Herding behavior in CEE stock markets under asymmetric conditions: a quantile regression analysis

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Abstract

This paper investigates herding behavior in ten Central and East European (CEE) stock markets by using daily data on stock prices for 384 companies from January 2, 2003 to December 31, 2013. Our study is based on the methodology developed by Chang et al. [2000], adapted to detect herding behavior under different market conditions. We use the quantile regression analysis as an estimation method and find evidence of herding behavior in all CEE countries, except for Poland and Romania. Our results confirm the asymmetric effects of different market conditions on herding behavior.

JEL Classification: G15, G14

Keywords: herding behavior, asymmetric effects, cross-sectional absolute deviation of returns, CEE stock markets

1. Introduction

Financial literature describes herding behavior as investors' tendency to follow the decisions of other investors or the market consensus. Traditional explanations of herding in the theoretical literature include investors' lack of confidence, predilection to conformism, personal incentives like reputation and compensation structures in case of money-funds managers (see Bikhchandani et al. [1992], Banerjee [1992], Devenow and Welch [1996], Bikhchandani and Sharma [2001]).

As concerns the empirical literature, econometrical models have been developed in order to detect mimicking behavior among investors. Considering the importance of institutional investors on financial markets, many of these studies are focused on herding behavior among mutual fund managers and financial analysts (see Lakonishok et al., [1992]; Wermers, [1999]; Gleason et al., [2004]; Hsieh et al., [2011]; Choi and Skiba, [2015]). However, such analysis requires detailed information about investors' trading activities.

Another branch of the empirical literature is dedicated to market-wide herding, which refers to the mass behavior of all investors toward the market consensus. Christie and Huang [1995] use the *cross-sectional standard deviation of stock returns* (CSSD) to see how individual stock returns cluster around the market return during periods of market stress. The reasoning is that during periods of large absolute price changes, investors have the tendency to repress their own opinions in favor of the market view. The authors tested their methodology on the US stock market and found that dispersions are higher during periods of large price movements, which is considered a proof against herding.

Chang et al. [2000] proposed a different return dispersion measure, the *cross sectional absolute deviation of returns (CSAD).* The authors argued that the CSAD is likely to be a nonlinear function of the overall market return. Using daily stock prices for the period 1963-1997, they found no evidence of herding behavior in Hong Kong and US (consistent with the results of Christie and Huang [1995]), partial evidence in Japan and supporting evidence in South Korea and Taiwan. An alternative herding methodology based on the cross-sectional dispersion of the factor sensitivity of assets was developed by Hwang and Salmon [2004]. This approach argues that herding behavior can also arise when the market is tranquil. Their study, focused on US, UK and South Korean stock markets, demonstrated that investors' tendency to herd can be more pronounced during quiet periods than during periods of crisis.

Herding behavior in Chinese stock market was intensely investigated in the literature. The study of Demirer and Kutan [2006] included 375 Chinese stocks and revealed that investors in Shanghai and Shenzhen markets made investment decisions rationally at both individual and sector levels. Chiang et al. [2010] investigated the Chinese stock markets and found evidence of herding for the A-share market and no evidence for B-share market. However, by applying quantile regression analysis instead of ordinary least squared method (OLS), they found evidence of herding in both A and B-share markets. Lee et al. [2013] analyzed herding behavior in Chinese A-stock market at industry level with asymmetric herding effects and found strong evidence of herding behavior during 1999-2008. The authors proved that the high-tech sector plays an important role in explaining the herding activity from other industries. In a recent paper, Yao et al. [2014] found evidence of herding behavior in China B-share market, but no evidence in the A-share market during 2001-2010. When the dataset was divided into sub-periods, the authors noticed that investors herd also in the A-share market at the beginning of the decade. However, investors herding behavior declined over time, and they seem to make rational decisions at the end of the period. In an extensive study which evaluates herding behavior in 69 countries, Chen [2013] proved strong evidence of herding for almost all countries, as opposed to the results reported by Chang et al. [2000] who found no evidence of herding in developed markets.

There are few studies on herding behavior with reference to the European stock markets. Caparrelli et al. [2004] tested for herding behavior in the Italian stock market and found that herding is present under extreme market conditions. Blasco et al. [2012] studied herding within the Spanish stock market at intraday level and they observed that a higher volatility can be expected when herding intensity is higher. Examining the effect of joining a stock exchange group over herding dynamics, Economou [2015] revealed that Belgium, France and the Netherlands were characterized by significant herding after their merger into the Euronext. In Portugal herding behavior was present in both pre- and post-merger periods. Filip et al. [2015] analyzed herding behavior in ten CEE stock markets for size-ranked portfolios and used the CSAD methodology and the OLS estimation method to capture the impact of the recent global financial crisis on herding towards the market. They found evidence of herding under the financial crisis in five CEE countries: Croatia, Hungary, Latvia, Lithuania and Slovenia.

Empirical research on herding behavior, even if prolific, has neglected so far the European emerging markets, being mainly focused on developed Asian and on US capital markets. However, it is generally recognized that information-based herding and reputation-based herding are more likely to occur in emerging and frontier markets. This is caused by weak reporting requirements, poorer accounting standards, lax enforcement of regulations, and costly information acquisition which end in lack of transparency and propensity to herd (see Bikhchandani and Sharma [2001]).

In this paper we are interested in an extensive analysis of possible asymmetric herding behavior in the CEE area under different market conditions: up and down market, high and low volatility, high and low trading volume. Since it is known that the OLS estimators are based on the mean as measure of location and omit information about the tail of the distribution, we employ quantile regression analysis to find supporting evidence of herding behavior for the CEE countries under different market conditions. Nevertheless, this is the first paper, to the best of our knowledge, to investigate and reveal herding behavior on the CEE stock markets under up and down market, high and low volatility, high and low trading volume.

The reminder of this study is organized as follows: Section 2 presents the methodologies frequently used in the literature to capture herding behavior and outlines our specification and estimation method; Section 3 provides the dataset description; Section 4 reports and discusses the results and Section 5 concludes.

2. Methodology

This section exhibits the methodology which will allow us to assess herding behavior in CEE stock markets under different market conditions: up and down market, high and low volatility, and high and low trading volume.

2.1. Evidence on herding behavior

Christie and Huang [1995] argue that investors' investment decisions are dependent on the overall market conditions and during periods of market stress investors are more likely to abandon their private information in favor of the market consensus. The authors developed the CSSD methodology for quantifying the proximity of individual returns to the market return and proposed the following equation to detect herding behavior:

$$S_t=\alpha+\beta_1\cdot D_t^L+\beta_2\cdot D_t^U+\varepsilon_t \tag{1}$$

where S_t = the cross-sectional standard deviation of stock returns (CSSD)

$$S_t=CSSD_t=\sqrt{\frac{\sum_{i=1}^{n}(R_{i,t}-R_{M,t})^2}{n-1}} \tag{2}$$

$D_t^L = 1$ if the market return on day t lies in the extreme lower tail of the return distribution and 0 otherwise

$D_t^U = 1$ if the market return on day t lies in the extreme upper tail of the return distribution and 0 otherwise

n = the number of companies in the portfolio

$R_{i,t}$ = the stock return of company i at time t

$R_{M,t}$ = the market return at time t.

Rational asset pricing models predict that, under extreme market movements and market stress, the level of returns dispersion is expected to increase, in which case the coefficients β_1 and β_2 should be significantly positive. Christie and Huang [1995] argue that negative and statistically significant coefficients indicate evidence of herding behavior.

Chang, Cheng and Khorana [2000] propose an alternative methodology (thereafter CCK) which allows for detecting herding behavior over the entire distribution of market returns. The cross-sectional absolute deviation of stocks returns (CSAD) is computed as follows:

$$CSAD_t = \frac{1}{n} \cdot \sum_{i=1}^{n} \left| R_{i,t} - R_{M,t} \right| \tag{3}$$

CCK suggest the following herding equation which can be adapted to disclose the asymmetry in herding behavior in up versus down market:

$$CSAD_t = \gamma_0 + \gamma_1 \cdot \left| R_{M,t} \right| + \gamma_2 \cdot R_{M,t}^2 + \varepsilon_t \tag{4}$$

The authors argue that rational asset pricing models predict a linear relationship between the CSAD and the market return. In the presence of a market consensus, during periods of large price movements, the relation is expected to become non-linear. If investors follow the market, under extreme market movements the dispersion between individual returns and the market is expected to decrease or to increase at a decreasing rate. In consequence, the coefficient γ_2 is expected to be significantly negative.

Chiang and Zheng [2010] use the CSSD dispersion measure as proposed by Christie and Huang [1995] and estimate the following model based on CCK's specification:

$$CSSD_t = \alpha + \gamma_1 R_{M,t} + \gamma_2 \left| R_{M,t} \right| + \gamma_3 R_{M,t}^2 + \varepsilon_t \tag{5}$$

The introduction of the variable $R_{M,t}$, as suggested by Duffee (2001), in the right side of the original model is meant to capture an asymmetric herding behavior under different market conditions.

Yao et al.[2014] improve the previous herding models by introducing in the regression a 1-day lag variable ($CSSD_{t-1}$)and the centered market return, to reduce the autocorrelation and the multicollinearity between variables:

$$CSSD_t = \alpha + \gamma_1 \left| R_{M,t} \right| + \gamma_2 \left(R_{M,t} - \overline{R_M} \right)^2 + \gamma_3 CSSD_{t-1} + \varepsilon_t \tag{6}$$

In our study, we use the CSAD of stock returns as a measure for dispersion and we propose a modified empirical specification of the CCK's model in order to examine herding behavior:

$$CSAD_t = \beta_0 + \beta_1 \cdot R_{M,t} + \beta_2 \cdot \left| R_{M,t} \right| + \beta_3 \cdot \left(R_{M,t} - \overline{R_M} \right)^2 + \beta_4 \cdot CSAD_{t-1} + \varepsilon_t \tag{7}$$

The β_1 coefficient measures the sensitivity of the dispersion to the volatility of the market portfolio, while β_2 captures the sensitivity of the dispersion to the magnitude of the market movements. For conferring robustness to the model and in order to diminish the multicollinearity between explanatory factors, we add a 1-day lag variable $CSAD_{t-1}$ and we center the quadratic factor. In the presence of herding behavior the coefficient β_3 is expected to be negative and statistically significant.

