Remeasuring Sectoral Herding in the Financial Markets

Mohammad K. Elshqirat[1]

[1] School of Management, Walden University, Minnesota, U.S.A

Correspondence: Mohammad K. Elshqirat, Minnesota, U.S.A. E-mail: mohammad.elshqirat@waldenu.edu

Abstract

Herding behavior was concluded to exist in some sectors and under some market conditions in the Jordanian stock market when measured using the cross-sectional absolute deviation. The purpose of this study was to retest the existence of the sectoral herding using the cross-sectional dispersion of betas and compare the results with those reached using the measure of the cross-sectional absolute deviation. Behavioral finance theory represents the main base on which this study was built. In this study, the researcher tried to answer questions related to whether herding behavior exists in the Jordanian market and its sectors if measured using cross-sectional dispersion of betas and whether results will be different from those reached using other measures. In this quantitative study, data from Amman stock exchange were used and the period covered was from 2000 to 2018. These data were used to calculate the cross-sectional dispersion of betas which was tested using t-test, Kruskal–Wallis test, Mann-Whitney U test, and Wilcoxon Signed-Rank test. Results indicated that herding behavior existed in market and in each sector at the same level which was not affected by the financial crisis. Furthermore, the study revealed that herding level was the same when the market (sector) was rising and when it was falling and this similarity has not been changed by the occurrence of the global financial crisis. Finally, results indicated that herding was at its lowest level in the entire market and in the industrial sector during the time of financial crisis. These results are different from those of the study conducted in Jordan using cross-sectional absolute deviation which implies that using different herding measures yields different results.

1. Introduction

Herding behavior in the financial markets can increase the gap between the actual and the expected prices of stocks (Cakan, & Balagyozyan, 2016). This means that herding in the market causes loss to investors by pushing the prices to unexpected levels. Based on this, the problem is that herding behavior can lead the market to be inefficient where the prices are determined by other variables than the relevant information (Hilal, 2015). The specific problem is that there are many measures of herding to choose from and use to detect the behavior (Demirer & Zhang, 2018) and that using different measures can lead to different decisions about the existing of herding behavior in a given market or sector (Vieira & Pereira, 2015). Herding behavior may be concluded to exist in a financial market if a given measure is used while the behavior may be concluded as absent using another measure. This conflict of results may confuse investors about whether their price expectations will be affected by anomalies like herding or not. The existing of herding is an important factor that should be considered by investors because if it exists, prices of stocks will be different than those expected based on the available information (Filip, Pochea, & Pece, 2015). Many studies were conducted in many countries to test the existence of herding using only one measure (Akinsomi, Coskun, & Gupta, 2018; ; Dutta, Gahan, & Panda, 2016; Nasarudin, Noordin, Law, & Yahya, 2017; Sharma, Narayan, & Thuraisamy, 2015; Trenca, Pece, & Mihut, 2015). The conclusions of these studies may have provided misleading indicators about the existence of herding in their markets if the conclusions of other measures are different. To sum up, conclusion about herding existence may differ based on the measure used to detect the behavior (Vieira & Pereira, 2015).

Like many other countries, herding in the Jordanian stock market was studied using one measure only and at market level (Ramadan, 2015; Nasarudin et al., 2017) and at market and sectors levels (Elshqirat, 2019). This study was conducted to achieve the objective of examining the existence of the behavior of herding in Jordan at market and at sectors level using different measure than those used before and then compare the results with the other measures. Achieving this objective may help in understanding how different measures can lead to different

conclusions about the existence of herding in the financial markets. This study may contribute to the literature by revealing the results of testing herding behavior at market and sectoral level using the standardized herd measure in an emerging market like Jordan and compare these results with the results of other measures. To make the conclusions of this study comparable with the study of Elshqirat (2019), who studied the behavior in Jordan at market and sectors level using the cross-sectional absolute deviation (CSAD), the same four hypotheses used in that study were used in this study. The first hypothesis was about testing the existence of herding in the Jordanian market at market-level and at sector-level. Hypothesis two was about the influence of the global financial crisis on herding in the market and sectors while the third hypothesis was created to examine the behavior when market and sector indices are rising and when its falling. The last hypothesis was formulated to test the difference in the effect of market and sector rising and falling on herding before the financial crisis and after it. All hypotheses were tested based on the cross-sectional dispersion of betas introduced by Hwang and Salmon (2009).

2. Literature Review

2.1 Herding Behavior

Herding behavior can be defined as the act of copying the investment actions of other investors in the market (Senarathne & Jianguo, 2020). The presence of herding behavior in a financial market can cause a gap between the actual value of a stock in the market and its intrinsic value (BenSaïda, Jlassi, & Litimi, 2015). According to Indārs, Savin, and Lublóy (2019), herding can be an intentional or unintentional behavior. Unintentional herding exists when investors take the same investment decisions because they have the same information while intentional herding occurs when investors take the same investment decision because they want to copy the decisions of other investors (Adem & Sarıoğlu, 2020). Unintentional herding can lead the market to be efficient while intentional herding can bring inefficiency to it (Adem & Sarıoğlu, 2020). This last fact about intentional and unintentional herding may be true because if all investors are taking their decisions based on the available information then this information will be reflected in the prices and the market will become efficient. If investors are just imitating the decisions of others then, prices will not reflect the available information but it reflects the behavior pattern of investors which means that the market is inefficient.

