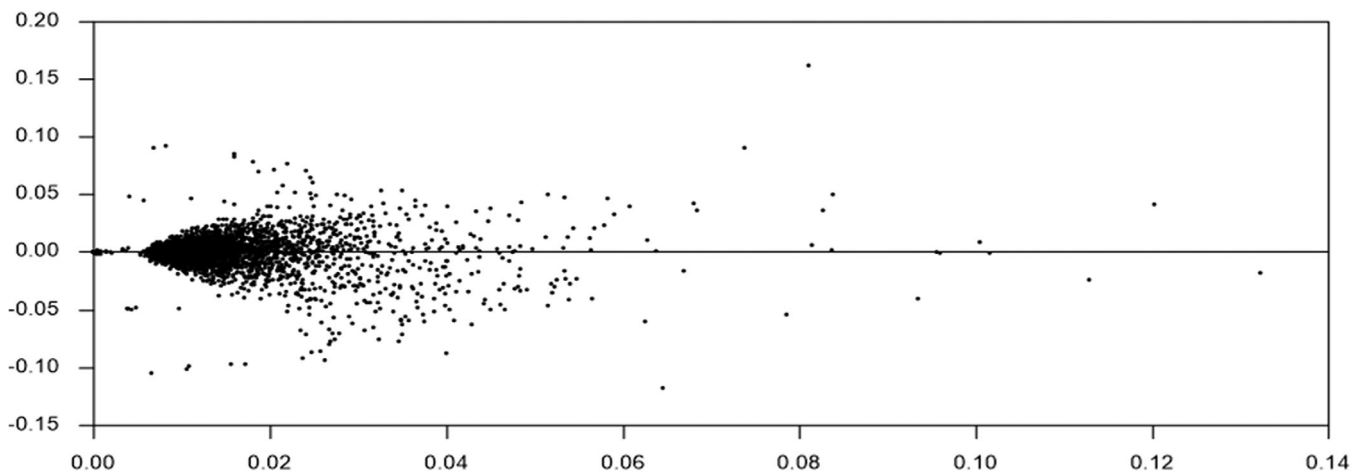
FIGURE 3 Scatter plot against the market factor

while the results of regressions run over down market dummy are presented in the "down-market" row.

Panel A shows the loadings when the regressions are run over the full sample (2005 to 2019). These results show that the linear parameter of absolute market return is positive while the parameter associated with squared market returns is negative and significant. This indicates that there was significant herding in Saudi equities during the full sample period. Hence, our results are in line with the evidence for Saudi market reported by Balcilar et al. (2013, 2014), Rahman et al. (2015), and Balcilar et al. (2017).

These results continue through all subsamples except for the sample that directly precedes the GFC (See Panel B). In this sample, the relationship between cross deviation and market returns is non-linear and negative, but insignificant, reflecting 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.[25] The oil price during this period was increasing and the flow of funds found its way through retail investors to equities, and therefore share prices had decoupled from their fundamental value in a classic example of a bubble which busted later. Hence, herding is expected in both the up and the down markets during this period.

However, as Panel B of Table 2 shows, there is strong and significant herding behaviour only in the downturn of the market while unexpectedly no significant cascades are found in the upmarket. To examine this in detail we regressed using a sample that contained only 2005 and 2006 and we find significant herding even in the upmarket as expected.[26]

The parameters associated with the down-market regressions are negative and significant during the 2005 to 2008 and the 2008 to 2010 samples. This indicates that

TABLE 2 Herding test results

	β_0	t-statistics	β_1	t-statistics	β_2	t-statistics	R^2
Panel A: 2005 to 2019							
In all markets	0.0097	25.92	0.634	8.46	−3.71	−2.54	0.264
Up market	0.0109	49.69	0.415	14.97	−0.557	−0.859	0.237
Down market	0.0104	41.55	0.498	13.77	−2.558	−3.845	0.252
Panel B: 2005 to 2008							
In all markets	0.017	18.41	0.545	4.92	−2.719	−1.610	0.146
Up market	0.0195	26.92	0.332	6.68	0.184	0.356	0.129
Down market	0.0185	23.40	0.464	7.075	−2.870	−2.740	0.149
Panel C: 2008 to 2010							
In all markets	0.00936	23.855	0.622	11.500	−5.083	−4.838	0.361
Up market	0.0112	25.35	0.311	6.20	−0.971	−0.616	0.28
Down market	0.0108	21.12	0.368	5.97	−1.89	−1.95	0.301
Panel D: 2010 to 2019							
In all markets	0.0084	55.337	0.488	17.186	−3.165	−4.906	0.360
Up market	0.0088	63.87	0.399	18.26	−2.81	−4.35	0.359
Down market	0.009	48.75	0.351	10.90	0.115	0.151	0.343

