Testing for herding in the Athens Stock Exchange during the crisis period

Fotini Economou[a], Epameinondas Katsikas[b] and Gregory Vickers[c]

[a] Corresponding author. Centre of Planning and Economic Research and Hellenic Open University, 11, Amerikis str. 106 72 Athens, Greece, Tel: (+30) 210 3676418, email: feconom@kepe.gr.

[b] Kent Business School, University of Kent, Parkwood Road, Canterbury, Kent, CT2 7PE, UK, email: E.Katsikas@kent.ac.uk.

[c] Durham University Business School, Mill Hill Lane, Durham DH1 3LB, UK, email: gregory.vickers@durham.ac.uk.

Abstract

This paper investigates herding behavior in the Athens Stock Exchange focusing on the recent crisis period. We employ a survivor bias free dataset of all listed stocks from 2007 to May 2015. We apply the cross sectional dispersion approach and provide results that extend and are comparable with previous studies regarding the Greek stock market. The empirical results indicate the presence of herding under different market states. Employing the quantile regression method, there is herding in the high quantiles of the cross sectional return dispersion. Finally, we document the impact of size effect on herding estimations.

Keywords: herding; cross sectional dispersion; Athens Stock Exchange

JEL Classification: G10; G14; G15

1. Introduction

Crises and periods of extreme market conditions facilitate market anomalies and deviations from the Efficient Market Hypothesis. Under these circumstances a herd, i.e. a crowd converging in its actions and beliefs (Hirshleifer and Teoh, 2003), is more likely to form having important implications for portfolio diversification and market stability (Chang et al., 2000; Demirer and Kutan, 2006; Chiang and Zheng, 2010; Economou et al., 2011). Despite the lack of conclusiveness in the empirical results both in emerging and developed markets, herding is expected to be more pronounced under extreme market conditions (Christie and Huang, 1995; Chang et al., 2000; Chiang and Zheng, 2010; Economou et al., 2011) when individual investors are more likely to follow the crowd instead of their own beliefs/knowledge (Christie and Huang, 1995). Mobarek et al. (2014) provide evidence of significant herding effects in various European stock markets during the global financial crisis and the Eurozone crisis, while Peltomäki and Vähämaa (2015) document that herding effects in the EMU markets affected herding in the non-EMU markets from September 2008 to January 2014. The Greek stock market provides an interesting setting for analysis due to the unprecedented debt crisis that occurred in recent years and the potential spillover effects on other Eurozone markets.

This paper investigates herding behavior in the Athens Stock Exchange (ASE) focusing on the recent crisis period. To this end we employ a survivor bias free dataset from January 2007 to May 2015. We apply the cross sectional dispersion approach and provide results that extend and are comparable with previous studies regarding the Greek stock market. Caporale et al. (2008) were the first to investigate herding in the ASE from 1998 to 2007. The authors identified evidence of herding which is much stronger using daily instead of weekly or monthly data. Moreover, herding was more pronounced during rising market days being also present during the stock market bubble of 1999. Tessaromatis and Thomas (2009) also confirmed strong evidence of herding for the period 1998-2004. Herding in the ASE has been extensively examined by Economou et al. (2011) for the period 1998-2008, testing for potential herding asymmetries with reference to different market states as well as for cross market effects in four South European stock markets, i.e. Greece, Italy, Spain and Portugal. The authors provide evidence of herding that is more pronounced on days with positive market returns, while there is no evidence of asymmetries regarding trading volume and stock market volatility. Mobarek et al. (2014) examined a large number of European stock markets from 2001 to 2012 and identified herding in Greece during the Eurozone crisis (from May 2010 to February 2012). Their dataset differs from previous studies since it only includes the ATHEX Composite constituent stocks instead of all listed stocks in the ASE. In this paper we extend the work of Economou et al. (2011) for the recent Greek debt crisis period. Our empirical results indicate the presence of herding under different market states. These findings provide insight into investors' behavior, especially in the light of the unprecedented events of the Greek crisis and are in line with the main findings of previous studies that identify herding in the ASE.

