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An Examination of Herd Behavior in the Jordanian Equity Market

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Abstract

The paper aims at examining the herd behavior in the Jordanian equity market before and after the 2008 global financial crisis. The most common approaches [Christie and Huang (1995) (CH) and Chang et al. (2000) (CCK)] are used to test for herding tendency of the financial and nonfinancial firms. By making use of the CH approach, estimated using the Ordinary Least Squares method (OLS), evidence of the absence of herding tendency is reported in extreme and normal market conditions. To investigate the tendency for herding further, the CCK approach is also implemented. The model of CCK is estimated using the OLS and the Quantile Regression (QR) methods. The results of CCK, using OLS, show evidence of the absence of linear herding for both types of firms before and after the crisis. But, only nonfinancial firms exhibit evidence of nonlinear herding in both sub-periods. In the extreme up and down market, evidence of linear herding is only found after the crisis for both types of firms when market is trending up. For all firms at the median level, the results of QR provide evidence of linear herding after the crisis while no evidence is reported for nonlinear herding. Financial firms exhibit only nonlinear herding at median level before the crisis when the market is trending up. Nonfinancial firms do not exhibit linear and nonlinear herding at the median level in both up and down markets. The results of OLS and QR are different for both types of firms. However, for linear herding the results of CH and CCK are similar. Jordanian investors exhibit a tendency for linear herding in extreme and normal market conditions but cannot have enough power to convert into nonlinear one.

Keywords: equities market, herding, quantile regression, behavioral finance, financial crises

1. Introduction

This paper examines whether herding behavior can be detected in the Jordanian equity market before and after the 2008 financial crisis. Herding is defined as the situation when a group of stock investors blindly follow other investors in either buying or selling stocks overtime (Bikhchandani and Sharma, 2000; Demirer and Kutan, 2006; Choi and Sias, 2009). Herding behavior is either rational or irrational as investors behave in different manners with regard to their tendency to mimic the actions of others. Rational herding means that investors mimic the actions of others by ignoring their own private information to keep their reputation in the market (Scharfstein and Stein, 1990; Bikhchandani et al., 1992; Lakonishok et al., 1992; Rajan, 1994; Wermers, 1999). In other words, they may rely on fundamental factors when herding, such as speculation, market volatility, the behavior of other investors, different techniques in measuring performance and the investment horizon (Chang, Chen and Khorana, 2000). However, irrational herding refers to investors who disregard their prior beliefs and blindly follow other investors' decisions (Christie and Huang, 1995; Devenow and Welch, 1996; Nofsinger and Sias, 1999).

Empirical literaure, focusing on investigating the existence of the herd behavior in equity markets, can be categorized in two main groups of studies. The first group of studies relies on detailed and unambiguous information on the trading activities as well as on the changes in their investment portfolios. Lakonishok, Shleifer and Vishny (1992) (LSV measure) and Wermers (1999) (PCM measure) are the best examples of such herd measures. The second group of studies examined herding by following the view that herding is the buying and the selling actions of the individual investors who follow the performance of specific factors or styles. In this context, herding was measured by taking the advantage of the information contained in the cross-sectional stock price movements. Following this view, three common measures are developed by Christie and Huang (1995) (CH), Chang, Cheng and Khorana (2000) (CCK), and Hwang and Salmon (2004) (HS). Empirical studies follow these three measures (e.g. Kim and Wei, 2002; Caparrelli et al., 2004; Henker et al., 2006; Demirer and Kutan, 2006; Tan et al., 2008; Chiang and Zheng, 2010; Fu and Lin, 2010; Chiang et al., 2010; Economou et al., 2011). These studies use different sets of data from well-developed stock markets such as the US, the UK, Japan, South Korea, Taiwan, Australia, China, the Germany, Italy, France, Spain, Greece and Portugal.

The Jordanian stock exchange (ASE) is considered one of the most active stock markets in the Middle East region. Recently, its trading volume has increased from 0.40 billion USD in 1978 to 9.4 billion USD in 2010. It follows that, over the last ten years, there has been an increase in the number of Jordanian listed firms. In fact, the number of listed firms has increased rapidly from 158 firms in 2002 to 277 firms in 2010 - an increase by 75% (ASE, 2003; 2011). The 2010 newsletter of ASE shows that the number of financial (nonfinancial) firms has risen from 43 (115) in 2003 to 123 (154) in 2010. The stock value traded in this market has increased rapidly (ASE, 2011). The total value traded by financial investors has risen from around 775 million USD in 2003 to nearly 9.16 billion USD in 2010 – an increase by 12 times. In addition, the total value traded by nonfinancial firms has increased from 3.52 billion USD in 2003 to nearly 4.65 billion USD in 2010 - an increase by 0.32 times. These substantial increases in the overall market capitalization and in the number of its listed firms indicate that Jordanian investors are more likely to engage into herding behavior more than before. Therefore, it is of interest to test for the tendency of herding in such a market and among these firms.

The recent new set of regulations adopted by the ASE is considered a strong motive for conducting such a study. One of these regulations is the comprehensive capital market reforming policy. The purpose of such a policy is to improve the regulation of the securities market to reach the international standards. For example, the government has endorsed the Temporary Securities Law (No. 23) in 1997. Such a temporary law is considered a turning point for regulating and completing the infrastructure of the Jordanian capital market. In addition, this endorsement is continued to adopt a new securities Law (No. 76) issued in 2002. This new Law is installed to set up other stock exchange issues, protect investor's fund, install ethical and professional codes, strengthening the application of the rule of law. Therefore, setting up these regulations would participate in increasing the probability of herding tendency among Jordanian investors because they would be more confident to perform more trading activities.

Motivated by the recent development, expansion and new regulations of the ASE, the tendency of herding in such a market is examined in this study. In this context, the present study contributes to the literature in many ways. Empirical studies in this field employ only the least squares estimation method to test for herding tendency without paying a strong attention to use the quantile regression method. Following Chian et al. (2010), this study uses both the least squares and the quantile regression methods to test for herding tendency. The use of quantile regression method under different quantiles would have the power to solve the statistical problems facing the least squares method to gain more fitting estimators of herding. Form methodological perspective, where the originality of this study is stemmed from, the two common approaches (CH and CCK) are used to test for herding. In addition, the asymmetric herding is also tested in this study by making use of a different regression specification technique. In this technique, one set of regressions is used to test for asymmetric herding for the up and the down market, instead of using two separate regressions that was used by CCK. The study also explores whether Jordanian investors do herd before and after the 2008 financial crisis for the daily stock returns of the financial and nonfinancial firms, as no study has been conducted using data representing such a market.

The study finds no evidence of the tendency of herding for both financial and nonfinancial firms before and after the crisis when using the CH approach. It reports also evidence for the absence of nonlinear herding for financial firms in normal and extreme market conditions (when applying the CCK method). But, nonfinancial firms present evidence of nonlinear herding in both market conditions. For herding in extreme conditions (the up and down market), evidence of the existence of herding is only found in the period before the crisis. Nonetheless, after the crisis, evidence of the absence of nonlinear herding is reported. Consistent with the results of the least squares, the results reported by the quantile regression signal no evidence of herding behavior. These results indicate that Jordanian equity investors (financial and nonfinancial) show a sign of herding tendency when using both approaches either in extreme or normal market conditions. Nevertheless, the results reported by QR and OLS are somewhat not similar across types of firms.

The remainder of this paper is as follows: the relevant literature on herding is reviewed in the next section. To give a better understanding of the examination setup, Section 3 introduces the methodology. Section 4 states the data of the study and Section 5 presents the empirical results. Section 6 summarizes the findings and concludes.

