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Investigating the effect of return jumps on herd behavior and its asymmetry in the Tehran Stock Exchange Market

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Abstract

Herding behavior is typically described as the inclination of investors to follow the actions of others in their investment decisions. Herding represents a behavioral tendency in which investors rely on collective rather than private information. Herd literature shows that return jumps can serve as a representation of information arrival, leading to significant price changes. This proposition is introduced due to its potential impact on investor sentiment, assuming greater awareness among other investors as a factor related to the occurrence of herding. Furthermore, it is believed that, in conditions of negative market returns, market participants are more inclined to mimic the behavior of others due to the stress induced by the risk incurred. In the background of previous research, evidence indicates the occurrence of herd behavior on days with return jumps and negative returns. In this study, we investigated herding behavior and its asymmetry through the utilization of return jumps, employing the CSAD method. Under circumstances in which there were no occurrences of return jumps and without taking into account negative market returns, our research was unable to verify the existence of herding at the market level. Nevertheless, when return jumps and negative market returns were present, the occurrence of herd behavior was proven, and the asymmetry of herd behavior was also verified.

Keywords: Stock Market, Herd Behavior, CSAD Method, Herd Asymmetry, Return Jump

Introduction

Herding behavior is typically described as the inclination of investors to follow the actions of others in their investment decisions. Herding represents a behavioral tendency in which investors rely on collective rather than private information (Tan et al., 2008). Herding has garnered significant attention from academics, researchers, and analysts due to its impact on the capital market, such as stock price fluctuations (Jabeen et al., 2022; Deng et al., 2018; Clarke et al., 2014), changes in liquidity levels (Radi et al., 2021; Vo & Phan, 2019), and its influence on market crashes (Deng et al., 2018; Chung & Kim, 2017)

Herding behavior in stock markets differs between underdeveloped markets and developed markets. Studies have shown that the effects of herding are more pronounced in developing countries due to factors such as incomplete financial market structures and low financial literacy (Chen, 2023). Furthermore, research has indicated that herding is more prominent in emerging markets, followed by frontier and developed markets (Chathurika & Tennekoon, 2022). Given the heightened presence of herding in underdeveloped markets and its various impacts on financial markets, a more detailed examination of herding in the Tehran Stock Exchange Market holds significant importance.

The herding phenomenon in financial markets has been observed across various nations in different scenarios (Hasan et al., 2023). Research has provided evidence of herding stemming from both non-fundamental and fundamental information. A study on the Latin American Integrated Market (MILA) demonstrated significant herding tendencies in general and specific market conditions (Vieito et al. 2023). Furthermore, examinations of BRIC countries and Turkey revealed instances of herding spillover during crises and volatile periods, indicating the presence of cross-country herding behaviors (Yasir & Önder, 2023). Research in the Asian region has yielded varied results, with some countries confirming the existence of herding behavior while others do not (Chathurika & Tennekoon, 2022).

The first study on herding behavior in Iran was conducted by Eslami and Shahriari (2006), who used the model introduced by Christie and Huang (1995) to investigate herding in the Iranian market from 2001 to 2005. They observed herding behavior in the Iranian market. Additionally, Yousefi and Shahabadi (2009) also examined the existence of herding among investors in the Tehran Stock Exchange Market from 2003 to 2007. They used the model Hwang and Salmon (2004) introduced for this analysis and found that herding is observable among investors in the Tehran Stock Exchange Market. However, they calculated a Pearson correlation coefficient of 0.007 between herding and market returns. They concluded that there is a negative relationship between market returns and herding, but it is not statistically significant.

After the stock market bubble in the Tehran Stock Exchange Market in 2013, we have witnessed a growth in research in the Tehran Stock Exchange market. Furthermore, there has been a resurgence of research in this area following the market bubble in the Iranian securities exchange in the years 2019-2020. It can be concluded that considering the confirmation of the presence of herding in the Iranian market in previous research (Nazari et al., 2022; Rostami et al., 2022; Jamali & Bakhtiari, 2022) and its effects on market fluctuations and investment returns, this topic is of great importance. A better understanding of it will significantly assist practitioners and researchers in this field.

