Journal of Money and Economy
Vol. 14, No. 3, Summer 2019
pp. 317-333

Impacts of Economic Variables on Herding Behavior in Tehran Stock Exchange Industries

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Received: 14 May 2019 Approved: 29 Feb 2020

The stock market is influenced by other parallel markets and macroeconomic variables; such variables have impacts on the behavior of financial market players. Accordingly, this study first examines the existence of herding behavior among investors in the Tehran Stock Exchange (TSE). It then investigates the effects of exogenous economic variables on this industry-level behavior in the Tehran Stock Exchange (TSE) throughout 2008-2018. For this purpose, 12 different industries were studied, and the results of nonlinear regression analysis showed the existence of herding behavior in all selected industries in the bearish market. However, this is not true for the bullish market. The findings also indicate that the effects of exogenous variables are not the same in different industries.

Keywords: Herding Behavior, Cross-Sectional Standard Deviation, Financial Market, Macroeconomics.
JEL Classification: C40, E31, I32

1 Introduction

The impacts of non-rational behaviors on the return of stock markets are well established today in behavioral finance literature (Denondt and Thaler, 1985; Odeon, 200; Daniel et al., 1998). Among these behaviors, herding behavior has been the most attractive one for academics and market participants (Christie and Huang, 1995; Chang and others, 2000; Chiang and Zheng, 2010; Pevzner et al., 2015).

Herding behavior is one of the most well-known objective phenomena in financial markets that shows an extreme tendency to winning operation. Many researchers believe that herding behavior is a by-product of information asymmetry in the market, whether herding behavior is rational or irrational. Different groups of investors obtain different information with different qualities, and the difference between the characteristics of each group and their access to information leads to different investment behaviors in different

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groups. The international financial crisis in 2008 made it clear that market prices can deviate substantially from the fundamental value of the stock over long periods. Liquidity constraints, information asymmetry, risk-takers, and other factors are commonly identified as significant contributors to this crisis. It is noteworthy that these factors lead to the loss of stability in the financial markets and put investors at a not covered systematic risk. In recent years, the degree of integration and economic dependence has increased significantly due to the greater interdependence between the financial market and international markets. During the process of globalization of the economy, international financial markets have been integrated, and numerous studies have provided evidence of linking between local financial markets and global markets in different ways (Vithessonthi & Kumarasinghe, 2016).

On the other hand, the development of information technology in the last decade has caused more communication in the financial markets, so that volatility in one market spreads to other financial markets. This dependency subjects the behavior of financial market actors to other markets and also the exogenous economic variables in each country. Eventually, the transfer of price volatility of different assets can take place in one market or across different markets, which will affect the investors' tendencies and behavior. It is widely accepted that the price volatility of financial variables is contagious across different markets over time (Hartmann et al., 2000; Longin and Solnik, 2001; Bae et al., 2003). Therefore, it is crucial to examine the impact of changes in other markets on herding behavior in the stock market.

However, it has been well noted in the research literature that the commodity market and macroeconomic variables have firmly been integrated with traditional financial markets (Jones and Kaul, 1996; Sadorsky, 1999). The main aim of this research is to examine the existence of herding behavior in the Tehran Stock Exchange and the effect of exogenous economic variables (macroeconomic variables) on herding behavior. It should be mentioned that this study is the first research to examine herding behavior and the effects of macroeconomic variables on the TSE simultaneously. Accordingly, after a review of the theoretical and empirical literature, the research methodology will be described, and the empirical findings of this study will be explained before the conclusion section.

2 Theoretical and Empirical Literature Review

The development of international markets and trade dependency among different countries has made financial markets more dependent and affected by macroeconomic and political conditions. So, changes in one market will

cause significant differences in other internationally associated markets. The concept of contagion in the financial markets has gained more attention in the last two decades due to the financial crisis and the process of globalization of the economy. It should be noted that this cannot merely be attributed to the price behavior of financial markets because the micro-level investors and financial market players will be affected as well. So, the confusion and trends of changes in the international and aligned markets, as well as the economic conditions, will have a direct impact on their investment behaviors (Yao et al., 2014).

In this regard, the forecasts and analyses of the individuals will be changed as the exogenous shocks from the global markets directly affect the future and herding behavior of the people in the stock market. According to the volatility and contagion theory, the shocks of the global market and macroeconomic variables could impact capital market investors' behavior. It can be justified in the theoretical framework of herding behavior because the market movement can be interpreted collectively, especially when market returns are more or less than average. Herding behavior, in particular, examines whether individuals acting on their investment information are more likely to influence and imitate others' decisions, actions, and practices. It makes similar transactions in one direction (Balcılar et al., 2017).

