A Cross-Country Analysis of Herd Behavior in Europe

Asma Mobarek,[a1] Sabur Mollah,[a] and Kevin Keasey[b]

[a] Stockholm Business School, Sweden
[b] Leeds University Business School, University of Leeds, UK

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Abstract

This paper examines country specific herding behavior in European liquid constituent indices for the period of 2001-2012. While we report insignificant results for the whole period, we document significant herding behavior during crises and asymmetric market conditions. Particularly, herding effect is pronounced in most continental countries during the global financial crisis and Nordic countries during the Eurozone crisis. However, PIIGS countries are the victims in both crises. Furthermore, we find evidence that the cross sectional dispersions of returns can be partly explained by the cross sectional dispersions of the other markets, with Germany having the greatest influence on the regional cross-country herding effect. Apprehensions heighten among the regulators, policy makers, and investors in the European markets for the herding behavior during volatile market conditions.

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[1] Corresponding author: Asma Mobarek, Associate Professor of Finance, Stockholm Business School, Stockholm University, SE-106 91, Stockholm, Sweden. Email: asma.mobarek@sbs.su.se

1. **Introduction**

In the aftermath of several widespread crises, herd behavior in financial markets has emerged as a relatively popular topic in the financial literature. Scholars stress that herd behavior by market participants aggravates market volatility and leads to market instability (see Shiller, 1990; Eichengreen et al., 1998; Folkerts-Landau and Garber, 1999; Furman and Stiglitz, 1998; Morris and Shin, 1999; and Persaud, 2000) [2]. Academics who map herding effects by empirically testing theoretical models can be classified into two main groups: first, researchers testing with aggregate market data analysis (e.g., Christie and Huang, 1995; Chang et al., 2000; Hwang and Salmon, 2004; and Wang, 2008) and, second, researchers using data analysis for portfolio investors (e.g., Lakonishok et al., 1992; Wermers, 1999; Trueman, 1994; Welch, 2000; and Walter and Weber, 2006). Our study is based on the former group and includes major developed European markets[3].

However, research on herd behavior is widely applied to emerging markets, only a few studies focus on developed markets (and provides controversial findings)[4]. In addition, the literature on asymmetric market conditions and their impact on herding in developed markets are not well-researched compared to emerging markets (e.g., Chiang and Zheng (2010). Our study focus on the comparative analysis of herding in

[2] Herding behavior is more pronounced during periods of turmoil than during periods of stability. Christie and Huang (1995) stress in their paper that a "herd" is more likely to form under conditions of market stress, when individual investors tend to suppress their own beliefs (cascades) and follow the market consensus.

[3] We consider only selected developed European countries including the sovereign affected PIIGS (Portugal, Ireland, Italy, Greece and Spain) countries and we do not, therefore, include emerging Europe in the study.

[4] Christie and Haung (1995) and Baur (2006) find no evidence of herding in developed markets. In contrast, Chiang and Zheng (2010), and Economou et al. (2011) find evidence of a significant herding effect in the developed markets.

the European stock markets, which is closely related to the study done by Economou et al., (2011) and Chiang and Zheng, (2010) but we include Ireland and Nordic countries in our sample and consider most liquid constituent indices in our data set.

Our study contributes to the field of study in three ways. First, we focus on the comparative analysis of herding in the European stock markets considering the liquid constituent indices in each country – this helps us to focus more on crisis aspects. We also argue that the sample selection processes, especially the selection of indices by Chiang and Zheng (2010) and Economou et al. (2011), are critical because of their limited ability to separate the impacts of crises and other constraints. Economou et al. (2011) consider all listed stocks (including active and dead stocks) of four PIGS market, while Cheng and Zheng (2010) consider all firms industry price indices of 18 advanced and emerging markets. We consider the actively traded individual firm level data and actively traded stock (liquid constituent) indices of 11 developed European stock markets. As we know that herding might be due to a series of market frictions, such as liquidity black holes, arbitrage opportunity as well as investors' behavioral biases lead to market conditions that can be ex-post characterized as irrational (Brunnermeier, 2001; Shlefier, 2000). Our sample, which differs from previous studies [Chang and Zheng, 2010; Economou et al., 2011], can help test the separate effect of crisis and market sentiment rather than herding due to information asymmetry and market microstructures. However, deterioration of investor's sentiment such as panic (Philippas et al., 2013) during crises might contribute significantly to the emergence of herding behavior. In recent years there has been significant debate about contagion and herding even in developed open economies (Chari and Kehoe, 2004; Corsetti et al., 2005; Chiang and Zheng, 2010; and Park and Sabourian, 2011). The updated literature on market efficiency has shifted from the efficient market hypothesis (EMH) that states that the level of market efficiency remains unchanged in a complete sense during the estimation period to advocating the possibility of time-varying efficiency or inefficiency[5]. Although it is important to distinguish between intentional herding and spurious herding in theory, it is difficult to separate them in practice. The reason for this difficulty is that there are many factors that influence investment decisions (Bikhchandani and Sharma, 2001, p.281). Bikhchandani and Sharma (2001) suggest that a group may privilege herding behavior if it is sufficiently homogeneous, given that every member is confronted with similar decisions and they can observe each other's transactions. Moreover, liquidity constraints, asymmetric information, limits to arbitrage (Shleifer, 2000; Brunnermier, 2001; and Hirshleifer and Teoh, 2003) pose a constant threat to financial stability exposing market participants and financial institutions to unhedgeable systematic risk (Economou et al., 2011). Furthermore, it is frequently argued that financial crises are a result of widespread herding among market participants that can be explained better by behavioral finance theory, that demands consideration of irrationality (such as panic) with the fundamentals. Our sample is free from non-synchronous stocks, that relief us to disregard the bias of information asymmetry and lack of arbitrage opportunity. We argue that our sample is able to capture investor's sentiment during crises since our sample is free from

[5] The latter approach has recently been gaining attention (e.g., Lo, 2004 and 2005; Yen and Lee (2008); Ito and Sugiyama, 2009; and Lim and Brooks, 2011). However, Lo (2004 and 2005) suggest that the new paradigm of an adaptive markets hypothesis (AMH), according to which the EMH may persist together with behavioral finance in a logically consistent way.

other causes of herding such as herding due to liquidity constraints, asymmetric information, limits to arbitrage.

Second, we include continental Europe, the Nordic countries and the PIIGS altogether in our sample and this helps us focus on the comparative analysis of herding in the European stock markets. Chiang and Zheng (2010) analyzed herd behavior among globally selected markets with little attention to Europe, and Economou et al. (2011) analyzed herd behavior with the selected European (the PIGS) countries only. We further assume that different groups of countries in Europe might not herd in the same way in Europe across two different crises periods. More specifically, our paper contributes to the comparative analysis of herd behavior among developed European countries[6], where the empirical evidence is limited[7]. Europe has suffered from austerity following the Eurozone sovereign crisis in the PIIGS (Portugal, Italy, Ireland, Greece, and Spain) countries and a key aspect of the monetary integration in Europe is the need for the European Union to take responsibility for all countries regardless of economic status/performance. The context is further complicated by the Nordic countries being different from the continental European countries (which are similar in nature in terms of legal regimes, corporate governance, ownership structures and macroeconomic environments). By critically analyzing the study of Holmes et al. (2013) for Portugal and Economou et al. (2011) for the PIGS (Portugal, Italy, Greece and Spain), we assume that the herd behavior is common in Southern Europe. However, the cross-country correlation of

[6] Continental European countries (e.g., France and Germany), the sovereign infected countries (e.g., The PIIGS- Portugal, Ireland, Italy, Greece and Spain), and Nordic countries (e.g., Sweden, Denmark, Finland and Norway).

[7] Economou et al. (2011) consider only four countries (the PIGS- Portugal, Italy, Greece and Spain) and do not investigate the impact of the Eurozone crisis.

dispersion of return among the European countries during two consecutives crises is an interesting addition of this paper.

Finally, our study stresses on the cross-country herding effect during the Eurozone crisis (EZC), whereas the sample period ends in 2008 for Chiang and Zheng (2010) and in 2009 for Economou et al. (2011). We argue that the PIIGS countries, which were severely affected during the global financial crisis (GFC), might contaminate the adverse economic and financial shocks (e.g., Karolyi and Stulz, 1996; Bae et al., 2003; and Chandar et al., 2009) from local to foreign markets via different economic channels during the recent crises. This might be also due to fact that investors are more likely to follow the herd and suppress their private information during financial turmoil. Our paper contributes to the extant literature by analyzing herd behavior among European countries for a period that includes the GFC and EZC.