Herding in financial markets is a behavior that exists in many countries such as United States and United Kingdom (Galariotis, Rong, & Spyrou, 2015), Turkey (Adem & Sarıoğlu, 2020), Pakistan (Shah, Shah, & Khan, 2017), China (Mahmud & Tini ç 2018), Jordan (Elshqirat, 2019), Germany (Kremer & Nautz, 2013), Nigeria and Kenya (Guney, Kallinterakis, & Komba, 2017), Spain (Andreu, Gargallo, Salvador, & Sarto, 2015),), Saudi Arabia (Rahman, Chowdhury, & Sadique, 2015), Tunisia (Hammami & Boujelbene, 2015), and Kuwait & Qatar (Demir & Solakoglu, 2016). The conclusions of these studies indicated that herding can be considered a global anomaly that affects the efficiency of many financial markets. Testing the existence of herding in the financial markets using different measures than those utilized in these studies may be of a great value in proving whether the behavior truly exists in these countries or not.

2.2 Measures of Herding Behavior

The presence of herding in the financial markets has been tested using many measures, these measures can be classified into two groups (Demirer, Lien, & Zhang, 2015): the first group is concerned with the relationship between the movement of stocks' returns and the movement of market returns while the second group is concerned with measuring herding by studying the concurrent or succeeding changes in the investor's ownership of the stock. The first group includes the measures of: cross-sectional standard deviation (CSSD) of dispersion of returns introduced by Christie and Huang (1995), the cross-sectional absolute deviation (CSAD) of returns introduced by Chang, Cheng, and Khorana (2000), the measure of cross-sectional dispersion of betas introduced by Hwang and Salmon (2004), and the standardized herd measure developed by Hwang and Salmon (2009). The measures of Hwang and Salmon belong to the first group but it uses the CSSD of systematic risk (beta) instead of the CSSD of returns (Khan & Rizwan, 2018). The second group includes the measures of Lakonishok, Shleifer, and Vishny (1992) and the measure introduced by Sias (2004).

There is no preference for one measure over another; researchers used all measures to detect herding in many markets all around the world. Herding was tested using CSSD measure by Vieira and Pereira (2015); Zafar and Hassan (2016); Lee, Liao, and Hsu (2015); Dutta, Gahan, and Panda, (2016); Ababio and Mwamba (2017); Mertzanis and Allam (2018); and Sharma (2019). CSAD measure of herding was utilized in many studies including Cakan and Balagyozyan (2014); Demirer, Kutan, and Zhang (2014); Mobarek, Mollah, and Keasey (2014); Gavriilidis, Kallinterakis, and Tsalavoutas (2016); Filip, Pochea, and Pece (2015); Demirer and Zhang (2018); and Akinsomi, Coskun, and Gupta (2018). Moreover, many researchers used the measure of Hwang and

Salmon (Güvercin, 2016; Krokida, Spyrou, & Tsouknidis, 2017; Lin, (2017); Teng, 2018). The measures of the second group, Lakonishoket al. (1992) and Sias (2004), were also used in many studies to measure herding behavior (Boyd, Buyuksahin, Haigh, & Harris, 2016; Cai, Han, Li, & Li, 2019; Choi, 2016; Fang, Lu, Yau, & Lee, 2017; Popescu & Xu, 2018). In addition, many studies were conducted using more than one measure including Shrotryia and Kalra (2019) who used three measures of CSSD, CSAD, and a modified CSSD measure introduced by Yao, Ma, and He (2014). Adem (2020) and Yousaf, Ali, and Shah, (2018) tested the behavior using CSSD and CSAD measures. Chen and Demirer (2018) tested herding using measures of CSSD, CSAD, and the measure of Hwang and Salmon (2004) while Nikulina and Bouev, (2018) used measures of CSSD, CSAD, Hwang and Salmon measure, and a measure developed by Munoz Torrecillas, Yalamova, and McKelvey (2016).

The same results about the presence of herding were concluded using different measures in some studies including the study of Shrotryia and Kalra (2019) and Yousaf, et al. (2018). On the other hand, testing the existence of herding using different measures may yield different results (Vieira & Pereira, 2015). In the same study, herding may be claimed to exist using one measure and concluded to be absent using another. For instance, Adem (2020) tested the behavior using CSSD and CSAD and found that each measure gave a different result about herding presence in Istanbul exchange. In that study, herding behavior during market rising was absent using CSSD measure but existed using CSAD measure. Another example is when Khan and Rizwan (2018) found that herding was absent in all sectors of Pakistani market using CSAD measure while they detected herding in two sectors using the CSSD measures. Finally, Hilal (2015), concluded that herding was absent when tested using both CSSD and CSAD while it existed using Hwan and Salmon measure. In Jordan, herding was tested using CSSD and CSAD measures by Al-Shboul (2012) who concluded that different measures resulted in different decisions regarding the presence of herding in Jordan. In addition, Chen (2013) examined herding behavior in many countries at market-level including Jordan and found that the behavior was absent when measured using CSSD while it existed when measured using CSAD and the measure of Hwang and Salmon (2004). Herding behavior at sector-level in the Jordanian stock market was not tested before using Hwang and Salmon measure. This study adds to the literature by filling the gap of detecting herding behavior using the measure of Hwang and Salmon (2009) at sectors level, by testing herding when the sector index is rising and when its falling, and by testing herding before and after the financial crisis. Moreover, the study may verify the existence of herding in the Jordanian market at market and sectors level by comparing its results with the results of previous study that tested herding in Jordan using another measure.