Barnes and Hughes [2002] argue that the *quantile regression analysis* is more suitable than the OLS in analyzing the dispersion of the returns in the distribution tails. The OLS estimators are based on the mean as a measure of location, omitting information about the tail of the distribution. To overcome these drawbacks and for a deeper analysis of the response of the CSAD to market movements, we use the quantile regression analysis as an estimation method.

Quantile regression analysis provides a thorough view on the relationship between our dispersion measure and the explanatory variables. The quantile regression estimators are obtained by minimizing the weighted sum of absolute errors considering specific quantiles values, which is an appropriate estimation method under the presence of extreme values.

The quantile (τ) regression for estimating the $CSAD_t$ and our explanatory variables (V_t) considered in the previous equation is expressed as follows:

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot R_{M,t}+\beta_{2,\tau}\cdot|R_{M,t}|+\beta_{3,\tau}\cdot\left(R_{M,t}-\overline{R_M}\right)^2+\beta_{4,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau} \quad (8)$$

2.2 Asymmetry in herding behavior under different market conditions

In the following, we display the steps of methodology to investigate the potential asymmetric effects of herding behavior under different market conditions.

2.2.1 Asymmetric effects of market return

Herding behavior is expected to be more pronounced when the market is declining and when turbulences occur, as investors are likely to become conservative and to follow the market consensus. We investigate the asymmetry in herding behavior under up and down market based on the following quantile regression:

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{ms}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1-D^{ms})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{ms}\cdot\left(R_{M,t}-\overline{R_M}\right)^2$$

$$+\beta_{4,\tau}\cdot(1-D^{ms})\cdot\left(R_{M,t}-\overline{R_M}\right)^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau} \quad (9)$$

The dummy variable D^{ms} takes value *1* when the market is up and value *0* when the market is down. In the presence of herding the coefficient β_3 and β_4 are expected to be negative and statistically significant.

2.2.2 Asymmetric effects of market volatility

Previous studies on developed markets found evidence that the investors' tendency to herd is more persistent during periods characterized by increased volatility. In order to examine the asymmetric effects of herding behavior relative to market volatility we use a dummy variable which takes value *1* when the market is characterized by above-the-average volatility and *0* otherwise. We use the following empirical specification:

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{vol}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1-D^{vol})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{vol}\cdot(R_{M,t}-\overline{R_M})^2$$
$$+\beta_{4,\tau}\cdot(1-D^{vol})\cdot(R_{M,t}-\overline{R_M})^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau} \qquad (10)$$

Market volatility is assumed to be high when it is higher than the average volatility over the previous 30 days. In the presence of herding the coefficient β_3 and β_4 are expected to be negative and statistically significant.

2.2.3 Asymmetric effects of trading volume

As the intensity of market activity may be connected to herding behavior, we examine the potential asymmetric effects of above- and below-the-average trading volumes by running the following quantile regression:

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{tv}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1-D^{tv})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{tv}\cdot(R_{M,t}-\overline{R_M})^2$$
$$+\beta_{4,\tau}\cdot(1-D^{tv})\cdot(R_{M,t}-\overline{R_M})^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau} \qquad (11)$$

The trading volume is considered high, when it exceeds the previous 30-day moving average. In the presence of herding the coefficient β_3 and β_4 are expected to be negative and statistically significant.

3. Data

All data were extracted from Thomson Datastream. The dataset comprises the daily stock prices and trading volumes for 384 companies listed in ten CEE countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovenia) from January 2, 2003 to December 31, 2013.

Logarithmic daily returns were computed for each stock based on the relation $R_{i,t}=\ln(P_{i,t}/P_{i,t-1})$, where $P_{i,t}$ represents the closing price of day t for stock i. As suggested by Chang et al. [2000], we compute the returns' dispersions across the stocks for each market:

$$CSAD_t=\frac{1}{n}\sum_{i=1}^{n}|R_{i,t}-R_{M,t}|$$

where n is the number of companies in the portfolio, $R_{i,t}$ is the stock return of company i at time t, $R_{M,t}$ is the market return at time t.

Table 1 summarizes the descriptive statistics for the daily CSAD of returns and the market portfolio in each country over the sample period (2/01/2003-31/12/2013).

[Please insert Table 1 about here]

As proxies for the market portfolios we use historical daily data for SOFIX, CROBEX, SE PX, TALSE, BUX, RIGSE, OMXV, WIG, BET and SBITOP Index from January 2, 2003 to December 31, 2013.

Table 1 reports the mean and the standard deviation for the market return and for the dispersion measure (CSAD). The Augmented Dickey-Fuller statistics are significant both for the market portfolio and the CSAD, indicating that both series are stationary. The serial correlation at lag *1* is also reported in the table, both for the CSAD and the market portfolio. It reveals a high level of autocorrelation in the CSAD series, substantiating the introduction of a lag variable in our regression model.

4. Empirical results

Table 2 reports the sign and statistical significance of herding coefficients estimates at market level for all countries. Extended results of the OLS estimates are presented in Appendix A, while quantile regression estimates are reported in Appendix B.

[Please insert Table 2 about here]

A significant value of the coefficient β_3 indicates a nonlinear relationship between the cross sectional standard deviation of returns and the market returns, while a negative significant value of the coefficient confirms the presence of herding towards the market among investors. Even if the herding coefficient is negative in most countries, it is significant only in Bulgaria, Estonia and Latvia.

As the OLS estimates may be distorted by the news which appears in the financial markets as extreme outliers, we further employ a quantile regression model to obtain the estimates for herding behavior in the returns of the CSAD distribution tails.

The quantile regression analysis offers a more comprehensive image of the conditional distribution of the CSAD of returns. Our results show that herding behavior was present on all CEE capital markets, except for Poland and Romania. In the Bulgarian stock market, we notice that β_3 coefficient is negative and statistically significant at all quantile levels except for the quantile of 90%, when using the quantile regression estimation method. The capital markets of Estonia and Latvia are also characterized by herding behavior at almost all quantile levels. The estimated statistics for Estonia show that β_3 coefficient is negative and statistically significant at the 1% level in all the quantiles, except for the quantile of 90%, showing that investors display homogeneous herding activity in this country. In Slovenia, we identified herding in the quantile up to the median (τ=10%, τ=25%, τ=50%). We have to highlight that the OLS analysis did not succeed to detect the herding behavior activity in the Slovenian market. This observation supports the statement that quantile regression analysis performs better than OLS method in identifying herding behavior. In other markets, herding behavior was an isolated phenomenon (Czech τ=10%, τ=90%; Croatia τ=25%; Hungary τ=10%; Lithuania τ=25%).

Having detected the presence of herding behavior on almost all markets inspires us to further investigate this behavioral bias under different market conditions.

Table 3 reports the sign and statistical significance of herding coefficients under up/down market, high/low volatility and high/low trading volume. We used the quantile regression analysis to estimate our empirical specifications: (9) – (11). Extended results on regression estimates are available in Appendix C (up/down market), Appendix D (high/low volatility) and Appendix E (high/low trading volume).

[Please insert Table 3 about here]

In most CEE countries, except for Romania, herding behavior is present under down markets on almost all quantile levels. A negative and significant β_4 indicates herding behavior when the market is declining. Even in Poland we identify a significant herding coefficient for the quantile of 50%. On the other hand, our results confirm that herding behavior is an isolated phenomenon under increasing markets. Latvia is the single CEE country in which herding behavior is present under both up and down market states. The results of the Wald test didn't show a significant difference in the coefficients of herding, so this phenomenon is present on the Latvian market regardless of the overall trend.

Our results confirm that volatility affects the cross-sectional deviation of stock returns in almost all countries, except for Romania. More than that, herding behavior is more pronounced for the quantiles up to the median. At the median level, herding behavior is present in almost all CEE stock markets under high volatility. Surprisingly, we didn't identify herding behavior in Romania, neither under down market, nor under high volatility.

On the most CEE stock markets, trading volume affects herding behavior in an asymmetric manner. If the coefficient β_3 is negative and significant, herding behavior is present under a high trading volume. This is the case of almost all countries, particularly for the quantiles up to the median (except for Croatia where herding is present only in the upper CSAD quantile). In Estonia and Latvia, herding behavior is present at quantile levels both below and above the median, particularly under high trading volume. Our results confirm the asymmetric effects of different market conditions on herding behavior.

5. Conclusion

This paper examines investors' herding behavior within ten CEE stock markets (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovenia) with regard to their preference to follow the market consensus. The testing methodology is based on the cross sectional absolute deviation of returns developed by Chang et al. [2000]. Estimates are based on daily stock prices for 384 companies and daily data for each country's stock market index from January 2, 2003 to December 31, 2013.

The ordinary least squared method estimates significant herding coefficients in Bulgaria, Estonia and Latvia. However, by using the quantile regression procedure to estimate the herding equation, we find supporting evidence in all countries for specific quantiles, except for Poland and Romania. We further investigate the impact of different market conditions such as up/down market, high/low volatility and high/low trading volume on herding behavior. The evidence confirms the asymmetric effects of different market conditions on herding behavior. Under down markets, herding behavior is present on almost all quantile levels in most CEE countries. Under high volatility and high trading volume, the phenomenon is more pronounced at the lower tails and the median of the CSAD distributions.

The results obtained within this study imply that the market regulators from CEE countries need to strengthen the legal framework regarding their stock exchanges. Some regulatory measures should be adopted for mitigating herding behavior and decreasing the level of speculative activities in the stock markets.