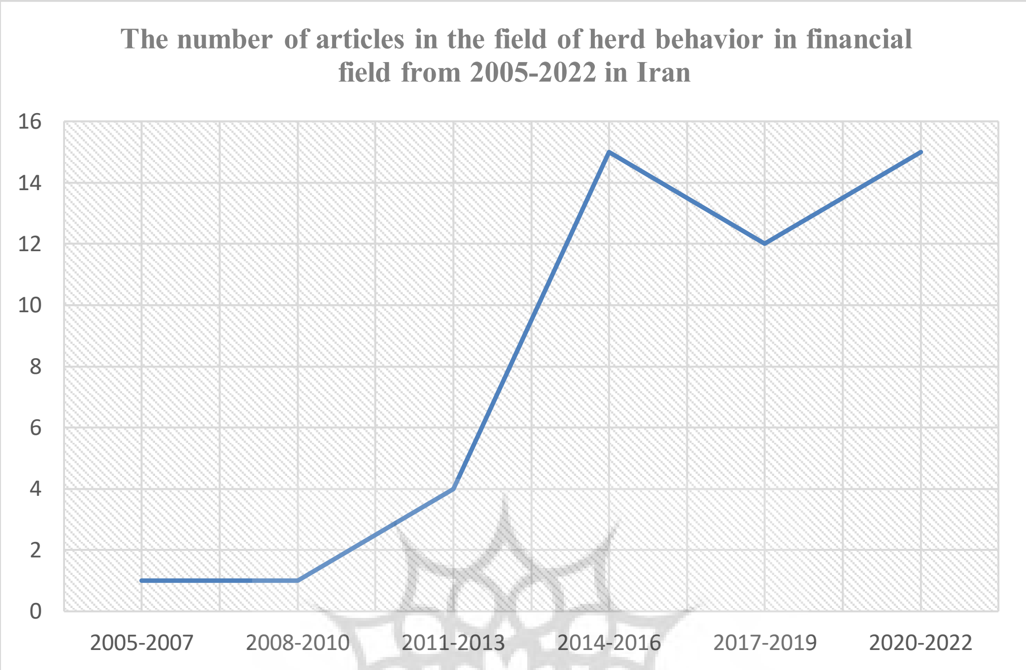

Figure 1. This review is based on articles that use the words mass behavior and herd behavior in their titles; Google Scholar and Civilica sites were used for this review. A total of 51 articles related to the financial field were reviewed and recorded according to the year of publication to examine the growth or decline of research in this field.

Kirkby and Aguilar (2023) state that return jumps in financial markets refer to sudden and significant changes in the value of an asset, which can occur due to news announcements, market events, or other macroeconomic factors, leading to increased market volatility. According to Chen et al. (2022), the drivers of herding include the assumption of more precise information by other active market participants, seeking social approval, and maintaining a positive self-concept. With the increase in market volatility due to jump returns, this phenomenon can lead to the assumption of greater awareness among other market participants and drive individuals toward herding behavior. However, return jumps can also lead to intentional herding, where individuals exhibit similar behavior due to the same shared information (Filip & Pochea, 2023).

Wanidwaranan and Padungsaksawasdi (2020) suggest that the identification of herding by using return jumps has a greater discriminative power. Due to the significance of herding in the Iranian market and its impacts on the capital market, such as its effects on liquidity and price fluctuations (Nazari et al., 2022), this research employs the methodology developed by Wanidwaranan and Padungsaksawasdi (2020), based on the approach of Chang et al. (2000), to investigate herding and its asymmetry in the Tehran Stock Exchange Market.

Herding behavioral asymmetry is a studied characteristic in the herding domain (e.g., Fei and Zhang, 2023; Lin et al., 2018; Park, 2011). Asymmetry in herding refers to the unequal behavior of investors in following market trends or imitating the actions of other investors, with a greater intensity of this imitative behavior in declining market conditions (Lin et al., 2018). In this research, in addition to identifying herding, we will also examine its asymmetry.

To carry out the investigation above, it is imperative that we initially address the subsequent preliminary inquiries in order to determine the presence of return jumps. Subsequently, we can proceed with the scrutiny of the research hypotheses. The preliminary research question involves identifying evidence of return jumps in the Tehran Stock Exchange. The first research hypothesis posits that return jumps elucidate the herd behavior. Additionally, the second research hypothesis posits that said herd behavior demonstrates asymmetry.

Research Methodology

The first research that introduced a statistical method for measuring herding at the market level was conducted by Christie and Huang (1995). They presented an intuitive measure of herding based on dispersion, known as Cross-Sectional Standard Deviation (CSSD), referred to as the CH method. The initial assumption of this method is that in conditions of herding, return dispersion should increase with a decreasing rate or even decrease significantly in the case of intense herding.

Chang et al. (2000) extended the CSAD method based on the CSSD approach, offering better detection capabilities in extreme fluctuations. While it adheres to the assumption that under herding conditions, return dispersion should increase with a decreasing rate or even decrease significantly in the case of intense herding, this method includes the consideration of return jumps in the CSAD equation to examine herding and its asymmetry.

An occurrence of return jump

The stochastic jump-diffusion model for return jumps is a class of models for random fluctuations that incorporates both volatility and return jumps for market modeling purposes (Dupret & Hainaut, 2023). Including jump returns in market modeling enhances its modeling capability (Sene et al., 2021).

$$dp_t = \mu_t dt + \sigma_t dW_t + K_t dq_t; t \geq 0 \tag{١}$$

In a context where dp_t represents the natural logarithm of a stock market index, μ_t stands for the drift term, σ_t is the instantaneous volatility during period t, W_t denotes the standard Brownian motion, q_t corresponds to the Poisson process, and K_t is the value of the return jump. In the presence of a return jump, the value of dq_t will be equal to ١; otherwise, it will be equal to 0.

Return jumps can be calculated based on realized variance and the quadratic variation of cumulative returns (Liu et al., 2019); regarding the computation of return jumps, Wanidwaranan and Padungsaksawasdi (2020) state that, since second-order changes are not observable, realized variance (RV) converges to quadratic variation (QV) when considering high frequency (M→∞) (Anderson et al., 2007). They demonstrate that under high-frequency conditions, the difference between RV and BV indicates the value of the return jump because the occurrence of return jumps has a more significant impact on RV than BV (Odusami, 2021).

To calculate RV, 5-minute returns are used during the examined days:

$$RV\ (t) = \sum_{i=1}^{M} r_{t,j}^2 \tag{٢}$$

Where:

$$r_{t,j} = p_{t,j} - p_{t,j-1}; j = 1, \ldots, M; t = 1, \ldots, T \tag{٣}$$

where j represents 5-minute intervals every day with M number of 5-minute intervals and the number of days under review equals T.