Notes: This table presents the estimates of the model specification in Equation (2): $CSAD_t = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t$. This specification retains both fundamental and non-fundamental components in the CSAD for the Saudi equity market herding and provides estimates for linear and non-linear herding parameters β_1 and β_2, respectively. This specification is estimated for full sample in panel A, for 2005–2008 in panel B, for period 2008–2010 (Global Financial Crisis period) in panel C and for the post-crisis period in panel D. The adjacent columns on the right side of each regression estimate provide t-statistics.

herding is more likely in market falls for settings of Saudi equity market type. However, in the period that follows, extending from 2010 to 2019, the Saudi market tends to herd more in a market rally rather than in a market fall as can be seen from the parameters reported in Panel D.

The parameter loadings clearly show that the shrinkage in the dispersion measure is more intense and significant in bearish markets. The parameters linked to squared returns indicate that for every unit change in market squared returns, the dispersion decreases by around 2.5% in a down market, but only by 0.5% in an upmarket. These results are not fully replicated in all subsamples, as pointed out by Panels B and C of Table 2. In the period from 2010 to 2019, herding is stronger in the up markets compared to the down markets. Hence, we may conclude that while herding, in general, is stronger and more significant when the market falls, there are periods when the market cascades in a rally are prominent as well. These results are generally in line with the literature that finds that herding is more pronounced in a crisis and down markets than it is in an upmarket.

As mentioned before, results based on CSAD do not distinguish between co-movement due to ignoring individual information (herding) or co-movement that stems from following a particular investment style and/or having the same reactions 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 displays result when we decompose the computed CSAD into $CSAD_{FUND,\ t}$ and $CSAD_{NONFUND,\ t}$, as determined by Equation (5) and the following relations. We regress both the fundamental and non-fundamental CSADs on absolute returns and squared returns. Panel A of Table 3 shows that the parameter associated with squared returns is still negative and significant. This shows that even when the shrinkage in dispersion accounts for the styles 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 investors' similar styles or reactions to the same information disclosure. In Panels B, C and D, we regress over various time periods. In all the panels of Table 3, the parameters on squared market returns are negative and significant using the non-fundamental CSAD.

With the fundamental CSAD this is only found in panel B that is, the period that precedes the GFC. It

TABLE 3 Testing results for fundamental and non-fundamental herding

	β_0	t-statistics	β_1	t-statistics	β_2	t-statistics	R^2
Panel A: 2005 to 2019							
Non-fund	−0.0047	−11.77	0.624	7.61	−3.74	−2.32	0.25
Fund	0.014	368.49	0.0092	1.11	0.029	0.178	0.028
Panel B: 2005 to 2008							
Non-fund	−0.0059	−6.13	0.508	4.68	−2.48	−1.50	0.13
Fund	0.023	224.22	0.034	3.41	−0.211	−1.898	0.028
Panel C: 2008 to 2010							
Non-fund	−0.0051	−13.00	0.623	10.90	−5.28	−4.59	0.349
Fund	0.014	264.4	−7.56e-04	−0.068	0.204	0.890	0.045
Panel D: 2010 to 2019							
Non-fund	−0.0027	−18.70	0.468	19.90	−3.50	−8.12	0.32
Fund	0.011	197.1	0.020	1.29	0.335	0.650	0.054

Notes: This table presents the estimates of the model specification in Equation (6): $CSAD_{NONFUND,t} = \beta_0 + \beta_1 |R_{m,t}| + \beta_2 R_{m,t}^2 + e_t$. This specification runs the regression on non-fundamental CSAD – purged of the return co-movements arising from Fama–French–Carhart factors. We replicate the estimation of this regression using fundamental CSAD where we replace non-fundamental CSAD with fundamental CSAD as the dependent variable in Equation (6). The estimates for linear and non-linear herding parameters β_1 and β_2, respectively, are provided and adjacent columns to regression estimates populate respective t-statistics. This specification is estimated for full sample in panel A, for 2005–2008 in panel B, for period 2008–2010 (Global Financial Crisis period) in panel C and for the post-crisis period in panel D.