In general, contagion theory refers to the fact that some information about financial variables is transmitted over time to the financial asset markets. The expansion of communication systems in recent years and the interdependence of the asset markets emphasize the importance of contagion theory. The mechanisms of contagion between returns and volatility of different assets are essential for the following reasons. First, contagion mechanisms provide information on the market return. The contagion between assets return indicates the existence of a profitable trading strategy. If the profitability of this trading strategy is higher than its operating costs, it potentially provides evidence of market inefficiencies and collective movement behavior among investors. Second, contagion mechanisms are essential in asset portfolio management because having information on the impact of contagion on portfolio selection and risk reduction is very useful. Third, information on the contagion theory can be used to predict asset volatility. Therefore, the contagion effect is a valuable theory in financial risk management and explaining investor behavior.

Therefore, based on the above, it can be stated that an increase in volatility at the level of macroeconomic variables can cause an immediate reaction of financial market players and influence the decisions of others. Also, it leads

to an increase in the cross-sectional deviation of returns of different companies and various industries in the stock market. This phenomenon, according to the theory, can affect the probability of herding behavior (Chang, 2013). New empirical evidence has examined the dynamic relationship between macro shocks and herding behavior during a crisis (Chang, 2013; Choi and Hammoudeh, 2010; Cifarelli and Paladino, 2010; Filis and others, 2011; Sadorsky, 2011).

Also, behavioral financial researchers, such as Greer (2000), Chiu and Lee (2009), and Choi (2010), have found that the movement of prices of macroeconomic variables, such as oil prices, affect returns in recent years. In short, commodity prices and macro variables play a crucial role in explaining financial markets. Yau et al. (2014) have studied the role of corporate size on the existence of herding behavior. They believe that large companies stand differently in the process of herding behavior of the financial market compared to smaller ones because of (1) higher trading volume, (2) more considerable attention from market analysts, and (3) a faster response to the market good news. In another study, Yau et al. (2014) confirmed the existence of herding behavior in the Chinese capital market. Their research findings also indicated that the reaction at the industry level is stronger than at the market level. Besides, the results of their research showed that herding behavior in growth stocks is more robust than value stocks.

In another study, Vieira and Pereira (2014) examined herding behavior and the relationship between investor sentiment and herding-market behavior in the European market from 2003 to 2011. In this study, two different approaches were used to measure the severity of herding behavior. The results show that investor sentiment has little effect on herding behavior. Gong and Dai (2017) studied the impact of monetary policy and exchange rate on the herding behavior of listed companies in the China Stock Exchange. The results of this study showed that there is a herding behavior among traders in the market, as, during devaluation of the Chinese currency and rising interest rates, herding behavior has increased in this country. The findings of recent research also indicated that monetary policy events, as well as the dissemination of news on these policies, would significantly change the extent of the herding behavior in the Chinese stock market.

In another study, Balcilar et al. (2017) investigated and explained herding behavior in the Persian Gulf region from 2004 to2014. Their research is aimed at examining the impact of oil prices as an exogenous variable on herding behavior in the stock market of these countries. The results show that in the crude oil-exporting countries, stock market traders respond to oil price signals,

and this behavior is more severe in times of crisis and negative messages in these countries. Thomas et al. (2018) observed the existence of herding behavior in the digital currency market. The results of this study showed that during the studied period, the amount of herding behavior in the digital currencies market with the lower market size is more considerable than others. In a survey by Kabir and Shakur (2018), the effect of macro variables on herding behavior in emerging financial countries was investigated using a nonlinear approach. The results of the study, based on nonlinear smooth transition regression, showed that the herding behavior is more in higher-yielding volatility regimes. Also, the US financial situation and the global stock market price have a significant effect on this behavior.

Our literature review showed that the theory of volatility and contagion could explain the behavior of stock market actors. Their behavior can be influenced by other markets, as well as macro variables such that the political decisions, that may lead to irrational choices and actions. It is worth noting that this behavior can be different for investors at the industry level and even for different companies. Accordingly, this study explores the effects of exogenous economic variables on the herding behavior of investors at various industries in the Tehran Stock Exchange. It is worth mentioning that, based on the current studies, there was no similar study explaining the effects of exogenous economic variables on herding behavior of investors across different industries in Iran capital market. The present study aims to investigate the herding behavior of investors at the level of various industries in the Tehran Stock Exchange. The second aim of this study is to explore the causal relationship between exogenous economic variables at the industry level.

3 Research Method

The research methodology is divided into two main branches for the study of herding behavior. The first branch of research is the method of studying herding behavior measures based on return dispersion (Christie & Huang, 1995; Chang et al., 2000; and Huang, 2004). The second branch of research is to propose a statistical index based on the analysts' transactions (Laconisch, 1992). Chang et al. (2000) extend the studies of Christie and Huang (1995) and propose the cross-sectional absolute deviation (CSAD) to measure stock return dispersion. In this study, based on the findings and research model of Chang et al. (2000), the herding behavior in the stock market and the impact of macroeconomic variables on it has been investigated.