2.3 Cross-Sectional Dispersion of Betas

This measure of herding belongs to the group of measures that detect herding by testing the movement of the stock's returns compared to the movement of market returns. CSSD and CSAD use the dispersion of returns from the market to detect herding while the measure of Hwang and Salmon uses the dispersion of stocks' betas from the equilibrium to detect the behavior (Khan & Rizwan, 2018). When investors in the financial market herd, the betas of capital asset pricing model (CAPM) will deviate from what it should be in the equilibrium and its cross-sectional dispersion will become less than that in the equilibrium (Hwang & Salmon, 2004). The measure of cross-sectional dispersion of betas was first introduced by Hwang and Salmon (2004) and they test it in the stock markets of the United States, United Kingdom, and South Korea. The first measure of Hwang and Salmon was a state space model that includes the following equations (Hwang & Salmon, 2004):

$$\text{Log}[\text{Stdc}(\beta^b_{imt})] = \mu_m + H_{mt} + \upsilon_{mt}$$
$$H_{mt} = \varphi_m H_{mt-1} + \eta_{mt} \tag{1}$$

Where $\text{Stdc}(\beta^b_{imt})$ is the cross-sectional standard deviation of the stocks' betas, $\mu_m = E[\text{Log}[\text{Stdc}(\beta_{imt})]$, H_{mt} is the herding effect, $\upsilon_{mt} \sim iid\ (0,\sigma^2_{m\upsilon})$, and $\eta_{mt} \sim iid\ (0,\sigma^2_{m\eta})$. If herding exists in the market, $\sigma^2_{m\eta}$ will have a significant value while if its value is zero, herding behavior is absent (Hwang & Salmon, 2004). This measure was adjusted by Hwang and Salmon (2009). The two equations for the new herding measure were as follows (Hwang & Salmon, 2009):

$$H_{mt} = \frac{1}{N_t} \sum_{i=1}^{N_t} (b^s_{imt} - 1)^2 \tag{2}$$

$$H_{mt}^* = \frac{1}{N_t} \sum_{i=1}^{N_t} \left(\frac{b_{imt}^s - 1}{\hat{\sigma}_{Eit} / \hat{\sigma}_{mt}} \right)^2 \qquad\qquad (3)$$

Where H_{mt}^* is the standardized herd measure, N_t is the number of stocks at time t, b_{imt}^s is the observed estimate of beta of stock i at time t, $\hat{\sigma}_{Eit}$ is the sample standard deviation of the ordinary least squares (OLS) residuals, and $\hat{\sigma}_{mt}$ is the sample standard deviation of market excess return at time t. The lower the value of H_{mt}^* the higher the standardized beta herding (Hwang and Salmon, 2009). If H_{mt}^*=0, then perfect standardized beta herding exists because this is the minimum value of the measure.

The measure of herding calculated in Equation 2 is called "beta-based herd measure" while the measure in Equation 3 is called the "standardized herd measure" (Hwang and Salmon, 2009) and it has the advantage of dealing with herding as a dynamic behavior that changes over time rather than a static phenomenon (Krokida, Makrichoriti, & Spyrou, 2017). This measure can be used to test herding at market-level and sector-level (Hwang and Salmon, 2009). In this study, I used the standardized herd measure calculated in equation 3 to detect herding in the Jordanian stock market at both levels of market and sectors. The standardized herd measure was utilized in many studies to measure herding behavior including the study of Krokida, Spyrou, et al. (2017) who used the measure to measure herding and study its relationship with liquidity and the study of Jokar, Shamsaddini, and Daneshi (2018) who utilized the measure to estimate herding variable and include it in their model which was developed to test the effect of investors' behavior and management on the stock returns in the Iranian market. In Jordan, studies conducted to detect herding using Hwang and Salmon's standardized herd measure are absent at market and at sectoral level. This study may contribute to the literature by revealing the results of testing herding behavior at market and sectoral level using the standardized herd measure in an emerging market like Jordan and compare these results with the results of other measures.

2.4 Hypotheses

Four hypotheses were developed to achieve the purpose of measuring herding behavior in the Jordanian stock market and its sectors using the standardized herd measure. Following Elshqirat (2019), each hypothesis was divided into two sections: the first section is related to the entire market and the second section is related to each sector. The purpose of the first hypothesis was to test the existence of herding in the market and in its sectors while the second hypothesis was formulated to examine the effect of the financial crisis of 2008 on the presence of herding in the market and sectors. The third hypothesis was about whether the existence of herding behavior is different during market (sector) rising and falling. The last hypothesis was formulated to test whether the effect of market conditions of rising and falling on the presence of herding was the same before the financial crisis and after it. For each hypothesis there were two sub-hypotheses, the first sub-hypothesis was related to the market (denoted with m like H1$_m$) and the other sub-hypothesis is related to the sectors (denoted with s like H1s). The study hypotheses were as follows:

H1$_m$: Herding exists in the Jordanian stock market

H1s: Herding exists in each sector of the market

H2$_m$: Existence of herding behavior in the market is not the same prior to and post financial crisis

H2$_s$: Existence of herding behavior for each sector is not the same prior to and post financial crisis

H3$_m$: Existence of herding behavior is not the same during conditions of market increasing and decreasing

H3$_s$: Existence of herding behavior is not the same during conditions of sector increasing and decreasing

H4$_m$: The effect of market increasing and decreasing on the existence of herding behavior is different prior to and post financial crisis

H4$_s$: The effect of sector increasing and decreasing on the existence of herding behavior is different prior to and post financial crisis

3. Method

3.1 Research Data

All companies that were listed on Amman Stock Exchange from January, 2000 to December, 2018 were included in this study which is the same period covered by Elshqirat (2019). The total number of listed companies as on

December 31, 2018 was 191 companies while the total number of companies included in the study was 85 companies from which 33 companies were from the financial sector, 19 companies were from the services sector, and 33 companies were from the industrial sector. Companies that became unlisted during the study period were excluded. For the purposes of testing the hypotheses related to the global financial crisis, the same two sub-periods in Elshqirat (2019) were used: 2000 – 2007 (before financial crisis) and 2009 – 2018 (after the financial crisis). The ASE free float index was used to calculate the market return for the covered period and the interest rates on the Jordanian treasury bills were used as the risk-free rate of return for the same period. Monthly closing prices for the ASE index and for the included stocks for the period from January 2000 to December 2018 were obtained from the website of ASE while the interest rates on the treasury bills were obtained by email from the central bank of Jordan who provides such information to the public through its website and email. Beta's of stocks were estimated using the standard capital asset pricing model (CAPM) and then the data were used to calculate the standardized herd measure presented in Equation 3.