seems that it is only during the 2005 to 2008 period that investors may have herded as a result of following similar investment styles and/or responding to fundamentals. For the rest of the periods, herding of equity returns observed is not spurious and it is not induced by investors' styles. This indicates that most of the non-linear negative relation that is found between dispersion and market returns stems from investors ignoring their information and following the market. Overall, our results point to the fact that there is cascading behaviour in Saudi equities especially when we filter out the fundamental part of CSAD.[27]

Table 4 presents the influence of oil volatility on the herding of Saudi equities. In columns two and four, we display the non-linear parameter of the CSAD associated with the oil market and in columns three and five we show its t-statistics.[28] We run three regressions: the first regresses the full CSAD on oil volatility (the "all deviation" row) and the second regresses the non-fundamental CSAD on oil volatility (the "non-fundamental" row) and finally the third regresses the fundamental CSAD on oil volatility (the "fundamental" row).

The parameters in columns two and four show that the parameters are largely positive and insignificant when oil volatility is estimated unconditionally. This is true in all investigated samples and, therefore, we conclude that there is no evidence of interaction between herding in the Saudi market and the volatility of the oil market. The results using the non-fundamental CSAD

are not different.. Similarly, the results of the fundamental CSAD indicate that there is no style or fundamental herding in the Saudi equities that results from changes in oil market uncertainty. The results with conditional market volatility estimates, that is, column four of the Table 4, only endorses our general conclusion that oil market volatility is unrelated with herding in the Saudi equities and this effect is statistically significant across all samples and herding measures. The estimations in the full period and period following GFC using fundamental CSAD are the only exceptions. In sum, these results show that different CSAD components, and the sum of it as well, in the Saudi equities are independent of the oil market variance.

These results contradict Balcilar et al. (2013) who find that oil is an important factor in affecting market switching states from herding to not herding and back again. However, this result conforms Balcilar et al. (2017): they find that oil returns and volatility do not influence herding in Saudi equities and that speculation in the oil market matters.

To check if there is herding around the OPEC meeting days, we run a regression on the multiplication of the GARCH volatility of oil returns and a dummy that takes a value of 1 around the OPEC meeting days and zero otherwise. Four windows are investigated: 1, 2, 3, 4 and 5 days before and after the OPEC meeting day. The parameters associated with the multiplicative term with its t-statistics are reported in Table 5. The coefficients on

TABLE 4 Volatility spillovers from the oil market testing result

	β_3	t-statistics	β_3	t-statistics
Panel A: 2005 to 2019				
All deviations	0.1017	1.135	0.771	3.61
Non-fund	0.0986	1.10	0.824	3.93
Fund	0.0026	0.258	−0.053	−1.70
Panel B: 2005 to 2008				
All deviations	0.203	0.222	12.06	3.31
Non-fund	0.231	0.255	11.24	3.11
Fund	−0.048	−0.418	0.715	1.26
Panel C: 2008 to 2010				
All deviations	0.341	2.85	2.23	10.26
Non-fund	0.327	2.794	2.19	10.19
Fund	0.013	1.20	0.036	1.03
Panel D: 2010 to 2019				
All deviations	0.173	1.31	0.621	2.55
Non-fund	0.179	1.61	0.928	3.92
Fund	−0.007	−0.162	−0.307	−3.68

Notes: This table presents the estimates from the regression Equation (3) using CSAD inclusive of fundamental and non-fundamental deviations and from Equation (7) using non-fundamental CSAD – purging the return co-movements arising from Fama–French–Carhart systematic GCC factors, respectively. For completeness, these regressions are also fitted using $CSAD_{FUND,\ t}$. The β_3 in the second column of the table is on squared oil market return that is, $R^2_{o,t}$ (Equations (3) and (7)) and β_3 in the fourth column of the table is oil market volatility estimated from GARCH (1,1) model that we notate by $\hat{\sigma}^2_{o,t}$ [Equations (3) and (7)]. These specifications are estimated for full sample in panel A, for 2005–2008 in panel B, for period 2008–2010 (Global Financial Crisis period) in panel C and for the post-crisis period in panel D. The adjacent columns on the right side of each regression estimate provide t-statistics.

the conditional oil volatility during the OPEC meeting windows are insignificant and hence we conclude that oil volatility, whether estimated conditionally or unconditionally, is unrelated to herding – either of fundamental and the non-fundamental parts – in the Saudi equities. This result appears to be valid for varying time periods that extend from 1 day to 1 week before and after the OPEC conference meeting day. The result is also uniform across all sub-samples.