The reason for choosing these criteria is because this approach, without individual judgment, determines the herding market behavior based on the correlation between return on a share and the distribution of total stock at a declining rate. The criterion of cross-sectional absolute standard deviation has also been used in the studies of Balcilar et al. (2017), Gong and Dai (2017), Thomas et al. (2018), and Kabir and Shakoor (2018). To capture herd behavior, the authors use the cross-sectional standard deviation of returns (CSSD), also named dispersion. Details of this model are as follows.

$$CSAD = \frac{1}{N}\sum_{i=1}^{N}|R_{i.t} - R_{m.t}| \quad (1)$$

in which, N represents the number of companies in the market, R_{it} is the return of individual stock i at time t.and R_{mt} is the cross-sectional average of N stock returns in the portfolio at time t. It should be noted that to test the existence of herding behavior, Chang et al. (2000) proposed the following regression model:

$$CSAD_t = \alpha + \lambda_1|R_{m.t}| + \lambda_2(R_{m.t})^2 + \varepsilon_t \quad (2)$$

Where the dependent variable is the cross-sectional standard deviation of each company's return on total market return based on Equation (1), and according to the approach of Chang et al. (2000), the negative coefficient λ2 indicates the existence of herding behavior.

Also, the behavior of stock market actors may depend on whether the market is bearish or bullish. By developing Equation (2), we can distinguish the absolute magnitudes of market return and the other power of market return in decreasing and increasing market conditions. For this purpose, given the asymmetry in the herding behavior in different market conditions, the equations can be considered nonlinear.

$$CSAD_t{}^{D} = \alpha + \gamma^{D}{}_1\left|R^{D}{}_{m,t}\right| + \gamma^{D}{}_2\left(R^{D}_{m,t}\right)^2 + \varepsilon_t \quad , \quad R_{m,t} < 0$$
$$CSAD_t{}^{u} = \alpha + \gamma^{u}{}_1\left|R^{u}{}_{m,t}\right| + \gamma^{u}{}_2\left(R^{u}_{m,t}\right)^2 + \varepsilon_t \quad , \quad R_{m,t} > 0$$

In these equations, the nonlinear relationship between $CSAD_t$ and $R_{m.t}$ represents herding behavior, in a way that when $\gamma 2 < 0$, the herding behavior in the market is such that the increase of correlation between a stock return and stock return dispersion occurs with a decreasing rate. It can be seen in the following diagram.

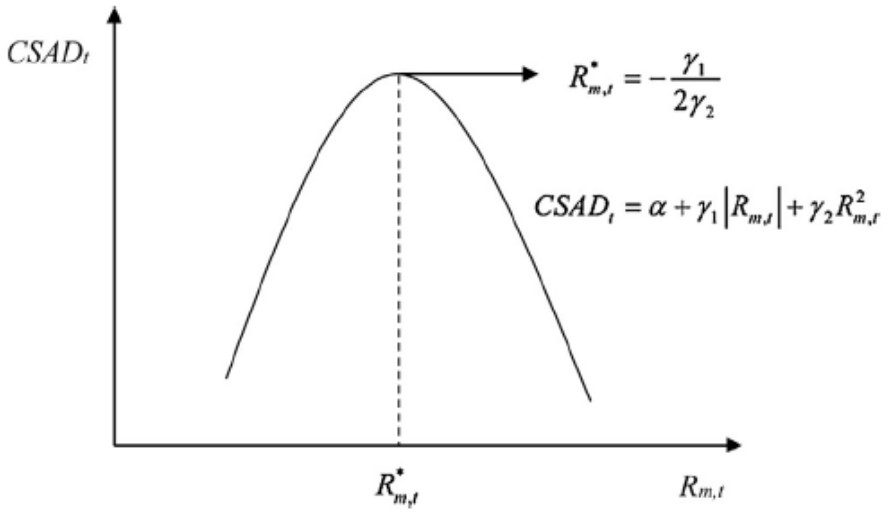

Figure 1. The nonlinear relationship between CSADt and $R_{m,t}$

Given the theoretical foundations outlined in the previous section and based on the contagion theory in financial markets, it is expected that changes in the parallel markets and economic variables will cause irrational behavior among investors and affect herding behavior in the stock market concerning the market conditions. In this study, using the models presented by Balcker et al. (2017) and Gong and Dai (2017), the following equations will be used to investigate the impact of other variables affecting herding behavior, which is the main difference between this study and the previous ones.