3.2 Research Design

This quantitative study was conducted to examine the existence of herding in the stock market of Jordan and its sectors, to examine the effect of the financial crisis on the presence of herding, to test the impact of market and sector increasing and decreasing on the existence of herding, to examine the effect of financial crisis on the herding presence when market and sectors increasing and decreasing, and to compare the results with those of the other measure used before.. These objectives were achieved using the standardized herd measure which consists of the dependent variable of the herding measure (H_{mt}^*) and the independent variables of stocks beta (b_{imt}^s), the sample standard deviation of the OLS residuals ($\hat{\sigma}_{Eit}$), and the sample standard deviation of market excess return ($\hat{\sigma}_{mt}$).

3.3 Variables Definitions

Beta of the stock with the market (b_{imt}^s): is the sensitivity of the rate of return of the stock to the change in the rate of return for the market (Dzaja & Aljinovic, 2013). This variable can be calculated using the following equation (Matar, 2016):

$$b_{im}^s = \frac{\text{COV }(R_i, R_m)}{\sigma^2 R_m} \tag{4}$$

Where R_i is the rate of return of stock i, R_m is the rate of return on the market, and $\sigma^2 R_m$ is the variance of the market return. This variable was estimated using the standard capital asset pricing model by regressing the stock's excess return on the market excess return.

Beta of the stock with the sector (b_{ist}^s): is the sensitivity of the rate of return of the stock to the change in the rate of return for the sector. This variable can be calculated as follows:

$$b_{is}^s = \frac{COV\ (R_i, R_s)}{\sigma^2 R_s} \tag{5}$$

Where R_i is the rate of return of stock i, R_s is the rate of return on the sector, and $\sigma^2 R_s$ is the variance of the sector return. This variable was estimated using the standard capital asset pricing model by regressing the stock's excess return on the sector excess return.

Market excess return: is the rate of return on the market index for a given holding period (one month) less the risk-free rate of return for the same period

Rate of return on the stock (R_i): is the realized rate of return on stock i that actually generated during the month. This return is calculated as follows (Elshqirat, 2019):

$$R_{i,t} = \left[\frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}\right] * 100 \tag{6}$$

Where $P_{i,t}$ is the closing price of the stock at the end of month t and $P_{i,t-1}$ is the closing price of that stock at the end of month t-1 or the month before.

Rate of return on the market (R_m): is the realized rate of return on the market free float index and it was determined as follows:

$$R_{m,t} = \left[\frac{P_{m,t} - P_{m,t-1}}{P_{m,t-1}}\right] * 100 \tag{7}$$

Where $P_{m,t}$ is the closing price of the sector index at the end of month t and $P_{m,t-1}$ is the closing price of that index at the end of month t-1.

Rate of return on the sector (R_s): is the realized rate of return on the sector index. The following equation was used to calculate this variable:

$$R_{s,t} = \left[\frac{P_{s,t} - P_{s,t-1}}{P_{s,t-1}}\right] * 100 \tag{8}$$

Where $P_{s,t}$ is the closing price of the sector index at the end of month t and $P_{s,t-1}$ is the closing price of that index at the end of month t-1.

Risk-free rate of return: is the riskless return represented by the rates of return on the treasury bills issued by the central bank of Jordan during the study period.

Sector excess return: is the rate of return on the sector index for a given holding period (one month) less the risk-free rate of return for the same period.

Standardized herd measure for the market (H_m^*): is the standardized measure of beta herding that was introduced by Hwang and Salmon (2009) to test the herding behavior in the stock markets. This measure can be calculated as follows:

$$H_{mt}^* = \frac{1}{N_t} \sum_{i=1}^{N_t} \left(\frac{b_{imt}^s - 1}{\hat{\sigma}_{Eit} / \hat{\sigma}_{mt}}\right)^2 \tag{9}$$

Where H_{mt}^* is the standardized herd measure for the market at time t, N_t is the number of stocks at time t, b_{imt}^s is the observed estimate of beta of stock i with the market at time t, $\hat{\sigma}_{Eit}$ is the sample standard deviation of the OLS residuals, and $\hat{\sigma}_{mt}$ is the sample standard deviation of market excess return at time t

Standardized herd measure for each sector (H_{ms}^*): is the standardized measure of beta herding that was utilized to test herding behavior in the sectors of the financial market. This measure can be calculated as follows:

$$H_{mst}^* = \frac{1}{N_{st}} \sum_{i=1}^{N_{st}} \left(\frac{b_{ist}^s - 1}{\hat{\sigma}_{Eit} / \hat{\sigma}_{st}}\right)^2 \tag{10}$$

Where H_{mst}^* is the standardized herd measure for each sector at time t, N_{st} is the number of stocks in the sector at time t, b_{ist}^s is the observed estimate of beta of stock i with the sector at time t, $\hat{\sigma}_{Eit}$ is the sample standard deviation of the OLS residuals, and $\hat{\sigma}_{st}$ is the sample standard deviation of sector excess return at time t.

Stock excess return: is the rate of return on the stock for a given holding period (one month) less the risk-free rate of return for the same period.