Table 6 presents the effect of the OPEC announcements on the Saudi equity herding, specifically these results correspond to Equation (4) for total CSAD and its two components. Column 8 and Column 9 display the coefficient β_3 on the interactive variable, accounting for OPEC meeting days and squared market returns, and it's associate t statistics. The regression estimates on the interactive term are significant for non-fundamental herding during the GFC period. For the rest of the periods, this effect is insignificantly estimated. However, we note that sign on the interactive term is economically meaningful in the full sample and the sample preceding GFC as well. The only exception is the sample covering the period of 2010–2019. This applies to unfiltered,

fundamental and non-fundamental herding in the Saudi equities.

One explanation for these results could be that the Saudi market is sensitive OPEC news/declarations regarding the prospects of oil price discovery and global supply during the heightened stress periods such as GFC of 2008–2010. Since 2008, Saudi equities have dropped by more than 50%, as the country is mainly dependent on oil, and Saudi equity herding oil news sensitivity to mitigate ambiguity in the GFC. The different quotas and energy policies of the OPEC members may have introduced further 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 during this period may have led to herding in the Saudi equities. Essentially, the OPEC meetings function as a signalling mechanism in the Saudi market herding during global crises or perhaps in periods when global supply uncertainties are large.

On the contrary, over the 2005–2008 period oil demand and oil prices were high and except for the crash in late 2006, the Saudi equity market had not been

TABLE 5 Volatility spillovers from the oil market on and around the OPEC meeting testing results

	[−1d to +1d]		[−2d to +2d]		[−3d to +3d]		[−4d to +4d]		[−5d to +5d]	
	β_3	t-statistics	β_3	t-statistics	β_3	t-statistics	β_3	t-statistics	β_3	t-statistics
Panel A: 2005 to 2019										
All deviations	1.391	0.943	1.265	1.31	1.400	1.79	1.460	2.01	1.300	1.96
Non-fund	1.403	0.902	1.31	1.321	1.39	1.74	1.44	1.97	1.271	1.90
Fund	−0.015	−0.118	−0.051	−0.603	0.0017	0.025	0.0097	0.154	0.0265	0.464
Panel B: 2005 to 2008										
All deviations	−4.49	−0.81	−2.73	−0.658	−2.095	−0.526	−0.484	−0.136	0.250	0.079
Non-fund	−4.06	−0.75	−1.90	−0.462	−1.54	−0.391	−0.239	−0.068	0.357	0.114
Fund	−0.480	−0.659	−0.885	−1.537	−0.600	−1.266	−0.293	−0.589	−0.158	−0.350
Panel C: 2008 to 2010										
All deviations	1.18	1.04	0.807	1.17	0.930	1.80	0.91	1.74	0.66	1.30
Non-fund	1.03	0.871	0.675	0.96	0.766	1.45	0.82	1.63	0.549	1.12
Fund	0.14	0.730	0.131	1.085	0.163	1.96	0.092	1.016	0.111	1.50
Panel D: 2010 to 2019										
All deviations	1.47	1.14	1.06	0.99	0.885	1.06	0.264	0.37	−0.038	−0.063
Non-fund	0.99	0.85	0.93	0.98	0.835	1.081	0.361	0.55	0.095	0.167
Fund	0.48	1.08	0.12	0.34	0.049	0.188	−0.097	−0.45	−0.13	−0.669

Notes: This table presents the estimates from variants of the regression Equation (4a), using CSAD inclusive of fundamental and non-fundamental deviations, and 8a using non-fundamental CSAD – purging the return co-movements arising from Fama–French–Carhart systematic GCC regional factors. For completeness, these regressions are also fitted using $CSAD_{FUND, t}$. The β_3 estimates in the second, fourth, sixth, eighth and tenth columns of the table are on contemporaneous fitted oil volatility, instead of squared oil market returns, that is given by GARCH(1,1) model, for 1, 2, 3, 4 and 5 days before and after the OPEC meeting day. These specifications are estimated for full sample in panel A, for 2005–2008 in panel B, for period 2008–2010 (global financial crisis period) in panel C and for the post-crisis period in panel D. The adjacent columns on the right side of each regression estimate provide t-statistics.

stressed during the period. Between 2005 and 2008 global oil production was almost equivalent to global oil consumption and any disruption to supplies or changes in demand would have created short term shortages and would have increased oil 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. However, as shown by our results, the increasing price pressures do not bring cascades in the Saudi equities. This is probably because when the equity market is not distressed, and oil prices are relatively high, market participants are less interested in oil news and OPEC meetings.

