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An Empirical Investigation of Herd Behaviour in Surplus Economy: Evidences from Muscat Stock Market

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Abstract: This study investigates herd behaviour in the surplus economy of the Sultanate of Oman under Bear and Bull market conditions. The first aim of the study is to determine if the investors at Muscat Stock Market (MSM) exhibit herd behavior or not. The second aim of the study is to compare the different stochastic time-series models commonly used to test and forecast herd behavior. Finally, the study aims to determine whether herd behavior in the MSM is predominantly risk-driven as measured by Cross-Sectional Standard Deviation (CSSD) or return-driven as measured by Cross-Sectional Absolute Deviation (CSAD) of stock returns from the overall market return. Our analyses are based on daily Muscat Stock Market's (MSM) index returns for the period starting 1st of January 2010 and ending 31st of December 2019, the pre Covide-19 pandemic. Our findings disclose: (1) that MSM exhibits herd behavior, (2) that there are statistically significant among the different stochastic time-series models used to test and forecast herd behavior in MSM, where ARIMA (1,0,0) model exhibits the highest predictive power of herd behavior in MSM (3), that MSM's herd behavior is driven more by CSSD than CSAD in the bearish and bullish market conditions.

Keywords: Herd Behaviour, Cross Section Absolute Deviation, Cross Section Standard Deviation, Muscat Stock Market, Bearish Market, Bullish Market

1. Introduction

Muscat Stock Market (MSM) was established in 1989. By the end of 2019, it ranked fourth among the seven Gulf Cooperation Council (GCC) stock markets with its 111 listed companies, while it ranked sixth with its US$ 17.12 billion market capitalization. In the same year, MSM exhibited a Retrieved Stock Market Turnover (RSMT) of 10.4, coming second after the Abu Dhabi Securities Market (ADX), which had an RSMT of 10.51[1]. RSMT is calculated by dividing the total value of traded shares by their market capitalization and is used to compare markets on the matter of liquidity.

In line with Avery and Zemsky (1998) herd behavior in financial decision-making is defined as following market trends [3], rather than adhering to the principles of economically-rational decision-making. Similarly, Smith and Sorensen (2000) define herd behavior in stock markets as the imitative behavior of individual investors [19], who disregard their own information, and rather rely on the overall market trend when making trading decisions. Since the early 1990s, herd behavior has been an area of interest to economics and finance researchers, and post the 2007-2008 Global Financial Crisis (GFC), the attention to such behavior has even remarkably increased. This growing attention has been basically built on Chang et al.'s (2000) call for confirming the existence of herd behavior during times of economic stress and uncertainty [6].

1 Data is based on Theworldeconomy.com data extracted 10.03.2020

2. Literature Review and Hypotheses

In compliance with Chang et al. (2000), Munkh-Ulzii et al. (2018) investigated herd behavior in 13 Asian countries and reported strong evidence of such behavior [6, 17]. Further, Mulki and Rizkianto (2020) analyzed data from the BRICS stock markets (for the period 1997-2017) and reported the existence of herd behavior in these markets [16]. Furthermore, in an attempt to inspect herd behavior using Chang et al.'s (2000) model [6], Filip et al. (2015) reported evidence of herd behavior in the Czech Republic, Hungary, Romania, and Bulgaria during the GFC (2008-2010) [10]. However, Filip et al. (2015) conveyed that such behavior was absent in Poland, and attributed this absence to the fact that the Polish market was characterized by a higher level of information efficiency, as compared to the other markets involved in the study [10]. Moreover, herd behavior in GCC stock markets has been reported. For instance, Balcilar et al. (2014) found evidence of herd behavior in all Gulf countries except for Qatar [4].

Nevertheless, despite the fact that herd behavior in financial markets has been rather extensively addressed in academic research, two voids in knowledge still exist. First, no research was conducted to compare the different stochastic time-series models used to test and forecast herd behavior. Second, there is an ambiguity concerning whether herd behavior is driven more by absolute return or by the standard deviation of return. In an attempt to fill those two knowledge gaps, we will test the two following hypotheses:

H_1: There are statistically significant differences among the different scholastic time-series models used to test and forecast herd behavior in MSM.