2. Literature Review

Herding is a hardly measurable concept, stemmed from the behaviors of humans, with difficult quantifiable parameters. Focusing on irrational herding, one of the common methods was developed by Christie and Huang

(1995) (so-called CH) (Note 1). This method examined the investment behavior of equity investors in the US market. It developed a measure to test for herding by using the cross-sectional standard deviation of returns (CSSD) (i.e. the dispersion of the average of individual stock returns from the average market returns) in normal and extreme market conditions. It argued that if market investors ignore their own beliefs and build their investment decisions merely on market consensus, stock returns will not deviate far from the overall market return. In periods of market stress in either up or down, stock investors tend to herd toward the market. Therefore, stock returns would cluster around the market return and the cross-sectional standard deviation of returns tends to decrease. Christie and Huang (1995) were unsuccessful in reporting evidence of herding in the United States, Hong Kong and Japan stock as returns dispersion increases instead of decreasing during periods of market stress in these markets.

Many empirical studies applied the CH method on data from emerging and developed equity markets. But, they produced mixed results. CH was unsuccessful in providing evidence of herding in the United States, Hong Kong and Japan. Proponents of the CH method found no evidence of the existence of herding in several worldwide stock markets. For example, Caparrelli et al. (2004) stated that the Italian stock investors do not herd, but herding was only present during extreme market conditions. Using a data set from the Chinese equity markets, Demirer and Kutan (2006) found no evidence of herding. Chiang and Zheng (2010) also reported no evidence of herding in Latin America stock markets during the 2008 crisis. Nevertheless, another group of recent studies were successful in reporting contradictory results to the findings of the CH approach. Chen et al. (2008), for instance, reported evidence of herding in the Italian stock market indicating that herding is present in extreme market conditions. Chiang and Zheng (2010) found evidence of herding in Latin America stock markets (except the US) and in Asian markets in normal market conditions.

But, most of studies, investigating the existence of the herding in developing markets, implemented datasets from different Asian countries. However, Baek (2006) documented that there are different factors affecting investments on Asia and Latin America. For example, investments in Asia are highly dependent on investors' preferences and the stock market volatility. In addition, in Latin America, investments are affected by the sensitivity of portfolio investments to the fundamental factors. Although it is difficult to generalize the conclusions that the presence of the herding behavior in the developing stock markets based on only evidence from Asian countries, these factors may also participate on pushing Jordanian investors to engage in the herd behavior. Most of these factors focus on fundamentals such as the high cost of information acquisition, lack of transparency, lack of financial reporting and information disclosures and lack of credibility and integrity to the public information (Zaharyeva, 2008). However, the low liquidity of the stock market may also prevent investors of being engaged in herd behavior (Devenow and Welch, 1996). Therefore, these factors can affect Jordanian investors. Jordanian investors who are willing to sell a particular asset may not succeed in finding buyers for this asset and therefore the possibility for engaging in the herd behavior would be significantly reduced.

Although the CH approach has been extensively used by many empirical studies, it has a number of failing points. First, the use of the cross-sectional deviations of returns, as a measure for herding, is considered a failing point. A decrease in the CSSD does not necessarily entail the existence of herding (see Hachicha et al., 2008). The reason of this failure is that herding might not be observable even if the CSSD is increased. Second, CH approach ignores to some extent the effects of changes in fundamentals (see Shiller and Pound, 1989; Chang et al., 2000). Therefore, the ability of this method to differentiate between rational and irrational herding might be feeble (Bikchandani and Sharma, 2001). In addition, there is no such rule that herding occurs only in extreme market periods. This is because the herd behavior is not necessarily observable only in these periods. But, it might be also identifiable in periods of normal market condition (Hwang and Salmon, 2004).

In light of these failing points, Chang et al. (2000) (so-called CCK) developed an alternative method to examine herding by relying on the Cross-sectional Absolute Deviation (CSAD). This method stated that herding can be detected by a nonlinear function between the CSAD and market return. The assumption of this method is that in periods of market stress the nonlinear relationship is more likely to be negative. This is because the CSAD would increase at decreasing rate. Chang et al. (2000) found evidence of the presence of herding in the stock markets of South Korea and Taiwan, whereas no evidence of herding was found in the US, Hong Kong, and Japan. Empirical studies adopted the CCK method to test for herding. The first group of these studies was unsuccessful in reporting evidence in favor of herding. Using an intraday data, Gleason et al. (2004) and Henker et al. (2006) reported no evidence of herd behavior of the Exchange Traded Funds sector in the U.S. stock market and of the Australian industry sectors, respectively. Finally, Fu and Lin (2010) failed in reporting evidence of herd behavior in the Chinese equity market. Khan et al. (2011) also suggested that herding in France, the UK, Germany and Italy is evident in normal market conditions, but herding was not found in periods of market stress.

Conversely, evidence of the existence of herding was reported by another group of studies. For instance, for both individual and institutional investors on the Shanghai and Shenzhen stock markets, Tan et al. (2008) found evidence of the herd behavior. For individual investors, evidence was found within both the Shanghai and Shenzhen A-share markets while for foreign institutional investors evidence of herding was also found within both markets for B-share. Zhou and Lai (2009) stated that herding is more likely to be observable for small stocks when selling rather than when buying stocks. Using data from the Polish stock market, Goodfellow et al. (2009) found evidence of herding for individual investors during market downswings, while during the upswing market there was a weak evidence of herding. They also argued that institutional investors do not show any sign of herd behavior. Using data from the Banja Luka stock market, Kallinterakis et al. (2010) examined herding behavior and argued that herding is insignificant during extreme market periods. In both the Shanghai and Shenzhen A-share markets, evidence of herding was found by Chiang et al. (2010). They argued that Chinese investors herd in both the up and the down markets. Economou et al. (2011) provided evidence of herding in the Portuguese, Italian, Spanish and Greece markets before and after the 2008 crisis.

To sum up, almost all the above studies relating to the two herding common approaches have used the OLS with no considerations for the other statistical estimation methods such as the QR, the Generalized Method of Moments, Seemingly Unrelated Method, and the Weighted Least Squares Method. Therefore, one can use one or more of these methods to test for herding tendency rather than the OLS. In addition, the majority empirical studies discussed previously did not take the most recent financial crisis into account. Therefore, the present study has taken a break point representing the financial crisis by testing for the tendency of herding between Jordanian investors before and after the 2008 financial crisis.

3. Methodology

3.1 Christie and Huang (1995) – CH Method

As mentioned in the introduction section, the Jordanian stock market, as other stock markets in the world, may exhibit herding tendency. Therefore following the CH method, herding phenomenon is measured by the following specification.

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}(R_{it} - R_{mt})^2}{N-1}} \tag{1}$$

where R_{it} is the stock return on a firm i at time t. R_{mt} refers to the return of the stock market index at time t. N is the number of firms in the sample study. The CH method argues that, when investors suppress their own beliefs in favor of herding to market consensus, security returns would not disperse far from the overall market return. In addition, it states that the security return is more volatile during periods of market stress, thus, herding is more likely to be present. The presence of herding is more likely to happen when there would be an increase in dispersion at a decreasing rate, or merely by a decrease in dispersion at an increasing rate. Therefore, the current study examines whether equity return dispersions are significantly lower than average during periods of extreme and normal market conditions as follows:

$$CSSD_t = \alpha_0 + \beta_1 D_{Lt} + \beta_2 D_{Ut} + \varepsilon_t \tag{2}$$

where D_{Lt} is a dummy variable taking a value of unity if the market returns on time t lies in the extreme lower tail of the distribution, or zero otherwise. D_{Ut} is a dummy variable taking a value of unity if the market returns on time t lies in the extreme upper tail of the distribution, or zero otherwise. If the estimated coefficients are negative and significant, herding will be detected. In other words, when the CSSD of stock returns is low under large price movements, herding is detected. This contradicts the CAPM theory which suggests that, in periods of market stress, large dispersions should be expected because individual securities may have a different degree of sensitivities to market return.