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Table 1

Descriptive statistics of the CSAD and market daily returns

Country	Nb. of obs.	Variables	Mean (%)	Std. Dev. (%)	ADF	Serial correlation at lag 1
Bulgaria	2737	*CSAD*	1.942	1.15	-7.2315***	0.4975
		R_m	0.036	1.31	-20.7018***	
Croatia	2693	*CSAD*	1.590	1.03	-10.4669***	0.4488
		R_m	0.015	1.37	-27.4523***	
Czech Rep	2765	*CSAD*	2.100	3.29	-15.6475***	0.3877
		R_m	0.027	1.50	-39.0365***	
Estonia	2770	*CSAD*	1.730	1.02	-5.1964***	0.5551
		R_m	0.048	1.18	-45.4877***	
Hungary	2753	*CSAD*	2.350	1.35	-8.4213***	0.2666
		R_m	0.031	1.64	-38.8562***	
Latvia	2762	*CSAD*	2.040	1.39	-14.7188***	0.2344
		R_m	0.031	1.26	-54.6457***	
Lithuania	2737	*CSAD*	1.710	1.22	-10.7654***	0.5458
		R_m	0.057	1.18	-32.1714***	
Poland	2759	*CSAD*	1.520	0.52	-6.7437***	0.5337
		R_m	0.026	1.54	-50.1663***	
Romania	2737	*CSAD*	2.160	1.76	-8.0727***	0.6541
		R_m	0.050	1.71	-48.0644***	
Slovenia	2680	*CSAD*	0.159	1.15	-10.7418***	0.3971
		R_m	0.006	1.12	-35.5073***	

***** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Table2

Estimates of herding behavior in CEE countries

	$CSAD_t=\beta_0+\beta_1\cdot R_{M,t}+\beta_2\cdot\lvert R_{M,t}\rvert+\beta_3\cdot\left(R_{M,t}-\overline{R_M}\right)^2+\beta_4\cdot CSAD_{t-1}+\varepsilon_t$					
Methodology	OLS	Q (τ=10%)	Q (τ=25%)	Q (τ=50%)	Q (τ=75%)	Q (τ=90%)
Herd coefficient	β_3	β_3	β_3	β_3	β_3	β_3
Bulgaria	(-)***	(-)*	(-)**	(-)***	(-)*	(-)
Croatia	(-)	(-)	(-)***	(-)	(+)*	(+)
Czech Rep	(-)	(-)***	(-)	(+)	(-)	(-)**
Estonia	(-)**	(-)**	(-)***	(-)***	(-)***	(-)
Hungary	(+)	(-)**	(-)	(+)	(+)*	(+)
Latvia	(-)***	(-)***	(-)	(-)***	(-)**	(-)**
Lithuania	(+)	(-)	(-)***	(+)	(+)	(+)***
Poland	(+)***	(+)**	(+)**	(+)***	(+)***	(+)***
Romania	(+)***	(+)*	(+)	(+)	(+)***	(+)***
Slovenia	(-)	(-)**	(-)***	(-)**	(-)	(-)

Note: This table reports the sign and statistical significance of herding coefficients in overall CEE markets. A negative and significant herding coefficient indicates the presence of herding behavior (grey cells).

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Table 3

Quantile regression evidence of herding behavior under different market conditions

Up/Down Market

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{ms}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1\text{-}D^{ms})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{ms}\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{4,\tau}\cdot(1\text{-}D^{ms})\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

	Q ($\tau = 10\%$)		Q ($\tau = 25\%$)		Q ($\tau = 50\%$)		Q ($\tau = 75\%$)		Q ($\tau = 90\%$)	
Herd Coef.	β_3	β_4	β_3	β_4	β_3	β_4	β_3	β_4	β_3	β_4
Bulgaria	(-)	(-)**	(-)	(-)*	(-)***	(-)***	(-)	(-)***	(-)	(-)
Croatia	(-)	(-)	(+)*	(-)**	(+)***	(-)***	(-)	(-)***	(+)	(-)***
Czech Rep	(+)***	(-)***	(+)**	(-)	(+)	(+)	(+)	(+)	(+)*	(+)
Estonia	(-)	(-)***	(-)	(-)***	(-)***	(-)	(+)	(-)**	(+)	(-)*
Hungary	(+)	(-)***	(+)	(-)	(+)	(-)	(+)	(+)	(+)**	(-)
Latvia	(-)***	(-)***	(-)***	(-)	(-)**	(-)*	(-)	(-)**	(-)***	(-)***
Lithuania	(-)	(-)*	(+)	(-)	(+)***	(-)***	(+)	(-)	(+)***	(+)***
Poland	(-)	(-)	(-)***	(-)	(-)	(-)**	(+)	(-)	(+)	(-)
Romania	(+)	(+)	(+)***	(-)	(+)***	(+)*	(+)***	(+)***	(+)***	(+)***
Slovenia	(+)***	(-)	(+)***	(-)***	(+)***	(-)***	(+)***	(-)***	(+)	(-)***

High /Low Volatility

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{vol}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1\text{-}D^{vol})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{vol}\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{4,\tau}\cdot(1\text{-}D^{vol})\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

	Q ($\tau = 10\%$)		Q ($\tau = 25\%$)		Q ($\tau = 50\%$)		Q ($\tau = 75\%$)		Q ($\tau = 90\%$)	
Herd Coef.	β_3	β_4	β_3	β_4	β_3	β_4	β_3	β_4	β_3	β_4
Bulgaria	(-)	(-)**	(-)**	(-)***	(-)	(-)***	(-)	(-)***	(-)	(-)
Croatia	(-)	(-)**	(-)**	(-)	(-)***	(-)	(-)	(+)	(-)	(+)
Czech Rep	(-)***	(+)***	(-)	(+)	(+)	(+)**	(+)	(+)	(-)	(+)
Estonia	(-)	(-)	(-)**	(+)	(-)***	(+)	(-)	(+)	(-)	(-)
Hungary	(-)	(+)	(-)	(-)	(+)	(+)*	(+)	(+)	(+)	(+)
Latvia	(-)***	(-)***	(-)	(-)***	(-)*	(-)	(-)***	(-)	(-)	(-)
Lithuania	(-)*	(+)	(-)	(+)***	(-)***	(+)***	(+)	(+)***	(+)	(+)
Poland	(+)	(-)***	(-)	(-)**	(-)***	(-)	(-)	(-)	(-)	(-)
Romania	(+)	(+)	(+)	(+)***	(+)	(+)***	(+)***	(+)***	(+)	(+)**
Slovenia	(-)	(-)	(-)**	(+)	(-)***	(+)	(-)	(+)	(-)	(-)

High/Low Trading Volume

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{tv}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1\text{-}D^{tv})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{tv}\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{4,\tau}\cdot(1\text{-}D^{tv})\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

	Q ($\tau = 10\%$)		Q ($\tau = 25\%$)		Q ($\tau = 50\%$)		Q ($\tau = 75\%$)		Q ($\tau = 90\%$)	
Herd Coef.	β_3	β_4	β_3	β_4	β_3	β_4	β_3	β_4	β_3	β_4
Bulgaria	(-)*	(-)	(-)***	(-)**	(-)	(-)***	(-)	(-)***	(-)	(-)
Croatia	(-)	(-)	(-)	(+)	(-)***	(+)	(+)	(+)	(-)**	(+)
Czech Rep	(-)***	(+)	(-)	(+)	(+)	(+)	(+)	(+)	(-)	(-)
Estonia	(-)**	(+)	(-)***	(+)**	(-)	(+)	(-)***	(+)***	(-)***	(+)
Hungary	(-)***	(+)***	(-)*	(+)	(-)	(+)*	(+)	(+)***	(-)	(+)*
Latvia	(-)***	(-)	(-)***	(-)***	(-)***	(-)*	(-)	(-)***	(-)**	(-)*
Lithuania	(-)**	(-)	(-)*	(-)	(-)	(+)***	(+)	(+)	(+)***	(-)
Poland	(-)	(-)	(-)	(-)	(-)	(-)	(+)	(-)	(-)	(+)
Romania	(-)	(-)	(-)*	(+)***	(+)**	(+)***	(+)	(+)***	(+)***	(+)**
Slovenia	(-)**	(+)	(-)***	(+)	(-)***	(+)	(-)	(+)	(-)	(+)*

Note: This table reports the sign and statistical significance of herding coefficients under different market conditions: up and down market, high and low volatility, and high and low trading volume. The market is considered to be up if the daily market index return exceeds the average return of the previous 30-days. Under this condition, the dummy variable D^{ms} takes value 1. The market is down and the dummy variable takes value 0 if the daily market index return is below the average return of the previous 30-days. The daily volatility/trading volume is considered to be high ($D^{vol}=1$/ $D^{tv}=1$) if it is larger than the previous 30-day moving average volatility/trading and low ($D^{vol}=0$/ $D^{tv}=0$) if it is below this average. A negative and significant herding coefficient indicates the presence of herding behavior (grey cells). In order to test for the asymmetry in herding behavior under different market conditions we applied the Wald test with the null hypothesis: $\beta_3 = \beta_4$.