$$CSAD_t{}^{D} = \alpha + \gamma^{D}{}_1 |R^{D}{}_{m,t}| + \gamma^{D}{}_2 \left(R^{D}_{m,t}\right)^2 + \gamma^{D}{}_3 Vol_t \times \left(R^{D}_{m,t}\right)^2 + \gamma^{D}{}_4 Ex_t \times \left(R^{D}_{m,t}\right)^2 + \gamma^{D}{}_5 Mony_t \times \left(R^{D}_{m,t}\right)^2 + \gamma^{D}{}_6 Oil_t \times \left(R^{D}_{m,t}\right)^2 + \gamma^{D}{}_7 Gold_t \times \left(R^{D}_{m,t}\right)^2 + \varepsilon_t \quad , \quad R_{m,t} < 0 \tag{4}$$

$$CSAD_t{}^{u} = \alpha + \gamma^{u}{}_1 |R^{u}{}_{m,t}| + \gamma^{u}{}_2 \left(R^{u}_{m,t}\right)^2 + \gamma^{u}{}_3 Vol_t \times \left(R^{u}_{m,t}\right)^2 + \gamma^{u}{}_4 Ex_t \times \left(R^{u}_{m,t}\right)^2 + \gamma^{u}{}_5 Mony_t \times \left(R^{u}_{m,t}\right)^2 + \gamma^{u}{}_6 Oil_t \times \left(R^{u}_{m,t}\right)^2 + \gamma^{u}{}_7 Gold_t \times \left(R^{u}_{m,t}\right)^2 + \varepsilon_t \quad , \quad R_{m,t} > 0 \tag{5}$$

The model uses variables such as exchange rate growth (Ex), liquidity growth (money), oil price return, gold price return, and stock market volatility (Vol), using the GARCH approach calculations during the years 2008 to 2018.

The main difference of this research with the mentioned articles is the use of macroeconomic variables affecting herding behavior in TSE and across different industries. In this study, two principles in selecting variables have been emphasized. 1) Depending on the nature of the response, variables with a short-term impact or the ones in the form of cross-sectional shocks are selected as the exchange rate. Also, the variables such as GDP that reflect the general state of the economy and the economic trend are not taken into consideration in this model. 2)

Furthermore, the approach of this model is to use the economic variables affecting the stock market in terms of their impacts on herding behavior, which has been mentioned in the study of Balcker et al. (2017) and Gong and Dai (2017). Accordingly, variables such as exchange rate and logarithmic growth of liquidity are considered; however, variables such as inflation rate that are results of policymaking and are highly correlated with liquidity growth rate are not considered (Chiang and Zheng, 2010). Therefore, immediate changes in exchange rate growth and liquidity growth as macroeconomic indices cause short-term irrational behavior because the asymmetry of essential information in this area causes herding behavior among micro-investors. Also, changes in the oil and gold markets due to their international structure can be useful as exogenous variables affecting the way people invest in the stock market and cause abnormal behavior among investors (Gong and Dai, 2017).

4 Research Findings

4.1 Statistical Population and Research Variables

For this study, we use the dataset of the Tehran Stock Exchange index from February 2008 until the end of August 2018. It should be noted that sampling from different industries was considered to evaluate the herding test, with the requirement of having at least ten companies in the whole study period. Accordingly, the selected sectors and the number of companies in each industry are as follows. 1) Construction, Real Estate (12). 2) Automotive and Parts Manufacturing (30). 3) Other Non-metallic Mineral Products (19). 4) Cement, Lime, and Plaster (29). 5) Petroleum Products, Coke, and Nuclear Fuel (10). 6) Primary metals (26). 7) Sugar (34). 8) Machinery and equipment, (19). 9) Electrical machinery and equipment (11). 10) Chemical products (27). 11) Food and Beverage except for Sugar (23) and Pharmaceuticals and Materials (25).

It should be noted that research data on OPEC oil and gold prices during the period under review were obtained from OPEC and the London gold market. Besides, free exchange rates and liquidity are provided every month.

Table 1 summarizes the descriptive statistics on the variables studied for different industries and the macroeconomic variables used in this study.

Table 1
Statistical characteristics of research variables

Variable	Number	Average	Mean	Max.	Min.	St.D	Skew	Elongation
Total index return	-	2.393	1.693	23.446	-7.893	5.778	0.762	3.574
Construction, Real Estate	12	9.161	8.477	24.762	3.473	3.967	1.425	5.742
Automotive and Manufacturing	30	10.927	10.023	31.924	4.577	4.975	1.651	6.293
Other Non-metallic Mineral Products	19	10.655	9.805	34.623	3.033	5.105	1.592	6.776
Cement, Lime and Plaster	29	8.393	7.931	20.607	2.099	3.731	1.170	4.640
Petroleum Products, Coke and Nuclear Fuel	10	10.575	8.809	58.344	3.085	7.645	3.265	17.701
Basic metals	26	9.771	9.043	21.300	5.127	3.287	0.973	3.719
Sugar	34	13.437	11.747	48.872	3.511	7.205	1.782	8.618
Machinery and equipment	19	9.982	9.108	31.278	3.097	4.672	1.590	7.001
Electrical machinery and equipment	11	10.081	9.405	35.252	2.611	5.096	2.126	9.215
Chemical products	27	9.510	8.576	19.622	4.255	3.486	1.018	3.438
Food and Beverage except Sugar	23	10.306	9.318	34.754	4.341	5.006	2.033	8.860
Pharmaceuticals and Materials	25	9.064	8.079	32.276	1.757	4.359	1.919	9.751
Oil return	-	0.533	1.156	23.719	-28.127	8.627	-0.179	4.277
Gold return	-	0.281	0.445	13.026	-15.690	5.042	-0.126	3.589
Liquidity logarithm	-	8.635	8.623	9.870	7.540	0.681	0.087	1.751
Currency logarithm	-	10.086	10.367	11.775	9.188	0.616	-0.150	2.306

Also, the results of the Unit root test of variables are presented in Table (2). The result shows that we can reject the null hypothesis, and the text implies that all the variables are stationary at the 95% level of significance.