And to calculate BV:

$$\mathrm{BV(t)} = \mu_1^{-2} \left(\frac{M}{M-2}\right) \sum_{i=1}^{M} |r_{t,j-2}|\,|r_{t,j}|; \mu_1 = \sqrt{\frac{2}{\pi}} \tag{4}$$

And based on RV and BV, it can be said that J(t) (value of return jump every day) is equivalent to:

$$J(t) \equiv RV(t) - BV(t) \rightarrow \sum_{j=1}^{M} K_{t,j}^{2} \tag{5}$$

The Z-statistic proposed by Huang and Tauchen (2005) is utilized to examine the occurrence of return jumps on each day. Based on this approach, the days with significantly noticeable changes in market return are identified. According to the research by Andersen et al. (2010-2011), it has been suggested that if Z(t) is greater than the critical value of the standard normal distribution (Φ_α) at a level of statistical significance (α= 0.99 and 0.0999), that day is recognized as a return jump.

$$Z(t) = \frac{\frac{RV(t) - BV(t)}{RV(t)}}{\sqrt{\left[\left(\frac{\pi}{2}\right)^2 + \pi - 5\right]\frac{1}{M} max\left[1, \frac{TP(t)}{BV(t)^2}\right]}} \tag{6}$$

$$TP(t) = M\mu_{4/3}^{-3}\left(\frac{M}{M-4}\right)\sum_{j=5}^{M}\left|r_{t,j-4}\right|^{4/3}\left|r_{t,j-2}\right|^{4/3}\left|r_{t,j}\right|^{4/3} \tag{7}$$

$$\mu_{4/3} = \frac{2^{2/3}\Gamma\left(\frac{7}{6}\right)}{\Gamma\left(\frac{1}{2}\right)} \tag{8}$$

TP(t) is the tri-power quarticity statistic, an integrated quarticity estimator used to determine the scale of realized variance and bipower variation.

Herd behavior model with return jump

The CSAD method is a reliable approach for calculating herd behavior, as noted by Liu et al. (2006), indicating that the CSAD test may yield more precise results in identifying herding behavior in financial markets. Per the recommendation of Wanidwaranan and Padungsaksawasdi (2020), this research utilizes the model presented by Chang et al. (2000) (the CSAD method). This choice is made because combining a quadratic term to depict nonlinear relationships, especially during periods of significant events (which were overlooked by Christie and Huang (1995), who introduced the CSSD method), contributes to better detecting herd behavior.

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right| \tag{9}$$

$$CSAD_t = \alpha + \gamma_1\left|R_{m,t}\right| + \gamma_2\left(R_{m,t}\right)^2 + \varepsilon_t \tag{10}$$

In this equation (9), $CSAD$ is equal to the cross-sectional Absolute Deviation at time t, where N is the number of companies examined in the portfolio. $R_{i,t}$ represents the return of stock i on day t, and $R_{m,t}$ is the equally weighted portfolio return at time t and ε_t is the error term at time t.

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (1١)$$

$$R_{m,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \quad (١2)$$

Vidal-Tomás et al. (2019) state that, according to Chang et al. (2000), herding is examined through CSAD in a manner where the coefficients γ_1 and γ_2 significantly negative indicate herding, while a considerably positive value represents conditions conforming to the rational asset pricing model. In fact, the negative values of γ_1 and γ_2 contradict the assumption of the rational asset pricing model and indicate irrational decision-making.

Herd behavior model with jump effect and asymmetry in herd behavior

Wanidwaranan and Padungsaksawasdi (2020) state that, to investigate herding asymmetry, a dummy variable should be included in equation (10) for market conditions during negative returns. This variable, denoted as D_d, takes the value 1 when market returns are negative and 0 otherwise. Additionally, to examine return jumps, a variable (D_{jump}) is defined. It takes the value 1 when a return jump is present and 0 otherwise. By incorporating all permutations of these two variables into equation (10) and examining their respective γ coefficients, we investigate the relationship between return jumps and herd behavior, as well as explore herding asymmetry.

$$\begin{aligned} CSAD_t = \alpha &+ \gamma_1 D_{jump} + \gamma_2 D_d + \gamma_3 D_{jump} D_d + \gamma_4 |R_{m,t}| + \gamma_5 D_{jump} |R_{m,t}| \\ &+ \gamma_6 D_d |R_{m,t}| + \gamma_7 D_{jump} D_d |R_{m,t}| + \gamma_8 (R_{m,t})^2 \\ &+ \gamma_9 D_{jump} (R_{m,t})^2 + \gamma_{10} D_d (R_{m,t})^2 \\ &+ \gamma_{11} D_{jump} D_d (R_{m,t})^2 \end{aligned} \quad (13)$$

In this equation, γ_5 and γ_9 depict the impact of a return jump on the overall market-level herd behavior model. These coefficients are expected to be significantly negative, indicating that herding is stronger on days with return jumps compared to days without return jumps. γ_6 and γ_{10} represent the asymmetric herd behavior between the period with negative returns and other periods, which is assumed to be negative. Finally, the negative values of γ_V and γ_{11} illustrate the herd behavior at the market level when a jump coincides with a period of negative market returns.