Surprisingly, there is fundamental herding in Saudi equities on the days in which the OPEC conference meetings are held but only during the period from 2008 to 2010. These results are significant at the 10% significance level. Hence, the investors in the Saudi market follow the investment styles on these days. This contributes and enforces the overall herding observed during the GFC. For the rest of the period, the style investments are less

pronounced and the majority of the herding originates from non-fundamental investment decisions.

To see whether the validity of these results persists around the OPEC meeting days. We repeat our analysis using four windows extending from 1 to 5 days before and after the conference day. Specifically, we insert 1 in the time series on "n" days before and "n" days after the event where n assumes values from 1 to 5. Table 7 shows the results regarding the significance of the herding parameter that is associated with the squared market returns around OPEC event windows. The reported results reinforce our earlier finding that herding is significant during the global financial crisis period from 2008–2010: the non-fundamental CSAD is significantly influenced by the interaction term in Equation (4) in all the event windows. However, these results show that the effect of the interactive term that is, OPEC meeting and squared market returns also results in herding in the non-fundamental component during the post-GFC sample period, see panel D in Table 7. For the rest of the periods herding is insignificant. There is no evidence of fundamental herding around the OPEC meetings: the

T A B L E 6 Herding on the OPEC conference meeting day testing results

	β_0	t-statistics	β_1	t-statistics	β_2	t-statistics	β_3	t-statistics	R^2
Panel A: 2005 to 2019									
All deviations	0.00974	25.8	0.636	8.46	−3.73	−2.55	−3.85	−0.698	0.264
Non-fund	−0.0047	−11.77	0.626	7.62	−3.76	−2.33	−3.84	−0.643	0.253
Fund	0.014	368.0	0.0092	1.116	0.029	0.178	−0.0067	−0.012	0.028
Panel B: 2005 to 2008									
All deviations	0.0178	18.3	0.55	4.98	−2.795	−1.642	−8.29	−1.46	0.149
Non-fund	−0.0059	−6.17	0.518	4.74	−2.55	−1.54	−7.94	−1.25	0.133
Fund	0.023	223.6	0.035	3.42	−0.21	−1.91	−0.33	−0.42	0.028
Panel C: 2008 to 2010									
All deviations	0.0093	23.89	0.624	11.52	−5.11	−4.86	−18.01	−4.56	0.362
Non-fund	−0.0051	−13.0	0.625	10.92	−5.31	−4.60	−15.57	−4.18	0.34
Fund	0.014	264.7	−4.8e-04	−0.043	0.20	0.87	−2.43	−1.82	0.046
Panel D: 2010 to 2019									
All deviations	0.0084	55.3	0.487	17.11	−3.15	−4.89	3.28	1.95	0.360
Non-fund	−0.0027	−18.65	0.467	19.8	−3.49	−8.11	1.42	1.63	0.32
Fund	0.0111	197.5	0.020	1.25	0.342	0.663	1.85	1.76	0.055

Notes: This table presents the estimates from the regression Equation (4) using CSAD inclusive of fundamental and non-fundamental deviations and from Equation (8) using non-fundamental CSAD – purging the return co-movements arising from Fama–French–Carhart systematic GCC regional factors, respectively. For completeness, these regressions are also fitted using $CSAD_{FUND,\ t}$. The β_2 and β_3 in the fifth and seventh columns of the table are on squared market returns that is, $R^2_{m,t}$ and on the OPEC meeting dummy variable interacted with the squared market return that is, $DUM_t R^2_{m,t}$. This specification is estimated for full sample in panel A, for 2005–2008 in panel B, for period 2008–2010 (Global Financial Crisis period) in panel C and for the post-crisis period in panel D. The adjacent columns on the right side of each regression estimate provide t-statistics.

significant coefficients on the interaction variable are estimated with an opposite sign to what is expected. For example, 4-day event window in the period preceding GFC, 3-day event window during GFC, and all event windows in the period following GFC that is, panel D. Only sign of fundamental herding is found in a 2-day event window in the period preceding GFC (see Panel B of Table 7).