Table 2
Results of the unit root test _ADF Method

Variable	Test statistics	Probability
$\lvert r_{mt} \rvert$	-7.30	0.000
$(r_{mt})^2$	-3.87	0.000
Oil return	-8.57	0.000
Gold return	-12.17	0.000
Logarithmic exchange rate growth	-6.58	0.000
Logarithmic growth of liquidity	-9.00	0.000
Construction, Real Estate (CSAD)	-4.68	0.000
Automotive and Manufacturing (CSAD)	-4.34	0.000
Other Non-metallic Mineral Products (CSAD)	-7.25	0.000
Cement, Lime and Plaster (CSAD)	-7.07	0.000
Petroleum Products, Coke and Nuclear Fuel (CSAD)	-10.36	0.000
Basic metals (CSAD)	-7.98	0.000
Sugar (CSAD)	-8.74	0.000
machinery and equipment (CSAD)	-7.86	0.000
Electrical machinery and equipment (CSAD)	-9.26	0.000
Chemical products (CSAD)	-7.26	0.000
Food and Beverage except for Sugar (CSAD)	-4.72	0.000
Pharmaceuticals and Materials (CSAD)	-6.02	0.000

4.2 Research Hypotheses

According to the theoretical foundations and the mentioned problem in this research, the principal and subsidiary hypotheses investigated are as follows:

- Herding behavior in "bull market" and "bear market" conditions, in Tehran Stock Exchange (TSE) and at different industry levels, is affected by economic variables.
- Herding behavior exists in bearish and bullish markets, in TSE, in various industries.

4.3 Testing the Research Hypotheses

In the first step of this study, the existence of herding behavior among companies of different industries of the Tehran Stock Exchange from 2008 to 2018 has been examined every month. It is evident in Table (3) that $\gamma 2$ is negative and significant in bearish markets for all industries. The negative coefficient for market return squared indicates a deviation decline in corporate profits from market returns in recessionary or bearish market conditions. Also, the reduction in deviations of corporate returns from market returns means that there is herding behavior in the market.

Table 3
Model estimation to test the hypothesis of herding behavior

Industry	parameter	α^D	γ_1^D	γ_2^D	α^U	γ_1^U	γ_2^U	R^2
Construction, Real Estate	coefficient	4.92	0.77	-0.12	4.13	0.43	0.00	
	statistic	17.69	3.25	-3.60	8.36	2.42	0.13	0.32
	probability	0.00	0.00	0.00	0.00	0.02	0.90	
Automotive and Manufacturing	coefficient	8.41	2.71	-0.34	11.22	-0.19	0.05	
	statistic	5.38	1.63	-1.74	15.57	-0.95	4.99	0.38
	probability	0.00	0.11	0.09	0.00	0.34	0.00	
Other Non-metallic Mineral Products	coefficient	9.10	1.49	-0.15	15.21	-0.62	0.04	
	statistic	39.23	2.94	-2.29	6.74	-1.56	2.88	0.7
	probability	0.00	0.00	0.02	0.00	0.12	0.01	
Cement, Lime and Plaster	coefficient	4.05	1.67	-0.14	11.63	-0.27	0.03	
	statistic	3.18	2.05	-1.67	4.95	-0.67	1.98	0.31
	probability	0.00	0.04	0.10	0.00	0.51	0.05	
Petroleum Products, Coke and Nuclear Fuel	coefficient	-3.75	13.31	-1.35	13.20	-0.37	0.02	
	statistic	-0.52	2.36	-1.92	5.74	-1.90	4.41	0.35
	probability	0.60	0.02	0.06	0.00	0.06	0.00	
Basic metal	coefficient	6.89	2.82	-0.30	10.00	0.21	0.01	
	statistic	3.62	2.00	-1.79	7.88	0.96	0.98	0.24
	probability	0.00	0.05	0.08	0.00	0.34	0.32	
sugar	coefficient	1.73	11.08	-1.27	12.70	0.14	0.02	
	statistic	0.28	2.06	-1.88	13.68	0.58	1.61	0.3
	probability	0.78	0.04	0.06	0.00	0.56	0.11	
Machinery and equipment	coefficient	7.36	5.84	-0.82	10.43	2.28	-0.08	
	statistic	6.67	5.28	-5.80	3.15	3.78	-3.84	0.37
	probability	0.00	0.00	0.00	0.00	0.00	0.00	
Electrical Machinery and equipment	coefficient	8.01	3.83	-0.43	25.11	-1.15	0.07	
	statistic	5.48	3.42	-2.94	7.33	-1.76	2.97	0.68
	probability	0.00	0.00	0.00	0.00	0.08	0.00	
Chemical products	coefficient	7.43	4.76	-0.70	15.26	-0.22	0.01	
	statistic	4.34	4.44	-5.41	6.25	-0.42	0.62	0.13
	probability	0.00	0.00	0.00	0.00	0.67	0.54	
Food and Beverage except Sugar	coefficient	9.18	1.81	-0.19	1.80	3.43	-0.11	
	statistic	4.52	1.67	-1.98	0.70	9.42	-9.74	0.56
	probability	0.00	0.10	0.05	0.49	0.00	0.00	
Pharmaceuticals and Materials	coefficient	8.90	4.12	-0.67	11.14	0.33	0.02	
	statistic	3.95	2.07	-2.31	6.95	0.62	1.20	0.83
	probability	0.00	0.04	0.02	0.00	0.54	0.23	