The major findings of our study suggest that, in general, herding effects are almost insignificant in Europe under normal conditions. However, we find significant herding in asymmetric market conditions and crises periods. The empirical evidence suggests a significant herding effect during the GFC in continental and PIIGS markets as compared to Nordic markets; with the Nordic markets being more affected during the EZC. We also find that the German market has the greatest influence on the regional cross-country herding effect.

The remainder of the paper is organized as follows. Section 2 describes the hypotheses and reviews the related literature, while Section 3 presents the methodology and data. Section 4 reports the empirical results and Section 5 offers conclusions.

2. Hypotheses Development and Related Literature

Herding in financial markets has been typically described as the tendency of market participants to mimic the action of others. This collective investment behavior is said to be strongest during extreme market conditions, when market volatility and information flows impede the reliability and accuracy of investment predictions. As a result, investors are more likely to disregard their private information and search for the market-wide consensus, which is seen as a cost-efficient solution compared to the cost of gathering reliable information during a volatile period (Christie and Huang, 1995). In addition, it might be due to the fact that following the herd generates at least the average market return (Gleason et al., 2004). In brief, the underlying causes of this behavior are portrayed as being either 'rational' (i.e., the investor follows the majority believing that they possess superior information or analytical skills) or 'irrational' (i.e., the investor acts without any rational consideration) (see Hirshleifer and Teoh, 2003).

The empirical literature utilizing the market-wide approach focuses on the cross-sectional correlations of the entire stock market and this is the primary focus of our study. A pioneering study in this area is that of Christie and Huang (1995), who, utilizing the cross-sectional standard deviation of returns (CSSD) as a measure of the average proximity of individual asset returns to the realized market average, introduced an econometric method to detect herd behavior. Chang et al. (2000) extend the model proposed by Christie and Huang (1995) by using a non-linear regression specification. Their results show no evidence of herding on the part of market participants in the US and Hong Kong, but offer partial evidence of herding in Japan. However, during periods of extreme price movements, equity return dispersions for developed countries tend to increase rather than decrease, providing strong evidence against any market-wide herding, which is consistent with Christie and Huang (1995). However, for South Korea and Taiwan, the two emerging markets in their sample, they document significant evidence of herding. Further, Gleason et al. (2004) use intraday data to examine whether traders herd during periods of extreme market movements using sector Exchange Traded Funds (ETFs). Implementing the methods of Christie and Huang (1995) and Chang et al. (2000) and analyzing up and down markets, they report no evidence of herding. They also report a weak presence of an asymmetric reaction to news during periods of stress in up markets and down markets. They also find that investors respond to bad news quickly with a higher incentive to mimic the market, which indicates that market participants may fear the potential loss from a down market during the period of stress more than they might enjoy the potential gains from an up market during the period of stress. Similarly, using high frequency data on the Australian market, Henker et al. (2006) find no evidence of herding towards market portfolios. In addition, even in extreme market conditions, participants seem to have a high level of firm-specific information. The use of daily data in this type of study was first motivated by Caporale et al. (2008) and also supported by Tan et al. (2008).

Economou et al. (2011) examine whether the cross-sectional dispersion of returns in one market is affected by the cross-sectional dispersion in the other three markets. They find evidence of a strong co-movement between the cross-sectional dispersions of the four stock markets, indicating that the portfolio diversification benefits are rather small considering these markets in the presence of herding. Their results confirm the presence of market-wide herding in the Portugal Italian and Greek stock markets, as already shown by Caparrelli et al. (2004) and Caporale et al. (2008). In this context, the current study addresses the issues around cross-country herd behavior, especially investigating the Eurozone spillover of herding across European markets.

We assume that different markets in Europe are not at the same level in terms of informational dissemination and transparency with heterogeneous firms or industry structures. We have conducted a hierarchical cluster analysis applying Dandrograms (see Figure 1) using both market returns (R_m) and CSAD data for eleven markets in our sample. Dandrogram reports show the ranking of sample countries in terms of median linkage variances. We divide our sample into three country groups based on these diagrams. The country groups are: the PIIGS countries (Portugal, Italy, Ireland, Greece and Spain), the Nordic countries (Finland, Norway, Denmark and Sweden), and continental countries (France and Germany). We find that continental countries are ranked 1-2, the PIIGS countries are ranked 3-7, and the Nordic countries are ranked 8-11. We assume that herding behavior within each panel group might be similar due to similar characteristics in terms of market microstructure and information dissemination processes.

Figure 1 about here

We further expect a heterogeneous pattern of herd behavior among the three groups according to the wakeup call hypothesis. The wakeup call hypothesis (Goldstein, 1998) argues that market participants wake up after a crisis and considers that similar market fundamentals between markets (i.e., the same level of market transparency and industrial structure) leads to similar market behaviors. In addition, countries with weak macroeconomic fundamentals are vulnerable to the propagation of financial crises. In the aftermath of the global financial crisis, some studies (e.g., Bekaert et al., 2011) have found contagion from countries with similar characteristics as a complement to the wakeup call hypothesis. Thus, our first hypothesis is as follows:

H_1: There is a herding effect among the European stock markets for the entire sample period.

We expect, however, that country-wise herding affects are not similar among the continental, Nordic and PIIGS countries for the entire sample period. Another aspect of studying herd behavior focuses on the scattering of the cross-sectional correlation of stock returns in response to disproportionately changing market conditions. While investigating the information asymmetry in stock markets, researchers (Tan et al., 2008; Chiang and Zheng 2010; and Economou et al., 2011) have predicted that investors in financial markets are more likely to exhibit herd behavior. For countries with different regimes of boom, bust and market asymmetry within a long sample period, herd behavior may arise differently across different country groups because of differences in geographic and cultural heritage and information asymmetry. This leads us to test the asymmetry of the market up and down, with positive and negative returns signaling good news and bad news, high and low volume, volatility etc. Thus, our second hypothesis is as follows:

H_2: Herd behavior responds differently to asymmetry in market conditions across different country groups in Europe.

This hypothesis investigates the herd behavior around market asymmetry, but we divide **H_2** into three sub-hypotheses to capture asymmetric market conditions of rising and falling markets (**H_{2a}**), higher and lower volume (**H_{2b}**) and higher and lower volatility (**H_{2c}**), respectively.

In addition, herd behavior is a key phenomenon to examine and document from both regulatory and investment perspectives. As noted earlier, it is well known that similar sub-groups of European countries may have similar institutional, cultural, economic and financial linkages, which differ among different groups of markets. This observation motivates us to test our third hypothesis as follows:

H_3: There is cross-country herd behavior between different country groups.

Finally, the herd behavior in foreign markets during the global crisis (e.g., Economou et al., 2011) raises a research issue for the European countries because the Eurozone crisis devastated the European countries. Country-wise herding behavior might be influenced by foreign markets in addition to domestic markets due to flights to quality (see Allen and Gale, 2000), portfolio rebalancing (Brunnermeier and Pedersen, 2005; and Brunnermeier and Pedersen, 2009), liquidity channels, risk premium channels under the contagion literature (Longstaff, 2010), and cross listing effects, (Chandar et al., 2009). Further, in periods of market turbulence, herd behavior may pose a threat to financial stability because initial negative shocks may be exacerbated and amplified via pro-cyclical market mechanisms, which leads us to our final hypothesis as follows:

H_4: Country-wise herd behavior changes during the GFC and the EZC.

3. Methodology and Data

3.1 Basis of Estimation Procedure:

We use daily stock returns of constituent stocks for a panel of European Stock markets to measure return dispersion via the cross sectional absolute deviations. Chang et al. (2000) argue that a linear and increasing relation between dispersion and market returns, as suggested by standard asset pricing models, does not hold in times of large average price movements. Thus, herd behavior around the market consensus during periods of large price movements is sufficient for converting the linear relation into a non-linear one. To capture this effect, we estimate the cross-sectional absolute deviation (CSAD) as a measure of return dispersion[8], which was implemented by Chang et al. (2000), as follows:

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

where, $R_{i,t}$ is the observed stock return of asset i at time t and $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t. The non-linear framework for modeling the relationship between individual stock return dispersions and the market average is specified as follows:

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

where, $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t, the squared market return ($R^2_{m,t}$) is used to capture the non-linearity in the relationship, α is the constant, γ_1, and γ_2 are coefficients, and ε_t is the error term at time t. We use the Newey-West (1987) estimator to obtain heteroskedastic and autocorrelation consistent (HAC) co-variances for all the

[8] CSAD is free from the outlier problem (Economou et al., 2011) as compared to CSSD that is measured by Christie and Huang (1995).

ordinary least square (OLS) regressions. This model is implemented to test **H_1** and Eq. (3), which is estimated for each country (*i*). In the absence of herding effects, Eq. (3) assumes $\gamma_1 > 0$ and $\gamma_2 = 0$. But herding effects are present if $\gamma_2 < 0$ (negatively significant).