3.2 Chang, Cheng and Khorana (2000) – CCK Method

CCK generated a new technique to test for herding by using the CSAD. This technique relies on the CAPM specification to estimate the cross-sectional absolute deviation (CSAD) of stock return from market return. The cross-sectional absolute deviation (CSAD) is specified as follows:

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N} AVD_{it} = \frac{1}{N}\sum_{i=1}^{N}\left|\beta_{it} - \beta_{mt}\right| \times E(R_{mt} - R_{ft}) \tag{3}$$

where AVD is the absolute value of the cross-sectional deviation of stock's i at time t. E(.) stands for the expected returns of stock's i at time t. R_{ft} refers to the risk-free return of interest rates at time t. R_{mt} is the excess return on the stock market index at time t. R_{it} is the excess return of stock's i at time t. β_{it} is the time-invariant systematic risk measure of the stock's i at time t. N is the number of firms. β_{mt} is the systematic risk of stock market index which is generated by the average of betas of all firms.

CCK stated that the nonlinear relationship between CSAD and market return is more efficient to detect for herding compared with the linear one. However, the theory of finance proposes that a linear function is more likely to detect for herding in normal market condition. Therefore, this assumption of finance theory would be violated in periods of market stress because herding might not be detected by a linear function. Therefore, the nonlinear relationship is originated as follows:

$$CSAD_t = \alpha_0 + \delta_1 \left| R_{mt} \right| + \delta_2 (R_{mt})^2 + \varepsilon_t \tag{4}$$

If the nonlinear coefficient (δ_2) is negative and significant, herding would be detected and therefore the linear function would not have the power to capture herding tendency. The linear function may convert into a nonlinear function. This conversion occurs because of the increase in the number of market participants who intend to herd around the market consensus during periods of large price movements. Those market participants are more likely to suppress their own predictions in respect with asset prices in such periods, especially in the presence of moderate herding. Therefore, it is expected that return dispersions will decrease or increase at a decreasing rate.

In this study, the asymmetric herding is tested using a different specification from that used by the CCK. CCK generated two separate regressions for the up and the down market. These regressions did not consider the asymmetric effects when the market falls and rises. Therefore, the current study allows for the possibility of asymmetric herding using one regression without restriction. It does not restrict for the estimation of δ_1 and δ_2. A new specification, in Eq. (5), is created. It places both the up and down market proxies in one model to test whether linear herding shows an asymmetric reaction when the market goes down only if the nonlinear market return is included.

$$CSAD_t = \alpha_0 + \delta_1 (1 - D_t) R_{mt} + \delta_2 D_t * R_{mt} + \delta_3 (R_{mt})^2 + \varepsilon_t \tag{5}$$

where D_t is a dummy variable taking the value of unity at time t if $R_{mt} < 0$, or taking zero otherwise. In fact, some empirical studies provided evidence of the asymmetric behavior under different market conditions (Hong et al., 2007; Tan et al., 2008). Because of this evidence, it is of interest to examine whether nonlinear herding behavior presents an asymmetric reaction for both the up and down situations of market returns. Therefore, the specific expression is generalized by Eq. (6) as follows:

$$CSAD_t = \alpha_0 + \delta_1 (1 - D_t) R_{mt} + \delta_2 D_t * R_{mt} + \delta_3 (1 - D_t) * (R_{mt})^2 + \delta_4 D_t * (R_{mt})^2 + \varepsilon_t \tag{6}$$

CCK proposed that the rational asset-pricing model implies a linear relationship between the dispersion in individual security returns and market return. The model suggests that if the absolute value of the market return increases, the dispersion in individual asset returns should increase. During periods of extreme market movements, investors may exhibit herding behavior. This behavior is likely to increase the correlation between security returns and therefore individual security return dispersion will decrease or at least increase at a decreasing rate with the market return. For this reason, a non-linear market return, R^2_{mt} multiplied by its down and up dummy variables, is included in the equation to test whether nonlinear herding shows an asymmetric reaction when the market does down and up. A significantly negative coefficient would be consistent with the tendency of herding behavior.

Although the least squares method (OLS) is employed extensively in the herding literature, it might have some shortfalls. It would cause a loss of efficiency in reporting regression coefficients. The first reason of this loss of efficiency is that OLS is based on the mean function of the conditional of stock returns dispersions. Estimating the mean coefficients may not have the ability capture the extreme tail information in stressful periods. Therefore, the models specified by CH and CCK would not efficiently capture herding behavior. Passing the normality test is the other reason of losing efficiency. Financial data usually does not pass this test. The quantile regression (QR) as a non-parametric estimation method is more efficient because it may have the power to alleviate statistical problems. These problems are the normality, the measurement errors of variables, sensitive outliers, and non-Gaussian error distribution (Alexander, 2008). Because of market stress models are commonly used in finance literature, using QR would be a flexible method in analyzing extreme quantiles of return distribution. To resolve the so-called 'extreme' and observing herding only in market stress conditions, QR would capture the effects on the dependent variable over the entire distribution. The fourth reason is that the method based on CSSD would be sensitive to outliers. Given that QR is robust to the presence of outliers, it will not harm the reliability of results (Koenker and Hallock, 2001, p. 17).

In addition, QR would have the power to gain herding estimates in the tails of market return distribution in period of market stress without requiring a high-level of nonlinearity as in CH (see Chang et al., 2000). To obtain the quantile estimates for the extremely low returns, τ = 0.10 and τ = 0.25 are undertaken. Similarly, τ = 0.75 and τ = 0.90 are undertaken to get the quantile estimates for the extremely high returns. Eq. (6) is estimated to point out the quantile regression estimators that can be attained by minimizing a weighted sum of the absolute errors. This regression is not restricted only to the median regression (τ = 0.5). But, it allows for estimating the interrelationship between a dependent variable and its explanatory variables at any specific quantile. Therefore, it provides a clearer estimation of the asymmetric relation between CSAD and R_{mt} is as:

$$CSAD_{\tau}(\tau \mid x) = \delta_{0\tau} + \delta_{1\tau}(1-D_t)R_{mt} + \delta_{2\tau}D_t * R_{mt} + \delta_{3\tau}(1-D_t)*(R_{mt})^2 + \delta_{4\tau}D_t*(R_{mt})^2 + \varepsilon_t \quad (7)$$

where D is a dummy variable which takes value of unity at time t if $R_{mt} < 0$, or zero otherwise. If the estimated coefficients are negative and significant, herding is present. In addition, the nonlinear herding exists in the up and down markets, respectively, if the coefficients, δ_3 and δ_4, are significant and negative for different quantiles.