Hence, we conclude that most of the herding observed in Saudi equities is coming from non-fundamental sources and that the contribution of following of similar investment styles (and assuming similar factors) is sporadic and mostly implies otherwise. Furthermore, herding is independent of the oil market volatility, but we find robust evidence of non-fundamental herding on and around the OPEC conference meeting days. The non-fundamental herding is also found after the GFC period when assessing the impact of OPEC meetings using several event windows around the OPEC meetings.

6 | CONCLUSION

In this paper, we study the herding behaviour in the Saudi equity market. The main tests include analyzing the influence of oil market volatility and the effect of OPEC meetings on herding behaviour in the Saudi equity market. The investigation covers various periods between 2005 and 2019. In particular, we look into the pre- and post-financial crisis samples along with the GFC period (2008–2010).

Unlike previous studies, we draw our herding inference by accounting for potential spurious herding that may arise when investors have the same strategies or responses 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 are 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. Equities herded on and around the days of OPEC meeting, but only during the GFC period and this disappears with the start of global recovery in 2010. However, our results show that the separation of non-fundamental herding from the total

TABLE 7 Herding around the OPEC conference meeting testing results: Various time windows

	[−1d to +1d]		[−2d to +2d]		[−3d to +3d]		[−4d to +4d]		[−5d to +5d]	
	β_3	t-statistics	β_3	t-statistics	β_3	t-statistics	β_3	t-statistics	β_3	t-statistics
Panel A: 2005 to 2019										
All deviations	−1.53	−0.397	−0.14530	−0.10901	0.74018	0.43761	−0.01428	−0.01129	0.11764	0.09678
Non-fund	−1.69	−0.419	−0.23266	−0.17311	0.62451	0.35882	−0.24873	−0.18813	−0.05572	−0.04372
Fund	0.166	0.572	0.08850	0.65298	0.11723	0.94668	0.23584	2.13679	0.17487	1.52064
Panel B: 2005 to 2008										
All deviations	−4.08	−0.675	−1.57763	−0.99286	−0.91948	−0.48859	−1.43002	−1.01891	−1.35370	−0.99729
Non-fund	−4.18	−0.700	−1.23796	−0.79237	−0.74505	−0.40258	−1.47762	−1.04464	−1.36683	−0.99957
Fund	0.110	0.178	−0.33337	−1.87827	−0.16630	−0.87955	0.05531	0.29837	0.02142	0.12286
Panel C: 2008 to 2010										
All deviations	−2.18	−1.58	−2.15894	−1.73295	−1.40950	−0.96503	−2.94724	−2.84828	−3.05781	−3.02599
Non-fund	−2.93	−2.39	−2.80064	−2.46772	−2.33070	−1.64605	−3.54274	−3.64092	−3.41042	−3.71385
Fund	0.751	1.53	0.64170	1.22411	0.92120	2.91587	0.59550	1.30292	0.35261	0.74239
Panel D: 2010 to 2019										
All deviations	0.055	0.059	−0.25604	−0.31385	−0.39330	−0.50337	−0.82942	−0.94597	−0.99002	−1.05977
Non-fund	−1.24	−1.65	−1.56536	−2.11690	−1.91475	−2.40013	−2.25505	−2.31036	−2.35250	−2.31308
Fund	1.30	3.35	1.30932	3.37033	1.52145	3.00199	1.42563	3.18378	1.36248	3.25783

Notes: This table presents the estimates from the regression Equation (4) using CSAD inclusive of fundamental and non-fundamental deviations and from Equation (8) using non-fundamental CSAD – purging the return co-movements arising from Fama–French–Carhart systematic GCC regional factors, respectively. For completeness, these regressions are also fitted using $CSAD_{FUND,\ t}$. The β_3 estimates in the second, fourth, sixth, eighth and tenth columns of the table are on the interaction term of OPEC dummy that value of 1 during the event window and squared market return. The event windows are 1, 2, 3, 4 and 5 days before and after the OPEC meeting day. This specification is estimated for full sample in panel A, for 2005–2008 in panel B, for period 2008–2010 (Global Financial Crisis period) in panel C and for the post-crisis period in panel D. The adjacent columns on the right side of each regression estimate provide t-statistics.

herding is illuminating: around the OPEC meeting days, the non-fundamental herding is present even in the post of the GFC period. These results inform existing research on behavioural decision biases for equity markets in natural resource-abundant countries as well as emerging equity markets.