4. Results

4.1 Descriptive Statistics

Companies included in this study belong to the three groups of companies in Amman stock exchange (ASE): financial group, services group, and industrial group. Because of the exclusion of companies that became unlisted during the study period, the percentage of included companies to the total number of listed companies in each sector at the end of 2018 was as follows: 34% of listed financial companies, 41% of services companies, and 70% of industrial companies. This means that industrial companies have the most stable listing status among all sectors while the financial companies have the least stable status. Some univariate statistics for the variables included in the study are presented in Table 1.

Table 1. Descriptive statistics about variables of: b_{imt}^s, b_{ist}^s, stocks excess returns, market excess return, sector excess return, $\hat{\sigma}_{Eit}$, $\hat{\sigma}_{mt}$, and $\hat{\sigma}_{st}$

Variable	Mean	Standard deviation	Min	Max
Market				
b_{imt}^s*	0.668	0.408	-0.038	2.084
Stocks excess returns %	-0.046	11.543	-86.367	232.853
Market excess returns %	-0.164	4.501	-22.996	15.347
$\hat{\sigma}_{Eit}$	10.466	3.473	5.423	21.327
$\hat{\sigma}_{mt}$	4.511	0.000	4.511	4.511
Financial sector				
b_{ist}^s*	0.682	0.456	0.003	1.884
Stocks excess returns %	-0.087	11.263	-86.367	213.045
Sector excess return %	-0.002	5.245	-17.765	21.489
$\hat{\sigma}_{Eit}$	9.951	3.162	5.424	21.021
$\hat{\sigma}_{st}$	5.256	0.000	5.256	5.256
Services sector				
b_{ist}^s*	0.667	0.305	0.242	1.433
Stocks excess returns %	-0.032	10.882	-79.327	212.357
Sector excess return %	-0.379	3.979	-21.458	12.426
$\hat{\sigma}_{Eit}$	9.874	3.603	5.795	21.607
$\hat{\sigma}_{st}$	3.988	0.000	3.988	3.988
Industrial sector				
b_{ist}^s*	0.469	0.388	-0.048	1.693
Stocks excess returns %	-0.013	12.173	-79.100	232.853
Sector excess return %	-0.140	5.363	-34.916	18.785
$\hat{\sigma}_{Eit}$	11.204	3.586	5.910	19.840
$\hat{\sigma}_{st}$	5.375	0.000	5.375	5.375

* Percentage of significant b_{imt}^s's for the market at 5% = 85%, percentage of significant b_{ist}^s's at 5%: for financial sector = 85%, for services sector = 95%, for industrial sector = 61%

4.2 Hypotheses Testing

4.2.1 Hypothesis One

There were two sections in this hypothesis: the first section was to test the existence of herding at the level of market and section two was to examine the same in each sector. Calculated values and descriptive statistics of H_{mt}^* and H_{mst}^* (market-level and sector-level herding measures) are summarized in Table 2. It can be noticed from Table 2 that herding was very high when measured at market-level because the value of H_{mt}^* for the entire

period was very close to zero (perfect herding). At sector-level, however, the highest level of herding was in the services sector followed by the financial sector and then the industrial sector. In addition, the maximum values of H_{mt}^* for market-level and H_{mst}^* for the industrial sector were in the year 2008 which is the year of the global financial crises. This means that herding behavior in market and in the industrial sector was at its lowest level during the global financial crisis.

Table 2. Values and descriptive statistics for H_{mt}^* and H_{mst}^*

Details	Value for the entire period	Yearly calculated 2000 - 2018			
		Mean	Standard deviation	Min	Max
H_{mt}^*	0.071	0.548	0.323	0.218	1.248
H_{mst}^* financial sector	0.120	0.625	0.500	0.137	1.811
H_{mst}^* services sector	0.044	0.417	0.282	0.083	1.019
H_{mst}^* industrial sector	0.135	0.724	0.723	0.151	3.066