4. Data

The daily stock returns of the Jordanian listed firms and the market returns are sourced from the Amman stock exchange (ASE) database. The sample study consists of 43 financial firms and 112 nonfinancial firms which have data availability for the whole period of 2003 until end of 2006. In addition, the number of firms with data available for the whole period from 2007 until 2010 is 105 for financial firms and 145 for nonfinancial firms. The study period was from the beginning of January 2003 to the end of December 2010. It is divided into two sub-periods before and during the 2008 financial crisis. The reason of dividing the sample into the two major sub-periods is that they would provide a greater insight into the nature of herding behavior in the Jordanian equity market before and after the 2008 financial crisis. Melvin and Taylor (2009) argued that the 2008 financial crisis started at the mid of 2007 and began to lose its effect at the end of 2008. Following this argument, the crisis period in this study starts at the beginning of 2007. The reason of this choice is that although the real crisis event was observed in the mid of 2008, it would have started before this date by a period of time. The risk-free rate of interest (6-months Jordanian Treasury-bill rate) is sourced from the monthly bulletins of the Central Bank of Jordan (CBJ). All data sets are stationary as the Dickey–Fuller (1979; 1981) (ADF) tests suggest.

5. Empirical Results

5.1 Univariate Statistics

Table 1 reports the univariate statistics of the average daily returns R_t, the CSSD, the CSAD and H_t for financial and nonfinancial firms. The data series of all these variables show no sign autocorrelation. But, they are stationary as the AR and ADF tests show. Before the crisis, the average daily returns of financial (nonfinancial) firms ranges between -0.143 (-0.024) and 0.132 (0.035). In fact, financial firms express higher range of daily returns more than nonfinancial firms but with low volatility (standard deviation of financial (nonfinancial) firms is 0.009 (0.006)). After the crisis, the average daily returns are reported for financial (nonfinancial) firms ranging between -0.027 (-0.024) and 0.032 (0.035). It also reports a low standard deviation of 0.007 (0.005) for financial (nonfinancial) firms, respectively. This low of average daily returns would indicate a sign of herding, although of the effect of the crisis.

Before the crisis, the daily average CSSD ranges are between 0.001 (0.026) and 0.806 (0.898) for financial (nonfinancial) firms. This means that both types of firms display a higher range, but a lower volatility. Therefore, there would be no tendency to herding as the dispersion of stock return from market returns would remain too high with no decrease. After the crisis, the daily average CSSD ranges are between 0.002 (0.046) and 0.29 (0.545) for financial (nonfinancial) firms. Daily CSSD of those firms present a lower range and a lower volatility compared to those in the period before crisis. However, although those firms show low ranges of CSSD after the crisis, these ranges are still considered too high. These higher ranges of stock dispersion from market portfolio suggest that stock returns diverge far from their average which might show no sign of herding.

Table 1. Summary statistics of herding measures for the Jordanian financial and nonfinancial firms

Period	Var.	Mean	StDev	Min.	Max.	Serial correlation (*rho value*) AR(1)	AR(5)	AR(10)	AR(20)	ADF-test
2003-2010	**Financial firms**									
	R_t	0.001	0.009	-0.143	0.132	0.167	0.012	0.023	0.013	306.25***
	$CSSD_t$	0.026	0.032	0.001	0.806	0.006	0.005	0.015	0.006	317.39***
	$CSAD_t$	-0.002	0.019	-0.228	0.279	0.336	0.045	0.022	-0.010	229.51***
	H_t	0.963	0.507	0.086	1.962	0.885	0.004	-0.001	0.010	20.429***
	Nonfinancial firms									
	R_t	0.000	0.006	-0.024	0.035	0.199	0.002	0.012	-0.011	310.22***
	$CSSD_t$	0.022	0.015	0.002	0.343	0.059	0.023	0.020	0.024	311.83***
	$CSAD_t$	-0.002	0.014	-0.096	0.094	0.261	0.063	0.047	-0.004	238.83***
	H_t	0.496	0.362	0.009	1.113	1.334	-0.007	-0.021	0.017	119.39***
2003-2006	**Financial firms**									
	R_t	0.001	0.011	-0.143	0.132	0.135	0.019	0.036	0.006	160.00***
	$CSSD_t$	0.027	0.043	0.001	0.806	-0.001	0.002	0.009	0.003	157.90***
	$CSAD_t$	-0.004	0.021	-0.228	0.279	0.198	0.056	0.076	0.003	126.80***
	H_t	0.822	0.645	0.086	1.895	1.042	-0.006	-0.018	-0.000	60.44***
	Nonfinancial firms									
	R_t	0.000	0.006	-0.023	0.027	0.148	0.029	0.029	-0.035	168.92***
	$CSSD_t$	0.156	0.056	0.026	0.898	0.049	0.029	0.010	0.021	154.30***
	$CSAD_t$	-0.004	0.013	-0.096	0.040	0.308	0.056	0.052	-0.005	123.79***
	H_t	0.732	0.178	0.401	0.936	1.024	-0.034	-0.024	-0.011	51.30***
2007-2010	**Financial firms**									
	R_t	-0.001	0.007	-0.027	0.032	0.106	-0.004	0.007	0.004	133.29***
	$CSSD_t$	0.024	0.014	0.002	0.297	0.039	0.003	0.046	0.013	145.65***
	$CSAD_t$	-0.001	0.016	-0.04	0.06	0.213	0.017	-0.031	-0.004	99.960***
	H_t	1.101	0.252	0.775	1.962	0.567	0.032	0.049	-0.000	54.77***
	Nonfinancialfirms									
	R_t	0.000	0.005	-0.024	0.035	0.137	-0.028	-0.012	0.017	140.64***
	$CSSD_t$	0.153	0.027	0.046	0.545	0.074	0.007	0.030	0.025	154.27***
	$CSAD_t$	0.000	0.014	-0.027	0.059	0.225	0.007	-0.009	-0.003	101.79***
	H_t	0.264	0.347	0.009	1.113	1.448	0.222	-0.004	0.011	21.79***

This table reports the daily summary statistics of average stock returns R_t, $CSSD_t$, $CSAD_t$ and H_t over the sample periods. In addition, the serial correlations are reported for lags 1, 5, 10 and 20 together with test-statistics of the Augmented Dickey-Fuller test (includes constant and trend). The confidence level parentheses of (1%, 5%, and 10%) are (***, **, and *), respectively. For both types of firms, the daily data availability periods range from (1960) days for the whole period, (988) days for the sub-period before the crisis, and (972) days after the crisis.

The summary statistics of the daily average of the CSAD are also reported in Table 1. Before the crisis, the average daily of CSAD ranges between -0.228 (-0.096) and 0.279 (0.04) for financial (nonfinancial) firms. Financial firms exhibit a higher range and volatility (0.021 and 0.013, respectively) more than nonfinancial firms. This would indicate that financial sectors' investors might be involved in more traded values than nonfinancial investors. After the crisis, the average daily of CSSD ranges between -0.04 (-0.027) and 0.06 (0.059) for financial (nonfinancial) firms. Those firms present a low dispersion of stock returns with low volatility because of the effect of the crisis. CSAD does not show a sign of serial correlation but show a sign of stationary.

Table 1 also shows that, before the crisis, the averages of the daily variation of the betas for financial (nonfinancial) firms are 0.822 (0.732), respectively. These high variations suggest that the dispersion of stock returns diverge far from market portfolio. So, no sign of herding would present. However, the standard deviations of beta variations for financial firms equals to 0.645 which is higher than that for nonfinancial firms of 0.178. This suggests that the variability of stock dispersion of nonfinancial firms is less than the variability of stock dispersion of financial firms. Therefore, it is more likely to nonfinancial firms to display herding more than financial firms. After the crisis, the average of daily beta variation of financial firms rises to 1.101 (with standard deviation of 0.252). But, the average of daily beta variations of nonfinancial firms decreases to 0.264 (with standard deviation of 0.347). This confirms the presence of herding within nonfinancial firms, but financial investors are more likely not to herd.