Our results indicate that Saudi equity herding mainly is non-fundamental and it originates from ignoring own information and imitating other investors. The evidence that herding results from following similar investment styles or responding to similar fundamental factors are weak.

These findings are important for policymakers 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 when global uncertainty is high such as GFC 2008–09.

The absence of influence of oil volatility on the herding of equity markets in oil-producing countries has important implications for 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 OPEC during stressed global times.

DATA AVAILABILITY STATEMENT

In reference to the "Expects data" policy of the journal, I note that the datasets used in the work are from licensed data portal i.e. DataStream that restricts us from sharing data. In this case sharing data will compromise legal requirements and thus cannot be shared. Nonetheless, appropriate acknowledgements are provided in the data sections to know from where to source the same datasets. However, the data that support the findings of this study are available from DataStream - a licensed third-party database. Restrictions apply to the availability of these

data, which were used under license for this study. Data are available from the DataStream.

ORCID

Nader Virk https://orcid.org/0000-0001-6338-2198

ENDNOTES

[1] This conforms nicely with the empirical literature that finds a unidirectional information spillover from the US to numerous international equity markets.

[2] For expositional convenience, we interchangeably use herding behavior, herding tendency or simply herding to imply the same.

[3] Government spending constitutes around 50% of aggregate spending.

[4] The oil price had jumped from $47 in July to $67 in August 1990 after the Iraqi invasion of Kuwait.

[5] For details see here: https://www.reuters.com/article/us-global-oil/oil-steadies-on-opec-cuts-but-oversupply-fears-persist-idUSKCN1TV119.

[6] For more on oil equity linkages see Maghyereh and Al-Kandari (2006), Park and Ratti (2008), Filis, Degiannakis, and Floros (2011), Arouri and Nguyen (2010), Awartani and Maghyereh (2013), Bouri, Awartani, and Maghyereh (2016), Maghyereh and Awartani (2016), Maghyereh, Awartani, and Bouri (2016), Awartani, Javed, Maghyereh, and Virk (2018) and references therein. The increase in oil prices increases costs and reduces company cash flows and values. 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.

[7] 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.

[8] See for instance, Christie and Huang (1995), Chang, Cheng, and Khorana (2000), Caporale, Economou, and Philippas (2008), Gleason, Lee, and Mathur (2003), Hwang and Salmon (2004), and Demirer and Kutan (2006).

[9] 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-folds and has improved style returns measurement.

[10] There are also the studies by Balcilar et al. (2014, 2017), Youssef and Mokni (2018), and Chaffai and Medhioub (2018).

[11] 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.

[12] 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.

[13] 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.

[14] The Saudi Arabian Monetray Authority (SAMA) repo rate is used to proxy the risk free rate.

[15] More details about the construction of these factors can be found in the next section.

[16] We have also estimated another version of Equation (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.

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

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

[19] 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.

[20] 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.

[21] 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.

[22] We follow Ince and Porter (2006) and Griffin, Kelly, and Nardari (2010) in their industry codes to remove non-equity securities and to filter the equity data.

[23] The average daily reported CSAD in similar studies ranges from 0.5 to 3%. See Rahman et al. (2015) and Gavriilidis, Kallinterakis, and Tsalavoutas (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 6.5%, which is comparable to the monthly US equity return dispersion reported by Christie and Huang (1995).

[24] The bull and bear days are separated based on the Saudi market index returns.

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

[26] Results for these two years are not displayed, but they are available from the authors upon request.

[27] The 2005 and 2006 regressions show significant herding. These are available upon request.

[28] The results in columns 2 and 3 are based on an oil volatility that is measured using squares returns. The results in columns 4 and 5 are based on an oil volatility that is measured by a GARCH (1,1) process.

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How to cite this article: Gabbori D, Awartani B, Maghyereh A, Virk N. OPEC meetings, oil market volatility and herding behaviour in the Saudi Arabia stock market. *Int J Fin Econ*. 2020;1–19. https://doi.org/10.1002/ijfe.1825