The rest of the paper is organized as follows: Section 2 presents the dataset and methodology employed, Section 3 reports the empirical results and Section 4 concludes.

2. Methodology and Data

Christie and Huang (1995) and Chang et al. (2000) proposed a cross sectional dispersion approach to capture herding, employing the cross sectional dispersion of individual asset returns as follows:

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

where $R_{i,t}$ is the return of stock i on day t, $R_{m,t}$ is the stock market return on day t and N is the number of all listed stocks in the stock market on day t. The non-linear model proposed by Chang et al. (2000) estimates the relationship between the CSAD and the stock market return in order to capture herding as follows:

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

Under rational asset pricing models, this relationship is expected to be positive and linear, i.e. under extreme market conditions the CSAD is expected to increase since the individual stocks differ in sensitivity to the stock market returns. If herding effects are present this relationship is non linear and coefficient γ_2 is expected to be negative and statistically significant. The Chang et al. (2000) model is quite influential in the aggregate data studies of herd behavior. Chiang and Zheng (2010) proposed an adaptation of this model adding $R_{m,t}$ to the standard equation, which permits the interpretation of asymmetric effects by estimating a single model, which is more streamlined than the initial regression of Chang et al. (2000). It also permits greater analysis of the asymmetries present in up and down markets and it is specified as follows:

$$CSAD_t = a + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R_{m,t}^2 + \varepsilon_t \quad (3)$$

In equation (3), the relationship between return dispersion and stock market return is captured by $(\gamma_1 + \gamma_2)$ when market returns are positive, and by $(\gamma_2 - \gamma_1)$ when they are negative or zero. Thus, the asymmetric relationship between stock return dispersion and stock market return can be presented by the ratio $(\gamma_1 + \gamma_2)/(\gamma_2 - \gamma_1)$ (Duffee, 2001). Following Chang et al. (2000), $R_{m,t}^2$ is used to identify a non-linear relationship and a negative and statistically significant coefficient γ_3 will indicate the presence of herding.

Apart from the traditional OLS method, we also employ the quantile regression method following Chiang et al. (2010) and Zhou and Anderson (2010). This is a popular approach, originally introduced by Koenker and Bassett (1978). In this case we examine the coefficients of model (3) for different quantiles of the dependent variable.[1] The τ-th conditional quantile function of the dependent variable distribution is defined as follows:

$$QY_i(\tau / x) = x_i{}' \beta \quad (4)$$

where Y_i is a dependent variable, x_i is a vector of independent variables and β is a vector of coefficients. The $\hat{\beta}_{(\text{quantile}\tau)}$ estimator results from the following weighted minimization:

$$\hat{\beta}_{(\text{quantile}\tau)} = \arg\min \sum_{i=1}^{n} \rho_\tau (y_i - x_i{}' \beta) \quad (5)$$

where ρ_τ is a weighting factor, also called check function. For any $\tau \in (0,1)$ a weighting function is defined as follows:

[1] See Koenker (2005) for a more technical presentation of the method.

$$\rho_{\text{quantile}\,\tau}(u_i) = \begin{cases} \tau u_i & \text{if } u_i \geq 0 \\ (\tau-1)u_i & \text{if } u_i \prec 0 \end{cases} \tag{6}$$

where $u_i = y_i - x_i'\beta$. From equations (5) and (6) we get the quantile regression estimator by minimizing the weighted sum of absolute errors, where the weights depend on the quantile under examination as follows:

$$\hat{\beta}_{(\text{quantile}\tau)} = \arg\min\left(\sum_{i:y_i > x_i'\beta} \tau \left| y_i - x_i'\beta \right| + \sum_{i:y_i < x_i'\beta} (1-\tau) \left| y_i - x_i'\beta \right| \right) \tag{7}$$