In this study, 5-minute price index data have been used for the identification of jump returns. This data was employed to discern the days when return jumps occurred. Given that the implementation of the CSAD method requires the examination of the equally weighted index and the Tehran Stock Exchange weighted index was introduced on March 5, 2015, the study period spans from the introduction of the weighted index of the Tehran Stock Exchange to March 29, 2023. Additionally, price data of the constituent stocks of the Tehran Stock Exchange index were utilized for CSAD calculation, enabling us to investigate herding.

Results

This research examined 1,942 trading days (from February 23, 2015, to March 29, 2023) to identify days involving return jumps. The calculation of the Cross-Sectional Absolute Deviation ($CSAD$) was performed based on the number of companies listed on the Tehran Stock Exchange index (TSE)(495 companies).

Figure 2 depicts the scatter diagrams representing the market portfolio's CSAD and daily weighted returns (Rm) across the time period.

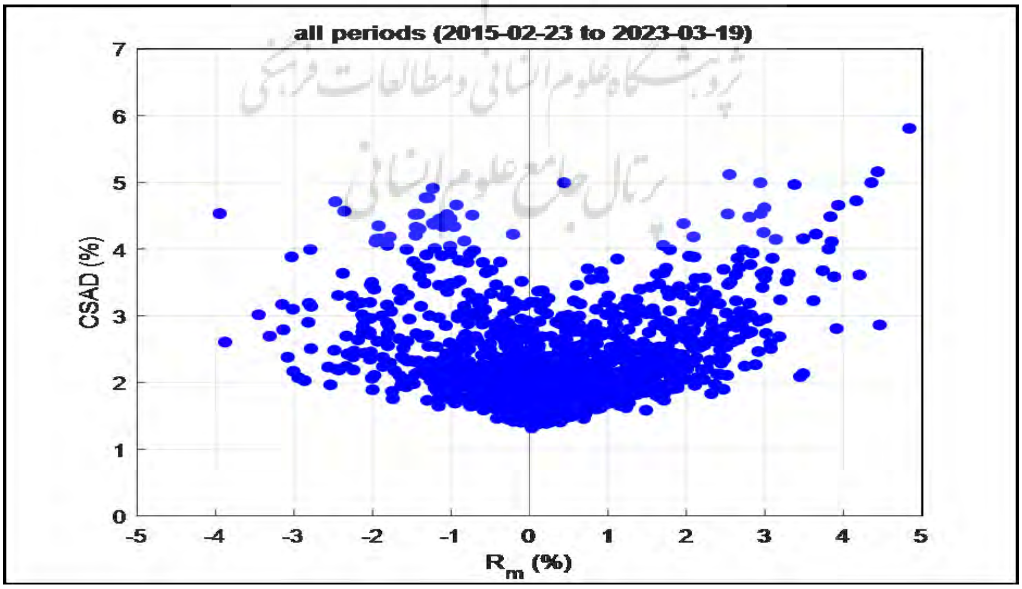

Figure 2. Scatter plots corresponding to the under investigation period, depicting the relationship between CSAD and Rm.

In accordance with the proposition put forth by Christie and Huang (1995), for periods exhibiting the likelihood of herding, a linear and positive slope in the relationship between CSAD and Rm seems apparent. As Wanidwaranan and Padungsaksawasdi (2020) articulated, Chang et al. (2000) later introduced nonlinear expressions for market returns in their model and proposed a change in slope for detecting herding. They assert that if the increase in return dispersion is less than the absolute increase in market return, the presence of herding becomes more observable. The ambiguous angle (between 90 and 180 degrees), as suggested by Wanidwaranan and Padungsaksawasdi (2020), provides evidence of pronounced herding. Furthermore, a concave relationship between CSAD changes and Rm changes also signifies herding. Due to the slope exceeding 90 degrees between the two lines, the plots pertaining to the examined period indicate a high likelihood of herding occurrence.

Table 1 displays the results of the data summary and the statistical significance of Augmented Dickey-Fuller (ADF) tests. According to the outcomes of the ADF test, the stationarity of both CSAD and Rm within the examined interval is affirmed.

Table 1. The data summary and the results of the Augmented Dickey-Fuller (ADF) tests for both CSAD and Rm are provided for examined intervals.

		Data Summary				ADF			Serial correlation at lag				
Period	Variable	Average (%)	Min (%)	Max (%)	S.D. (%)	cValue	pValue	interpretation	1	2	3	5	20
23/2/2015-19/3/2023	CSAD	2.206	1.321	5.811	0.638	-4.637	0.001	stationary in 1% level	0.710	0.619	0.641	0.580	0.520
	Rm	0.221	-3.949	4.840	1.082	-26.159	0.001	stationary in 1% level	0.456	0.200	0.268	0.121	0.023

Regarding the visual representation provided in Figure 3, one can gain insight into the fluctuations and alterations that occur in the parameters of Rm and CSAD as time progresses. This graphical depiction serves as a visual tool in highlighting the highest points reached by CSAD and Rm and conveying the extent of their transformations throughout the duration of the time frame under observation.