The movement of standardized beta herding measure for the market and for each sector during the study period is illustrated in the Figure of herding measure movement (Figure 1). The higher the value of herding measure, the lower the level of standardized beta herding. The Figure clarifies that herding movement was slightly different between market-level and other sectors except for industrial sector which had only one big peak related to 2008, the year of global financial crisis. No trends were noticed in the movement of herding behavior at market-level and at sectors-level.
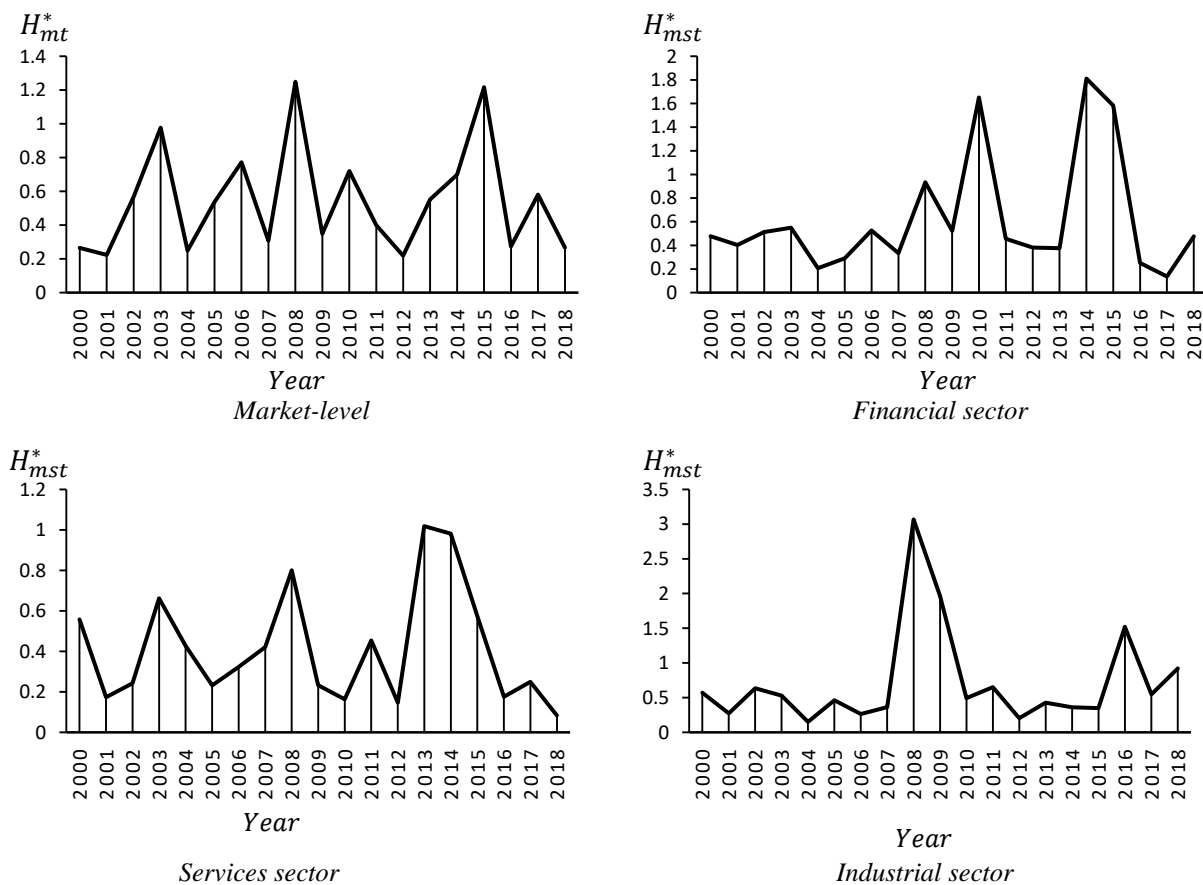

Figure 1. Herding measure movement 2000-2018

To test whether there herding behavior at market-level and at sectors-level was different, I used Kruskal–Wallis test. I used this test because I have more than two groups (market-level and three sectors) and because the data of H_{mt}^*, H_{mst}^* were not normal at a significance level of 5% as suggested by the results of Shapiro-Wilk test of normality summarized in Table 3. Based on the results of Kruskal–Wallis test, it can be concluded that herding behavior at market and sectors level was the same during the study period (Kruskal–Wallis statistic = 3.687, p = .297). To sum up, herding behavior existed in market and in each sector at the same level.

Table 3. Results of Shapiro-Wilk test of normality for hypothesis one

Details	Market-level	Financial sector	Services sector	Industrial sector
Statistic	.869	.735	.885	.683
P value	.014	<.001	.026	<.001

4.2.2 Second Hypothesis

This hypothesis was about the impact of the financial crisis of 2008 on the herding behavior at market-level and sector level. The first section of the hypothesis was about the effect of the crisis on herding at the level of market. To test this hypothesis, data were first tested for normality using Shapiro-Wilk test. Based on the test of normality clarified in Table 4, data of H_{mt}^* for market-level were normal while data of H_{mst}^* for sector-level were not normal. The value of H_{mt}^* (as calculated for the whole period before the crisis and the whole period after the crisis) for market-level before the financial crises was 0.088 and after the crisis was 0.064. Both values are very close to zero which means that herding was high before and after the crisis. To examine the first section of this hypothesis, I used the independent samples t-test because there were two groups for this hypothesis (before and after financial crisis) with homogenous variance (Levene's test p = .998) and because data were normal. The results of t-test showed that herding level in the entire market can be considered the same before the financial crisis and after it, $t(16) = -0.291$, $p = .774$.

Table 4. Results of Shapiro-Wilk test of normality for the second hypothesis

Details	Market-level		Financial sector		Services sector		Industrial sector	
	Before financial crisis	After financial crisis	Before financial crisis	After financial crisis	Before financial crisis	After financial crisis	Before financial crisis	After financial crisis
Statistic	.878	.875	.921	.770	.944	.812	.957	.815
P value	.181	.114	.442	.006	.650	.020	.785	.022

The values of H_{mst}^* for each sector (as calculated for the whole period before the crisis and the whole period after the crisis) are clarified in Table 5. From the values of herding measure in Table 5, it can be said that herding level was high in all sectors because all values are close to zero. Because data for sectors were not normal, I used Mann-Whitney U test to examine the second section of hypothesis two.

Table 5. Values of H_{mst}^* for each sector before and after the financial crisis

Details	H_{mst}^* before financial crisis	H_{mst}^* after financial crisis
Financial sector	0.159	0.09
Services sector	0.037	0.088
Industrial sector	0.061	0.161

The results of Mann-Whitney test for each sector are illustrated in Table 6. These results suggest that the null hypothesis that the presence of herding behavior in each sector is the same pre and post the financial crisis cannot be rejected and thus, it can be said that the crisis had no effect on the herding behavior in all sectors.

Table 6. Results of Mann-Whitney U test for the second hypothesis-second section

Details	Statistic	P value
Financial sector	35	.657
Services sector	35	.657
Industrial sector	26	.214

4.2.3 Third Hypothesis

This hypothesis was related to the level of herding behavior at times of market (sector) rising (i.e. $R_{m,t}$, $R_{s,t} > 0$) and falling (i.e. $R_{m,t}$, $R_{s,t} < 0$). As done in the previous hypotheses, the first step was to test market and sectors' data for normality. The results of Shapiro-Wilk test of normality are illustrated in Table 7. These results indicate that data for market and sectors were not normal.