5.2 Multivariate Results

5.2.1 Dummy Variable Regression Results Using CSSD – The CH Method

The multivariate results are reported in the rest of tables in the following pages. Table 2 records the regression coefficients ofherding using the CH method. These coefficients shed the light on the extent of herd behavior across trading days with extreme upward or downward price movements (Note 2). Eq. (2) is estimated using the three criteria (1%, 10%, and 20%) of market returns to apply definition of extreme price movement. Findings of this study are consistent with earlier studies. The coefficients (β_1 and β_2) of the lower and upper extreme variables are positive and significant in periods before and after crisis. This suggests no evidence of herding since equity return dispersions tend to increase rather than to decrease. This evidence is consistent with CH approach but inconsistent with Zhou and Lai (2009), Chiang et al. (2010) and Economou et al. (2011).

Table 2. The coefficients of herding using the cross-sectional standard deviation– The CH approach

	ALL period (2003-2010) 1960 = (-) 894 and (+) 1067			**Before (2003 – 2006)** 972 = (-) 414 and (+) 558			**After (2007 – 2010)** 988 = (-) 480 and (+) 508		
	Criterion 5%	***Criterion 10%***	***Criterion 20%***	***Criterion 5%***	***Criterion 10%***	***Criterion 20%***	***Criterion 5%***	***Criterion 10%***	***Criterion 20%***
Panel A: All Firms									
β_1	0.006*** (3.234)	0.004*** (3.061)	0.003*** (2.501)	0.007* (1.862)	0.005* (1.899)	0.003 (1.391)	0.006*** (3.899)	0.004*** (3.325)	0.003*** (3.086)
β_2	0.019*** (9.441)	0.011*** (7.231)	0.007*** (6.112)	0.030*** (8.270)	0.016*** (6.147)	0.010*** (4.600)	0.008*** (4.860)	0.005*** (3.959)	0.004*** (4.765)
R^2	0.05	0.04	0.03	0.07	0.05	0.02	0.04	0.02	0.03
F(p-val)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Panel B: Financial firms									
β_1	0.004 (1.454)	0.003 (1.269)	0.001 (0.796)	0.005*** (2.517)	0.005*** (2.517)	0.001 (0.292)	0.009*** (3.849)	0.007*** (4.079)	0.005*** (3.499)
β_2	0.020*** (6.120)	0.011*** (4.606)	0.006*** (3.201)	0.006*** (2.951)	0.006*** (2.951)	0.009*** (2.603)	0.026*** (11.160)	0.015*** (8.469)	0.010*** (7.406)
Adj. R^2	0.10	0.13	0.15	0.17	0.17	0.15	0.12	0.17	0.20
F(p-val)	0.000***	0.000***	0.006***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Panel C: Nonfinancial firms									
β_1	0.008*** (5.390)	0.006*** (5.322)	0.004*** (4.871)	0.009*** (3.849)	0.007*** (4.079)	0.005*** (3.499)	0.007*** (3.866)	0.005*** (3.458)	0.004*** (3.450)
β_2	0.018*** (11.740)	0.010*** (9.180)	0.008*** (9.252)	0.026*** (11.160)	0.015*** (8.469)	0.010*** (7.406)	0.009*** (5.012)	0.006*** (4.103)	0.006*** (5.560)
R^2	0.15	0.19	0.17	0.12	0.17	0.20	0.22	0.15	0.20
F(p-val)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

The table reports the estimated coefficients of the relationship between the Cross-sectional standard deviation (*CSSD*) and the up (down) market returns. Eq. (2) is estimated to provide the results in this table. Recall, $\beta_1(\beta_2)$ are the coefficients of D_{Lt} (D_{Ut}), respectively. They are equals 1 if the market return on day *t* lies in the extreme lower (upper) tail of the return distribution, otherwise D_{Lt} (D_{Ut}) equals zero. The 1%, 2% and 5% criterion refers to the percentage of observations in the upper and lower tail of the market return distribution used to define extreme price movement days. Before the crisis period, the number of financial (nonfinancial) firms is 43 (112). After the crisis, In addition, the number of financial (nonfinancial) firms is 105 (145). The levels of confidence (1%, 5%, and 10%) are signed by ***, **, and *, respectively.

5.2.2 The Non-linear Function of Market Return and CSAD – The CCK Approach

Table 3 shows the estimated coefficients of the nonlinear herding (Eq. 4), as designed in the CCK method. In general, Jordanian firms display evidence of herding only before the crisis (normal market conditions). For financial firms, the coefficients (δ_1 and δ_2) are positively significant. This suggests no evidence of linear and nonlinear herding in periods before and after the crisis. This is consistent with CH findings and Kallinterakis et al. (2010) while contradicts the results of Economou et al. (2011). However, nonfinancial firms display a tendency of nonlinear herding. This means that evidence of the nonlinear function of CSAD on market returns is captured before and after the crisis. To explain, let us apply the general quadratic function (Eq. 4) between

CSAD and market returns, for nonfinancial firms before the crisis. The presence of a negative parameter, α_2, is a signal of a tendency of herding. The quadratic relation suggests that CSAD reaches its maximum value when $R_{mt} = -(\alpha_1/2\alpha_2)$ reaches its minimum value. That is, if R_{mt} increases, over the range where average daily returns are less than R_{mt}, CSAD will fall down. Using a 0.044 maximum market return as a threshold of market stress, with α_1= 0.393, the estimated value of the α_2 parameter needs to be (-4.455) or smaller.

Table 3. The coefficients of herding using the CSAD against market return – The CCK approach

	Obser.	δ1	δ2	Adj. R2	P-val. (F)
All Firms					
ALL Period(2003-2010)	1960	0.393(1.00)	65.88***(3.89)	0.09	0.001***
Before (2003-2006)	972	0.463***(12.05)	-5.14***(-3.14)	0.14	0.000***
After (2007- 2010)	988	0.771(0.93)	172.5***(36.51)	0.08	0.000***
Financial firms					
ALL Period (2003-2010)	1960	0.495***(13.59)	1.338*(1.78)	0.10	0.000***
Before (2003-2006)	972	0.585***(10.97)	0.966*(1.87)	0.11	0.000***
After (2007- 2010)	988	0.415***(8.533)	3.95*(1.84)	0.18	0.000***
Nonfinancial firms					
ALL Period (2003-2010)	1960	0.376***(14.06)	-1.171*(-1.92)	0.10	0.000***
Before (2003-2006)	972	0.393***(11.53)	-4.455***(-3.07)	0.13	0.000***
After (2007- 2010)	988	0.137***(30.12)	-0.184***(-22.18)	0.51	0.000***

The Table reports the estimated coefficients of the regression model in Eqs (4). $CSAD_t$ is the dependent variable. δ_1 and δ_2 are the coefficients of $|R_{mt}|$ and $(R_{mt})^2$, respectively. Before the crisis, the number of financial (nonfinancial) firms is 43 (112) before the crisis. However, during the crisis, the number of financial (nonfinancial) firms is 105 (145). The levels of confidence (1%, 5%, and 10%) are signed by ***, **, and *, respectively.

Table 4 provides the results of the empirical specification, in Eq. 5, estimated for the up and down market returns values. In Panel A, the value of $(1-D)*R_{mt}$ (coefficient δ_1) simplifies a comparison of linear coefficients in the up market. However, $D*R_{mt}$ (coefficient δ_2) is used to compare the linear coefficients of the down market. The coefficient, δ_1, is negative and significant in the period after the crisis for both types of firms. This strongly confirms the prediction that CSAD decreases when market return increases. This suggests evidence towards herding in extreme market conditions.This result is inconsistent with the predictions of the rational capital asset pricing model and the dummy variable regression results in Table 2. No evidence of linear herding is reported when the market falls down in both periods. For all firms, evidence of linear herding is reported before and after the crisis only when market is trending up. However, the coefficients, δ_3, for both types of firms, are positive and significant before and after the crisis. This strongly confirms the prediction that there is no evidence of the herd behavior which consistent with the results of Fu and Lin et al. (2010) and Henker et al. (2006). The finding of this study however contradicts the results of Chen et al. (2008) and Goodfellow et al. (2009). To interpret, in the Jordanian stock market, market participants would not have enough power to convert the linear herding to nonlinear one.