Furthermore, considering the evidence available regarding herding asymmetries we examine the relationship more formally, through the implementation of a series of dummy variables in line with both Chiang and Zheng (2010) and Economou et al. (2011). This method is more robust compared to examining the relationship using two different regressions, as in previous studies (see Tan et al., 2008 among others). In this case the model is structured as follows:

$$CSAD_t = \gamma_0 + \gamma_1(1-D)\left|R_{m,t}\right| + \gamma_2 D\left|R_{m,t}\right| + \gamma_3(1-D)\,R_{m,t}^2 + \gamma_4 D\,R_{m,t}^2 + \varepsilon_t \tag{8}$$

where $D = 1, if\ R_{m,t}$ is negative, and $D = 0$, otherwise. The hypothesis of asymmetric herding is examined using equality tests of pairs of up and down market coefficients (i.e. γ_1 and γ_2 and γ_3 and γ_4) by subtracting the coefficient of the down markets from up markets and testing if the result is equal to zero. If herding is present then we expect coefficients γ_3 and γ_4 to be negative. The relative magnitudes of coefficients γ_3 and γ_4 will demonstrate any asymmetric herding effects. If herding is more pronounced on days when the market is down, then we expect $\gamma_4 < \gamma_3$.

Moreover, dummy variables are assigned to days of high/low market trading volume. A day of high (low) trading volume is when the value of the traded stocks on that day is above (below) the previous 30-day moving average. The respective model specification follows:

$$CSAD_t = \alpha + \gamma_1(1-D^v)\left|R_{m,t}\right| + \gamma_2 D^v\left|R_{m,t}\right| + \gamma_3(1-D^v)R_{m,t}^2 + \gamma_4 D^v R_{m,t}^2 + \varepsilon_t \tag{9}$$

where $D^v = 1,$ if high trading volume on that day, and $D^v = 0$, otherwise. If herding is present then we expect coefficients γ_3 and γ_4 to be negative. The relative magnitudes of coefficients γ_3

and γ_4 will demonstrate any asymmetric herding effects. If herding is more pronounced on days with high average value of total trading volume, then we expect $\gamma_4 < \gamma_3$.

Moreover, according to Christie and Huang (1995), herding is more likely to appear during periods of extreme market movements being obviously more prevalent during market crisis periods. Economou et al. (2011) also address the potential issue of high market volatility employing a dummy variable determined by the relationship of the day's market volatility ($R_{m,t}^2$) relative to the previous 30-day moving average. The examined regression is the following:

$$CSAD_t = \alpha + \gamma_1(1 - D^{vl})\left|R_{m,t}\right| + \gamma_2 D^{vl}\left| R_{m,t}\right| + \gamma_3(1 - D^{vl})R_{m,t}^2 + \gamma_4 D^{vl} R_{m,t}^2 + \varepsilon_t \quad (10)$$

where $D^{vl} = 1,$ if high market volatility that day, $D^{vl} = 0$, otherwise. If herding is present then we expect coefficients γ_3 and γ_4 to be negative. The relative magnitudes of coefficients γ_3 and γ_4 will demonstrate any asymmetric herding effects. If herding is more pronounced on days with high volatility, then we expect $\gamma_4 < \gamma_3$.

Finally, we test for possible asymmetric herding effects relative to the sovereign bond spreads. Given that the euro area sovereign bond yield differentials can be explained by general risk aversion and its interaction with macroeconomic fundamentals, as well as by domestic factors, especially during times of financial stress (Barrios et al., 2009), we examine herding under different market states with reference to the 10-year Greek bond spread over the German. To this end we employ a dummy variable that equals to 1 when the value of the spread on day t is above the previous 30-day moving average. The model is structured as follows:

$$\mathrm{CSAD}_{i,t} = \alpha + \gamma_1\left(1 - \mathrm{D}^{\mathrm{spread}}\right)\left|\mathrm{R}_{m,t}\right| + \gamma_2 \mathrm{D}^{\mathrm{spread}}\left| \mathrm{R}_{m,t}\right| + \gamma_3\left(1 - \mathrm{D}^{\mathrm{spread}}\right)\mathrm{R}_{m,t}^2 + \gamma_4 \mathrm{D}^{\mathrm{spread}}\mathrm{R}_{m,t}^2 + \varepsilon_t \quad (11)$$

where, $D^{spread} = 1$, if spread is higher than the 30-day moving average that day, $D^{spread} = 0$, otherwise. If herding is present then we expect coefficients γ_3 and γ_4 to be negative. We expect that high spreads, reflecting greater risk aversion and negative country-specific factors, facilitate herding behavior. The relative magnitudes of coefficients γ_3 and γ_4 will demonstrate any asymmetric herding effects. If herding is more pronounced on days with high spreads, then $\gamma_4 < \gamma_3$.

The data employed in this paper consists of daily stock price, market value, and trade value data for the ASE, obtained from Thomson Reuters Datastream. The stocks included are those within the Worldscope Greece stock index, which also includes dead stocks. This helps us eliminate survivorship bias. Thus, the number of stocks in the sample ranges from 188 to 309. The date range for the data used is 02/01/2007 to 29/05/2015. Days in which no trading was recorded have been manually eliminated. Return is calculated as $R_t = (\ln(P_t) - \ln(P_{t-1})) \times 100$ (12) and CSAD is calculated as reported in the methodology section employing both equally and value weighted market[2] returns in the estimations to account for size effect in the stock market.

3. Empirical Results

Table 1 presents the descriptive statistics for the calculated CSAD and market return, both equal and value weighted. A first point of interest is that the mean for both market return variables is negative as a result of the poor performance of the ASE over the period under examination. The mean return for the equally weighted market return is more negative than that of the value weighted one suggesting that smaller market value stocks have suffered greater losses. The same holds for CSAD, with the value of equally weighted CSAD being much greater than that of the value weighted one suggesting that the dispersions from the market return are likely to be more prevalent in smaller stocks. The data presents high levels of leptokurtosis with this close clustering around the mean and thicker tails meaning that there is a high probability for extreme values. This is consistent with theory, as a large number of extreme values are to be expected during periods of financial instability. The decrease in Kurtosis when comparing value weighted to equally weighted returns also indicates that these extreme results are more likely to appear in smaller stocks.

Table 1. Descriptive statistics for CSAD and stock market returns

	Equal Weighted Market Returns		Value Weighted Market Returns	
	CSAD	**R_m**	**CSAD**	**R_m**
Mean	1.0991	-0.0441	0.1924	-0.0043
Median	1.0494	-0.0226	0.1779	0.0009

[2] We employ daily data of each stock's market value in order to assign the weights to estimate the value weighted market return. These weights are re-adjusted on a daily basis.

Maximum	3.1332	2.9124	0.7912	0.9979
Minimum	0.5440	-4.8087	0.0360	-0.8480
Std. Dev.	0.3114	0.5240	0.0898	0.1682
Skewness	1.1161	-0.5972	1.7083	-0.0778
Kurtosis	5.4158	9.6710	8.3409	6.4800
Jarque-Bera	942.61	4001.54	3502.27	1057.25
Sum	2298.1850	-92.1493	402.3974	-9.0277
Sum Sq. Dev.	202.7282	573.850	16.8600	59.1594
Observations	2091		2091	

The results of the empirical analysis begin with the standard model (3) in order to test for the presence of herding effects (using both equal weighted and value weighted methods of calculating market returns), and examine for differences in herding behavior between up and down markets. All the results are derived using a Newey-West (1987) consistent estimator to correct for autocorrelation and heteroskedasticity.