We mainly follow Economou et al. (2011), who apply the Chang et al., (2000) model called CCK later in this paper using the PIGS sample. Further, we also use Chiang and Zheng's (2010) extended model for robustness checking - they applied the model in the developed markets and included the market return along with the absolute and squared market return to reduce the misspecification error.

However, since the relationship between CSAD and market returns may be asymmetric, we further examine whether herd behavior is more pronounced when market returns, trading volumes, and return volatility are high. We follow the approach of Chiang and Zheng (2010), who utilize a dummy variable approach in a single model, which is considered to be more robust than that of Tan et al. (2008).

We test **H_2** separately for returns, volume and volatility using Eq. (3-5). The asymmetric behavior of return dispersion with respect to market returns is estimated as follows:

$$\begin{aligned} CSAD_{i,t} = \alpha + \gamma_1 D^{up}\left|R_{m,t}\right| + \gamma_2(1-D^{up})\left|R_{m,t}\right| + \gamma_3 D^{up}(R_{m,t})^2 \\ + \gamma_4(1-D^{up})(R_{m,t})^2 + \varepsilon_t \end{aligned} \quad (3)$$

where, $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time *t*, the squared market return $(R_{m,t})^2$ is used to capture the non-linearity in the relationship, D^{up} is a dummy variable with a value of 1 for days with positive market returns and a value of 0 for days with negative market returns, α is the constant, γ_1, γ_2, γ_3, γ_4 are coefficients and ε_t is the error term at time t. In the absence of herding effects, Eq. (3) assumes $\gamma_1 > 0$ and $\gamma_2 > 0$. This model is implemented to test **$H_{2(a)}$**. Herding effects are present if $\gamma_3 < 0$ and $\gamma_4 < 0$, with $\gamma_4 < \gamma_3$ if these effects are more pronounced during days with negative market returns.

Furthermore, the asymmetric behavior of return dispersions with respect to trading volume can be estimated as follows:

$$\begin{aligned} CSAD_{i,t} &= \alpha + \gamma_1 D^{Vol-High}\left|R_{m,t}\right| + \gamma_2(1-D^{Vol-High})\left|R_{m,t}\right| \\ &\quad + \gamma_3 D^{Vol-High}(R_{m,t})^2 + \gamma_4(1-D^{Vol-High})(R_{m,t})^2 + \varepsilon_t \end{aligned} \tag{4}$$

where, $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t, the squared market return $(R_{m,t})^2$ is used to capture the non-linearity in the relationship, $D^{Vol\text{-}High}$ is 1 for days with a high trading volume and 0 otherwise, α is the constant, γ_1, γ_2, γ_3, γ_4 are coefficients and ε_t is the error term at time t. The trading volume on day t is regarded as high if it is greater than the previous 30-day moving average and low if it is lower than the previous 30-day moving average. In the absence of herding effects, Eq. (4) assumes $\gamma_1 > 0$ and $\gamma_2 > 0$. This model is used to test **$H_{2(b)}$**. Herding effects are present if $\gamma_3 < 0$ and $\gamma_4 < 0$, with $\gamma_3 < \gamma_4$ if these effects are more pronounced during days with a high trading volume.

The asymmetric behavior of return dispersion with respect to market volatility is estimated as follows:

$$\begin{aligned} CSAD_{i,t} &= \alpha + \gamma_1 D^{\sigma^2-High}\left|R_{m,t}\right| + \gamma_2(1-D^{\sigma^2-High})\left|R_{m,t}\right| \\ &\quad + \gamma_3 D^{\sigma^2-High}(R_{m,t})^2 + \gamma_4(1-D^{\sigma^2-High})(R_{m,t})^2 + \varepsilon_t \end{aligned} \tag{5}$$

where, $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t, the squared market return $(R_{m,t})^2$ is used to capture the non-linearity in the relationship, $D^{\sigma 2\text{-High}}$ is 1 for days with high market volatility and 0 otherwise, α is the constant, γ_1, γ_2, γ_3, γ_4 are coefficients and ε_t is the error term at time

t. Market volatility on day t is regarded as high if it is greater than the previous 30-day moving average and low if it is lower than the previous 30-day moving average. In the absence of herding effects, Eq. (5) assumes $\gamma_1 > 0$ and $\gamma_2 > 0$. This model is applied to test **$H_{2(c)}$**. Herding effects are present if $\gamma_3 < 0$ and $\gamma_4 < 0$, with $\gamma_3 < \gamma_4$ if these effects are more pronounced during days with high market volatility.

In addition, markets that exhibit a certain degree of co-movement with correlated cross-sectional return dispersions are also likely to show synchronized herding patterns to test **H_3**. Following Economou et al. (2011), Eq. (2) is modified by adding explanatory variables for the cross-sectional dispersions of the N markets included in our sample as follows:

$$CSAD_{i,t} = \alpha + \gamma_1 |R_{m,t}| + \gamma_2 (R_{m,t})^2 + \sum_{j=1}^{n} \delta_j CSAD_{j,t} + \varepsilon_t \qquad (6)$$

where, $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t, the squared market return $(R_{m,t})^2$ is used to capture the non-linearity in the relationship, α is the constant, γ_1, γ_2 are coefficients, δ_j is the CSAD coefficient for other countries (j), and ε_t is the error term at time t. The cross-country herding effects are present if $\delta_j<0$.

Finally, this paper also examines whether herding effects are more pronounced during periods of financial crises. This model tests **H_4**. For the empirical testing, a dummy variable, D^{CRISIS}, that is 1 for days of crisis and 0 otherwise is added to the benchmark Eq. (3) as follows:

$$CSAD_{i,t=}\alpha + \gamma_1 |R_{m,t}| + \gamma_2 (R_{m,t})^2 + \gamma_3 D^{CRISIS} (R_{m,t})^2 + \varepsilon_t \qquad (7)$$

where, $R_{m,t}$ is the cross-sectional average of the N returns in the aggregate market portfolio at time t, the squared market return $(R_{m,t})^2$ is used to capture the non-linearity in the relationship, α is the constant, γ_1, γ_2, γ_3 are coefficients, and ε_t is the error term at time t. We test Eq. (7) using both GFC and EZC dummies separately. If herding effects are more pronounced during the crises periods and differ among country groups, the crises coefficients 'γ_3' in both crises should be greater than 0.

3.2 Data

The data set is constructed from the most liquid constituent shares of the main indices of Germany (DAX-30), France (CAC-40), Portugal (PSI-20), Italy (FTSE-MIB), Ireland (ISEQ), Greece (ATHEX Composite), Spain (IBEX-35), Sweden (OMXS-30), Norway (OSLO OBX), Denmark (OMXC-20) and Finland (OMXH-25). These are the market capitalization weighted index traded in the continuous market. The sample period stretches from 01-01-2001 to 16-02-2012. Daily returns for the constituent firms are calculated as follows: $R_{it} = \ln(\frac{P_t}{P_{t-1}}) \times 100$. The constructed market portfolio return $R_{m,t}$, which is needed to calculate the CSAD measure in Eq. (1), is equally weighted. The Thomson Data stream was used to retrieve stock prices and Bloomberg for trading volumes. The GFC and EZC periods are identified as 09 August 2007-31st December 2009 and 02 May 2010-16 February 2012[9]. There are more than 2900 daily observations for each country from 2001 to 2012.

Table 1 about here

[9] Since BNP Paribas ceased all its banking operations on the 9th August, 2007, we consider this date as the beginning of GFC. However, by following Ahmed et al. (2012), we set 31st December 2009 as the end date for the GFC. Further, Greece gets its first bailout money on the 2nd May, 2010, which is considered as the beginning of Eurozone crisis. However, our data point ends on the 16th February, 2012; therefore, we consider the EZC as 02 May 2010-16 February 2012.

Table 1 reports the descriptive statistics of the CSAD measure and the market return for each of the eleven markets. As we noted before that we consider only the active stocks in our sample, which include liquid firms and the number of firms listed in the selected indices for the eleven markets ranges from 20 to 45 firms. The statistics presented in table 1 show that the average CSAD is higher in Ireland, Greece and Norway as compared to other countries. Similarly, the standard deviations of CSAD for these countries are higher than for the others. Chiang and Zheng (2010) stress, in this context, that a higher standard deviation in similar markets may suggest that the markets had unusual cross-sectional variations due to unexpected news or shocks; otherwise, the rest of the countries' average CSADs are close to each other. As expected, we observe that continental Europe (France and Germany) and the Nordic countries (Denmark, Finland, and Sweden) have similar means and standard deviations, except Norway. This finding leads us to test whether countries of the same group have different types of herd behavior. Among the PIIGS countries, Greece and Ireland have higher average CSAD values compared to Italy, Portugal and Spain, and this gives the impression that the former countries might have herding given asymmetric market conditions.