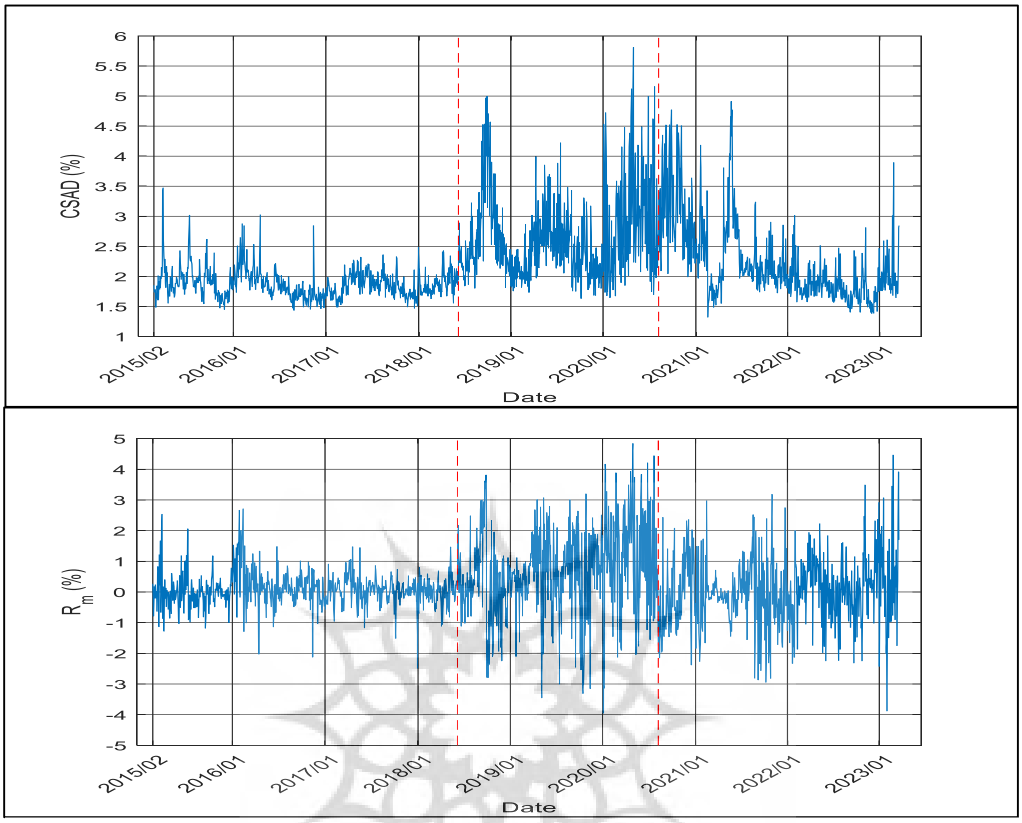

Figure 3. Variations in CSAD and Rm throughout the examined period (February 23, 2015, to March 19, 2023).

Pure herd behaviour

To the proposal by Wanidwaranan and Padungsaksawasdi (2020), our inquiry commences with an examination of pure herd behaviour, as articulated in the research conducted by Chang et al. (2000). As indicated in Table 2, the adjusted coefficient of determination for this investigation stands at 35.1%, signifying alignment with the conducted study. Strikingly, herd behavior was not observed during the scrutinized period in the Tehran Stock Exchange. The dispersion of returns, exhibiting a positive correlation with absolute market returns in the Tehran Stock Exchange, signifies a lack of pronounced herd behavior in the examined market.

Table 2. Pure herd behavior

	Estimated Coefficients	p-value	t-statistic
Intercept	1.857***	0.0000	91.08
$\lvert R_{m,t} \rvert$	0.431***	0.0000	10.85
$R^2_{m,t}$	0.016	0.2220	1.22
Adj. R^2	Ordinary	0.352	
	Adjusted	0.351	

The computation of pure herd behavior in this study relies on the methodology introduced by Chang et al. (2000) [21]. They employ the $CSAD = \alpha + \gamma_1 \lvert R_{m,t} \rvert + \gamma_2 (R_{m,t})^2 + \varepsilon_t$ formula to quantify herd behavior in their calculation.
**The statistical significance is indicated at a 5% level.
*** The statistical significance is indicated at a 1% level.

Asymmetric herd behaviour

Various studies (Islam, 2022; Dang & Lin, 2016) have provided evidence of asymmetric herd behavior. In order to further investigate this phenomenon in both positive and negative market conditions, the researchers have utilized the variable "$D_d R^2_{m,t}$", which takes on a value of 1 when the market return is less than 0 and 0 otherwise. It is worth noting that the adjusted R^2 for this analysis, as presented in Table 3, reaches 38.3%, thereby surpassing the determination coefficient found in Table 2. This higher value, as explained by Wanidwaranan and Padungsaksawasdi (2020), indicates a more accurate fit for the proposed model, reflecting a stronger level of goodness.

Upon examining Table 3, it becomes evident that the negative coefficient of $D_d R^2_{m,t}$ provides further support for the existence of herd behavior in negative market conditions. The research suggests that individuals in such conditions tend to have a greater inclination towards imitating the behavior of others. This tendency arises due to the uncertainty often associated with negative markets. Fear, uncertainty, and a desire for collective approval ultimately amplify herd behavior in negative market conditions (Dang & Lin, 2016; Houda & Mohamed, 2013).

Return Jumps Affecting Herd Behavior

Zare Bahnamiri and Michaghani (2023) assert that traditional herd behavior models do not often identify herd behavior in most cases. However, when return jumps are incorporated into the model, stronger evidence of herd behavior becomes observable. Return jumps are more prevalent in conditions of high market stress and financial turmoil (Naguyen & Prokopczuk, 2019). It has been suggested that return jumps are associated with flight-to-safety periods, indicating times when investors shift their investments from equities to gold (Dungey et al., 2016).