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Appendices

Appendix A. OLS regression estimates of herding behavior in CEE countries

$$CSAD_t=\beta_0+\beta_1\cdot R_{M,t}+\beta_2\cdot|R_{M,t}|+\beta_3\cdot(R_{M,t}-\overline{R_M})^2+\beta_4\cdot CSAD_{t-1}+\varepsilon_t$$

Country	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	Adj. R^2
Bulgaria	0.0084***	-0.0031	0.6543***	-1.5483***	0.2941***	0.4603
	(12.9000)	(-0.1932)	(17.8881)	(-3.1954)	(7.6307)	
Croatia	0.0073***	0.0203**	0.6833***	-0.3472	0.1854***	0.6078
	(28.9831)	(2.1941)	(32.0411)	(-1.2964)	(14.1826)	
Czech Rep	0.0074***	0.0081	0.5963***	-0.3905	0.3716***	0.1867
	(7.6833)	(0.2116)	(6.6048)	(-0.3510)	(21.5604)	
Estonia	0.0062***	0.0206*	0.3829***	-1.2478**	0.4796***	0.3868
	(19.1838)	(1.6010)	(11.9621)	(-2.0500)	(31.0929)	
Hungary	0.0130***	0.0190	0.5228***	0.0661	0.1828***	0.2654
	(24.9469)	(1.4046)	(14.5446)	(0.1252)	(10.9707)	
Latvia	0.0110***	0.0329*	0.8717***	-3.1114***	0.1298***	0.2976
	(24.0168)	(1.8700)	(18.5316)	(-3.3801)	(7.9375)	
Lithuania	0.0059***	0.0404***	0.4451***	0.1391	0.4669***	0.4122
	(17.0212)	(2.6513)	(12.4407)	(0.2592)	(30.9926)	
Poland	0.0060***	0.0491***	0.2398***	1.0047***	0.3968***	0.6006
	(30.574)	(4.640)	(17.804)	(3.653)	(32.004)	
Romania	0.0050***	0.0018	0.2822***	1.6375***	0.5990***	0.5057
	(10.8802)	(0.1299)	(7.4398)	(3.0903)	(43.6178)	
Slovenia	0.0066***	0.0022	0.6066***	-0.8041	0.3066***	0.3236
	(18.0187)	(0.1336)	(14.0440)	(-0.8860)	(18.8042)	

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Appendix B. Quantile regression estimates of herding behavior in CEE countries

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot R_{M,t}+\beta_{2,\tau}\cdot|R_{M,t}|+\beta_{3,\tau}\cdot(R_{M,t}-\overline{R_M})^2+\beta_{4,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

Bulgaria	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	Adj. R^2
Q (τ=10%)	-0.0044***	-0.0001	0.6576***	-2.0949*	0.1185***	0.2543
	(15.5409)	(-0.0098)	(14.8934)	(-1.8856)	(7.5552)	
Q (τ=25%)	0.0054***	0.0193*	0.6616***	-2.0081**	0.2101***	0.2845
	(13.5740)	(1.6623)	(17.3891)	(-2.2276)	(7.8891)	
Q (τ=50%)	0.0066***	0.0073	0.6384***	-1.6361***	0.3361***	0.3207
	(17.5259)	(0.5143)	(22.4286)	(-3.6398)	(14.7951)	
Q (τ=75%)	0.0090***	0.0118	0.6396***	-1.3510*	0.4350***	0.3508
	(15.8771)	(0.5012)	(16.4816)	(-1.7296)	(13.5633)	
Q (τ=90%)	0.0124***	0.0049	0.7299***	-2.0688	0.4698***	0.3593
	(19.2407)	(0.0624)	(8.1244)	(-0.7007)	(20.1171)	
Croatia	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	Adj. R^2
Q (τ=10%)	0.0038***	0.0157	0.6859***	-0.8916	0.0706***	0.3350
	(12.6991)	(0.8016)	(10.2277)	(-0.4701)	(6.9619)	
Q (τ=25%)	0.0049***	0.0092	0.6566***	-0.5221***	0.1380***	0.3649
	(23.8672)	(1.3838)	(45.3782)	(-3.8032)	(9.8461)	
Q (τ=50%)	0.0058***	0.0163	0.6656***	-0.8411	0.2235***	0.4018
	(18.6465)	(1.1462)	(12.5671)	(-0.6193)	(11.1418)	
Q (τ=75%)	0.0071***	0.0236	0.6360***	0.4534*	0.3370***	0.4299

	(20.5945)	(1.1481)	(22.9062)	(1.9028)	(15.1365)	
Q (τ=90%)	0.0099***	0.0195	0.7320***	0.2917	0.3725***	0.4473
	(16.3301)	(0.4525)	(9.8792)	(0.2205)	(10.6316)	
Czech Rep	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0022***	0.0185*	0.6195***	-0.4499***	0.0287***	0.2195
	(13.9661)	(1.9266)	(39.1859)	(-3.4247)	(3.4291)	
Q (τ=25%)	0.0029***	0.0052	0.6371***	-0.3974	0.0824***	0.2114
	(15.0066)	(0.6066)	(26.7225)	(-0.8497)	(8.6496)	
Q (τ=50%)	0.0036***	0.0043	0.5998***	0.3117	0.2588***	0.2121
	(7.2733)	(0.4327)	(20.2044)	(0.5494)	(6.2794)	
Q (τ=75%)	0.0036***	0.0145	0.6033***	-0.1522	0.6128***	0.2288
	(3.9526)	(0.6498)	(10.4367)	(-0.1606)	(8.8110)	
Q (τ=90%)	0.0071***	0.0210	0.6181***	-1.0807**	0.9785***	0.2447
	(8.2108)	(0.9483)	(7.8683)	(-1.9877)	(88.0621)	
Estonia	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0033***	-0.0030	0.4060***	-2.8451**	0.2055***	0.1613
	(11.2891)	(-0.1703)	(8.7820)	(-2.3105)	(11.1903)	
Q (τ=25%)	0.0038***	-0.0005***	0.4236	-3.5028***	0.3360***	0.1993
	(13.8102)	(-0.0391)	(8.8728)	(-2.7116)	(18.1995)	
Q (τ=50%)	0.0049***	0.0223*	0.3663***	-0.8801***	0.4834***	0.2436
	(18.1316)	(1.8201)	(14.4204)	(-3.4836)	(25.2313)	
Q (τ=75%)	0.0063***	0.0209	0.4374***	-1.8726***	0.6442***	0.2790
	(13.4043)	(1.0315)	(10.8579)	(-4.7451)	(23.8887)	
Q (τ=90%)	0.0093***	0.0558	0.4880***	-1.0529	0.7739***	0.2958
	(15.3532)	(1.1884)	(5.6619)	(-0.5677)	(37.8201)	
Hungary	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0062***	0.0234***	0.5319***	-0.4757**	0.0856***	0.2267
	(17.3238)	(3.2041)	(25.3377)	(-2.4554)	(5.8237)	
Q (τ=25%)	0.0083***	0.0140*	0.5264***	-0.0963	0.1119***	0.2160
	(26.2959)	(1.7059)	(26.0956)	(-0.4720)	(8.6229)	
Q (τ=50%)	0.0109***	0.0150	0.4857***	0.3693	0.1829***	0.2108
	(21.9728)	(1.1896)	(13.5670)	(0.4626)	(9.3059)	
Q (τ=75%)	0.0146***	0.0149	0.4499***	1.7356*	0.2521***	0.1985
	(19.2511)	(1.1190)	(9.4841)	(1.8861)	(8.6269)	
Q (τ=90%)	0.0185***	0.0116	0.4476***	2.1277	0.3875***	0.1554
	(6.6679)	(0.3102)	(3.0694)	(0.7814)	(3.1015)	
Latvia	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0026***	0.0041	0.8963***	-3.6348***	0.0593***	0.2767
	(9.6389)	(0.4215)	(23.9132)	(-3.7664)	(5.8000)	
Q (τ=25%)	0.0047***	0.0078	0.8557***	-2.9051	0.0913***	0.2541
	(10.0417)	(0.4819)	(8.0977)	(-0.7487)	(7.0839)	
Q (τ=50%)	0.0084***	0.0216	0.8123***	-1.5447***	0.1294***	0.2274
	(22.5022)	(1.5910)	(22.7318)	(-2.9760)	(8.8330)	
Q (τ=75%)	0.0144***	0.0670**	0.8130***	-2.3248**	0.1837***	0.1992
	(17.9319)	(2.3635)	(12.8791)	(-2.2938)	(4.7248)	
Q (τ=90%)	0.0212***	0.0787**	0.8090***	-3.4303**	0.2672***	0.1708
	(15.5902)	(2.5092)	(7.9561)	(-2.0920)	(5.2093)	
Lithuania	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**Adj. R^2**

Q (τ=10%)	0.0043***	0.0303**	0.5010***	-0.6805	0.1519***	0.2296
	(10.1099)	(2.5095)	(12.3152)	(-0.7220)	(4.5253)	
Q (τ=25%)	0.0044***	0.0311***	0.4920***	-0.9187***	0.3038***	0.2676
	(12.9581)	(3.4005)	(21.3466)	(-3.9010)	(11.4821)	
Q (τ=50%)	0.0054***	0.0448**	0.4749***	0.0083	0.4011***	
	(14.9372)	(2.2170)	(12.9455)	(0.0083)	(15.1669)	
Q (τ=75%)	0.0066***	0.0613***	0.4954***	0.0530	0.5463***	0.3361
	(11.1668)	(3.1383)	(15.3143)	(0.1209)	(13.2748)	
Q (τ=90%)	0.0083***	0.0685	0.4666***	1.8589***	0.6948***	0.3511
	(9.4532)	(1.5328)	(8.0317)	(3.1172)	(11.5723)	
Poland	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0044***	0.0397***	0.2281***	0.6589**	0.2807***	0.2683
	(18.7753)	(3.4374)	(12.8843)	(2.0089)	(16.8472)	
Q (τ=25%)	0.0050***	0.0407***	0.2441***	0.5828**	0.3296***	0.3063
	(21.9128)	(3.9391)	(17.1972)	(2.2023)	(19.3340)	
Q (τ=50%)	0.0058***	0.0737***	0.2245***	1.7797***	0.3711***	0.3488
	(21.1395)	(4.2405)	(12.2404)	(3.9697)	(19.2612)	
Q (τ=75%)	0.0066***	0.0801***	0.2186***	1.7710***	0.4634***	0.3900
	(18.6493)	(3.7478)	(10.3486)	(3.4133)	(19.0032)	
Q (τ=90%)	0.0076***	0.0633***	0.2345***	1.3560***	0.5519***	0.4245
	(16.1579)	(6.2941)	(9.6014)	(3.6770)	(16.0083)	
Romania	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0053***	0.0374***	0.4435***	0.4312*	0.1611***	0.3054
	(27.6928)	(4.8047)	(23.7324)	(1.8984)	(14.7282)	
Q (τ=25%)	0.0057***	0.0401***	0.4103***	0.7382	0.2664***	0.3219
	(18.3166)	(4.7603)	(18.4327)	(1.5960)	(14.6955)	
Q (τ=50%)	0.0067***	0.0145	0.3781***	1.3912	0.3828***	0.3461
	(8.8162)	(1.1647)	(3.7339)	(0.4557)	(9.9397)	
Q (τ=75%)	0.0066***	0.0132	0.3451***	2.0076***	0.6122***	0.3801
	(7.3616)	(1.1033)	(12.7718)	(5.9858)	(10.8465)	
Q (τ=90%)	0.0068***	0.0104	0.3338***	1.8975***	0.8527***	0.4235
	(7.5627)	(0.3826)	(6.2846)	(3.7195)	(15.0840)	
Slovenia	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0038***	0.0130	0.7027***	-0.7313**	0.0605***	0.3187
	(27.2135)	(1.4800)	(37.3085)	(-2.2602)	(6.8892)	
Q (τ=25%)	0.0048***	0.0078	0.6960***	-1.0088***	0.1075***	0.3176
	(27.5200)	(1.2162)	(37.5789)	(-3.6916)	(7.4791)	
Q (τ=50%)	0.0060***	0.0102	0.6800***	-1.1812**	0.1915***	0.3128
	(16.6515)	(0.9690)	(26.6354)	(-2.2629)	(6.3546)	
Q (τ=75%)	0.0077***	0.0164	0.6231***	-0.6836	0.3293***	0.2847
	(11.1580)	(0.8660)	(20.5830)	(-1.3641)	(6.1889)	
Q (τ=90%)	0.0091***	0.0311	0.6258**	-0.8007	0.5858***	0.2503
	(7.2154)	(0.7345)	(2.1855)	(-0.0737)	(7.4817)	