4. Empirical Results

This section presents the main results concerning hypotheses '$\mathbf{H_1}$-$\mathbf{H_4}$'.

4.1 Herding Behavior in Europe for the Overall Sample

The first set of results, which we present in Table 2, corresponds to the base model Eq. (2). The results are estimated for each market for the whole sample period (January 2001 to February 2012).

Table 2 about here

Initially, from Table 2 we observe that in each country, the results show significantly positive coefficients on the linear term $|R_{m,t}|$ for all countries, which confirms that the cross-sectional absolute dispersion (CSAD) of returns increases with the magnitude of the market return. However, the squared market returns in the models allow us to test whether the cross-sectional dispersion increases at a decreasing rate during extreme market movements. When analyzing coefficient γ_2 for the squared market return, the results indicate that the coefficient is significantly negative for Finland at the 10% level accepting the null hypothesis of no difference in herd behavior among the country groups during the entire sample period (**H1**). We find such evidence but it is only significant (weakly) in the case of Finland from the Nordic group. We do not observe any herding effect for the continental and the PIIGS European countries during the entire sample period and hence, accept the alternative hypothesis that similar country groups have similar herding behavior. At the same time, however, for the Nordic group we find different herding behavior within a similar country group. The reason that we did not find any negatively significant herding coefficient for the rest of the countries might be due to the sample we have taken for the most liquid indices rather than all sector price indices. However, our study is able to capture the herding issues related to liquidity constraints and focus more on crises and other stress related aspects rigorously. Nevertheless, the extended model by Chiang and Zhang (2010), which were originally developed by CCK, is presented in model 2, offer consistent results.

4.2 Herding Behavior under Different Market Conditions

We use three sub-hypotheses (**H_{2a}, H_{2b}, and H_{2c}**) to test **H_2**. This hypothesis investigates the herd behavior around market asymmetry. The next set of results that we report in Tables 3, 4 and 5 investigates whether there is any significant herding during asymmetric market conditions of rising and falling markets (Table 3), during higher and lower volume (Table 4) and higher and lower volatility (Table 5), respectively. We also run the Wald test of coefficient diagnostics testing to check whether the coefficients are equal under asymmetric conditions in each case. The rejection of the Wald test confirms the described asymmetry.

Table 3 about here

We find (Table 3) that the herding coefficient dummy for the negative returns $(1-D[up])R_{m,t}^2$ becomes significant for the markets in Portugal, Greece, Sweden and Germany during negative returns suggesting that herding behavior is much more likely to be encountered on days of negative returns. Moreover, the Wald test,[10] which also suggests that the null of no difference in herding coefficients between positive and negative returns is rejected. It is interesting to see that the benchmark model for the German market, when we considered the market asymmetry of the down market, is reversed suggesting a strong herding effect relating to market conditions. This result supports the conclusion of McQueen et al. (1996) that in down markets increased betas across many stocks would lead to increased pairwise stock correlation and would result in CSAD decreasing. Moreover, this might be explained

[10] We use the Wald test as a robustness check for the herding coefficient between positive and negative returns, high and low volumes and volatility.

with the behavioral aspect of investors during stress or panic. This could be also due to rational herding for the institutional investors due to a potential loss of reputation.

Table 4 about here

Table 4 presents the herding coefficients during high and low volume, where we consider a 30 day moving average to calculate the high and low volume dummy in a similar approach to Economou et al. (2011). We find that only Ireland and Norway have a significant herding effect ($1\text{-}D(vol\text{-}High)Rmt^2$) during low volume trading periods, which is further confirmed by the Wald test that the asymmetry effect in terms of high and low volume market condition – this rejects the hypothesis of an equality of herding coefficients. It is worth mentioning that we find a high average cross sectional dispersion of returns in those markets (see Table 1). This source of asymmetry in herding under different market condition might be the outcome from portfolio managers' response to investors' behavior during extreme market events.

Table 5 about here

Table 5 presents herding behavior during high and low volatility periods calculated in the same way as the volume dummy using 30 day moving averages. We observe a significant herding coefficient $D[\sigma^2\text{-High}]\ (Rmt)^2$ in Greece, Sweden and Denmark during high and low volatility periods. This finding is confirmed by the results of the Wald test, which rejects the hypothesis of an equality of herding coefficients.

A question that might be raised is why some of the European markets do not have herding under asymmetric conditions while others do? Herding coefficients during asymmetric market conditions in some countries might be due to panic or overreaction and the result of noise trading by the participants of the markets during crises. However, this asymmetric impact of negative market returns, volume and volatility is supported by a series of existing studies (e.g., Christie and Haung, 1995; Chang et al., 2000; Gleason et al., 2004; Demirer et al., 2006; and Chiang and Zheng, 2010) that have argued that herding effects are expected to be more pronounced during periods of market losses with respect to trading volume and volatility. These studies stress that the human behavioral tendency to herd becomes stronger during periods of abnormal information flows, market losses and volatility since investors seek the comfort of the consensus opinions (Economou et al., 2011).

4.3 The Cross-country Herding Effect and the Influence of Regional Markets

Post the establishment of the European Union, European countries has become well integrated through cross border trade, common creditors and cross listings. It is, therefore, worth testing whether herding forces synchronized across these markets. Economou et al. (2011) observes a cross-country herding effect within the PIGS countries. Chiang et al. (2007) document that contagion effects spread financial risk across markets, and herding activity further exacerbates market crises.

We attempt to investigate further how this cross-country herding effect impacts on the different country groups in our sample. We expect that the Continental and Nordic Europe's open market economies are potentially subject to contagion effects from the PIIGS markets due to bilateral trade and payoffs. The correlation in cross sectional deviation of market returns may be due to geographic proximity that produces close trading relation in the region or to a similar cultural background. To investigate the integration of CSAD, we also consider the role and significance of common factors by including the German foreign influence for each cross sectional integration analysis of the cross sectional standard deviation of returns (see Table 6). We find a positive and highly significant CSAD coefficient across all markets suggesting a dominant influence of German market dispersions in all the European markets. In particular, France, Norway, Sweden, Greece and Italy show more significant herding around the German market. This might be due to the fact that any shockwave in a similar industry firms tends to transmit across borders. We also observe negative coefficients of the German market ($GermanRmt^2$) with most of the markets except Portugal and Ireland. The significantly negative value may imply that herding formation for each European market is influenced by German market conditions.

Table 6 about here

We estimate cross-country herding behavior including UK return and US lag returns along with eleven sample countries' CSAD. The results are reported in Table 7. We find overwhelming evidence that the cross sectional dispersions of returns can be partly explained by the cross sectional dispersions of the other markets. The regression results show whether the cross-sectional dispersion in each market is affected by the measure of dispersion in the other markets. The regression results indicate that 58 country coefficients are statistically significant out of 110 cross-country coefficients, which means that common herding forces exist across a great number of markets in Europe. The results suggest a superior explanatory power of this extended model as compared to the base model when we compare the adj. R^2 in both models. The average adj. R^2 refers that cross-country influence of cross sectional deviation of returns is lower in the markets of the PIIGS (32.5%) compared to the continental (43%) and Nordic countries (48%). The highest adj. R^2 is in France (56.5%) followed by Norway (54.8%), and Sweden (45.8%). This finding could be due to the contagion effect among the country groups in our sample.

Table 7 about here

However, similar to Economou et al. (2011), in most of the cases, we find a strongly positive significant relationship between the CSAD measures among the markets. We find that the cross sectional dispersions of returns is influenced by both similar and different market groups. For example, we observe that Greece market's CSAD is influenced by the rest of the PIIGS markets, most of the Nordic markets except Denmark as well as by the continental markets. The French market's CSAD is influenced by most of the PIIGS sample except Spain, but none of the Nordic markets are influenced the French market's CSAD. In short, we observe a strong influence of CSAD from one to the other country groups, which accepts the alternative hypothesis H_3 that there is significant cross-country herding effect within the country groups.

4.4 Herding Effects during Turbulent Periods

Chiang and Zheng (2010) show the impact of different crises on herding coefficients, including both advanced and emerging markets. They have included the impact of Asian, Mexican, Argentinian and subprime credit crises. However, they found that in most of the cases there are no differences in herding coefficients during crisis and tranquil periods, except for the US and Latin America. Unlike Chiang and Zheng (2010), but similar to Economou et al. (2011), we used the crises dummies instead of sub-sampling the period. The empirical evidence of this study (Table 8) reports significant herding coefficients during the global financial crisis in the continental and the PIIGS markets as compared to the Nordic markets. However, the Nordic markets' herding coefficients of EZC are more significant as compared to the GFC.