H_2: Herd behavior in the MSM stock market is more risk-driven.

3. Methodology

3.1. Data Collection

Because herd behavior is typical of transitory nature, we build our analyses on time-series data of daily MSM's index returns for the pre-COVID-19 period, starting 1st of Jan. 2010 and ending 31st of Dec. 2019. Data were obtained from Thomson Reuter's database, which constitutes a reliable source of GCC stock markets data as reported by Al-Shboul, 2012; Balcilar *et al.*, 2014; Chaffai & Medhioub, 2018; Chiang *et al.*, 2010; Galariotis *et al.*, 2016; Klein, 2013 [2, 4, 5, 7, 11, 13].

3.2. Measures of Herd Behavior

In this study, herd behavior is conceptualized as the condition where individual investors disregard the essentials of rational asset-pricing and guiding information, and, instead, follow the overall market trend (Lindhe, 2012) [15]. According to Christie and Huang (1995) [9], the impact of herd behavior in a financial market can be assessed in terms of the dispersion of individual stocks returns around the average market return. In this context, an increase in dispersion signifies a non-herding behavior, while a decrease in dispersion indicates herding behavior (Lindhe, 2012) [15]. In this milieu, if investors think and behave differently, performances of individual stocks would considerably vary. Conversely, when individual investors think and act alike and engaged in herd behavior, stock returns would not exhibit as much variation and would cluster around the overall market return. In the following paragraphs, we discuss two common measures of dispersion of individual stock return: (1) Christie and Huang's (1995) CSSD -as a proxy of risk-driven herd behavior [9]; and (2) Chang et al.'s (2000) CSAD -as a proxy of absolute return-driven herd behavior [6].

3.2.1. Christie and Huang's (1995) CSSD

The formula for computing CSSD is as follows:

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

Where:

$CSSD_t$ is the cross-sectional standard deviation of the index returns at time t,

$R_{i,t}$ is the index return at time t,

$R_{m,t}$ is the average return of the sample at time t, and

N is the sample size.

As aforementioned, in line with Christie and Huang (1995) [9], herd behavior only occurs during stressful market conditions, where people fail to rationalize their decisions and find it easier to follow other investors. In this context, stressful conditions are defined as conditions where market returns fall at the tails of their distribution. The corresponding regression model is:

$$CSSD_t = \alpha + \beta^{up} D_t^{up} + \beta^{down} D_t^{down} + \varepsilon_t \quad (2)$$

Where:

A denotes the average dispersion of the sample that is not captured by the dummy variables,

D_t^{down} is a dummy variable that takes the value of 1 if the market index return falls at the lower tail at 95% and 99% of the index distribution and zero otherwise, and

D_t^{up} is a dummy variable that takes the value of 1 if the market index return falls at the upper tail at 95% and 99% of the index distribution and zero otherwise.

Thus, the null and alternative hypotheses are as follows:

H_0: $\beta^{down} < 0$ (i.e. herd exists when returns fall at the lower tail of the returns' distribution – bearish market)

$\beta^{up} < 0$ (i.e. herding exists when returns fall at the upper tail of the returns' distribution – bullish market)

H_2: $\beta^{down} \geq 0$ (i.e. herding does not exist when returns fall at *the* lower tail of the returns distribution)

$\beta^{up} \geq 0$ (i.e. herding does not exist when returns fall at the *upper* tail of the returns distribution)

If the dummies' coefficients are negative and statistically significant at the 95% confidence interval, we fail to reject the null hypothesi and conclude that herd exists in stressful market conditions. Conversely, if the coefficients are positive and statistically significant, we reject the null hypothesis, and conclude that adverse herd exists in the market during stressful conditions.