Table 4. The coefficients of asymmetric herding in the up and down market

	Panel A: The coefficients of herding in the up and down markets using the CSAD– The CCK approach						Panel B: The regression coefficients of linear and nonlinear herding in the up and down markets							
	Obs.	δ_1	δ_2	δ_3	Adj. R^2	P-val. (F)	δ_1	δ_2	δ_3	δ_4	Adj. R^2	P-val. (F)	Wald Coeff test H_0: $\alpha_3-\alpha_4=0$ $\alpha_3-\alpha_4$	χ^2
ALL firms														
ALL Period	1960	-3.10***	4.03***	165.9***	0.02	0.00***	-1.050	5.98***	72.23	247.0***	0.09	0.00***	-174.9	10.12***
(2003-2010)		(-2.06)	(2.58)	(3.70)			(-0.62)	(3.45)	(1.25)	(4.50)				
Before	972	0.36***	0.56***	-4.97***	0.14	0.00***	0.183	0.714***	5.74	3.96	0.13	0.00***	1.78	0.62
(2003-2006)		(-5.12)	(8.51)	(-8.51)			(1.06)	(3.93)	(1.02)	(0.70)				
After	988	-6.56***	8.36***	388.8***	0.03	0.00***	-1.96	11.77***	169.6	537.4***	0.05	0.00***	-367.8	11.85***
(2007-2010)		(-2.16)	(2.66)	(4.15)			(-0.55)	(3.54)	(1.33)	(4.87)				
Financial Firms														
ALL Period	1960	-3.592	1.12***	19.82***	0.1	0.00***	16.23***	1.12***	--	19.82***	0.10	0.00***	---	38.08***
(2003-2010)		(-0.64)	(7.94)	(4.18)			(6.95)	(7.94)		(4.18)				
Before	972	0.232	0.954***	11.84*	0.11	0.00***	0.364***	0.755***	263.13*	5.03	0.11	0.00***	257.83	1.71
(2003-2006)		(1.09)	(4.31)	(1.92)			(2.28)	(3.10)	(1.83)	(0.66)				
After	988	-0.58***	1.45***	33.42***	0.1	0.00***	-0.384*	1.60***	23.84***	39.89***	0.10	0.00***	-16.05	20.86***
(2007-2010)		(-3.32)	(7.98)	(6.17)			(-1.87)	(8.09)	(3.22)	(6.24)				
Nonfinancial firms														
ALL Period	1960	-9.21***	0.991***	17.12***	0.11	0.00***	7.92***	0.991***	--	17.12***	0.11	0.00***	---	26.84***
(2003-2010)		(-2.25)	(9.60)	(4.93)			(4.62)	(9.60)		(4.93)				
Before	972	0.197	0.598***	1.032	0.14	0.00***	0.223***	0.642***	-7.13	2.71	0.13	0.00***	-4.42	0.17
(2003-2006)		(1.45)	(4.23)	(0.26)			(2.20)	(4.12)	(-0.08)	(0.55)				
After	988	-0.49***	1.31***	30.6***	0.12	0.00***	-0.33***	1.421***	23.09***	35.65***	0.12	0.00***	-12.56	23.65***
(2007-2010)		(-3.29)	(8.46)	(6.65)			(-1.92)	(8.47)	(3.67)	(6.56)				

In Panel A, the estimated coefficients of the regression model in Eq. (5) are reported. $CSAD_t$ is the dependent variable. δ_1 and δ_2 are the coefficients of $(1\text{-}D)*R_{mt}$ and $D*R_{mt}$ representing the proxies for herding in the up and the down market on day t, respectively. The dummy variable (D) takes value of unity if $R_{mt}<0$, or zero otherwise. δ_3 is the coefficient of R_{mt}^2 as a proxy for nonlinear herding. In Panel B, the estimated coefficients of the non-linear regression model in Eq. (6) are reported. $CSAD_t$ is dependent variable at time t. δ_1 and δ_2 are the coefficients of $(1\text{-}D)*R_{mt}$ and $D*R_{mt}$ representing the proxies for linear herding in the up and the down market at time t, respectively. The dummy variable (D) takes value of unity if $R_{mt}<0$, or zero otherwise. δ_3 and δ_4 are the coefficient of $(1\text{-}D)*R_{mt}^2$ and $D*R_{mt}^2$ as a proxies for nonlinear herding in the up and down market, respectively. For both Panels, the number of financial (nonfinancial) firms is 43 (112) before the crisis. After the crisis, the number of financial (nonfinancial) firms is 105 (145). The levels of confidence (1%, 5%, and 10%) are signed by ***, **, and *, respectively.

Recall, to test for herding (linear and nonlinear jointly) in the up and down markets, this study modifies the model as in Eq. (5). This modification is achieved by using a dummy variable procedure which takes the value of unity if $R_{mt}<0$ on day t, or zero otherwise. The proxy for linear (nonlinear) herding in the up market is generated by multiplying the positive dummy variable, 1-D, by linear (nonlinear) market return. And, the proxy for linear (nonlinear) herding in the down market is generated by multiplying the dummy variable, D, by linear (nonlinear) market return. Panel B of Table 4 reports the estimated coefficients of linear and nonlinear herding for the up and down markets as in Eq. (6). The coefficients of the up market, δ_1, are negative and significant. This suggests evidence for both types of firm in the extreme market conditions (after the crisis) confirming the finding of Chiang et al. (2010). This suggests that, when market is trending up, herding would exist because return dispersion decreases rather than increases. However, no evidence is reported for the linear herding when market is going down. That is, the coefficients of the down market, δ_2, are positive and significant. The coefficients, δ_3 and δ_4, shows evidence of the absence of the nonlinear herding when the market is down and up in both normal and extreme market conditions. To specify a test for the nonlinear coefficients of the up and down cases, the equality test of Wald is used. This test tests the null hypothesis of H_0: $\delta_3=\delta_4=0$. It is rejected for both types of firms only in the period after the crisis with a negative sign. This contradicts the predictions that CSAD in general decreases when market return decreases. Indeed, these coefficients show that beyond a certain threshold, the CSAD may increase when R_{mt} increases. This evidence confirms the findings of the CH method above.

In the preceding section, it was noted that different results are reported of herding behavior. Financial firms presented no evidence of nonlinear herding while nonfinancial firms displayed evidence of nonlinear herding. It follows that, when the data are divided into up and down markets, no evidence of nonlinear herding is reported for both types of firms. These results are useful, since they provide information conditional on certain groups of the data such as financial and nonfinancial firms. Because of this, the issue of whether herding behavior is sensitive to different quantiles of stock return dispersions is addressed here. It is also of interest to examine whether the error distribution is following a Gaussian setting. That is, quantile estimators would be more efficient than the estimators of the least squares (Buchinsky, 1998) (Note 3). In extreme market conditions, the flow of news and information can significantly influence the tails values, thus biases the estimators. To overcome these issues, a quantile regression is employed with range of conditional quantile functions for robustness. Thus, it produces more efficient estimates compared with the least squares.