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Appendix C. Estimates of herding behavior in CEE countries under up and down market

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{ms}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1-D^{ms})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{ms}\cdot\left(R_{M,t}-\overline{R_M}\right)^2+\beta_{4,\tau}\cdot(1-D^{ms})\cdot\left(R_{M,t}-\overline{R_M}\right)^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

Bulgaria	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	β_5 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0044***	0.6170***	0.7032***	-2.3334	-2.7858**	0.1278***	02555
	(13.0095)	(8.5576)	(13.2908)	(-0.9232)	(-2.0181)	(6.4880)	
Q (τ=25%)	0.0052***	0.6294***	0.7028***	-1.6881	-2.2950*	0.2283***	0.2869
	(13.6605)	(14.8562)	(14.4252)	(-1.5809)	(-1.7192)	(8.5692)	
Q (τ=50%)	0.0063***	0.6357***	0.6996***	-1.6324	-2.4303***	0.3525***	0.3245
	(18.6979)	(16.3516)	(16.2464)	(-1.4311)	(-6.4937)	(16.7841)	
Q (τ=75%)	0.0089***	0.5975***	0.6874***	-1.2474	-2.0643***	0.4412***	0.3572
	(15.6453)	(11.2599)	(16.5659)	(-0.8574)	(-3.3025)	(13.7748)	
Q (τ=90%)	0.0122***	0.7336***	0.7343*	-1.9719	-2.6489	0.4792***	0.3686
	(7.8820)	(6.7664)	(2.1620)	(-0.9544)	(-0.1855)	(7.9451)	
Croatia	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	β_5 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0041***	0.6669***	0.6449***	-0.1123	-0.5537	0.0676***	0.3378
	(17.4995)	(16.1026)	(12.8033)	(-0.1128)	(-0.5421)	(6.0420)	
Q (τ=25%)	0.0050***	0.6318***	0.6333***	0.5402*	-0.3260**	0.1415	0.3700
	(19.1872)	(6.0551)	(27.9361)	(0.1315)	(-2.0167)	(10.7382)	
Q (τ=50%)	0.0059***	0.6389***	0.6358***	1.0571***	-0.6913***	0.2250***	0.4103
	(22.7161)	(31.1542)	(40.5310)	(7.8323)	(-5.3270)	(11.2796)	
Q (τ=75%)	0.0067***	0.7269***	0.6668***	-0.0279	-1.4027***	0.3509***	0.4414
	(19.5506)	(19.3085)	(23.1052)	(-0.1080)	(-6.9657)	(15.9839)	
Q (τ=90%)	0.0098***	0.7302***	0.7602***	1.0240	-2.2642***	0.3742***	0.4598
	(17.9829)	(11.4876)	(12.7687)	(1.2015)	(-5.8909)	(10.9808)	
Czech Rep	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	β_5 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0024***	0.5648***	0.6097***	2.3673***	-0.5096***	0.0283***	0.2223
	(13.2992)	(23.1747)	(33.4430)	(4.1411)	(-4.6820)	(3.2953)	
Q (τ=25%)	0.0031***	0.5841***	0.6119***	1.7683**	-0.2002	0.0826***	0.2131
	(15.7397)	(19.5530)	(21.8113)	(2.1845)	(-0.3606)	(8.2884)	
Q (τ=50%)	0.0037***	0.5822***	0.5634***	1.9070	0.6746	0.2549***	0.2125
	(6.9511)	(12.2146)	(17.8969)	(1.0853)	(1.1872)	(6.0104)	
Q (τ=75%)	0.0038***	0.5845***	0.5386***	2.0095	0.6648	0.6121***	0.2274
	(3.4197)	(5.2283)	(2.5910)	(0.9766)	(0.1164)	(9.5252)	
Q (τ=90%)	0.0069***	0.6511***	0.5045***	3.3892*	0.0698	0.9855***	0.2469
	(6.8940)	(4.2915)	(5.4495)	(1.6984)	(0.0720)	(85.3344)	
Estonia	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	β_5 *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0034***	0.3759***	0.4887***	-1.8428	-5.6334***	0.2071***	0.1668
	(10.8407)	(5.7013)	(10.4536)	(-1.0115)	(-4.5681)	(10.7247)	
Q (τ=25%)	0.0039***	0.3853***	0.4647***	-2.1839	-4.3270***	0.3299***	0.2031
	(12.1239)	(5.0634)	(11.0134)	(-0.8612)	(-4.0456)	(16.6780)	
Q (τ=50%)	0.0048***	0.3793***	0.3991***	-0.8028***	-2.1674	0.4879***	0.2467
	(16.0011)	(11.4636)	(9.1702)	(-2.8482)	(-1.6298)	(24.9285)	
Q (τ=75%)	0.0061***	0.4262**	0.4381***	0.4080	-2.9063**	0.6485***	0.2837
	(9.9848)	(2.5069)	(5.3306)	(0.0600)	(-2.0245)	(25.2883)	
Q (τ=90%)	0.0092***	0.3578**	0.6083***	3.1838	-6.8813*	0.7754***	0.3016
	(12.5122)	(2.0913)	(4.9193)	(0.7962)	(-1.8884)	(36.2321)	
Hungary	β_0 *(t-stat)*	β_1 *(t-stat)*	β_2 *(t-stat)*	β_3 *(t-stat)*	β_4 *(t-stat)*	β_5 *(t-stat)*	**Adj. R^2**

Q (τ=10%)	0.0063***	0.4775***	0.5441***	0.2078	-0.7788***	0.0897***	0.2299
	(18.2612)	(17.2806)	(25.1008)	(0.8020)	(-3.9731)	(6.4607)	
Q (τ=25%)	0.0084***	0.4802***	0.5368***	1.0022	-0.2077	0.1102***	0.2193
	(22.4467)	(8.3456)	(16.1076)	(0.5556)	(-0.4113)	(8.7430)	
Q (τ=50%)	0.0111***	0.4275***	0.5311***	1.9065	-0.2608	0.1770***	0.2136
	(19.5530)	(4.7303)	(12.5023)	(0.6002)	(-0.3270)	(9.1795)	
Q (τ=75%)	0.0150***	0.3524*	0.5282***	4.1881	0.2873	0.2379***	0.2024
	(17.6117)	(1.8844)	(5.0162)	(0.5904)	(0.1205)	(9.2463)	
Q (τ=90%)	0.0212***	0.1092	0.5904***	10.0746**	-0.6282	0.3101*	0.1616
	(5.1220)	(0.5170)	(2.8064)	(2.1133)	(-0.1878)	(1.8481)	
Latvia	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0026***	0.8958***	0.9237***	-3.3313***	-4.4455***	0.0550***	0.2790
	(10.2004)	(34.5191)	(20.2391)	(-12.1510)	(-3.5636)	(5.2318)	
Q (τ=25%)	0.0047***	0.8726***	0.8635***	-3.2965***	-3.0910	0.0916***	0.2562
	(14.3465)	(25.3219)	(12.4395)	(-7.1451)	(-1.2654)	(6.7303)	
Q (τ=50%)	0.0083***	0.8638***	0.7955***	-2.6689**	-1.5670*	0.1325***	0.2303
	(21.5323)	(17.5716)	(17.6099)	(-2.3706)	(-1.8887)	(9.0118)	
Q (τ=75%)	0.0145***	0.8896***	0.7504***	-1.7646	-1.6213**	0.1687***	0.2013
	(18.4874)	(9.3119)	(13.7970)	(-1.2341)	(-2.3148)	(4.4638)	
Q (τ=90%)	0.0202***	0.9882***	0.6957***	-4.7829***	-2.5384***	0.2924***	0.1775
	(17.8570)	(9.1104)	(10.6978)	(-3.0657)	(-3.1384)	(6.8952)	
Lithuania	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0040***	0.5013***	0.4938***	-0.8037	-0.8259*	0.1767***	0.2283
	(8.3519)	(14.0186)	(13.2019)	(-0.9674)	(-1.7423)	(4.4851)	
Q (τ=25%)	0.0042***	0.4517***	0.5056***	0.5904	-1.0932	0.3145***	0.2678
	(8.5587)	(3.7121)	(12.4761)	(0.1010)	(-1.5553)	(11.6404)	
Q (τ=50%)	0.0055***	0.4525***	0.5041***	1.2202***	-1.3237***	0.4036***	0.3072
	(13.5667)	(13.9101)	(16.3573)	(3.9100)	(-4.0271)	(13.6682)	
Q (τ=75%)	0.0065***	0.4887***	0.6048	0.6874	-2.7424	0.5447***	0.3381
	(8.9751)	(8.0643)	(1.4419)	(1.2309)	(-0.1277)	(11.3746)	
Q (τ=90%)	0.0085***	0.3922***	0.4493***	5.6386***	1.4233***	0.6975***	0.3559
	(8.2061)	(3.8779)	(8.0898)	(2.5814)	(3.2901)	(10.3870)	
Poland	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0044***	0.2491***	0.2741***	-0.2900	-0.2996	0.2853***	0.2702
	(18.3911)	(14.1149)	(13.7237)	(-1.2070)	(-0.9665)	(16.9310)	
Q (τ=25%)	0.0050***	0.2753***	0.2958***	-0.6102***	-0.3923	0.3369***	0.3101
	(20.5741)	(22.9569)	(14.3724)	(-2.8901)	(-1.0296)	(19.3610)	
Q (τ=50%)	0.0060***	0.2817***	0.3159***	-0.3194	-0.4968**	0.3737***	0.3509
	(21.1988)	(24.3119)	(22.5186)	(-1.3536)	(-2.0969)	(18.8456)	
Q (τ=75%)	0.0067***	0.2775***	0.3194***	0.0407	-0.3876	0.4663***	0.3899
	(16.5423)	(22.6779)	(19.9801)	(0.1015)	(-1.1357)	(16.9145)	
Q (τ=90%)	0.0080***	0.2761***	0.3461***	0.3151	-0.3937	0.5167***	0.4266
	(17.2127)	(23.1589)	(9.4852)	(0.8431)	(-1.1822)	(15.0287)	
Romania	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0054***	0.4283***	0.4421***	1.3185	0.1220	0.1601***	0.3006
	(21.2309)	(8.2015)	(16.6776)	(0.7739)	(0.4756)	(14.0694)	
Q (τ=25%)	0.0057***	0.3819***	0.4307***	2.1752***	-0.1196	0.2710***	0.3200
	(18.8588)	(16.5361)	(17.6383)	(6.9555)	(-0.4576)	(14.5567)	
Q (τ=50%)	0.0068***	0.3566***	0.3970***	2.2009***	1.0812*	0.3769***	0.3463
	(10.9224)	(13.6676)	(11.6435)	(4.5886)	(1.8674)	(9.5009)	