When the stock market is booming, only the machinery and equipment industry and the food and beverage industry, except sugar, have a square negative return factor. It indicates that in a bullish market, there is less industry-wide herding behavior, as only the machinery and equipment

industries and the food industry have experienced investor-driven reaction. It also confirms the goodness of fit for parameters, including the coefficient of determination (R-squared) and F-statistic value.

The results of the model in equation (4) have been reported in table 3. It should be mentioned that initially, the GARCH model estimated volatilities. As can be seen in the expected results, in this study, the impact of economic variables in the bearish market has been stipulated differently in a way that their effects are statistically meaningful in all mentioned industries. It shows that herding behavior exists in the presence of macroeconomic variables in the stock markets. In this regard, considering the oil market return in interaction with market return, it could be stated that the estimated coefficient in Construction and Real Estate, Other Non-metallic Mineral Products, Cement, Lime and Plaster, Basic metal, Sugar, Machinery and equipment, Electrical Machinery and equipment and Chemical products is negative and meaningful. The results demonstrate that in these industries, the return of the OPEC oil price leads to a herding behavior of investors. Finally, an increase in the oil market return when the stock market is bearish may increase the herding behavior of investors.

Among several industries that we tested, there was a significant negative relationship between gold market return and herding behavior in Real Estate, and Machinery and equipment industries. It shows that when the stock market is bearish, an increase in the Gold market return will result in a herding behavior in investors of Construction and Real Estate, and Machinery and equipment industries.

Besides, the results of our study showed a significant positive relationship between the rate of currency and herding behavior among Petroleum Products, Coke, and Nuclear Fuel industries. In the field of monetary policy, we have the same results for Non-metallic Mineral Products, and Cement, Lime and Plaster industries. This result indicates the fact that increasing liquidity will lead to herding behavior while the market is bearish.

Moreover, herding behavior will be intensified by exogenous variables, which is different in each industry based on their natures. Eventually, to study the relation between volatilities and herding behavior of investors, it could be said that in Construction and Real Estate, Petroleum Products, Coke and Nuclear Fuel, Machinery and equipment, and Food and Beverage except Sugar industries herding behavior has happened in the bearish market. It is observed that an increase in volatility will lead to herding behavior in the industries mentioned above.

Table 4
Model estimation of herding behavior with exogenous economic variables in decreasing market