Table 5. The coefficients of the quantile estimation of herding behavior for all firms

	α_1	α_2	α_3	α_4	Pseudo R^2	Chi- χ^2 (4)
Panel A: ALL period (2003-2010)						
Quantile =	-0.18***	1.06***	-3.46	7.95	0.02	35.76***
10%	(-0.94)	(5.31)	(-0.51)	(1.44)		
Quantile =	-0.71***	0.81***	31.32***	10.66***	0.02	77.78***
25%	(-7.83)	(8.65)	(10.88)	(3.77)		
Quantile =	0.064	1.38***	17.52***	20.98***	0.04	--
50%	(0.35)	(7.42)	(2.84)	(3.60)		
Quantile =	-0.155	1.54***	34.89***	18.20***	0.02	169.12***
75%	(-1.01)	(9.84)	(6.69)	3.56		
Quantile =	-4.79***	8.60***	263.3***	519.19***	0.04	103.69***
90%	(-4.41)	(7.22)	(8.10)	12.87		
Panel B: Before (2003-2006)						
Quantile =	-0.27***	0.359***	-2.04	1.73	0.11	28.82***
10%	(-3.02)	(3.62)	(-0.68)	(0.64)		
Quantile =	-0.18***	0.442***	-5.26**	3.30	0.09	47.97***
25%	(-2.37)	(5.41)	(-2.15)	(1.43)		
Quantile =	1.080***	0.551***	-6.03	4.78	0.09	--
50%	(8.74)	(4.16)	(-1.53)	(1.17)		
Quantile =	0.440***	1.671***	-0.407	23.45***	0.17	356.02***
75%	(4.66)	(17.98)	(-0.14)	(8.88)		
Quantile =	0.407***	-0.0731	0.310	-20.5***	0.12	65.73***
90%	(3.55)	(-0.45)	(0.09)	(-3.40)		
Panel C: After (2007-2010)						
Quantile =	-1.73	1.832	90.28*	-113.9***	0.03	31.73***
10%	(-1.35)	(1.47)	(1.99)	(-2.96)		
Quantile =	-1.45***	2.19***	74.90***	33.61***	0.02	34.47***
25%	(-3.83)	(5.80)	(6.18)	(2.83)		
Quantile =	-1.37***	1.93***	88.82***	41.35***	0.02	--
50%	(-9.71)	(14.15)	(17.55)	(9.37)		
Quantile =	-3.69***	8.36***	246.5***	520.16***	0.04	436.63***
75%	(-7.22)	(15.62)	(14.82)	(27.63)		
Quantile =	-19.5***	32.36***	1027.7***	1774.9***	0.08	54.32***
90%	(-2.54)	(4.55)	(4.07)	(8.96)		

The table reports the coefficients of the quantile regressionsfor Eq. (6) for all listed Jordanian firms using different quantiles. $CSAD_t$ is dependent variable at time *t*. δ_1 and δ_2 are the coefficients of $(1-D)*R_{mt}$ and $D*R_{mt}$ representing the proxies for linear herding in the up and the down market at time *t*, respectively. The dummy variable (*D*) takes value of unity if $R_{mt}<0$, or zero otherwise. δ_3 and δ_4 are the coefficient of $(1-D)*R_{mt}^2$ and $D*R_{mt}^2$ as a proxies for nonlinear herding in the up and down market, respectively. The levels of confidence (1%, 5%, and 10%) are signed by ***, **, and *, respectively. The $\chi^2(4)$ is the Chi-squared distribution with four degrees of freedom for the Wald test.

In Tables (5 and 6), the estimated coefficients of the quantile regressions of Eq. (7) with different quantiles (10%, 25%, 50%, 75%, and 90%) are recorded. Table 5 shows the estimated coefficients, α_3 and α_4, for all firms. These coefficients are positive and significant at the 5% level of confidence or better in the low quantiles (τ = 10% and 25%) up to the median level (τ = 50%). This suggests no evidence of nonlinear herding in periods before and after crisis. Beyond the median level, these coefficients remain positive and significant. It also reports evidence of linear herding for the quantile coefficients lower and upper the median level in the all sub-period. This evidence of linear herding reflects herding tendency which is more likely to happen at the lower tails of the distribution in the period after the crisis and at higher tails before the crisis. Thus, herding is observed in lower and upper levels of quantiles for periods of market stress. However, in general, no evidence of nonlinear herding is reported in lower and upper quantiles. But, before the crisis, herding appears in lower quantiles when market is falling down (τ =25% with α_4). These results confirm the findings in Panel B of Table 4.

Panel A in Table 6 shows that financial firms display evidence of linear herding at the levels below the median when the market is trending up in the all period, before and after the crisis. This result suggests that Jordanian financial investors tend to herd in bullish markets more than beaten markets. Evidence of nonlinear herding behavior is found in the all period and in the period before the crisis at median level (see τ = 50% with α_3). In fact, the Table records negative and significant coefficients of the up market in low and high quantiles.Thus, evidence of herding is observed in the lower and upper levels of quantiles in normal market conditions. These results suggest that Jordanian financial investors display similar trading behavior to other investors. However, no evidence of asymmetric herding is captured in the up and down markets (see α_3 and α_4).

Table 6. The coefficients of the Quantile estimation of herding behaviorfor financial and nonfinancial firms