The presence of return jumps in volatility is also significant because it allows for substantial changes in volatility, especially during stock market crash periods (Caporin et al., 2011). Generally, the occurrence of return jumps is more likely in market stress conditions and can considerably impact market dynamics and investor behavior.

Table 3. Asymmetric herd behavior

	Estimated Coefficients	p-value	t-statistic
Intercept	1.840***	0.0000	69.40
D_d	-0.018	0.6636	-0.43
$\|R_{m,t}\|$	0.279***	0.0000	5.79
$D_d\|R_{m,t}\|$	0.576***	0.0000	6.79
$R_{m,t}^2$	0.071***	0.0000	4.73
$D_d R_{m,t}^2$	-0.224***	0.0000	-7.39
Adj. R^2	Ordinary	0.384	
	Adjusted	0.383	

Asymmetric herd behavior in this section is assessed based on the equation $CSAD_t = \alpha + \gamma_1 D_d + \gamma_2 |R_{m,t}| + \gamma_3 D_d |R_{m,t}| + \gamma_4 (R_{m,t})^2 + \gamma_5 D_d (R_{m,t})^2 + \varepsilon_t$

**The statistical significance is indicated at a 5% level.

*** The statistical significance is indicated at a 1% level.

Considering the results in Table 4, which depict the examination outcomes of the occurrence of return jumps in the Tehran Stock Exchange, it can be observed that at the 99% confidence level, out of the 1942 days under scrutiny, 656 days confirm the incidence of return jumps, constituting 33.8% of the days. At the 99.9% confidence level, out of the 1942 days under investigation, the occurrence of return jumps is confirmed in 245 days, encompassing 12.6% of the days. Additionally, based on Figure 4, the Z-Score results related to the occurrence of return jumps can be observed, where the upper line indicates the 99.9% confidence level, and the lower line represents the 99% confidence level.

Table 4. Jump Days and Jump Ratio were examined over 1942 days based on BV (Bipower Variation) and RV (Realized variation) at confidence levels of 99% and 99.9% (jump ratio=$\frac{\text{jump days}}{\text{No.of trading days}}$).

Jump days (99%)	656
Jump ratio (99%)	0.338
Jump days (99.9%)	245
Jump ratio (99.9%)	0.126
No. of trading days	1942

Now, with the assistance of Table 5 and Table 6, we delve into the examination of herd behavior through return jumps (without considering positive or negative market returns) at 99% and 99.9% confidence levels. At the 99% confidence level, the adjusted R^2 is 37.7%, and for the 99.9% confidence level, the adjusted R^2 is 35.6%. These values indicate consistency in calculations in both scenarios.

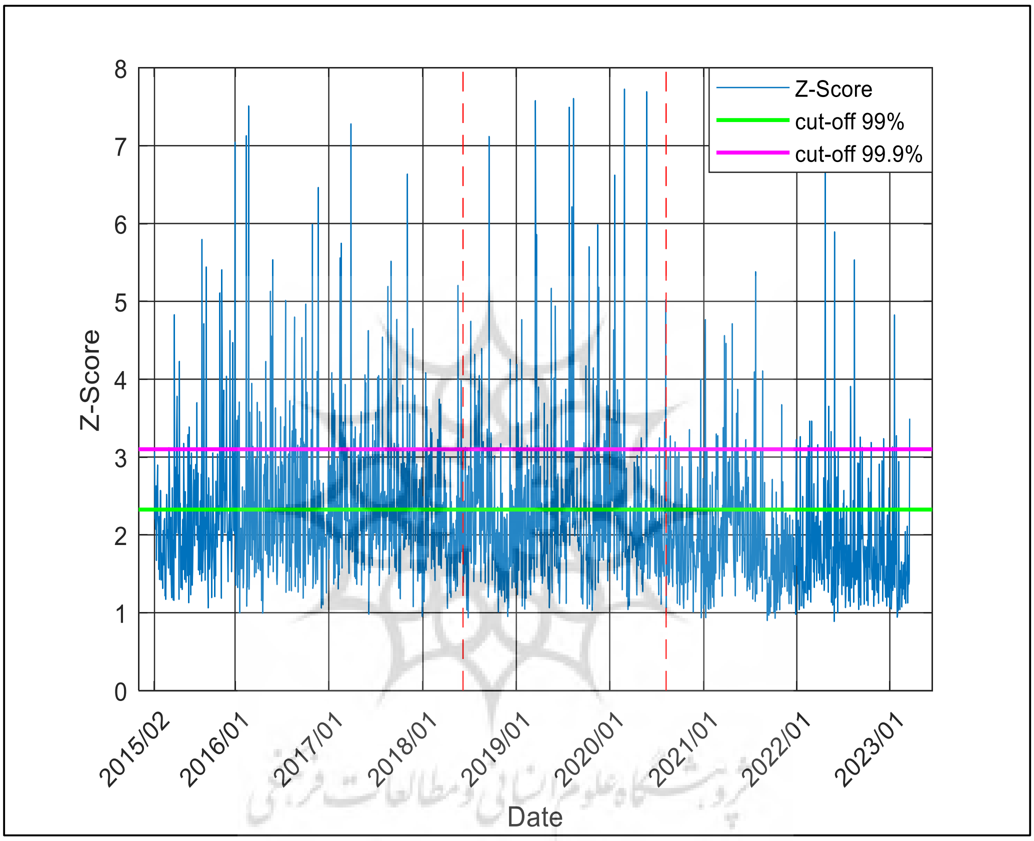

Figure 4. The result of the Z-Score test for examining the outcomes of the RV and BV tests to identify days involving return jumps at confidence levels of 99% and 99.9%.