Table 8 about here

For countries like France, Italy and Spain, there is no presence of herding under the benchmark model and asymmetric models (Eqs. 2-5). However, in the augmented benchmark model with a crisis dummy (Eq. 7), we find that the dispersion of returns of those markets is significantly and negatively affected by the GFC period. We also find evidence of herd behavior during the GFC in the Nordic market and this implies that the cross-sectional dispersion of return decreased during the crisis. Finally, during the EZC period, the countries characterized by the presence of herd behavior include Norway, Denmark, and Sweden from the Nordic markets and Greece and Spain from the PIIGS markets. Essentially, Nordic markets are primarily affected during the EZC, but continental and the PIIGS are primarily affected during the GFC.

Our findings[11] on the continental European sample, which include firm-level data, do not support the findings of Chiang and Zheng (2010). They consider all firms industry indices and report the ongoing presence of herd behavior in France, Germany and the UK. We find evidence of herd behavior in those countries only during the crises. However, our study supports their view that herding effects are present in the developed markets despite the fact that we have a different sample. Further, our study supports the finding of Economou et al. (2011) that herd behavior is more prominent during crisis (GFC) in the PIGS countries. Our study supports the findings of Economou et al. (2011) and Holmes et al. (2013) that the herd behavior persists in Portugal, but this is true only during negative market returns. Our study is different from Chiang and Zheng (2010) and Economou et al. (2011) in that we investigate the cross-country herding among developed Europe during the GFC and EZC with a new data set with a sample period that fully captures GFC or EZC.

Finally, given the criticism of applying the CCK model, Chiang et al. (forthcoming) provide details that during the crisis period, the herding coefficient can be endogenous to the market conditions, including the change of market volatility. As a result, the interacting term of variance and market return can be significant, leading to a specification error if we use the original model by Chang et al. (2000) in testing herding. As a robustness checking, we used the analysis developed by Chiang and Zheng (2010) including the addition of Rmt (market portfolio return) to the right hand side of the estimation equation. This specification permits us to take care of the asymmetric investor behavior under different market conditions. The results are

[11] We also try value-weighted data and additionally include US lagged market returns as a global factor in the regression estimates, but the results do not change significantly.

presented in Tables 2 and 7 only for the overall market sample with and without crises[12]. However, we find consistent results between the CCK models and Chiang and Zheng, (2010) extended model.

5. Conclusions

This paper investigates herd behavior among European markets (e.g. continental, Nordic and the PIIGS) for a period including the GFC and EZC. The comparative country-wise analysis of herd behavior among European countries suggests that herding is not significant in Europe during normal times, but is significant during crises and in regimes of different extreme market conditions. We observe significant herding coefficients during asymmetric market conditions and crises periods, but these differ among the country groups. The study also concludes that common herding forces exist across a large number of markets in Europe, and they are highly related within similar types of markets.

An interesting finding of the study concerning herd behavior in the European stock markets is that the continental and the PIIGS markets are more intensely affected by the global financial crisis and the Nordic markets are more affected by the Eurozone crisis than the global financial crisis. This might be the outcome of bailout policies and capital injection in the PIIGS markets during Eurozone crisis. The policy makers of the European Union need to consider the challenge of financial instability and the contagion effect of the PIIGS on developed European markets, especially continental Europe and Nordic countries. The convergence of trading strategies has important

[12] We did not present the results of different market conditions due to limited space but are available on request.

consequences for stock market efficiency because herding might systematically misprice financial assets and promote the creation of asset bubbles.

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Figure 1: Clustering Analysis of Three Country Groups using CSAD and R_m

The figure below presents Dandrograms of CSAD and Rm for the eleven countries in the sample. CSAD is the daily cross-sectional absolute deviation and Rm is the daily market return.

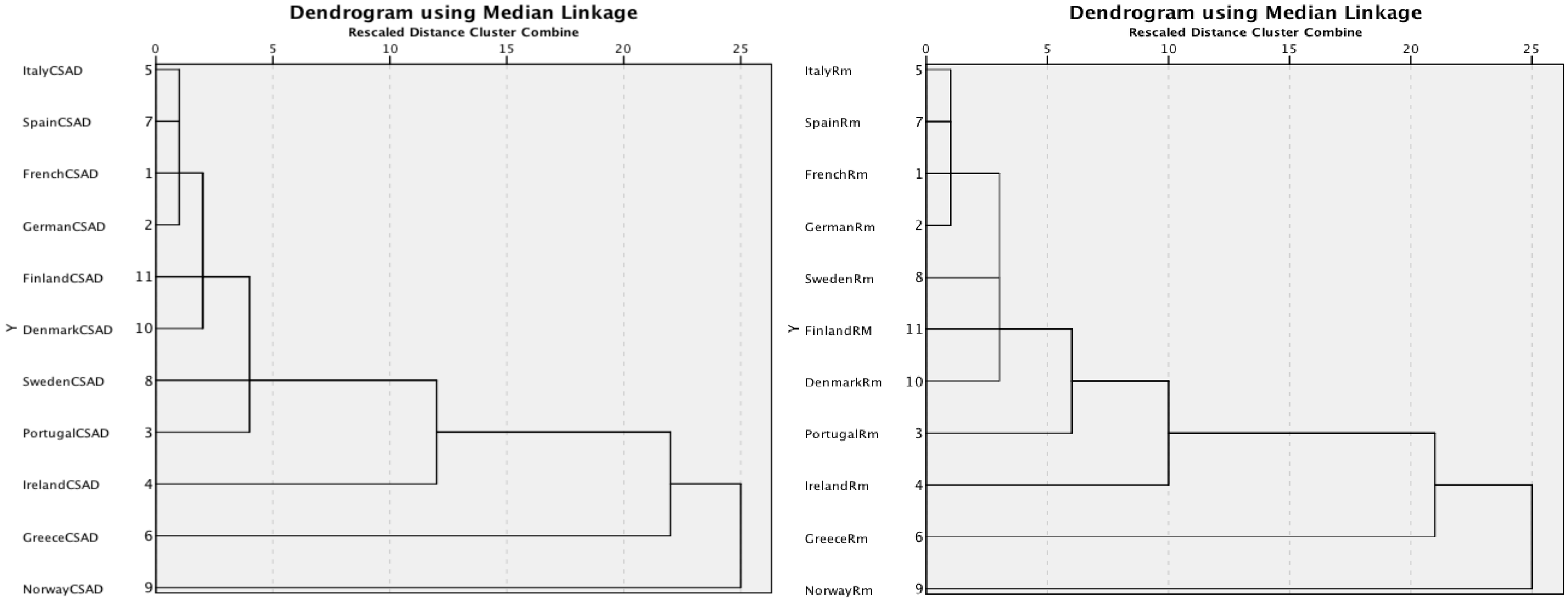

Table 1: Descriptive Statistics:

	Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)										*Panel B: Nordic Europe*								*Panel C: Continental*			
	Portugal		**Italy**		**Ireland**		**Greece**		**Spain**		**Finland**		**Norway**		**Sweden**		**Denmark**		**France**		**Germany**	
	CSAD	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*	*CSAD*	*Rm*
Mean	0.556	-0.017	0.402	-0.014	0.712	-0.014	0.790	-0.046	0.420	0.012	0.501	0.021	0.836	0.010	0.546	0.022	0.507	0.016	0.456	-0.011	0.503	0.002
Median	0.430	0.034	0.298	0.045	0.533	0.026	0.570	0.000	0.326	0.051	0.383	0.042	0.631	0.074	0.403	0.015	0.381	0.015	0.337	0.025	0.372	0.062
Maximum	3.673	11.326	3.062	9.541	6.782	6.700	8.727	12.643	3.498	10.053	4.175	8.920	7.526	11.940	4.233	9.781	4.206	9.253	3.915	10.694	5.217	11.786
Minimum	0.000	-9.254	0.000	-7.625	0.000	-9.176	0.000	-13.173	0.000	-7.827	0.000	-8.951	0.001	-11.717	0.000	-8.069	0.000	-10.452	0.001	-9.911	0.000	-8.397
Std. deviation	0.499	1.125	0.384	1.338	0.676	1.108	0.789	1.574	0.381	1.315	0.458	1.432	0.807	1.877	0.522	1.584	0.478	1.295	0.445	1.588	0.482	1.464
N	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904	2904

Note: This table reports descriptive statistics of daily cross-sectional absolute deviations (CSAD) and daily market returns (Rm) for eleven sample countries for the period 2001-2012.