Q (τ=75%)	0.0067***	0.3248***	0.3649***	2.5194***	1.7292***	0.6096***	0.3799
	(7.6158)	(7.9320)	(11.5056)	(2.7282)	(5.4266)	(11.2521)	
Q (τ=90%)	0.0071***	0.2456***	0.3672***	3.9014***	1.5408***	0.8572***	0.4242
	(5.2562)	(3.4899)	(6.4908)	(3.0533)	(3.5283)	(9.2160)	
Slovenia	**β_0 *(t-stat)***	**β_1 *(t-stat)***	**β_2 *(t-stat)***	**β_3 *(t-stat)***	**β_4 *(t-stat)***	**β_5 *(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0040***	0.6298***	0.7074***	2.3238***	-0.8746	0.0598***	0.3200
	(26.3159)	(23.5100)	(29.5361)	(3.4189)	(-1.4588)	(6.6313)	
Q (τ=25%)	0.0050***	0.5333***	0.6796***	6.1903***	-0.8542***	0.1123***	0.3202
	(28.6787)	(14.0073)	(34.0324)	(3.8116)	(-2.9796)	(8.8496)	
Q (τ=50%)	0.0064***	0.5103***	0.6825***	6.6676***	-1.5803***	0.1848***	0.3152
	(17.8640)	(15.5211)	(25.9734)	(5.7203)	(-4.0240)	(6.5009)	
Q (τ=75%)	0.0080***	0.4388***	0.6399***	6.4649***	-1.3122***	0.3333***	0.2873
	(10.3072)	(9.4690)	(13.6809)	(6.1480)	(-1.3150)	(5.5282)	
Q (τ=90%)	0.0093***	0.3610**	0.7127***	7.1557	-3.5177***	0.6021***	0.2529
	(8.4288)	(2.0216)	(9.7348)	(0.8421)	(-3.93634)	(8.4042)	

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Appendix D. Estimates of herding behavior in CEE countries under high and low volatility

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{vol}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1-D^{vol})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{vol}\cdot(R_{M,t}-\overline{R_M})^2+\beta_{4,\tau}\cdot(1-D^{vol})\cdot(R_{M,t}-\overline{R_M})^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

Bulgaria	**β_0 *(t-stat)***	**β_1 *(t-stat)***	**β_2 *(t-stat)***	**β_3 *(t-stat)***	**β_4 *(t-stat)***	**β_5 *(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0043***	0.5824***	0.7036***	-0.6154	-2.7561**	0.1250***	0.2552
	(12.7681)	(10.9206)	(13.8317)	(-0.5748)	(-2.0654)	(6.4904)	
Q (τ=25%)	0.0051***	0.6595***	0.6500***	-2.4370**	-1.1908***	0.2328***	0.2861
	(13.6688)	(15.6865)	(20.2293)	(-2.4898)	(-4.3605)	(8.9471)	
Q (τ=50%)	0.0062***	0.6634***	0.6854***	-2.8246	-2.3045***	0.3532***	0.3242
	(18.4143)	(13.1763)	(20.0763)	(-1.5187)	(-7.3932)	(16.7740)	
Q (τ=75%)	0.0087***	0.6075**	0.6615***	-0.2451	-1.8093***	0.4473***	0.3563
	(14.7739)	(2.0615)	(13.8704)	(-1.0163)	(-2.6148)	(14.6467)	
Q (τ=90%)	0.0120***	0.7194***	0.7473***	-1.7330	-1.8157	0.4809***	0.3686
	(20.0887)	(10.9864)	(8.2596)	(-1.3312)	(-1.3967)	(17.1855)	
Croatia	**β_0 *(t-stat)***	**β_1 *(t-stat)***	**β_2 *(t-stat)***	**β_3 *(t-stat)***	**β_4 *(t-stat)***	**β_5 *(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0039***	0.6584***	0.7268***	-0.5663	-2.0842**	0.0709***	0.3382
	(18.3130)	(18.1591)	(22.5372)	(-0.9120)	(-2.5392)	(6.4120)	
Q (τ=25%)	0.0049***	0.6340***	0.6592***	-0.3553**	-0.3744	0.1398***	0.3698
	(26.2167)	(34.5807)	(19.6649)	(-2.0094)	(-0.4006)	(11.4565)	
Q (τ=50%)	0.0058***	0.6623***	0.6699***	-0.8685***	-0.8585	0.2258***	0.4072
	(21.5092)	(30.7517)	(24.2421)	(-5.4447)	(-1.2443)	(11.4876)	
Q (τ=75%)	0.0071***	0.6600***	0.5982***	-0.7598	1.7798	0.3449***	0.4374
	(18.4008)	(12.1413)	(10.9138)	(-0.6881)	(1.1146)	(15.5039)	
Q (τ=90%)	0.0095***	0.7180***	0.6622***	-0.3013	1.7389	0.4073***	0.4575
	(17.6229)	(11.1899)	(10.8675)	(-0.7264)	(1.5108)	(15.1339)	
Czech Rep	**β_0 *(t-stat)***	**β_1 *(t-stat)***	**β_2 *(t-stat)***	**β_3 *(t-stat)***	**β_4 *(t-stat)***	**β_5 *(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0024***	0.6067***	0.5688***	-0.4910***	2.0283***	0.0283***	0.2225
	(13.5696)	(33.7116)	(22.3179)	(-4.5455)	(2.6641)	(3.2270)	
Q (τ=25%)	0.0030***	0.6273***	0.5959***	-0.3597	0.9285	0.0825***	0.2125
	(15.0777)	(21.7551)	(21.2507)	(-0.6339)	(1.2737)	(8.1809)	
Q (τ=50%)	0.0037***	0.5699***	0.5776***	0.6172	2.4116**	0.2522***	0.2124
	(7.3620)	(18.8562)	(16.8836)	(1.1044)	(2.5704)	(6.2159)	
Q (τ=75%)	0.0038***	0.5612***	0.5738***	0.2573	2.1820	0.6127***	0.2274