3.2.2. Chang et al.'s (2000) CSAD

Building on Christie and Huang's (1995) work [9], Chang et al. (2000) developed the CSAD of returns as a method to detect herd behaviour [6]. Chang et al. argue that, when the market is stable, asset-pricing models disclose a non-linear relationship between individual stock returns and the overall market return. As per Chang et al., during periods of market uncertainty, herd behavior exists, and such behavior would cause the relationship to become non-linear, and would also decrease the level of dispersion. As such, the dispersion of individual stock returns would decrease, or at least increase at a less than-proportional rate, with the overall market return (Chiang & Zheng, 2010) [8]. Thus, the method of Chang et al. (2000) [6], being more absolute return-oriented, is better for detecting herd behavior during all market conditions (normal and stressful). Additionally, the CSAD is less sensitive to outliers than the CSSD. Chang et al.'s (2000) formula for computing CSAD is as follows:

$$CSAD_t = \frac{\sum_{t=1}^{N} |R_{i,t} - R_{m,t}|}{N} \quad (3)$$

Where:
$R_{i,t}$ is the index return at time *t*,
$R_{m,t}$ is the average return of the sample at time *t*, and
N is the sample size.

$$CSAD_t = \alpha + \beta^{down} D_t^{down} + \beta^{up} D_t^{up} + \varepsilon_t \quad (4)$$

Chang et al. (2000) argue that herd would increase the correlation of stock returns [6], and that the linear relationship proposed by the CAPM, which normally exists between individual stock returns and the market return, would become nonlinear when herd occurs in the market.

We use the modified regression model proposed by Lee, Chen, and Hsieh (2013) [14]:

$$CSAD_t = \alpha_0 + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t \quad (5)$$

Where:
$R_{m,t}$ Is the average return of the sample at time t.
$|R_{m,t}|$ Is the absolute market return at time *t* to account for *the* magnitude and not the direction of the market, and
$R_{m,t}^2$ Captures the nonlinear relationship that would arise *due* to herd.

A negative, significant γ_3 coefficient would indicate the presence of herd behavior. Because the relationship between CSAD and market returns can be asymmetric in bull and bear markets, Lee et al. (2013) split model 5 into two equations to measure herd behavior in bull and bear markets [14].

In bull markets:

$$CSAD_t^{Up} = \alpha + \gamma_1^{Up} |R_{m,t}^{Up}| + \gamma_2^{Up} R_{m,t}^{Up\,2} + \varepsilon_t, \text{ if } R_{m,t} > 0 \quad (6)$$

In bear markets

$$CSAD_t^{Down} = \alpha + \gamma_1^{Down} |R_{m,t}^{Down}| + \gamma_2^{Down} R_{m,t}^{Down\,2} + \varepsilon_t, \text{ if } R_{m,t} < 0 \quad (7)$$

Where, a negative, significant γ_2^{Up} coefficient would indicate the presence of herd behavior in bullish markets, and a negative, significant γ_2^{Down} coefficient would indicate the presence of herd behavior in bearish markets.

4. Findings

4.1. Descriptive Statistics of MSM's Index Returns

Table 1 summarizes the descriptive statistics for daily MSM's index returns using the CSSD and the CSAD methods. Under the CSSD method, returns averaged 0.001588 with a St. Dev. of 0.002920, 0.002652 with a St. Dev. of 0.004476, and 0.00252 with a St. Dev. of 0.003902 in the entire, bullish and bearish markets, respectively. Under the CSAD method, returns averaged 0.003551 with a St. Dev. of 0.003689, 0.00405 with a St. Dev. of 0.004882, and .001963 with a St. Dev. of 0.003365 in the entire, bullish and bearish markets, respectively.