Table 2 presents the results of the basic model employing both equal and value weighted returns. Following Chiang and Zheng (2010), the coefficient on $R^2_{m,t}$ (γ_3) detects the presence of non-linearity in the relationship between CSAD and stock market returns. The estimate for coefficient γ_3 is negative and statistically significant at the 5% level, indicating herding towards the market return. Coefficients $\gamma_1$and γ_2 are also important in the analysis of the model, as the ratio $(\gamma_1 + \gamma_2)/(\gamma_2 - \gamma_1)$ is a measure of the relative amount of asymmetry in the relationship. Given the insignificance of the coefficient γ_1 at the 5% level, the value of this ratio is 1, although coefficient $\gamma_1$is significant at the 10% level, where by the ratio would be 1.108, showing large, but weakly significant asymmetry. The adjusted R-squared value indicates that this regression captures 34.09% of the CSAD deviation through these independent variables.

Table 2. Herding estimations – Standard model

	Equal Weighted Market Returns	**Value Weighted Market Returns**
γ_0 (p-value)	0.9048 0.0000***	0.1202 0.0000***
γ_1 (p-value)	0.0285 0.0585*	0.0072 0.2876
γ_2 (p-value)	0.5567 0.0000***	0.5628 0.0000***
γ_3 (p-value)	-0.0360 0.0250**	0.1449 0.0050***
Adj-R^2	0.3409	0.6850

Notes: This table presents the estimated coefficients of the following model: $\mathrm{CSAD_t} = \alpha + \gamma_1 \mathrm{R_{m,t}} + \gamma_2 |\mathrm{R_{m,t}}| + \gamma_3 \mathrm{R^2_{m,t}} + \varepsilon_t$. Daily data from January 2007 to May 2015. ***,**,* statistically significant at 1%, 5% and 10% level, respectively.

The second column in Table 2 tests the same model as the first column employing the value weighted method to calculate the stock market return in order to eliminate any potential size bias in the dataset, as smaller firms' stocks are known to have greater herding effects (Lakonishok et al., 1992). As a result, the impact of these firms is overstated in an equal weighted market return specification. In this specification, whilst the final value for coefficient γ_3 is even more significant than the same value in the equally weighted model, its value is positive indicating absence of herding. Smaller firms' stocks are expected to be more susceptible to herding due to poorer information flow, and equal weighting of market returns will over-estimate the impact of these effects. Thus, this empirical evidence is in line with theory as it suggests greater levels of herding in smaller stocks. In order to evaluate the herding effect on small capitalization stocks[3] we re-estimate model (3) employing a small capitalization equity portfolio. To this end we created 5 quintiles based on market value and employed the smallest size one for our estimations. The empirical results presented in equation (13) confirm our assumptions since coefficient γ_3 is negative and higher compared to the results presented in Table 2. All coefficients apart from γ_1 are statistically significant at 1% level.

$$CSAD_t = 2.348 - 0.003 R_{m,t} + 0.892 |R_{m,t}| - 0.065\, \gamma_3 R^2_{m,t} + \varepsilon_t\,, \quad \text{Adj-R}^2\ 26.52\% \qquad (13)$$

[3] We would like to thank an anonymous reviewer for making this suggestion.

Table 3 reports the quantile regression results. The results employing the equally weighted returns (Panel A) indicate that herding is present only in the high quantiles of the cross sectional return dispersion. The sign and statistical significance of coefficient γ_3 change across quantiles, from positive for τ=10% to negative for τ=10%, τ=25%, τ=50%, τ=75% and τ=90%, with the results being statistically significant only for τ=75% and τ=90%. This finding is in line with Zhou and Anderson (2010), who document herding in the US REITS only in the high quantiles and attribute this behavior to high-quantile dispersion being typically associated with large market price movements and volatile market conditions. However, when employing the value weighted approach (Table 3, Panel B) there is no evidence of herding, consistent with the results of Table 2. In this case, coefficient γ_3 is positive for all quantiles and statistically significant for τ=50%, τ=75% and τ=90%.