Table 7. Results of Shapiro-Wilk test of normality for the third hypothesis

Details	Market-level		Financial sector		Services sector		Industrial sector	
	Market rising	Market falling	Sector rising	Sector falling	Sector rising	Sector falling	Sector rising	Sector falling
Statistic	.835	.837	.614	.435	.397	.778	.499	.794
P value	.008	.009	<.001	<.001	<.001	.001	<.001	.001

The values of H_{mt}^* and H_{mst}^* (as calculated for the whole period during market rising and the whole period during market falling) for market and sectors are illustrated in Table 8. Because all values are close to zero, it can be claimed that herding was high at market-level when the market was rising and falling and high at sector-level for all sectors when the sector was rising and when it was falling.

Table 8. Values of H_{mt}^* and H_{mst}^* for market and for each sector when market (sector) increasing and decreasing

Details	Market-level		Financial companies		Services companies		Industrial companies	
	Market rising	Market falling	Sector rising	Sector falling	Sector rising	Sector falling	Sector rising	Sector falling
H_{mt}^*	0.036	0.057						
H_{mst}^*			0.077	0.085	0.034	0.047	0.098	0.098

To test this hypothesis at market and sector levels, I used Wilcoxon Signed-Rank test. The results of this test are summarized in table 9. It can be noticed from Table 9 that all p values are insignificant at 5% level which means that herding measure was the same at times of increasing and decreaing in market and in sectors. In other words, conditions of market (sector) increasing and decreasing did not affect the level of herding in market and in each sector.

Table 9. Results of Wilcoxon Signed-Rank test for the third hypothesis

Details	Market-level	Financial companies	Services companies	Industrial companies
z	-0.724	-0.310	-0.806	-0.121
P value	.469	.756	.420	.904

4.2.4 Hypothesis Four

This hypothesis was about whether herding during times of market (sector) increasing and decreasing is different pre and post the financial crisis of 2008. Data required to test this hypothesis were normal at market-level before the crisis but not normal after the crisis and at sector-level, it was not normal before and after the crisis as clarified in Table 10. The values of H_{mt}^* and H_{mst}^* (as calculated during market (sector) rising and falling for the entire period before financial crisis and the entire period after the financial crisis) are illustrated in Table 11.

Table 10. Results of Shapiro-Wilk test of normality for the fourth hypothesis

Details	Market-level		Financial sector		Services sector		Industrial sector	
	Before financial crisis	After financial crisis	Before financial crisis	After financial crisis	Before financial crisis	After financial crisis	Before financial crisis	After financial crisis
Under rising								
Statistic	.869	.760	.849	.698	.557	.476	.538	.508
P value	.262	.005	.193	.001	<.001	<.001	<.001	<.001
Under falling								
Statistic	.941	.810	.728	.736	.744	.840	.812	.764
P value	.675	.019	.018	.002	.007	.057	.038	.005

It can be noticed from Table 11 that highest herding level before the financial crisis was in the services sector during the time of sector falling while the lowest level was in in the financial sector during the time of falling. After the financial crisis, however, the highest level of herding changed to be at market-level during market falling and the lowest level changed to be in the industrial sector during sector increasing.

Table 11. Values of H_{mt}^* and H_{mst}^* for market and for each sector during market (sector) increasing and decreasing pre and post the financial crisis

Details	Market-level		Financial companies		Services companies		Industrial companies	
	Pre-financial crisis	Post financial crisis	Pre-financial crisis	Post financial crisis	Pre-financial crisis	Post financial crisis	Pre financial crisis	Post financial crisis
H_{mt}^* under rising	0.056	0.071						
H_{mt}^* under falling	0.102	0.030						
H_{mst}^* under rising			0.107	0.109	0.050	0.115	0.058	0.165
H_{mst}^* under falling			0.151	0.048	0.029	.035	0.032	0.057

To test the first section of this hypothesis (at market-level) before the financial crisis, I used the paired samples *t*-test because data for the market were normal and because there were two values for each year (increasing and decreasing). The results of this test indicated that herding behavior before the financial crisis was the same under market rising and falling $t(4) = 0.255$, $p = .811$. To test data at market-level after the crisis, Wilcoxon Signed-Rank test was used because data were not normal. The results of the test indicated that herding after the financial crisis was the same under market rising and falling $z = -1.173$, $p = .241$. Based on this, the null

hypothesis of the first section cannot be rejected and it can be concluded that investors in the entire market herded during market increasing and decreasing in the same manner prior to and post the crisis. To test the second section of this hypothesis (at sector-level), Wilcoxon Signed-Rank test was used because data for sectors were not normal before and after the crisis. The results of this test are illustrated in table 12. As the results revealed, the alternate hypothesis can be rejected and thus, it can be concluded that investors in each sector herded during sector increasing and decreasing in the same way pre and post the crisis.

Table 12. Results of Wilcoxon Signed-Rank test for second section of fourth hypothesis (sectors-level)

Details	Financial companies		Services companies		Industrial companies	
	Before crisis	After crisis	Before crisis	After crisis	Before crisis	After crisis
z	-1.214	-0.968	-0.980	-0.533	-0.420	-0.357
P value	.225	.333	.327	.594	.674	.721

4.2.5 Comparing Results

The results of this study can be compared with the study of Elshqirat (2019) because it covered the same period (2000-2018) and the same financial market (Jordanian stock market). In addition, the same hypotheses were tested in this study to facilitate the comparison. Elshqirat (2019) used the measure of CSAD to test herding while in this study, the measure of Hwang and Salmon (2009) was used. The purpose of the comparison was to determine if different herding measures yield different results. The results of the comparison are illustrated in Table 13. Results are different between the two measures for all hypothesis except for the effect of financial crisis at market-level and the effect of rising and falling at sector-level. From these results, it can be claimed that different herding measures result in different decisions about the behavior even if those measures belong to the same family. In other words, results of detecting herding in the stock market depend on the measure used and thus, reaching reasonable results about herding in a market may require utilizing more than one measure.