Table 2: Regression Estimates of Herding Behavior:

Model 1	*Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)*					*Panel B: Nordic Europe*				*Panel C: Continental*	
Variable	Portugal	Italy	Ireland	Greece	Spain	Finland	Norway	Sweden	Denmark	France	Germany
Constant	0.388***	0.225***	0.466***	0.392***	0.274***	0.269***	0.318***	0.239***	0.330***.	0.168***	0.276***
	(26.80)	(18.53)	(19.06)	(17.04)	(25.35)	(19.14)	(16.22)	(15.04)	(24.02)	(15.70)	(19.76)
$\|R_{mt}\|$	0.229***	0.186***	0.300***	0.346***	0.162***	0.255***	0.385***	0.030***	0.205***	0.262***	0.002
	(9.93)	(7.47)	(5.77)	(11.04)	(10.05)	(10.82)	(13.58)	(3.63)	(9.66)	(14.07)	(0.26)
R_{mt}^2	-0.0013	0.0025	0.0135	0.011	0.0004	-0.0086*	0.0054	0.289	0.0048	-0.005	0.2089***
	(-0.30)	(0.35)	(0.81)	(1.45)	(0.12)	(-1.94)	(1.12)	(1.00)	(-0.33)	(-0.07)	(9.04)
Adj. R^2	0.145	0.248	0.173	0.347	0.170	0.249	0.498	0.361	0.156	0.465	0.321
Model 2	*Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)*					*Panel B: Nordic Europe*				*Panel C: Continental*	
Variable	Portugal	Italy	Ireland	Greece	Spain	Finland	Norway	Sweden	Denmark	France	Germany
Constant	0.389***	0.227***	0.467***	0.393***	0.273***	0.268***	0.318***	0.239***	0.330***	0.168***	0.277***
	(26.70)	(18.71)	(19.09)	(17.16)	(25.17)	(18.99)	(16.21)	(15.04)	(24.06)	(15.57)	(19.77)
R_{mt}	-0.008	-0.007	0.0106	-0.002	0.005	0.013	0.008	0.030***	0.005	0.015**	0.002
	(-0.06)	(-0.86)	(0.68)	(-0.21)	(0.62)	(1.54)	(0.82)	(3.64)	(0.50)	(2.26)	(0.26)
$\|R_{mt}\|$	0.229***	0.185***	0.298***	0.346***	0.163***	0.259***	0.384***	0.289***	0.204***	0.266***	0.209***
	(9.73)	(7.56)	(5.77)	(11.02)	(9.89)	(11.10)	(13.76)	(10.01)	(9.69)	(14.34)	(9.05)
R_{mt}^2	-0.001	0.002	0.015	0.011	0.003	-0.009*	0.006	-0.004	-0.002	-0.004	0.009*
	(-0.28)	(0.37)	(0.90)	(1.41)	(0.08)	(-1.84)	(1.25)	(-0.50)	(-0.30)	(-0.09)	(1.91)
Adj. R^2	0.145	0.248	0.173	0.346	0.170	0.250	0.499	0.360	0.156	0.467	0.321

Note**:** This table reports the estimated coefficients for the benchmark model Eq. (2). The sample period is January 2001–February 2012. Newey-West (1987) correction is applied to estimate standard errors. The T-statistics are reported in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% levels. We employ the extended model by Chiang and Zheng (2010), which was originally developed by Chang, Cheng, and Khorana (2000: CCK). Model 1 represents the CCK(2000) considering only absolute market return in the right hand side of the equation and model 2 represents Chiang and Zheng's, (2010) extended model including market return in the right hand side of the equation. Model 2 is employed for robustness checks.

Table 3: Regression Estimates of Herding Behavior in Rising and Declining Markets:

	Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)					*Panel B: Nordic Europe*				*Panel C: Continental*	
	PORTUGAL	ITALY	IRELAND	GREECE	SPAIN	FINLAND	NORWAY	SWEDEN	DENMARK	FRANCE	GERMANY
Constant	0.345***	0.296***	0.439***	0.552***	0.315***	0.338***	0.630***	0.360***	0.371***	0.268***	0.355***
	(23.62)	(23.37)	(23.00)	(21.06)	(27.47)	(23.96)	(24.90)	(19.77)	(24.12)	(20.10)	(22.75)
D[up](Rmt)	0.233***	0.101***	0.292***	0.337***	0.092***	0.228***	0.218***	0.245***	0.178***	0.225***	0.101***
	(7.94)	(4.57)	(7.02)	(7.03)	(4.346)	(6.69)	(3.43)	(5.56)	(5.75)	(6.22)	(2.97)
(1-D[up])(Rmt)	0.320***	0.1487***	0.351***	0.338***	0.163***	0.230***	0.239***	0.274***	0.194***	0.247***	0.240***
	(10.87)	(4.84)	(7.43)	(6.50)	(7.20)	(8.87)	(4.45)	(8.55)	(5.54)	(8.21)	(7.57)
$D[up]R_{m,t2}$	0.008	0.006	0.035**	-0.019	0.012*	-0.01	0.009	0.002	-0.007	0.008	0.029***
	(0.85)	(1.37)	(2.54)	(-1.54)	(1.89)	(-1.04)	(0.41)	(0.15)	(-0.77)	(0.80)	(2.65)
(1-D[up])Rm,t^2	-0.024***	0.0006	-0.010	-0.028*	-0.007	-0.021***	0.019	-0.032***	-0.013	-0.0098	-0.012*
	(-3.25)	(0.06)	(-0.73)	(-1.67)	(-1.39)	(-3.42)	(1.48)	(-4.42)	(-1.43)	(-1.38)	(-1.68)
Adj. R^2	0.184	0.249	0.226	0.347	0.172	0.251	0.499	0.366	0.162	0.469	0.321
γ_4-γ_5	0.032	0.005	0.045	0.009	0.019	0.011	-0.010	0.034	0.006	0.018	0.041
Wald test of Chi-square	7.681***	2.647	1.060	6.305***	7.769**	2.275	2.448	15.905***	0.225	3.572	22.031***

Note: This table reports the estimated coefficients for the model described in Equation (3). The sample period is between January 2001–February 2012. Newey-West (1987) correction is applied to estimate standard errors and T-Statistics are reported in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% level. D[up] is dummy variable for the up market and (1-D[up]) is dummy variable for the down market. γ_4-γ_5 represents a Wald test of the significant difference of coefficients between up and down markets with respect to squared market return.

Table 4: Regression Estimates of Herding Behavior on days of High and Low Trading Volume:

	Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)					*Panel B: Nordic Europe*				*Panel C: Continental*	
	PORTUGAL	ITALY	IRELAND	GREECE	SPAIN	FINLAND	NORWAY	SWEDEN	DENMARK	FRANCE	GERMANY
Constant	0.347*** (22.53)	0.297*** (23.14)	0.454*** (23.14)	0.560*** (20.63)	0.315*** (25.98)	0.341*** (23.73)	0.647*** (27.33)	0.366*** (20.30)	0.373*** (24.13)	0.270*** (20.61)	0.353*** (21.03)
D[Vol-High](Rm,t)	0.294*** (9.30)	0.136*** (5.67)	0.301*** (7.04)	0.327*** (6.95)	0.137*** (5.74)	0.232*** (8.07)	0.260*** (5.32)	0.277*** (7.39)	0.198*** (6.20)	0.224*** (6.52)	0.171*** (4.75)
(1-D[Vol-High])(Rm,t)	0.244*** (6.95)	0.099*** (3.32)	0.252*** (5.92)	0.299*** (4.37)	0.116*** (4.45)	0.221*** (7.29)	0.079 (1.64)	0.214*** (4.91)	0.160*** (4.58)	0.239*** (7.18)	0.170*** (3.96)
D[Vol-High]Rmt^2	-0.011 (-1.49)	0.0008 (0.15)	0.005 (0.47)	-.0280*** (-2.68)	0.0006 (0.12)	-.017*** (-2.77)	-0.001 (-0.14)	-0.020* (-1.77)	-0.013* (-1.78)	-0.0005 (-0.06)	0.008 (0.8611)
(1-D[Vol-High])Rmt^2	-0.002 (-0.14)	0.013 (1.43)	-0.051*** -(3.78)	-0.0001 (-0.003)	0.003 (0.29)	-0.016* (-1.71)	-0.082*** -(5.50)	-0.008 (-0.60)	-0.003 (-0.23)	0.0007 (0.07)	0.007 (0.47)
Adj. R^2	0.180	0.235	0.224	0.336	0.163	0.231	0.521	0.345	0.154	0.434	0.312
γ_4-γ_5	-0.009	-0.01253	.056	-0.027	-0.0024	-0.0008	0.081	-0.012	-0.010	-0.001	0.001
Wald test of Chi-square	2.407	1.932	12.479***	1.251	0.946	0.242	17.764***	2.748	1.152	0.721	0.027

Note: This table reports the estimated coefficients for the model described in Eq. (4). The sample period is between January 2001–February 2012. Newey-West (1987) correction is applied to estimate standard errors and t-Statistics are given in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% level. D [Vol-High] refers to a dummy for high volume market condition; (1-D [Vol-High]) refers to a dummy for low volume market condition. γ_4-γ_5 represents a Wald test of the significant difference of coefficients between high and low volume market conditions with respect to the squared market return.