	Panel A: Financial Firms						Panel B: Non-financial Firms					
	α_1	α_2	α_3	α_4	Pseudo R^2	Chi-χ^2 (4)	α_1	α_2	α_3	α_4	Pseudo R^2	Chi-χ^2 (4)
ALL period (2003-2010)												
Quantile	-0.23***	0.37***	1.12	3.40	0.05	20.65***	-0.18***	0.33***	-2.91	0.901	0.10	56.55***
= 10%	(-2.99)	(4.82)	(0.48)	(1.54)			(-2.86)	(5.40)	(-1.33)	(0.53)		
Quantile	-0.59***	0.52***	22.65***	5.47***	0.05	86.10***	-0.33***	0.45***	6.98***	3.81***	0.07	59.39***
= 25%	(-10.02)	(8.46)	(12.59)	(2.85)			(-6.18)	(8.16)	(4.11)	(2.30)		
Quantile	1.41***	1.34***	-19.1***	24.61***	0.11	--	1.22***	1.07***	-14.36***	17.60***	0.11	--
= 50%	(9.08)	(8.35)	(-3.72)	(4.84)			(9.49)	(8.22)	(-3.31)	(4.26)		
Quantile	-0.008	1.70***	11.02***	19.93***	0.08	424.14***	0.066	1.54***	7.82***	18.43***	0.08	570.92***
= 75%	(-0.09)	(19.08)	(4.08)	(6.69)			(0.97)	(22.01)	(3.72)	(7.90)		
Quantile	0.30***	0.003	3.35	4.71*	0.05	35.70***	0.32***	0.056	-0.025	8.43***	0.08	103.85***
= 90%	(3.60)	(0.03)	(1.24)	(1.77)			(7.54)	(1.24)	-0.02	(6.24)		
Before (2003-2006)												
Quantile	-0.26***	0.426***	-22.68	4.395	0.05	9.67***	-0.075	0.27***	-272.5***	-0.707	0.12	50.80***
= 10%	(-2.82)	(2.83)	(-0.33)	(1.04)			(-1.36)	(3.17)	(-5.78)	(-0.30)		
Quantile	-0.35***	0.486***	169.3***	4.025	0.06	27.15***	-0.20***	0.45***	-120.1***	3.72*	0.09	50.18***
= 25%	(-5.79)	(5.30)	(3.63)	(1.49)			(-4.01)	(5.99)	(-2.97)	(1.76)		
Quantile	1.07***	0.56***	-155.0*	4.78	0.08	--	0.61***	0.47***	70.04	3.182	0.09	--
= 50%	(10.36)	(3.42)	(-1.83)	(0.94)			(7.89)	(4.00)	(1.05)	(0.89)		
Quantile	0.43***	2.00 ***	28.72	31.41***	0.15	172.03***	0.46***	1.44***	-39.83	18.79***	0.17	554.26***
= 75%	(4.19)	(13.99)	(0.31)	(7.83)			(9.82)	(21.69)	(-1.03)	(9.59)		
Quantile	0.32***	0.523***	135.6*	-9.14	0.11	74.67***	0.42***	-0.134	-51.20	-20.6***	0.12	43.35***
= 90%	(2.98)	(2.37)	(1.83)	(-1.12)			(5.03)	(-0.77)	(-0.91)	(-3.19)		
After (2007-2010)												
Quantile	-0.50***	0.407***	18.27***	4.59*	0.04	22.86***	-0.49***	0.423***	15.01***	2.904	0.08	50.35***
= 10%	(-5.15)	(4.56)	(6.96)	(1.85)			(-6.71)	(6.08)	(7.46)	(1.57)		
Quantile	-0.69***	0.56***	30.85***	7.77***	0.04	98.73***	-0.61***	0.442***	29.17***	3.00	0.06	173.17***
= 25%	(-8.79)	7.20	(13.65)	(3.20)			(-9.99)	(7.28)	(16.63)	(1.55)		
Quantile	0.114	3.39***	6.98***	86.45***	0.18	--	0.183*	2.817***	6.114	72.17***	0.19	--
= 50%	(0.89)	27.96	(1.52)	(22.51)			(1.70)	(7.83)	(1.57)	(22.63)		
Quantile	0.068	0.24*	6.80***	11.74***	0.03	22.93***	0.123	0.383***	6.14***	16.94***	0.05	41.68***
= 75%	(0.82)	(3.01)	(2.49)	(4.66)			(1.64)	(5.31)	(2.41)	(7.49)		
Quantile	0.36***	-0.18*	-0.973	1.255	0.07	27.35***	0.321***	0.065	-0.308	12.15***	0.10	90.40***
= 90%	(3.84)	(-1.97)	(-0.36)	(0.48)			(5.40)	(1.10)	(-0.15)	(7.37)		

The table reports the coefficients of Eq. (7) using the quantile regression for financial and nonfinancial firms. $CSAD_t$ is dependent variable at time t. δ_1 and δ_2 are the coefficients of $(1\text{-}D)*R_{mt}$ and $D*R_{mt}$ representing the proxies for linear herding in the up and the down market at time t, respectively. The dummy variable (D) takes value of unity if R_{mt}<0, or zero otherwise. δ_3 and δ_4 are the coefficient of $(1\text{-}D)*R_{mt}^2$ and $D*R_{mt}^2$ as a proxies for nonlinear herding in the up and down market, respectively. The levels of confidence (1%, 5%, and 10%) are signed by ***, **, and *, respectively.

In comparison with prior results in Panel B of Table 4, the results reported in Panel A of Table 6 are different. It shows that, for financial firms, there is evidence of nonlinear herding in the all period and in period before crisis when the market is trending up. This result contradicts the findings in Table 3 as financial firms exhibit no evidence of nonlinear herding. After the crisis, evidence of the absence of herding is also reported confirming the results in Panel B in Table 4.

Panel B in Table 6 shows that for financial firms, no evidence of nonlinear herding is found before and after crisis in the up and down markets at median level (see τ = 50%). This result contradicts the results reported in Table 3. However, these results indicate that nonfinancial investors show similar trading patterns to other investors consistent. Thus, nonlinear herding is not observed in the lower and upper quantiles in extreme and normal market conditions. Therefore, Tables 5 and 6 clearly show evidence of herding, but this evidence differs among quantile levels. Assuming that the value of quantile is close to the mean value of the least squares estimation, the Wald test is conducted. It tests the null hypothesis that the four coefficients of each quantile are equal. The χ^2 (4) statistic indicates that the null is uniformly rejected at lower and higher quantile distributions for both firms. This suggests that the estimated coefficients for all quantiles are significantly different from that of the median distribution. This similarity in test results shows that a mean or a median estimation may yield a similar statistical inference.

It is also interesting to compare the quantile regression results in the two tables above with those obtained when using the least squares in Table 4. In these Tables (5 and 6), the coefficients on α_3 and α_4 are significantly positive for all firms before and after the crisis. In the current analysis, evidence is consistent with the evidence in Table 5 for the absence of nonlinear herding. To conclude, no difference in results between the least squares estimation and the quantile estimation. Therefore, although of using different levels of quantiles, the results remain the same as in the results of the least squares. These results contradict the findings reported by Alexander (2008) and Chiang et al. (2010).

6. Conclusion

This paper has examined the herd behavior in the Jordanian equity market for financial and nonfinancial firms before and during the recent global financial crisis. Different results are reported depending upon the methodology used to detect for herding behavior. The study reports no evidence of herding because stock return dispersion does not deviate far from market return for financial and nonfinancial firms. A positive linear function is found between CSSD and the up and down market returns in both extreme and normal market conditions for both types of firms. This result supports the rational asset pricing models through providing evidence of the absence of herding for both financial and nonfinancial firms before and after crisis. During extreme periods, equity return dispersions increase rather than to decrease, so providing evidence of the absence of herding.

The study provides evidence for the absence of herding for financial and nonfinancial firms before and after crisis. This is because the relationship between the CSAD and the quadric market returns is positive and significant. Nevertheless, both types of firms had evidence of linear herding in the bullish market. The results also show evidence of the absence of before and after crisis as equity return dispersions nonlinearly increase rather than to decrease for both types of firms. However, evidence of the tendency of linear herding is present in the Jordanian stock market. The linear herding would be present because of the incomplete information disclosures. In fact, in Jordan where the evidence in favor of herding is not pronounced, macroeconomic information do not play a significant role in the decision making process of market participants. A quantile regression is used with different conditional quantiles to test for herding through the nonlinear function of market returns. It confirms the results of least squares as evidence of linear herding is reported in the up market only in low quantiles. Financial firms display nonlinear herding before the crisis at the median in the bullish market, while no evidence of nonlinear herding is reported in up and down markets.

The important implication of this study is that, in the Jordanian stock market where market participants tend to herd around the market consensus, a larger number of securities are needed to achieve the same level of diversification than in a normal market. Future research can be undertaken through an application on mutual funds. And, it would be much valuable if the most recent developed herding tests such as Bernhardt et al. (2006) and Naujoks (2009) are applied to our study set of data.

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Notes

Note 1. It should be indicated that there is a long record of studies analyzing the herding behavior in the early 1990s, such as Scharfstein and Stein (1990), Zwiebel (1995) and Trueman (1994) among others.

Note 2. To satisfy the 5%, 10% and 20% criteria in the up (down) market before the crisis, the daily return of the Jordanian stock market index has to exceed (be less than) 0.024 (-0.029), 0.017 (-0.022), and 0.012 (-0.013), respectively. After the crisis period, the daily return of the Jordanian stock market index has to exceed (be less than) 0.019 (-0.026), 0.016 (-0.018), and 0.011 (-0.012) to satisfy the three criteria indicated above respectively.

Note 3. Hoenker (2005) indicated that one of the aspects of losing efficiency in producing estimators is that the least squares estimators focus on the mean value. In this case, information about whether the tails of a distribution are fatter, or not, would be lost.