In both cases, evidence suggesting the influence of return jumps on herd behavior is found due to the negative coefficient of $D_{jump}R_{m,t}^2$. However, due to the high P-value, the reliability of this influence is compromised. Notably, this issue aligns with 5 out of the eight countries examined in the study by Wanidwaranan and Padungsaksawasdi (2020).

Table 5. Herd behavior incorporating return jumps using the staggered return jump variation with the 99% confidence level

[jump: 99%]	Estimated Coefficients	p-value	t-statistic
Intercept	1.837***	0.0000	67.01
D_{jump}	-0.015	0.7098	-0.37
$\lvert R_{m,t}\rvert$	0.417***	0.0000	8.51
$D_{jump}\lvert R_{m,t}\rvert$	0.303***	0.0005	3.48
$R^2_{m,t}$	0.007	0.6566	0.44
$D_{jump}R^2_{m,t}$	-0.022	0.4337	-0.78
Adj. R^2	Ordinary	0.378	
	Adjusted	0.377	

To calculate this table, the model introduced by Chang et al. (2000) [21] has been employed, along with the inclusion of return jumps, as outlined below:

$$CSAD_t = \alpha + \gamma_1 D_{jump} + \gamma_2 \lvert R_{m,t}\rvert + \gamma_3 D_{jump}\lvert R_{m,t}\rvert + \gamma_4 (R_{m,t})^2 + \gamma_5 D_{jump}(R_{m,t})^2 + \varepsilon_t$$

**The statistical significance is indicated at a 5% level.

*** The statistical significance is indicated at a 1% level.

Table 6. Herd behavior incorporating return jumps using the staggered return jump variation with the 99.9% confidence level

[jump: 99.9%]	Estimated Coefficients	p-value	t-statistic
Intercept	1.861***	0.0000	83.45
D_{jump}	-0.074	0.1882	-1.32
$\lvert R_{m,t}\rvert$	0.407***	0.0000	9.75
$D_{jump}\lvert R_{m,t}\rvert$	0.368**	0.0120	2.51
$R^2_{m,t}$	0.021	0.1227	1.54
$D_{jump}R^2_{m,t}$	-0.048	0.3630	-0.91
Adj. R^2	Ordinary	0.358	
	Adjusted	0.356	

To calculate this table, the model introduced by Chang et al. (2000) [21] has been employed, along with the inclusion of return jumps, as outlined below:

$$CSAD_t = \alpha + \gamma_1 D_{jump} + \gamma_2 \lvert R_{m,t}\rvert + \gamma_3 D_{jump}\lvert R_{m,t}\rvert + \gamma_4 (R_{m,t})^2 + \gamma_5 D_{jump}(R_{m,t})^2 + \varepsilon_t$$

**The statistical significance is indicated at a 5% level.

*** The statistical significance is indicated at a 1% level.

A return jump is presumed to indicate potential leakage of company-specific private information to the external environment (Van Ness et al., 2021). Additionally, Christie and Huang (1995) state that a significant price movement (return jump) is favorable for herd behavior. However, based on the obtained results, definitive conclusions regarding the impact of return jumps on herd behavior in the Tehran Stock Exchange cannot be drawn.

Various studies indicate that herd behavior can vary under positive and negative market conditions (Kumar, 2022; Lin et al., 2018). Therefore, we will investigate the impact of return jumps on herd behavior in market conditions with both positive and negative returns.

Return Jumps affecting Herd Behavior in a negative market condition

In this section, we will explore the impact of return jumps on herd behavior in market conditions with negative returns. Considering the results from Tables 7 and 8, we will simultaneously examine two dummy variables, D_d and D_{jump} (based on return jumps at the 99% and 99.9% confidence levels). The adjusted R^2 for the examined data, considering return jumps at the 99% confidence level, is 41.8%, and for data considering return jumps at the 99.9% confidence level, it is 39%, indicating a high level of consistency in these analyses.

The estimated negative coefficient for $D_{jump}D_dR^2_{m,t}$ in both series of examinations signifies herd behavior when return jumps occur in market conditions with negative returns. However, while it is statistically significant for data considering return jumps at the 99% confidence level, it is not statistically confirmed for data considering return jumps at the 99.9% confidence level (it is important to note, in accordance with the research conducted by Wanidwaranan and Padungsaksawasdi (2020), which examined this research based on return jumps at the 99% confidence level across eight countries).

Table 7. herd behavior incorporating return jumps using the staggered return bepower variation with the 99% confidence level and market condition

[jump: 99%]	Estimated Coefficients	p-value	t-statistic
Intercept	1.800	0.0000	50.40
D_{jump}	0.033	0.5239	0.64
D_d	0.038	0.4835	0.70
$D_{jump}D_d$	-0.203	0.0131	-2.48
$\lvert R_{m,t}\rvert$	0.273	0.0000	4.49
$D_{jump}\lvert R_{m,t}\rvert$	0.239	0.0170	2.39
$D_d\lvert R_{m,t}\rvert$	0.465	0.0000	4.67
$D_{jump}D_d\lvert R_{m,t}\rvert$	0.816	0.0001	3.86
$R^2_{m,t}$	0.063	0.0008	3.35
$D_{jump}R^2_{m,t}$	-0.021	0.4977	-0.68
$D_dR^2_{m,t}$	-0.186	0.0000	-5.42
$D_{jump}D_dR^2_{m,t}$	-0.211	0.0075	-2.68
Adj. R^2	Ordinary	0.422	
	Adjusted	0.418	