Reported descriptive statistics in table 1 reveal non-normal distributions of returns in the entire, bullish, and bearish markets under CSSD and CSAD methods. In either method, returns are positively skewed in the three markets, indicating a high probability of earning excess returns. Furthermore, the high kurtosis statistics reported in table 1 confirm the non-normal distributions of returns in the three markets under CSSD and CSAD methods indicating a high risk in bullish and bearish markets. Under the CSAD method, the greatest kurtosis is exhibited in the bearish market, showing a high probability that MSM's herd behavior is driven more by absolute return in the bearish market than in the bullish-market conditions. Using the CSSD method to detect the existing herd behavior in MSM, the greatest kurtosis was exhibited in the bullish market indicating that the herd behavior of MSM is strongly driven by risk in bullish-market conditions. Under both methods, CSSD and CSAD, standard deviations of daily returns are higher in bullish markets, indicating that the MSM exhibits higher return volatility in the bearish market.

Table 1. *Descriptive Statistics for Daily MSM's Index Returns.*

Statistics	Using CSAD			Using CSSD		
	Entire Market	Bullish Market	Bearish Market	Entire Market	Bullish Market	Bearish Market
Minimum	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Maximum	0.113627	0.147611	0.113627	0.093580	0.147611	0.121577
Mean	0.003551	0.004805	0.001963	0.001588	0.002653	0.002152
Mean Standard Error	0.000057	0.000076	0.000052	0.000045	0.000069	0.000060
Standard Deviation	0.003689	0.004882	0.003365	0.002920	0.004476	0.003902
Skewness	11.09393	10.51559	10.40716	9.299049	9.781659	8.669715
Kurtosis	277.9496	256.7271	295.7794	242.5273	268.6826	216.3265

Source: Author calculation based on Reuters Thomson databases for MSM

4.2. Analysis of Fitted Time-Series Models for Forecasting MSM Index Returns

We tested a number of fitted time-series models for forecasting MSM's stock market index returns. These models are: (A) Random walk, (B) Random walk with drift, (C) Constant mean, (D) Linear trend, (E) Quadratic trend, (F) Simple moving average of two terms, (G) Simple exponential smoothing with alpha = 0.0291, (H) Brown's linear exp. smoothing with alpha = 0.0167, (I) Holt's linear exponential smoothing with alpha = 0.208 and beta = 0.001, (J) ARIMA(1,0,0), (K) ARIMA(2,0,0), (L) ARIMA(2,1,1), (M) ARIMA(2,0,1).

Table 2 summarizes the statistical performances of the selected models in fitting the historical data. The table displays the Root Mean Squared Error (RMSE) of each model, along with the results of the following tests: (1) test for excessive runs up and down (RUNS), (2) test for excessive runs above and below the median (RUNM), (3) Ljung-Box's test for excessive autocorrelation (AUTO), (4) test for difference in Mean 1st half to 2nd half (MEAN), and (5) test for difference in variance 1st half to 2nd half (VAR). Each of the statistics is based on the one-ahead forecast errors, which are the differences between the actual data value at time t and its forecasted value at time t-1. The Integrated Moving Average ARIMA(1,0,0) -Model J- has been selected to forecast the behaviour of MSM index returns (RMSE = 0.0088291).

Table 2. *Fitted Time-series Models for Forecasting MSM's Stock Market Index Returns.*

Model	RMSE	RUNS	RUNM	AUTO	MEAN	VAR
(A)	0.0111598	***	***	***	OK	***
(B)	0.0111611	***	***	***	OK	***
(C)	0.0091181	***	***	***	***	***
(D)	0.0091183	***	***	***	**	***
(E)	0.0091138	***	***	***	**	***
(F)	0.0103902	***	OK	***	OK	***
(G)	0.0090694	***	***	***	OK	***
(H)	0.0091009	***	***	***	OK	***
(I)	0.0093128	***	***	***	OK	***
(J)	0.0088291	**	***	***	**	***
(K)	0.0088291	***	***	***	**	***
(L)	0.0088300	***	***	***	OK	***
(M)	0.0088305	**	***	***	**	***

Notes: An OK means that the model passes the test ($p \geq 0.05$), *,**, and *** means that it fails at the 95%, 99%, and 99.9% confidence levels, respectively.