Table 5: Regression Estimates of Herding Behavior on days of High and Low Volatility:

	Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)					*Panel B: Nordic Europe*				*Panel C: Continental*	
	PORTUGAL	ITALY	IRELAND	GREECE	SPAIN	FINLAND	NORWAY	SWEDEN	DENMARK	FRANCE	GERMANY
Constant	0.345***	0.294***	0.432***	0.548***	0.313***	0.341***	0.624***	0.361***	0.368***	0.268***	0.353***
	(22.55)	(23.45)	(21.29)	(21.00)	(26.90)	(24.20)	(23.94)	(19.85)	(24.22)	(20.03)	(21.82)
D[2-High](Rmt)	0.312***	0.139***	0.392***	0.396***	0.183***	0.227***	0.287***	0.288***	0.248***	0.242***	0.214***
	(7.06)	(5.10)	(7.33)	(6.21)	(6.57)	(5.55)	(4.07)	(6.82)	(6.34)	(5.99)	(5.80)
(1-D[σ^2-High])(Rmt)	0.259***	0.121***	0.319***	0.328***	0.108***	0.225***	0.222***	0.250***	0.168***	0.234***	0.152***
	(9.46)	(5.09)	(7.41)	(7.59)	(5.29)	(8.41)	(4.22)	(6.88)	(6.17)	(7.62)	(4.61)
D[σ^2-High]Rmt^2	-0.0112	0.003	-0.0374*	-0.048**	-0.007	-0.014	-0.003	-0.031**	-0.025**	-0.007	0.004
	(-0.75)	(0.35)	(-2.42)	(-2.20)	(-1.08)	(-1.02)	(-0.15)	(-2.27)	(-2.37)	(-0.63)	(0.43)
(1-D[σ^2-High])Rmt^2	-0.006	0.004	0.018	-0.019	0.005	-0.017**	0.018	-0.013	-0.007	-0.0004	0.011
	(-0.98)	(0.74)	(1.41)	(-1.61)	(0.92)	(-2.42)	(1.15)	(-1.60)	(-1.59)	(-0.05)	(1.09)
Adj. R^2	0.177	0.223	0.225	0.342	0.172	0.223	0.501	0.321	0.175	0.442	0.312
γ_4-γ_5	-0.005	-0.001	-0.055	-0.029	-0.012	0.003	-0.021	-0.018	-0.018	-0.007	-0.007
Wald test of Chi-square	2.929	0.740	1.898	11.335***	2.166	0.083	1.513	3.090*	5.504*	0.512	4.038

Note: This table reports the estimated coefficients for the model described in Eq. (5). The sample period is between January 2001–February 2012. Newey-West (1987) correction is applied to estimate the standard errors and t-statistics are given in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% level. D [σ2-High] refers to a dummy for the high volatility market condition; (1-D [σ2-High]) refers to a dummy for the low volatility market condition. γ_4-γ_5 represents a Wald test of the significant difference of coefficients between high and low volatility market conditions with respect to squared market return.

Table 6: The Influence of the German Market on Cross-country Herding:

VARIABLES	*Panel A: PIIGS (Portugal. Italy. Ireland. Greece. Spain)*					*Panel B: Nordic Europe*				*Panel C: Continental*
	PORTUGAL	IRELAND	ITALY	GREECE	SPAIN	FINLAND	NORWAY	SWEDEN	DENMARK	FRANCE
Constant	0.353*** (19.23)	0.399*** (12.87)	0.178*** (14.38)	0.272*** (9.24)	0.219*** (16.27)	0.219*** (16.31)	0.232*** (9.67)	0.195*** (12.22)	0.276*** (17.44)	0.0950*** (8.00)
Rmt	-0.0019 (-0.13)	0.0241 (1.44)	-0.0053 (-0.70)	0.0010 (0.09)	0.0048 (0.64)	0.0134* (1.75)	0.0129 (1.47)	0.0249*** (3.05)	0.0072 (0.78)	0.0137** (2.09)
|Rmt|	0.2027*** (7.81)	0.2208*** (3.46)	0.1652*** (6.36)	0.3334*** (10.81)	0.1457*** (9.56)	0.2396*** (10.52)	0.3811*** (14.64)	0.2488*** (10.47)	0.1892*** (9.04)	0.2215*** (10.11)
Rmt^2	-0.0091* (-1.67)	0.0108 (0.48)	0.0166 (1.59)	0.0120* (1.72)	0.0082* (1.72)	-0.001* (-1.67)	0.0150*** (2.80)	0.0260*** (3.40)	0.0042 (0.82)	0.0194* (1.95)
GERMANCSAD	0.0753*** (2.64)	0.1294*** (2.98)	0.1510*** (5.72)	0.3242*** (5.97)	0.1551*** (6.24)	0.1495*** (6.40)	0.2584*** (6.86)	0.1877*** (6.19)	0.1549*** (5.51)	0.2462*** (7.64)
GERMAN Rmt^2	0.0126*** (3.41)	0.0314*** (6.29)	-0.0156*** (-3.04)	-0.0156** (-2.10)	-0.0102*** (-2.75)	-0.0122** (-2.53)	-0.0335*** (-4.52)	-0.0377*** (-7.68)	-0.0089*** (-2.63)	-0.0247*** (-3.27)
Adj. R^2	0.174	0.277	0.282	0.375	0.197	0.269	0.536	0.425	0.173	0.520

Note: The table reports the influence of Germany on the cross-country herding for the period of January 2001–February 2012. Newey-West (1987) correction is applied to estimate standard errors and t-Statistics are given in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% level.

Table 7: Regression Estimates of Cross-country Herding:

	Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)					*Panel B: Nordic Europe*				*Panel C: Continental*	
Variables	PORTUGAL	IRELAND	ITALY	GREECE	SPAIN	DENMARK	FINLAND	NORWAY	SWEDEN	FRANCE	GERMANY
Constant	0.234***	0.183***	0.076***	-8.59E	0.146***	0.190***	0.131***	0.230***	0.136***	0.066***	0.140***
	(10.38)	(5.32)	(4.63)	(-0.002)	(8.99)	(8.91)	(7.43)	(7.49)	(6.01)	(4.72)	(6.26)
|Rmt|	0.145***	0.174***	0.114***	0.313***	0.095***	0.138***	0.176***	0.371***	0.193***	0.176***	0.118***
	(5.55)	(3.22)	(4.69)	(11.06)	(5.95)	(6.78)	(6.90)	(12.19)	(8.58)	(8.20)	(5.46)
Rmt^2	0.001	0.014	0.021**	0.013**	0.020***	0.012**	-0.008***	0.018**	0.039***	0.035***	0.025***
	(0.11)	(0.72)	(2.30)	(2.19))	(4.01)	(2.24)	(2.85)	(2.24)	(6.57)	(3.46)	(5.59)
PORTUGALCSAD		0.047	0.012	-0.110***	0.011	-0.011	0.032	-0.059**	-0.029	-0.043***	-0.018
		(1.58)	(0.76)	(-3.31)	(0.64)	(-0.44)	(1.52)	(-1.99)	(-1.45)	(-2.93)	(-0.82)
IRELANDCSAD	0.040**		0.012	-0.072***	0.024*	0.004	0.007	-0.038*	0.005	0.033***	0.008
	(2.36)		(0.89)	(-2.60)	(1.78)	(0.22)	(0.38)	(-1.66)	(0.36)	(2.65)	(0.40)
ITALYCSAD	0.078**	0.123***		0.151***	0.107***	0.101***	0.008	0.039	0.025	0.085***	0.049*
	(2.36)	(2.98)		(3.38)	(4.57)	(3.43)	(0.32)	(0.80)	(0.81)	(3.78)	(1.63)
GREECECSAD	0.001	0.008	0.072***		0.082***	0.010	0.062***	0.030*	0.062***	0.091***	0.058***
	(0.07)	(0.43)	(6.51)		(6.26)	(0.58)	(4.38)	(1.69)	(4.05)	(8.96)	(3.56)
SPAINCSAD	0.021	0.078**	0.098***	0.177***		-0.006	0.013	-0.066	0.040	-0.017	0.056**
	(0.66)	(2.06)	(4.19)	(3.97)		(-0.18)	(0.468)	(-1.54)	(1.47)	(-0.78)	(2.15)
DENMARKCSAD	0.002	0.025	0.050***	-0.038	-0.009		0.062***	0.105***	0.073***	-0.001	0.041*
	(0.07)	(0.94)	(2.86)	(-1.23)	(-0.47)		(3.09)	(3.59)	(3.72)	(-0.05)	(1.89)
FINLANDCSAD	0.087***	0.074**	-0.026	0.181***	0.006	0.080***		-0.050	0.057**	0.004	-0.001
	(3.53)	(2.23)	(-1.59)	(5.68)	(0.29)	(3.49)		(-1.56)	(2.54)	(0.24)	(-0.05)
NORWAYCSAD	0.036**	0.030*	0.029***	0.047**	-0.00256	0.023*	-0.009		0.012	-0.012	0.049***
	(2.173)	(1.612)	(2.554)	(2.118)	(-0.250)	(1.698)	(-0.672)		(0.918)	(-1.150)	(3.259)
SWEDENCSAD	0.061**	0.063**	0.010	0.184***	0.029	0.060***	0.065***	0.033		0.000	0.003
	(2.27)	(2.20)	(0.61)	(5.54)	(1.58)	(2.66)	(3.23)	(1.16)		(0.009)	(0.16)
FRANCECSAD	0.036	0.250***	0.063***	0.425***	-0.004	0.047	0.090***	0.076*	-0.007		0.143***
	(1.06)	(6.07)	(2.83)	(9.21)	(-0.16)	(1.25)	(2.84)	(1.72)	(-0.32		(5.67)
GERMANCSAD	-0.002	0.007	0.072***	0.131***	0.071***	0.080***	0.060	0.191***	0.109***	0.193***	
	(-0.07)	(0.17)	(2.78)	(2.63)	(3.42)	(2.83)	(2.53)	(4.97)	(3.48)	(5.99)	-
GERMANRMSQR	0.013***	0.021***	-0.014***	-0.017*	-0.005	-0.006*	-0.007	-0.023***	-0.028***	-0.021***	
	(3.27)	(3.01)	(-2.78)	(-1.95)	(-1.14)	(-1.63)	(-1.55)	(-3.71)	(-4.65)	(-3.00)	-
UKRETSQR	-0.008**	-0.001	-0.004	-0.011*	-0.014***	-0.009**	-0.013***	-0.014	-0.018***	-0.015***	-0.017***
	(-2.05)	(-0.09)	(-1.45)	(-1.61)	(-5.88)	(-2.36)	(-3.04)	(-1.49)	(-5.32)	(-3.72)	(-5.85)
USLAGRETSQR	0.005***	-0.003	0.002	-0.004	0.010***	0.007*	0.004*	0.007	0.006***	0.002	0.010***
	(2.58)	(-1.28)	(0.63)	(-1.50)	(5.92)	(1.84)	(1.75)	(1.47)	(2.57)	(1.02)	(4.65)
Adj. R^2	0.207	0.327	0.336	0.481	0.275	0.206	0.316	0.548	0.458	0.565	0.396

Note: This table reports the estimated coefficients for the model described in Eq. (6). The sample period is for the period of January 2001–February 2012. Newey-West (1987) correction is applied to estimate standard errors and t-statistics are given in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% level. We use two additional control variables to capture the global factors, e.g. UKRETSQR (Squared UK returns) and USLAGRETSQR (Squared US lagged returns).

Table 8: Results of Regression Estimates of Herding Behavior for the GFC and EZC:

Model 1	*Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)*					*Panel B: Nordic Europe*				*Panel C: Continental*	
Variable	Portugal	Italy	Ireland	Greece	Spain	Finland	Norway	Sweden	Denmark	France	Germany
Constant	0.379***	0.230***	0.476***	0.418***	0.286***	0.269***	0.308***	0.257***	0.335***	0.188***	0.291***
	(23.84)	(21.27)	(19.45)	(17.97)	(26.16)	(19.74)	(17.23)	(18.64)	(22.38)	(17.44)	(21.16)
|Rmt|	0.289***	0.171***	0.269***	0.256***	0.106***	0.263***	0.431***	0.243***	0.171***	0.220***	0.187***
	(4.56)	(8.51)	(5.22)	(6.66)	(4.77)	(11.59)	(15.59)	(9.41)	(4.40)	(8.17)	(6.47)
Rmt^2	-0.0312	0.0191****	0.0286	0.0455***	0.0237***	-0.0201*	0.0153***	0.0246***	0.0297*	0.0335***	0.0291***
	(-0.84)	(3.00)	(1.39)	(4.14)	(3.65)	(-1.82)	(2.85)	(3.70)	(1.79)	(3.49)	(3.63)
GFC- Rmt^2	0.0303	-0.0253***	-0.0159	-0.0416***	-0.0233***	0.0076	-0.0095	-0.0315***	-0.0284*	-0.0299***	-0.0198**
	(0.81)	(-4.56)	(-1.00)	(-2.69)	(-3.23)	(0.80)	(-1.36)	(-2.82)	(-1.68)	(-3.05)	(-2.19)
EZC -Rmt^2	0.0330	-0.0085	0.0132	-0.0353**	-0.0204***	-0.0176*	-0.0228*	-0.0347***	-0.0627***	-0.0319***	-0.096*
	(0.87)	(-1.27)	(0.73)	(-2.25)	(-2.61)	(1.82)	(-1.92)	(-3.27)	(-3.44)	(-2.58)	(-1.67)
Adj. R^2	0.145	0.265	0.176	0.376	0.177	0.253	0.527	0.377	0.169	0.511	0.337
Model 2	*Panel A: PIIGS (Portugal, Italy, Ireland, Greece, Spain)*					*Panel B: Nordic Europe*				*Panel C: Continental*	
Variable	Portugal	Italy	Ireland	Greece	Spain	Finland	Norway	Sweden	Denmark	France	Germany
Constant	0.389***	0.235***	0.485***	0.418***	0.285***	0.267***	0.308***	0.253***	0.335***	0.186***	0.291***
	(27.36)	(23.84)	(21.52)	(17.95)	(26.35)	(19.63)	(17.28)	(18.42)	(22.42)	(17.45)	(21.65)
Rmt	-0.001	-0.005	0.012	-0.001	0.006	0.012	0.010	0.0310***	0.0077	0.0136**	0.0029
	(-0.08)	(-0.67)	(0.76)	(-0.09)	(0.75)	(1.44)	(1.11)	(3.76)	(0.87)	(2.23)	(0.35)
|Rmt|	0.227***	0.144***	0.217***	0.256***	0.106	0.264***	0.428***	0.245***	0.169***	0.222***	0.171**
	(9.15)	(6.97)	(4.42)	(6.58)	(4.78)	(11.82)	(15.59)	(9.60)	(4.32)	(8.36)	(7.67)
Rmt^2	-0.003	0.026***	0.047**	0.045***	0.024***	-0.019*	0.016***	0.024***	0.031*	0.033***	0.033***
	(-0.15)	(4.43)	(2.30)	(4.07)	(3.73)	(-1.78)	(2.99)	(3.67)	(1.84)	(3.53)	(5.12)
GFC- Rmt^2	0.001	-0.027***	-0.038	-0.042***	-0.024***	0.007	-0.010	-0.033***	-0.029*	-0.030***	-0.023***
	(0.06)	(-3.78)	(-1.38)	(-2.68)	(-3.29)	(0.72)	(-1.44)	(-3.10)	(-1.72)	(-3.15)	(-4.26)
EZC- Rmt^2	0.005	-0.028***	-0.006	-0.035**	-0.021***	0.017*	-0.023*	-0.033***	-0.064***	-0.032**	-0.025***
	(0.26)	(-3.05)	(-0.18)	(-2.17)	(-2.63)	(1.72)	(-1.86)	(-3.03178)	(-3.50)	(-2.53)	(-3.60)
Adj. R^2	0.145	0.269	0.176	0.376	0.177	0.254	0.527	0.387	0.169	0.513	0.336

Note: This table reports the estimated coefficients for the model described in Eq. (7). The sample period is between January 2001–February 2012. Newey-West (1987) correction is applied to estimate the standard errors and t-statistics are given in parentheses. ***, ** and * represent statistical significance at the 1%, 5%, and 10% level. We employ the extended model by Chiang and Zheng (2010) which were developed based on the CCK (2000) model. Model 1 represents the CCK (2000) model considering absolute market return in the right hand side of the equation and model 2 represents Chiang and Zheng's (2010) extended model including market return in the right hand side of the equation. This model is employed for robustness checks.