Table 13. Results of comparing the results of CSAD measure with the measure of Hwang and Salmon (2009)

Details	Market-level		Sector-level	
	CSAD	Hwang and Salmon	CSAD	Hwang and Salmon
Presence of herding	No herding	Herding exists	Herding exists in services and industrial sectors only	Herding exists in all sectors
Effect of financial crisis	No effect	No effect	Financial crisis affected services and industrial sectors	No effect
Effect of market(sector) increasing and decreasing	Herding affected	No effect	No effect	No effect
Financial crisis effect on herding during increasing and decreasing	Financial crisis affected herding during increasing and decreasing	No effect	Financial crisis changed herding during increasing and decreasing	No effect

5. Discussion

Study results revealed that investors in the stock market of Jordan practiced herding at the level of the entire market which is the same conclusion reached by Obaidat (2016), Ramadan (2015), Nasarudin et al. (2017), and Chen (2013) and opposite to the results of Al-Shboul (2012). In addition, results indicated that herding existed in

each sector of the market which supports the conclusions of Cakan, and Balagyozyan (2016) who detected herding in all industries of the stock market in Turkey. However, study results are different from other studies in which it was concluded that herding existed in some and not all of the market sectors including the study of BenSaïda (2017), Jabeen,and Rizavi (2019), and Litimi (2017). The results of this study indicated that investors herded at the same level in the entire market and in each sector. The results of this study indicated also that the global financial crisis of 2008 did not affect herding behavior neither at the level of market nor at the level of sectors (herding existed in both periods pre and post the crisis). The results about the effect of financial crisis at market-level do not support the results reached by Angela-Maria, Maria, and Miruna (2015) and BenSaïda, Jlassi, and Litimi (2015) who concluded that the global financial crisis had an effect on the herding behavior at market-level. On the other hand, these results are in line with those concluded by Al-Shboul (2012) who claimed that herding behavior was the same before and after the financial crisis at market-level and in the financial sector.

Based on the results of this study, it was concluded that herding behavior was the same during times of market (sector) rising and falling. These results are opposite to the results concluded by and Rahman, Chowdhury, and Sadique (2015) who claimed that herding at market-level is higher during the time of market rising and also opposite to the results of Tabesh, Kelly, and Poulose (2018) who concluded that herding behavior respond in different way in each sector when the market was rising and falling. These results, however, support the conclusions of Yousaf, et al. (2018) who concluded that herding at market-level was the same in times of market rising and falling and Elshqirat (2019) who claimed that herding at sector-level was not affected by the conditions of sector rising and falling. As concluded in this study, the level of herding behavior during market (sector) rising and falling was the same before and after the global financial crisis. Investors in Amman stock exchange continued herding in the same manner during market rising and falling even after the global financial crisis. Finally, the results of this study clarified that the results reached about herding using the measure of Hwang and Salmon (2009) were different from those reached using CSAD measure for the same market (Jordan) and the same period (2000-2018) implying that the decision about the behavior is affected by the measure used. Herding at market level was absent when tested using CSAD measure by Elshqirat (2019) while it existed when tested in this study using Hwang and Salmon (2009). At sector level, however, herding exited in some sectors when measured using CSAD while it exited in all sectors at the same level when measured using Hwang and Salmon (2009). When herding was measured using Hwang and Salmon measure, there was no effect for the financial crisis on herding at both levels: market and sectors while the crisis affected two sectors when herding was measured using CSAD. In addition, herding was affected by the market condition of rising and falling at market-level only when CSAD was utilized but these conditions had no effect at all levels when the measure of Hwang and Salmon was used. In addition, different herding manners during rising and falling were detected before and after the crisis using CSAD at all levels while the same manners were observed before and after the crisis using Hwang and Salmon measure. The latter conclusions about reaching different results using different measures of herding are supported by some studies including the study of Adem (2020) who concluded that herding existed during market rising using CSAD while it was absent using the measure of cross-sectional standard deviation (CSSD). Other studies that used different measures and reached different results include Khan and Rizwan (2018) and Hilal (2015). In Jordan, different conclusions about herding where reached using different measures by Al-Shboul (2012) who used CSAD and CSSD to test the behavior and Chen (2013) who used CSSD, CSAD, and the measure of Hwang and Salmon (2004) to test herding at market-level. What this study may add to the previous studies about herding is that different measures may result in different decisions about herding at sector-level and not only at market-level.

The results of this study can be generalized to all sectors of the Jordanian stock market because it included all companies listed for the entire period from 2000 to 2018 and not only a sample. In addition, results can be generalized to other markets that have the same specifications of the Jordanian stock market. It was known from the previous studies that using different measures may result in different decisions about herding but that was mostly at market-level and in countries other than Jordan. This study is the first study in Jordan to examine the effect of using different measures on the testing of herding at market-level and at sector-level by comparing the results of two measures: CSAD and Hwang &Salmon (2009). Knowing that different measures of herding may lead to different results can change the investors' view of the market. Investors may no longer depend on the results of one measure to decide if herding exists in the market and they may reconsider the factors included in their price expectations. In addition, the study results may benefit the management of the market by providing them with additional information about the existence of herding at market and at sector levels. Market management may plan to educate and train investors to make their own investment decisions instead of just copying others. Further research may be needed to gain more understanding about herding behavior at sector-level and to develop new measures that can be used when studying the behavior in each sector.

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