Figure 1 illustrates that the residuals fluctuate around zero, the mean of the series with lagged order of one (p=1), zero order of differencing (d=0), and a moving average window of zero (q=0). This means that the herd behaviour of MSM can be detected in one day since p is equal to one. Figure 2 illustrates the actual time series of the price index along with 95% confidence limits and forecasts. According to the goodness of fit criteria, MSM's index return follows ARIMA (1, 0, 0).

Reported Results in table 2 and illustrated by figures 1 and 2 provide support to the first hypothesis that there are statistically significant differences among the different scholastic time series models used to test and forecast herd behavior in MSM.

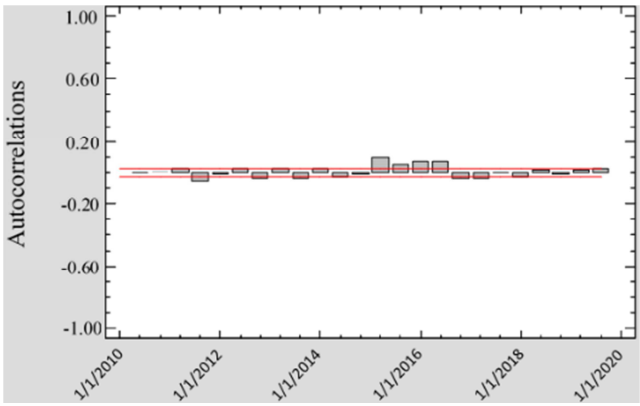

Figure 1. *Residual Autocorrelation for MSM's $R_{m,i}$ ARIMA(0,0,1).*

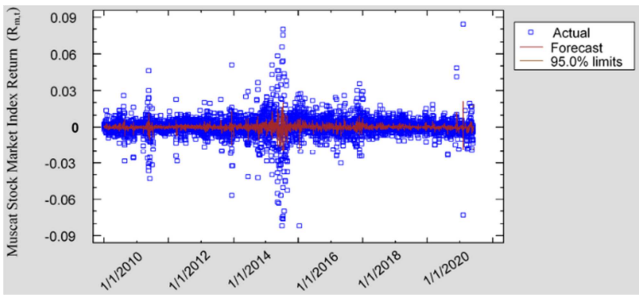

Figure 2. *Time Sequence Plot for MSM's $R_{m,i}$ ARIMA(0,0,1).*

4.3. Analysis of the MSM's Empirical Results Based on CSAD

Given R^2 and P-values reported by panel (A) of table 3, the model testing the behaviour of MSM's entire, bullish, and bearish stock markets is highly significant, at the level of 1%. Thus, the used stochastic time-series model is valid and efficient in detecting MSM behaviour. The higher R^2 for MSM bullish and bearish markets than for the entire market suggest that the MSM index should be investigated differently according to the direction of the market. The CSAD's R^2 of MSM index return shown by panel (A) of table 3 reveals that the model can explain 25.7%, 44.1% and 40.6% of the herd behaviour for the MSM's entire, bullish, and bearish markets, respectively. Also, reported results by panel (A) of table 3 indicate that the explanatory power of detecting the herd behaviour in MSM by CSAD models is higher for the bullish market than for the bearish market and the entire market, where the R^2 of CSAD = 44.1% and 40.6% for the markets bullish and bearish, and 25.7% for the entire market.

As shown by panel (A) of table 3, the reported positive and significant coefficient of $\gamma_{1,MSM}$ explains that CSAD of MSM's index return increase with the increase in the average index return at the rate of 0.556, 0.757, and 0.978 for the entire, bullish and bearish markets, respectively. The

negative coefficient of $\gamma_{2,MSM}$ documents the non-linear relationship between CSAD and the average MSM's daily index return. It shows that CSAD increases (decreases) at a decreasing rate when the average index return increases (decreases), providing evidence of herd behaviour in MSM's stock market. Panel (A) of table 3 shows that MSM has stronger herd behaviour when the stock market is bearish than when it is bullish, explained by a higher negative coefficient for the bearish market (-0.450) than the bullish market (-0.118). These results indicate that investors in MSM are more sensitive to loss than to absolute terms.