In this table, the model utilized in Chang et al. (2000) [21] has been employed with the addition of the variables D_{jump}(return jump) and D_d(market with negative returns) as follows:

$$CSAD_t = \alpha + \gamma_1 D_{jump} + \gamma_2 D_d + \gamma_3 D_{jump} D_d + \gamma_4 |R_{m,t}| + \gamma_5 D_{jump} |R_{m,t}| + \gamma_6 D_d |R_{m,t}| + \gamma_7 D_{jump} D_d |R_{m,t}| + \gamma_8 (R_{m,t})^2 + \gamma_9 D_{jump} (R_{m,t})^2 + \gamma_{10} D_d (R_{m,t})^2 + \gamma_{11} D_{jump} D_d (R_{m,t})^2$$

Table 8. herd behavior incorporating return jumps using the staggered return bepower variation with the 99.9% confidence level and market condition

[jump: 99.9%]	Estimated Coefficients	p-value	t-statistic
Intercept	1.850	0.0000	63.29
D_{jump}	-0.114	0.1052	-1.62
D_d	-0.035	0.4234	-0.80
$D_{jump}D_d$	0.017	0.8912	0.14
$\|R_{m,t}\|$	0.238	0.0000	4.68
$D_{jump}\|R_{m,t}\|$	0.481	0.0035	2.92
$D_d\|R_{m,t}\|$	0.605	0.0000	6.84
$D_{jump}D_d\|R_{m,t}\|$	0.735	0.2237	1.22
$R^2_{m,t}$	0.080	0.0000	5.12
$D_{jump}R^2_{m,t}$	-0.081	0.1467	-1.45
$D_dR^2_{m,t}$	-0.227	0.0000	-7.31
$D_{jump}D_dR^2_{m,t}$	-0.758	0.1864	-1.32
Adj. R^2	Ordinary	0.394	
	Adjusted	0.390	

In this table, the model utilized in Chang et al. (2000) [21] has been employed with the addition of the variables D_{jump}(return jump), and D_d(market with negative returns) as follows:

$$CSAD_t = \alpha + \gamma_1 D_{jump} + \gamma_2 D_d + \gamma_3 D_{jump} D_d + \gamma_4 |R_{m,t}| + \gamma_5 D_{jump} |R_{m,t}| + \gamma_6 D_d |R_{m,t}| + \gamma_7 D_{jump} D_d |R_{m,t}| + \gamma_8 (R_{m,t})^2 + \gamma_9 D_{jump} (R_{m,t})^2 + \gamma_{10} D_d (R_{m,t})^2 + \gamma_{11} D_{jump} D_d (R_{m,t})^2$$

Discussion and Conclusion

In general, the presence of herd behavior in the Tehran Stock Exchange was not confirmed without considering negative market returns and return jumps. Furthermore, despite the seemingly affirmative impact of return jumps on herd behavior, as indicated by the negative coefficient $D_{jump}R^2_{m,t}$, its reliability is compromised due to the high P-value.

Based on the results obtained from the Tables, it can be noted that the influence of return jumps on herd behavior is evident, as indicated by the negative estimated coefficient $D_{jump}D_dR^2_{m,t}$ in Table 7. Additionally, the impact of negative market returns on herd behavior is noticeable, confirming the presence of herd behavior asymmetry in the Tehran Stock Exchange. This implies that in market conditions with negative returns, the occurrence of sudden and substantial price changes leads to the formation of herd behavior among market participants.

Considering Table 4, the preliminary research question regarding the occurrence of return jumps in the Tehran Stock Exchange is confirmed. Moreover, the negative coefficient of $D_{jump} D_d R_{m,t}^2$ the first hypothesis of this research, positing that return jumps elucidate herd behavior, is validated. The second hypothesis, suggesting herd behavior asymmetry, is also confirmed.

This study examined and tested the relationship between return jump and herding in the Tehran Stock Exchange market for the first time. The observation that sudden price jumps are associated with herd behavior suggests the presence of two types of herding: intentional herding and spurious herding. Intentional herding arises from investors' tendency to imitate the behavior of others, as highlighted by Bikhchendani and Sharma (2000). Conversely, spurious herding occurs when investors encounter similar information. Notably, this study's CSAD method must differentiate between these two herding types.

Return jumps in stock prices are considered as arrivals of non-trivial information. Several papers provide evidence of the relationship between return jumps and information (Kanniainen & Yue, 2019; Wanidwaranan & Padungsaksawasdi, 2020)

The interpretation can be made that the relationship between return jumps and herd behavior may be attributed to the arrival of non-trivial information to market participants (spurious herding) or the occurrence of a sudden price change due to reasons unknown to individuals. Consequently, they decide to follow the actions of other market participants, assuming that others are more informed (Chen et al., 2022). This scenario is related to intentional herding, or the relationship between return jump and herd behavior can be attributed to a combination of both these reasons.

Furthermore, our study needs to examine the impact of psychological and sociological factors on herd behavior. This omission may contribute to the differing outcomes compared to studies conducted in the countries analyzed in Wanidwaranan and Padungsaksawasdi (2020). Future research should consider a broader perspective that includes psychological and sociological dimensions to enhance our understanding of herd behavior dynamics in the Tehran Stock .Exchange

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