	(3.8052)	(11.5891)	(7.8842)	(0.4114)	(1.5004)	(7.8997)	
Q (τ=90%)	0.0074***	0.5188***	0.4664	-0.0990	10.0263	0.9835***	0.2458
	(4.0220)	(3.9508)	(0.6126)	(-0.0789)	(0.2758)	(83.3980)	
Estonia	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0039***	0.6781***	0.7118***	-0.3472	-0.3180	0.0612***	0.3190
	(24.7773)	(34.4665)	(24.9645)	(-1.2504)	(-0.3713)	(6.4740)	
Q (τ=25%)	0.0048***	0.6700***	0.6717***	-0.6825**	0.5736	0.1112***	0.3160
	(28.0346)	(33.6415)	(24.3569)	(-2.4225)	(0.7068)	(8.8308)	
Q (τ=50%)	0.0062***	0.6508***	0.6439***	-1.1223***	0.8378	0.1881***	0.3106
	(16.8960)	(23.3769)	(11.5493)	(-2.8860)	(0.3687)	(6.4428)	
Q (τ=75%)	0.0079***	0.5998***	0.5741***	-0.6077	1.8627	0.3245***	02814
	(11.5925)	(16.1970)	(11.2389)	(-1.3039)	(1.5789)	(6.1669)	
Q (τ=90%)	0.0093***	0.6596	0.6217***	-1.5242	-0.7499	0.5685***	0.2470
	(7.7033)	(1.2766)	(4.5700)	(-0.0635)	(-0.2991)	(6.5605)	
Hungary	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0062***	0.5029***	0.5105***	-0.0337	0.5997	0.0919***	0.2283
	(16.0605)	(19.8070)	(17.2607)	(-0.1006)	(1.2408)	(5.6064)	
Q (τ=25%)	0.0081***	0.5065***	0.5662***	-0.0781	-0.5651	0.1152***	0.2198
	(22.5804)	(12.9093)	(17.5553)	(-0.0857)	(-0.8989)	(8.5144)	
Q (τ=50%)	0.0111***	0.4728***	0.4409***	0.0357	2.7618*	0.1776***	0.2139
	(22.2359)	(18.9171)	(8.8229)	(0.1295)	(1.9522)	(9.1586)	
Q (τ=75%)	0.0147***	0.4632***	0.4021***	1.3374	3.7841	0.2502***	0.2005
	(17.9351)	(4.8127)	(2.8176)	(0.5951)	(0.6971)	(7.8488)	
Q (τ=90%)	0.0198***	0.4445	0.1560	0.9302	12.1022	0.3793***	0.1591
	(5.0055)	(1.3676)	(0.0974)	(0.1480)	(0.1340)	(2.9109)	
Latvia	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0026***	0.8970***	0.9172***	-3.6862***	-3.5436***	0.0555***	0.2879
	(10.4797)	(24.3587)	(35.0590)	(-4.2712	(-13.0395)	(5.2758)	
Q (τ=25%)	0.0047***	0.8273***	0.8843***	-2.0501	-3.5631***	0.0935***	0.2564
	(14.0545)	(13.4034)	(26.5932)	(-0.9463)	(-9.7421)	(6.9041)	
Q (τ=50%)	0.0084***	0.7913***	0.8484***	-1.5275*	-2.5823	0.1325***	0.2302
	(21.3726)	(18.1683)	(13.7736)	(-1.9555)	(-1.6154)	(9.0777)	
Q (τ=75%)	0.0146***	0.7934***	0.8099***	-2.1310***	-1.6559	0.1728***	0.1990
	(17.7979)	(12.4792)	(6.6002)	(-2.6653)	(-0.4445)	(4.6816)	
Q (τ=90%)	0.0212***	0.7845***	0.7747***	-2.2536	-1.3095	0.2667***	0.1725
	(15.2303)	(8.0183)	(4.4194)	(-1.4103)	(-0.2790)	(5.3786)	
Lithuania	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0040***	0.4817***	0.4740***	-0.7185*	1.3662	0.1837***	0.2305
	(10.4654)	(13.6922)	(7.3683)	(-1.7298)	(0.6513)	(5.8527)	
Q (τ=25%)	0.0043***	0.4828***	0.4378***	-1.1067	2.1698***	0.3116***	0.2695
	(12.9201)	(14.7734)	(15.6576)	(-1.5913)	(9.4385)	(12.0501)	
Q (τ=50%)	0.0053***	0.4690***	0.4725***	-1.0379***	1.7190***	0.4144***	0.3092
	(13.7405)	(16.4403)	(15.8260)	(-3.5167)	(6.7779)	(14.4941)	
Q (τ=75%)	0.0065***	0.4901***	0.5174***	0.3296	1.1336***	0.5487***	0.3389
	(10.3315)	(11.2900)	(12.3819)	(0.5524)	(3.3017)	(12.1878)	
Q (τ=90%)	0.0085***	0.4677**	0.4693***	0.5916	3.3380	0.6864***	0.3559
	(8.7481)	(9.0335)	(1.9606)	(1.2797)	(0.3462)	(12.0561)	
Poland	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**

Q (τ=10%)	0.0043***	0.2366***	0.2929***	0.1755	-0.7152***	0.2922***	0.2710
	(17.2628)	(11.0672)	(21.7728)	(0.8624)	(-2.6970)	(17.7179)	
Q (τ=25%)	0.0049***	0.2662***	0.2892***	-0.2424	-0.5391**	0.3400***	0.3091
	(19.5688)	(14.7865)	(26.8444)	(-1.3911)	(-2.0873)	(19.5161)	
Q (τ=50%)	0.0059***	0.3076***	0.2929***	-0.4965***	-0.1241	0.3759***	0.3500
	(22.7219)	(29.1712)	(25.9550)	(-2.7462)	(-0.6116)	(19.5980)	
Q (τ=75%)	0.0064***	0.2881***	0.2998***	-0.1996	-0.1349	0.4907***	0.3891
	(17.8430)	(21.9556)	(21.4595)	(-0.8983)	(-0.4435)	(19.5116)	
Q (τ=90%)	0.0077***	0.3438***	0.2901***	-0.2376	-0.0065	0.5395***	0.4262
	(15.9476)	(7.5195)	(25.4732)	(-0.2976)	(-0.0377)	(16.0730)	

Romania	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0052***	0.4533***	0.4662***	0.0424	0.1644	0.1591***	0.3034
	(23.7921)	(21.8277)	(13.2726)	(0.2203)	(0.1880)	(14.2100)	
Q (τ=25%)	0.0056***	0.4133***	0.3941***	0.5114	2.0434***	0.2717***	0.3225
	(17.2886)	(14.2012)	(13.6779)	(0.7653)	(3.4884)	(13.6240)	
Q (τ=50%)	0.0065***	0.3923***	0.3733***	0.7058	2.1301***	0.3953***	0.3531
	(9.4886)	(13.5524)	(16.1832)	(1.1615)	(8.4028)	(9.0765)	
Q (τ=75%)	0.0062***	0.3493***	0.3771***	0.9686***	2.0489***	0.6263***	0.3920
	(8.0442)	(10.1363)	(11.6903)	(2.7155)	(8.6844)	(12.7449)	
Q (τ=90%)	0.0067***	0.2828***	0.4425***	1.6653	0.9809**	0.8632***	0.4417
	(12.0054)	(3.1426)	(7.4884)	(0.9056)	(2.2183)	(77.6219)	

Slovenia	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0039***	0.6781***	0.7118***	-0.3472	-0.3180	0.0612***	0.3190
	(24.7773)	(34.4665)	(24.9645)	(-1.2504)	(-0.3713)	(6.4740)	
Q (τ=25%)	0.0048***	0.6700***	0.6717***	-0.6825**	0.5736	0.1112***	0.3160
	(28.0346)	(33.6415)	(24.3569)	(-2.4225)	(0.7068)	(8.8308)	
Q (τ=50%)	0.0062***	0.6508***	0.6439***	-1.1223***	0.8378	0.1881***	0.3106
	(16.8960)	(23.3769)	(11.5493)	(-2.8860)	(0.3687)	(6.4428)	
Q (τ=75%)	0.0079***	0.5998***	0.5741***	-0.6077	1.8627	0.3245***	0.2814
	(11.5925)	(16.1970)	(11.2389)	(-1.3039)	(1.5789)	(6.1669)	
Q (τ=90%)	0.0093***	0.6596	0.6217***	-1.5242	-0.7499	0.5685***	0.2470
	(7.7033)	(1.2766)	(4.5700)	(-0.0635)	(-0.2991)	(6.5605)	

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*

Appendix E. Estimates of herding behavior in CEE countries under high and low trading volume

$$Q_\tau(\tau|V_t)=\beta_{0,\tau}+\beta_{1,\tau}\cdot D^{tv}\cdot|R_{M,t}|+\beta_{2,\tau}\cdot(1\text{-}D^{tv})\cdot|R_{M,t}|+\beta_{3,\tau}\cdot D^{tv}\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{4,\tau}\cdot(1\text{-}D^{tv})\cdot\left(R_{M,t}\text{-}\overline{R_M}\right)^2+\beta_{5,\tau}\cdot CSAD_{t-1}+\varepsilon_{t,\tau}$$

Bulgaria	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0043***	0.6831***	0.7070***	-2.1974*	-4.1917	0.1191***	0.2543
	(11.7656)	(11.5768)	(6.7776)	(-1.9221)	(-1.1854)	(7.8344)	
Q (τ=25%)	0.0052***	0.6555***	0.6518***	-1.2079***	-2.3162**	0.2267***	0.2847
	(13.8517)	(19.4681)	(16.8022)	(-4.4297)	(-2.5172)	(8.9222)	
Q (τ=50%)	0.0064***	0.6197***	0.6677***	-1.3255	-2.0995***	0.3462***	0.3210
	(16.9915)	(7.5730)	(19.8442)	(-0.4947)	(-3.6406)	(15.1466)	
Q (τ=75%)	0.0089***	0.6248***	0.6473***	-1.1504	-1.8740***	0.4413***	0.3516
	(16.6836)	(10.5149)	(16.9239)	(-1.0941)	(-3.6636)	(14.2322)	
Q (τ=90%)	0.0123***	0.7187***	0.7361***	-1.7099	-2.0763	0.4735***	0.3631
	(19.7707)	(5.5854)	(4.3308)	(-0.6996)	(-0.4038)	(16.5930)	

Croatia	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0039***	0.6779***	0.6681***	-1.0372	-0.3084	0.0728***	0.3363