4.4. Analysis of the MSM's Empirical Results Based on CSSD

In terms of CSSD and as shown by panel (B) of table 3, used models to predict the herd behaviour of MSM's stock market index are statistically significant at the level of 1% on the basis of *P*-value for the entire, bullish, and bearish markets. The higher R^2 of CSSD's model for the bullish than for the entire and bearish markets, as reported by panel (B) of table 3, shows higher predictive power of bullish market than for the entire and bearish markets. Selected model can explain 44.7%, 41.3% and 26.0% of the behaviour of MSM bullish, bearish, and entire markets.

As shown by panel (B) of table 3, the positive and significant coefficients of $\gamma_{1,MSM}$ for the entire, bullish and bearish markets indicate that the CSSD of MSM's index returns increases with an increase in the average index return at the rate of 0.571, 0.774 and 0.993 for the entire, bullish and bearish markets respectively. Reported negative coefficients ($\gamma_{2,MSM}$) by panel (B) of table 3 provides evidence of herd behaviour for the entire, bullish, and bearish markets of MSM. The negative coefficient of $\gamma_{2,MSM}$ indicates that CSSD for the up and down MSM index return increases (decreases) at a decreasing rate when the average index return increases (decreases), providing evidence of the existence of the herd behaviour in the bullish and bearish markets. Panel (B) of table 3 evidence strong herd behaviour in the bearish market than in the bullish market explained by the negative coefficients of 0.465 for the bearish market and 0.135 for the bullish market.

Table 3. *Regression Results Using CSAD and CSSD.*

Coefficients	Panel (A): Using CSAD			Panel (B): Using CSSD		
	The Entire Market	Bullish Market	Bearish Market	The Entire Market	Bullish Market	Bearish Market
α	---	---	---	---	---	---
P-Value	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
VIF	---	---	---	---	---	---
$\gamma_{1,Oman}$	0.556***	0.757***	0.978***	0.571***	0.774***	0.993***
P-Value	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
VIF	4.072	3.007	3.705	4.072	3.007	3.705
$\gamma_{2,Oman}$	-0.058***	-0.118***	-0.450***	-0.072***	-0.135***	-0.465***
P-Value	(.032)	(.000)	(.000)	(.007)	(.000)	(.000)
VIF	4.072	3.007	3.705	4.072	3.007	3.705
R^2	25.7%	44.1%	40.6%	26.0%	44.7%	41.3%
F-Value	718.778***	1641.397***	1426.200***	731.365***	1685.329***	1465.044***
P-Value	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)

Notes: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.
VIF: Variance Inflation Factor for Multicollinearity.

5. Conclusion

The study findings provide support to the first hypothesis that there are statistically significant differences among the different scholastic time series models used to test and forecast herd behavior in MSM. Further and consistent with Chiang and Zheng's (2010) model [8], our results suggest the existence of herd behavior in MSM, both when markets are bullish and bearish. Results of statistical analyses provided support to the study's second hypothesis that herd behavior in MSM is more risk-driven than return-driven, as reflected in the significantly greater capability of CSSD than CSAD of stock returns to indicate herd behavior.

The observed herd behavior of investors in MSM goes in line with Balcilar et. al. (2014) [4] and is anticipated when investors lack publicly-available information and follow those whom they believe have a better capability of making informed decisions. In line with our findings, all GCC stock markets have been consistently obtaining an average Regulatory Index score close to 0.7 out of the maximum 2.5 scores (The Global Economy). As per Abdallah and Ismail (2017) [1], this is indicative of a lack of information transparency in the GCC stock markets.

For a more enlightened interpretation of the study findings, it should be noted that, in GCC markets (which involve the MSM), ownership of financial assets is highly concentrated among wealthy families, and governmental and quasi-government institutions (Santos, 2015) [18]. Institutional investors' domination of GCC stock markets was also confirmed by Kern (2012) [12], who underlined the importance of such investors in GCC economies, which had been factually limited to native investors, and have only lately experienced the presence of foreign investors.

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