Table 3. Quantile Regression Results for Model 3

	τ=10%	**τ=25%**	**τ=50%**	**τ=75%**	**τ=90%**
Panel A.	**Equal Weighted Market Returns**				
γ_0 (p-value)	0.6735 0.0000***	0.7553 0.0000***	0.8728 0.0000***	1.0150 0.0000***	1.1818 0.0000***
γ_1 (p-value)	0.0310 0.0837*	0.0138 0.4488	0.0520 0.0006***	0.0484 0.1580	0.0122 0.6210
γ_2 (p-value)	0.3156 0.0000***	0.4776 0.0000***	0.5806 0.0000***	0.7113 0.0000***	0.7420 0.0000***
γ_3 (p-value)	0.0167 0.4926	-0.0378 0.3902	-0.0541 0.1356	-0.0557 0.0001***	-0.0608 0.0966*
Adj-R^2	0.0922	0.1256	0.1682	0.2024	0.2573
Panel B.	**Value Weighted Market Returns**				
γ_0 (p-value)	0.0584 0.0000***	0.0779 0.0000***	0.1103 0.0000***	0.1540 0.0000***	0.1923 0.0000***
γ_1 (p-value)	0.0106 0.0178**	0.0108 0.0713*	0.0086 0.1340	0.0132 0.1731	0.0070 0.6706
γ_2 (p-value)	0.6713 0.0000***	0.6135 0.0000***	0.5509 0.0000***	0.4757 0.0000***	0.4568 0.0000***
γ_3 (p-value)	0.0139 0.4508	0.0948 0.1851	0.1879 0.0001***	0.2624 0.0009***	0.3024 0.0001***
Adj-R^2	0.4508	0.4352	0.4183	0.4225	0.4570

Notes: This table presents the estimated coefficients of the following model: $CSAD_t = \alpha + \gamma_1 R_{m,t} + \gamma_2 |R_{m,t}| + \gamma_3 R^2_{m,t} + \varepsilon_t$. Daily data from January 2007 to May 2015. ***,**,* statistically significant at 1%, 5% and 10% level, respectively.

The first column in Table 4 provides a more in depth examination of the asymmetric relationship between the CSAD and the equal weighted stock market return. In this case, only coefficient γ_4 is negative and statistically significant, thus indicative of herding in down markets. Even though Economou et al. (2011) identified herding in up markets in the ASE for the period 1998-2008, the respective coefficient obtained from our study for days with negative market returns indicates significant rise in herding on down market days, This finding could be related to the prolonged exposure to negative market returns in the ASE over the period under examination. The second column in Table 4 presents the same model as the first employing the value weighted method to calculate the stock market return. The coefficients of interest, γ_3 and γ_4, are 0.1204 and 0.1774 respectively without being statistically significant different from each other (Wald coefficient test p=0.35). Both are statistically significant and positive, indicating a lack of evidence of herding in the value weighted sample.

Table 4. Herding estimations – Market asymmetry

	Equal Weighted Market Returns	Value Weighted Market Returns
γ_0 (p-value)	0.9054 0.0000***	0.1203 0.0000***
γ_1 (p-value)	0.5764 0.0000***	0.5785 0.0000***
γ_2 (p-value)	0.5295 0.0000***	0.5434 0.0000***
γ_3 (p-value)	-0.0287 0.4265	0.1204 0.0187**
γ_4 (p-value)	-0.0374 0.0336**	0.1774 0.0055***
Adj-R^2	0.3406	0.6850

Notes: This table presents the estimated coefficients of the following model: $CSAD_t = \gamma_0 + \gamma_1(1-D)|R_{m,t}| + \gamma_2 D\,|R_{m,t}| + \gamma_3(1-D)\,R^2_{m,t} + \gamma_4 D\,R^2_{m,t} + \varepsilon_t,\ D = 1, \text{if } R_{m,t} < 0,\ \text{and } D = 0, \text{otherwise}.$ Daily data from January 2007 to May 2015. ***,**, statistically significant at 1% and 5% level, respectively.