	(17.5501)	(12.1347)	(18.9110)	(-0.7014)	(-0.4539)	(5.7659)	
Q (τ=25%)	0.0049***	0.6565***	0.6182***	-0.7070	0.4649	0.1466***	0.3682
	(20.3518)	(13.2579)	(18.0411)	(-0.6654)	(0.5563)	(10.6451)	
Q (τ=50%)	0.0059***	0.6734***	0.6242***	-0.9553***	0.0808	0.2279***	0.4048
	(21.4984)	(31.3532)	(21.1901)	(-6.0819)	(0.1214)	(11.0610)	
Q (τ=75%)	0.0071***	0.7012***	0.5970***	0.0132	0.8369	0.3465***	0.4351
	(14.1044)	(3.9439)	(5.1477)	(0.0024)	(0.1939)	(15.2604)	
Q (τ=90%)	0.0099***	0.7952***	0.6677***	-0.7305**	0.7745	0.3785***	0.4546
	(19.0954)	(14.7686)	(11.5513)	(-2.2837)	(1.3065)	(13.3488)	
Czech Rep	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**β_5** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0023***	0.6318***	0.5723***	-0.6456***	0.8002	0.0287***	0.2212
	(12.8197)	(34.1237)	(21.7612)	(-5.9400)	(0.9287)	(3.2566)	
Q (τ=25%)	0.0031***	0.6427***	0.5624***	-0.4746	1.6522	0.0817***	0.2131
	(16.1223)	(23.6967)	(17.2478)	(-0.9360)	(1.6154)	(9.0248)	
Q (τ=50%)	0.0038***	0.6074***	0.5451***	0.2729	1.4158	0.2508***	0.2122
	(7.9254)	(20.1897)	(14.5754)	(0.4870)	(1.2259)	(6.3185)	
Q (τ=75%)	0.0040***	0.5721***	0.5456***	0.1578	1.4576	0.5977***	0.2262
	(3.4789)	(10.8682)	(7.5180)	(0.2483)	(0.8465)	(7.0228)	
Q (τ=90%)	0.0065**	0.6728***	0.8970***	-1.4193	-7.1201	0.9820***	0.2443
	(2.2207)	(3.6081)	(3.1466)	(-0.8522)	(-1.4635)	(4.8816)	
Estonia	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**β_5** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0035***	0.4490***	0.3324***	-4.4304**	1.5720	0.2023***	0.1685
	(11.6823)	(5.6322)	(8.3130)	(-1.9734)	(2.6628)	(10.9244)	
Q (τ=25%)	0.0042***	0.4329***	0.3555***	-3.9505***	1.8212**	0.3120***	0.2071
	(15.7553)	(9.1445)	(9.6832)	(-3.3796)	(2.1911)	(16.4146)	
Q (τ=50%)	0.0049***	0.3961***	0.3442***	-3.3958	1.8849	0.4861***	0.2474
	(13.6238)	(4.5049)	(4.4310)	(-1.0565)	(0.5290)	(24.5045)	
Q (τ=75%)	0.0066***	0.3955***	0.3052***	-1.3775***	3.1962***	0.6459***	0.2842
	(13.4124)	(6.6014)	(5.5965)	(-2.8888)	(3.7646)	(23.2801)	
Q (τ=90%)	0.0094***	0.4033***	0.3295**	-1.9007***	4.8771	0.7823***	0.3032
	(13.8249)	(5.4348)	(2.0581)	(-3.1421)	(0.9401)	(36.9800)	
Hungary	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**β_5** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0062***	0.5493***	0.4822***	-0.8215***	1.0396***	0.0926***	0.2286
	(16.4243)	(26.5413)	(16.9620)	(-4.3286)	(3.7546)	(5.8826)	
Q (τ=25%)	0.0085***	0.5410***	0.4539***	-0.6849*	1.9842	0.1105***	0.2187
	(21.5543)	(19.2816)	(7.3867)	(-1.7837)	(1.0124)	(8.7062)	
Q (τ=50%)	0.0110***	0.5063***	0.4163***	-0.2293	2.5350*	0.1817***	0.2127
	(21.7741)	(18.7560)	(8.1947)	(-0.8439)	(1.7469)	(9.4047)	
Q (τ=75%)	0.0150***	0.4869***	0.3438***	0.8839	4.8163***	0.2409***	0.2002
	(19.6596)	(5.7370)	(6.1405)	(0.4320)	(4.3658)	(8.2519)	
Q (τ=90%)	0.0202***	0.5204***	0.2109	-0.0450	8.2909*	0.3405***	0.1570
	(7.6066)	(5.2858)	(1.1704)	(-0.0323)	(1.8362)	(2.9556)	
Latvia	**β_0** ***(t-stat)***	**β_1** ***(t-stat)***	**β_2** ***(t-stat)***	**β_3** ***(t-stat)***	**β_4** ***(t-stat)***	**β_5** ***(t-stat)***	**Adj. R^2**
Q (τ=10%)	0.0027***	0.9287***	0.8922***	-4.1591***	-3.6718	0.0550***	0.2774
	(7.3083)	(20.4304)	(12.5502)	(-4.5363)	(-1.5099)	(4.9060)	
Q (τ=25%)	0.0049***	0.9685***	0.8312***	-5.0043***	-3.0231***	0.0830***	0.2559
	(16.5814)	(19.0951)	(28.5042)	(-3.7300)	(-8.6866)	(6.1599)	
Q (τ=50%)	0.0085***	0.8779***	0.7607***	-2.0501***	-1.1776*	0.1267***	0.2298
	(23.2693)	(18.7369)	(19.2001)	(-3.1583)	(-1.7438)	(8.9140)	

Q (τ=75%)	0.0144***	0.8429***	0.7991***	-1.1024	-2.9487***	0.1781***	0.1991
	(18.6139)	(9.5246)	(13.0953)	(-0.8537)	(-3.3267)	(4.7785)	
Q (τ=90%)	0.0213***	0.8261***	0.8180***	-2.5689**	-4.3029*	0.2607***	0.1722
	(17.7671)	(8.9147)	(6.4295)	(-2.0105)	(-1.7312)	(5.8953)	
Lithuania	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0039***	0.5082***	0.4809***	-1.0006**	-0.3916	0.1851***	0.2284
	(10.0317)	(14.2671)	(12.2908)	(-2.2047)	(-0.5270)	(5.5891)	
Q (τ=25%)	0.0044***	0.5262***	0.4784***	-1.2389*	-1.0666	0.3014***	0.2672
	(10.1448)	(15.9733)	(6.6012)	(-1.7735)	(-0.3017)	10.0966	
Q (τ=50%)	0.0055***	0.5115***	0.4262***	-0.9485	1.5175***	0.3979***	0.3047
	(13.9235)	(12.9088)	(12.0030)	(-1.0478)	(3.8886)	(14.0975)	
Q (τ=75%)	0.0068***	0.5316***	0.4711***	0.2794	1.1209	0.5304***	0.3349
	(9.7885)	(9.9664)	(4.6533)	(0.5521)	(0.3362)	(11.3230)	
Q (τ=90%)	0.0086***	0.4801***	0.4771***	1.1794***	-0.0857	0.6777***	0.3501
	(11.1831)	(9.5744)	(10.5828)	(2.9747)	(-0.1716)	(14.3000)	
Poland	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0046***	0.2638***	0.2392***	-0.1838	-0.4333	0.2766***	0.2770
	(16.6930)	(13.5869)	(9.5721)	(-0.6678)	(-1.0712)	(15.2880)	
Q (τ=25%)	0.0049***	0.2974***	0.2535***	-0.3441	-0.2366	0.3348***	0.3100
	(20.4509)	(23.5057)	(18.4739)	(-0.8144)	(-1.0353)	(20.7504)	
Q (τ=50%)	0.0059***	0.3068***	0.2645***	-0.0296	-0.2117	0.3812***	0.3527
	(21.6359)	(27.5514)	(19.3358)	(-0.1440)	(-1.4050)	(18.7280)	
Q (τ=75%)	0.0068***	0.3094***	0.2589***	0.1502	-0.1177	0.4648***	0.3925
	(21.0912)	(23.1559)	(22.5971)	(0.8849)	(-0.4488)	(21.0578)	
Q (τ=90%)	0.0079***	0.3380***	0.2608***	-0.1876	0.0882	0.5257***	0.4271
	(14.8780)	(10.4379)	(16.1322)	(-0.7097)	(0.3390)	(13.0487)	
Romania	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0053***	0.4724***	0.4510***	-0.1432	-0.1875	0.1592***	03024
	(24.9064)	(20.8611)	(12.4757)	(-0.6433)	(-0.1989)	(14.1688)	
Q (τ=25%)	0.0056***	0.4674***	0.3849***	-0.4302*	1.3298***	0.2716***	0.3234
	(17.6601)	(19.7695)	(16.9926)	(-1.7117)	(4.7955)	(13.7772)	
Q (τ=50%)	0.0067***	0.3902***	0.3491***	1.1226**	2.3315***	0.3882***	0.3513
	(10.6876)	(13.7576)	(14.0294)	(2.2489)	(9.8104)	(9.5564)	
Q (τ=75%)	0.0063***	0.3667***	0.3422***	1.6438	1.9158***	0.6228***	0.3885
	(7.2923)	(3.9643)	(10.3760)	(0.7139)	(7.0124)	(11.3168)	
Q (τ=90%)	0.0071***	0.3610***	0.2107**	1.5618***	4.3858**	0.8666***	0.4375
	(11.4229)	(5.6015)	(2.1270)	(3.2282)	(2.0146)	(75.6110)	
Slovenia	**β_0** *(t-stat)*	**β_1** *(t-stat)*	**β_2** *(t-stat)*	**β_3** *(t-stat)*	**β_4** *(t-stat)*	**β_5** *(t-stat)*	**Adj. R^2**
Q (τ=10%)	0.0039***	0.6997***	0.6775***	-0.6525**	0.2156	0.0598***	0.3188
	(26.7765)	(37.5523)	(26.4588)	(-2.2509)	(0.3888)	(6.8667)	
Q (τ=25%)	0.0048***	0.6869***	0.6461***	-0.8990***	1.0895	0.1094***	0.3180
	(27.8498)	(35.8380)	(23.2175)	(-3.1746)	(1.2155)	(7.8843)	
Q (τ=50%)	0.0062***	0.6549***	0.6159***	-1.2303***	1.9869	0.1922***	0.3129
	(16.7997)	(22.2012)	(12.0514)	(-2.9133)	(0.9118)	(6.4827)	
Q (τ=75%)	0.0079***	0.5841***	0.5373***	-0.4412	4.8837	0.3282***	0.2845
	(10.4093)	(14.3460)	(2.8994)	(-0.8659)	(0.4229)	(6.1695)	
Q (τ=90%)	0.0093***	0.5837**	0.5269***	-0.6620	5.2706*	0.5917***	0.2504
	(8.7391)	(2.0916)	(4.7332)	(-0.0720)	(1.8082)	(8.1375)	

**** statistical significance at the 1% level; ** statistical significance at the 5% level; * statistical significance at the 10% level.*