Industry	Parameter	α^D	γ_1^D	γ_2^D	γ_3^D	$\gamma^D{}_4$	$\gamma^D{}_5$	$\gamma^D{}_6$	$\gamma^D{}_7$
Construction, Real Estate	Coefficient	4.60	1.15	-0.11	0.00	-0.01	0.03	-0.21	-0.23
	Statistic	17.24	5.63	-3.36	-2.30	-2.61	4.26	-1.22	-1.77
	Probability	0.00	0.00	0.00	0.02	0.01	0.00	0.23	0.08
Automotive and Manufacturing	Coefficient	14.09	1.06	-0.49	0.00	0.01	0.09	-0.84	1.33
	Statistic	7.46	0.99	-2.43	0.53	1.12	1.87	-0.34	12.07
	Probability	0.00	0.32	0.02	0.59	0.27	0.06	0.74	0.00
Other Non-metallic Mineral Products	Coefficient	9.39	2.13	-0.56	-0.01	0.01	-0.26	-0.45	0.80
	Statistic	9.50	1.24	-3.76	-5.06	3.07	-6.00	-0.34	1.33
	Probability	0.00	0.22	0.00	0.00	0.00	0.00	0.74	0.19
Cement, Lime and Plaster	Coefficient	4.87	0.99	-0.33	0.00	0.00	-0.12	0.48	0.74
	Statistic	6.28	2.83	-8.22	-4.99	1.27	-24.50	1.92	7.99
	Probability	0.00	0.01	0.00	0.00	0.21	0.00	0.06	0.00
Petroleum Products, Coke and Nuclear Fuel	Coefficient	5.59	5.27	1.32	0.03	0.05	0.38	-7.60	-4.76
	Statistic	1.20	1.37	2.29	4.71	4.11	13.08	-4.11	-11.55
	Probability	0.23	0.17	0.02	0.00	0.00	0.00	0.00	0.00
Basic metal	Coefficient	9.10	0.26	-0.44	0.00	0.01	0.00	-0.11	1.54
	Statistic	6.23	0.23	-3.17	-3.88	3.51	0.02	-0.22	19.37
	Probability	0.00	0.82	0.00	0.00	0.00	0.98	0.82	0.00
Sugar	Coefficient	1.90	10.21	-1.30	0.00	0.00	0.02	7.72	-0.16
	Statistic	0.47	2.95	-2.48	-0.40	0.23	0.41	3.72	-0.29
	Probability	0.64	0.00	0.02	0.69	0.82	0.69	0.00	0.77
Machinery and equipment	Coefficient	6.12	6.94	-0.97	-0.01	-0.02	0.16	1.48	-0.24
	Statistic	7.30	10.56	-16.25	-6.86	-17.63	32.11	4.27	-3.10
	Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electrical Machinery and equipment	Coefficient	7.45	3.62	-0.99	-0.01	0.00	0.01	1.71	1.58
	Statistic	6.98	3.54	-4.73	-2.80	0.19	0.22	3.45	2.13
	Probability	0.00	0.00	0.00	0.01	0.85	0.83	0.00	0.04
Chemical products	Coefficient	8.97	3.20	-0.77	0.00	0.01	0.01	1.68	0.78
	Statistic	6.13	3.14	-7.19	-0.42	0.90	0.26	4.23	2.10
	Probability	0.00	0.00	0.00	0.67	0.37	0.79	0.00	0.04
Food and Beverage products	Coefficient	11.02	0.32	0.14	0.01	0.01	0.17	0.05	-0.40
	Statistic	9.51	1.29	2.19	2.68	3.46	6.32	0.12	-2.40
	Probability	0.00	0.20	0.03	0.01	0.00	0.00	0.91	0.02
Pharmaceuticals and Materials	Coefficient	10.09	2.45	-0.75	۰/۰۰	0.03	-0.03	3.59	0.83
	Statistic	5.49	1.45	-3.54	-0.02	2.16	-0.66	1.76	1.86
	Probability	0.00	0.15	0.00	0.99	0.03	0.51	0.08	0.07

The results of the herding behavior test in a bullish market are provided in Table (5). It shows that during the bullish condition of the market, herding behavior is evident in Construction and Real Estate, Automotive and Manufacturing, Petroleum Products, Coke and Nuclear Fuel, Basic metals, Machinery and equipment, Food and Beverage except for Sugar industries,

and Pharmaceuticals and Materials industries. Also, these results show that in almost all industries, herding behavior is possibly increased by macroeconomic variables.

Table 5
Model estimation of herding behavior with exogenous economic variables in increasing market