Table 5 presents the herding behavior estimates using a dummy variable which is based on the previous 30-day moving average of total market trading volume of the firms listed in our dataset. Using the equal weighted market return results for coefficients γ_3 and γ_4, only coefficient γ_4 is significant at the 1% level, and negative, indicating the presence of herding during days where the value of the traded stocks was greater than the moving average. Employing value weighted approach to calculate market returns, the coefficients of interest, γ_3 and γ_4, change dramatically, with coefficient γ_3 plummeting to 0.3196 and coefficient γ_4 to 0.0872, being statistically significant different from each other (Wald coefficient test p=0.00). These results are statistically significant at 1% and 10% level respectively demonstrating a lack of herding in the trading volume model specification if market weighted returns are used.

Table 5. Regression Results for Trading Volume Dummy Based Model

	Equal Weighted Market Returns	Value Weighted Market Returns
γ_0 (p-value)	0.9200 0.0000***	0.1216 0.0000***
γ_1 (p-value)	0.4397 0.0000***	0.4846 0.0000***
γ_2 (p-value)	0.59455 0.0000***	0.5954 0.0000***
γ_3 (p-value)	-0.0048 0.8834	0.3196 0.0000***
γ_4 (p-value)	-0.0543 0.0064***	0.0872 0.0762*
Adj-R^2	0.3446	0.6885

Notes: This table presents the estimated coefficients of the following model: $CSAD_{i,t} = \alpha + \gamma_1(1 - D^v)|R_{m,t}| + \gamma_2 D^v|R_{m,t}| + \gamma_3(1 - D^v)R^2_{m,t} + \gamma_4 D^v R^2_{m,t} + \varepsilon_t$, $D^v = 1$, if high trading volume that day, $D^v = 0$ otherwise. Daily data from January 2007 to May 2015. ***,* statistically significant at 1% and 10% level, respectively.

Table 6 shows the impact of market return volatility on the relationship between the CSAD and the stock market return in equal weighted and value weighted terms. The results demonstrate significance of above average daily market return volatility in the relationship between the CSAD and the squared market return. This finding differs from the ones reported by Economou et al. (2011) that did not document asymmetric herd behavior with reference to market volatility for the period 1998-2008. This could be attributed to the large rise market return volatility given the economic turbulence in the Greek market over recent years. As a result, there is potential for herding to be caused by this mechanism. This issue certainly needs further examination and understanding, especially given the current Greek sovereign debt crisis and the risks that is exposes the whole European Union to. However, the asymmetric herding behavior disappears when we employ the value weighted approach. The second column in Table 6 presents a distinct difference in the sign of the variables of interest, with coefficient γ_3 (γ_4) being positive and statistically insignificant (significant). As a result, herding could be attributed mostly to small capitalization stocks since the phenomenon disappears taking market value into consideration.

Table 6. Regression results for Volatility Dummy Based Model

	Equal Weighted Market Returns	Value Weighted Market Returns
γ_0 (p-value)	0.9067 0.0000***	0.1138 0.0000***
γ_1 (p-value)	0.5928 0.0000***	0.7101 0.0000***
γ_2 (p-value)	0.5543 0.0000***	0.5516 0.0000***
γ_3 (p-value)	-0.0946 0.2071	0.0008 0.9978
γ_4 (p-value)	-0.0398 0.0140**	0.1819 0.0008***
Adj-R^2	0.3375	0.6919

Notes: This table presents the estimated coefficients of the following model: $CSAD_{i,t} = \alpha + \gamma_1(1 - D^{vl})|R_{m,t}| + \gamma_2 D^{vl}|R_{m,t}| + \gamma_3(1 - D^{vl})R_{m,t}^2 + \gamma_4 D^{vl} R_{m,t}^2 + \varepsilon_t$, $D^{vl} = 1$, if high market volatility that day, $D^{vl} = 0$, otherwise. Daily data from January 2007 to May 2015. ***,** statistically significant at 1% and 5% level, respectively.

Finally, Table 7 reports the results testing for asymmetries relative to the 10 year 10-year Greek Government bond spread for both the equal weighted and the value weighted samples as in equation (11). The results document evidence of herding on days with high as well as low spread compared to the 30-day moving average with coefficients γ_3 and γ_4 being both negative and statistically significant. However, there is an asymmetric impact on herding since coefficients γ_3 and γ_4 are statistically significant different from each other (Wald coefficient test p=0.02). As a result, herding is more pronounced on days when the 10-year Greek bonds display low spread. Even though this finding does not confirm our initial hypothesis of increased herding on days with high spreads, which is quite common during crisis periods, it is consistent with studies that indicate reduced herding during crisis periods (Bowe and Domuta, 2004) as well as greater impact of sentiment during non-crisis periods (Chung et al., 2012; Hudson and Green, 2015).

Table 7. Regression results for Spread Dummy Based Model

	Equal Weighted Market Returns	Value Weighted Market Returns
γ_0	0.8982	0.1203

(p-value)	0.0000***	0.0000***
γ_1 (p-value)	0.7735 0.0000***	0.5239 0.0000***
γ_2 (p-value)	0.5272 0.0000***	0.5815 0.0000***
γ_3 (p-value)	-0.2257 0.0071***	0.2160 0.1275
γ_4 (p-value)	-0.0276 0.0674*	0.1165 0.0293**
Adj-R^2	0.3451	0.6867

Notes: This table presents the estimated coefficients of the following model: $CSAD_{i,t} = \alpha + \gamma_1(1 - D^{spread})|R_{m,t}| + \gamma_2 D^{spread}|R_{m,t}| + \gamma_3(1 - D^{spread})R^2_{m,t} + \gamma_4 D^{spread} R^2_{m,t} + \varepsilon_t$, $D^{spread} = 1$, if high spread, $D^{spread} = 0$, otherwise. Daily data from January 2007 to May 2015. ***,**,* statistically significant at 1%, 5% and 10% level, respectively.

4. Conclusions

This study is in line with the aggregate-data models of Chiang and Zheng (2010) and Economou et al. (2011), providing further insight into the recent developments of herding behavior in the the Greek stock market, i.e. in an economy undergoing a significant sovereign debt crisis. In order to test for herding towards the market consensus, we employ a survivorship bias free dataset, using the Worldscope Greece list of stocks from January 2007 to May 2015. Herding asymmetry has been tested for different market states regarding market return, trading volume, volatility and 10-year government bond spread alongside the basic model.

The empirical results are very conclusive, demonstrating herding in the case of the equal weighted market returns, being stronger in down markets, high volume and high market volatility days. This is consistent with previous studies about the ASE, as well as other studies that examine less developed economies, or economies undergoing extreme price movements (Chang et al., 2000; Chiang and Zheng, 2010; Economou et al., 2011). Moreover, testing for the impact of sovereign bond spreads herding behavior is more pronounced on days with low spreads. Finally, employing the quantile regression method, we document herding only in the high quantiles of the cross sectional return dispersion.

However, these empirical results are derived using an equal weighted market return measure to compute CSAD, and are not robust when size effect is accounted for indicating the impact of size effect on herding estimations in a thinly traded market. According to this finding, herding in the ASE can be attributed to small capitalization stocks.

The empirical findings are of significant importance, especially given the current economic situation in Greece and the ongoing sovereign debt crisis. A better understanding of the market participants' decisions could provide valuable insight for portfolio management and trading strategies formation. Investors should take into consideration the impact of herding in the asset allocation process, especially on small capitalization stocks, since correlated trading patterns reduce diversification benefits, exposing at the same time market participants to additional risk.

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