Industry	Parameter	α^U	γ^U_1	γ^U_2	γ^U_3	γ^U_4	γ^U_5	γ^U_6	γ^U_7
Construction, Real Estate	Coefficient	3.99	0.58	-0.03	0.001	-0.001	1.05	-0.10	-0.01
	Statistic	8.99	3.19	-1.57	1.03	0.97	4.75	-2.21	-3.45
	Probability	0.00	0.12	0.00	0.31	0.33	0.00	0.03	0.00
Automotive and Manufacturing	Coefficient	15.22	0.54	-0.09	-0.00	0.003	1.24	-0.05	0.09
	Statistic	7.22	1.12	-6.03	-1.83	2.92	6.39	-0.58	2.53
	Probability	0.00	0.26	0.00	0.07	0.00	0.00	0.56	0.01
Other Non-metallic Mineral Products	Coefficient	22.37	-1.79	0.02	0.000	-0.003	-0.21	-0.11	0.16
	Statistic	5.25	-1.96	0.30	0.33	-0.29	-0.58	-0.69	3.91
	Probability	0.00	0.05	0.77	0.74	0.77	0.56	0.49	0.00
Cement, Lime and Plaster	Coefficient	12.15	-0.57	0.03	0.001	-0.005	-0.13	-0.10	0.04
	Statistic	4.46	-0.95	0.90	1.71	-1.10	-0.42	-1.53	2.46
	Probability	0.00	0.35	0.37	0.09	0.28	0.68	0.13	0.02
Petroleum Products, Coke and Nuclear Fuel	Coefficient	12.76	-0.16	-0.05	-0.00	-0.004	0.04	0.12	0.13
	Statistic	5.23	-0.51	-3.65	-1.64	-0.66	0.29	2.86	6.03
	Probability	0.00	0.61	0.00	0.10	0.51	0.78	0.01	0.00
Basic metal	Coefficient	10.02	0.20	-0.01	0.001	-0.004	-0.05	0.00	0.04
	Statistic	8.93	1.31	-1.96	-3.70	-1.82	-0.71	0.05	4.93
	Probability	0.00	0.19	0.05	0.00	0.07	0.48	0.96	0.00
Sugar	Coefficient	12.89	0.09	0.001	-0.00	0.001	-0.11	0.12	0.05
	Statistic	10.55	0.24	0.03	-2.68	4.02	-0.35	2.86	3.16
	Probability	0.00	0.81	0.97	0.01	0.00	0.73	0.01	0.00
Machinery and equipment	Coefficient	13.73	0.63	-0.10	-0.01	0.005	1.26	-0.36	0.18
	Statistic	13.88	2.40	-4.04	-5.04	3.82	3.82	-1.73	3.15
	Probability	0.00	0.02	0.00	0.00	0.00	0.00	0.09	0.00
Electrical Machinery and equipment	Coefficient	25.77	-1.73	-0.01	0.01	-0.00	-0.09	0.01	0.17
	Statistic	5.63	-1.94	-0.36	5.65	-2.48	-0.26	0.11	4.50
	Probability	0.00	0.06	0.72	0.00	0.01	0.80	0.91	0.00
Chemical products	Coefficient	17.80	-1.31	0.08	-0.00	0.001	-0.63	-0.13	0.03
	Statistic	8.67	-2.68	2.45	-0.42	-0.13	0.06	4.23	2.10
	Probability	0.00	0.01	0.02	0.67	0.90	0.95	0.00	0.04
Food and Beverage products	Coefficient	11.02	0.56	-0.11	-0.00	-0.00	-1.26	0.46	0.32
	Statistic	13.24	2.55	-6.22	-1.49	-3.47	-12.43	16.13	16.26
	Probability	0.00	0.01	0.00	0.14	0.00	0.00	0.00	0.00
Pharmaceuticals and Materials	Coefficient	10.55	0.34	-0.10	0.001	0.0003	0.31	0.13	0.20
	Statistic	11.48	1.76	-10.31	0.81	0.88	2.79	3.75	21.36
	Probability	0.00	0.08	0.00	0.42	0.38	0.01	0.00	0.00

The results of studying the effect of the oil market on herding behavior in the Tehran stock market show that the impact of OPEC oil interaction return and market return are negative and significant in Automotive and Manufacturing, Petroleum Products, Coke and Nuclear Fuel, Sugar, and Machinery and equipment industries. So, herding behavior exists when the market is bullish, and the oil return is increasing.

Similarly, the results of studying the effect of global Gold market return on herding behavior illustrate that the variable of interaction between gold market and stock market return in Basic metals, Electrical Machinery and equipment, and Food and Beverage businesses is negative and meaningful. So, investors will be willing to invest in these markets when stock market return and Gold price returns are both increasing.

On the impact of liquidity growth on herding behavior variation, our results show that investors have herding behavior in Chemical products and Food and Beverage businesses when the stock market is bullish. In other words, an increase in liquidity, when the stock market is bullish, will lead to herding behavior in both Chemical products and Food and Beverage trades.

Studying the herding behavior of investors influenced by the currency exchange rate in an upward stock market, we found that an increase in the currency exchange rate will result in a temporary deviation in Construction and Real Estate, Machinery and equipment, and Chemical products industries. So, it can be said that there is herding behavior in these industries.

Likewise, the herding behavior is just noticeable in the Construction and Real Estate industries in a bullish market. In other words, herding behavior is at the minimum level, considering market volatilities, in a way that just one industry experiences it. It is worth mentioning that the results of bearish markets in this research are the same as the results obtained by Balcılar et al. (2017) and Gong and Dai (2017).

5 Conclusion

This study examines the herding behavior and the effect of macroeconomic variables on the Tehran Stock Exchange. The results of the herding behavior test indicate the existence of herding behavior among diverse industries in the Tehran Stock Exchange from 2008 through 2018. Also, the results of observing the effects of economic variables show the herding behavior in all selected trades when the stock market is bearish. Still, it is not observable in a bullish market. The effects of macroeconomic variables on the herding behavior of investors are different in various industries in TSE, and multiple variables lead to different outcomes. Notably, the results of monetary policies

are similar to the results obtained by Balcılar et al. (2017) and Gong and Dai (2017).

Given the fact that herding behavior in TSE is affected by parallel markets and macroeconomic variables, the study of parallel markets and their impacts on herding behavior is suggested for future studies. Furthermore, examining the effects of inflation or stagnation, or any combination of these two, can be suggested as the subject of a prospective study. In this regard, investigation of the impact of macro policies, which may have positive or negative effects on other markets and herding behavior, is another suggestion for future studies. Besides, according to dissimilar results of herding behavior in various markets and industries, it is proposed to pay more attention to the role of primary variables in different sectors. Finally, since herding behavior has an external cause in bearish or bullish markets and unalike macroeconomic variables affect it in different ways, proper investment strategies in each industry should be taken into consideration.

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