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Herding behavior in the Athens Stock Exchange

Abstract

This paper tests whether herding characterizes the behavior of investors in the Athens Stock Exchange (ASE) over the 1985-2004 period. Rational asset pricing suggests that given the exposure of stock prices to systematic factors, large market price increases or decreases will be associated with a larger dispersion of individual stock returns around the market aggregate. In contrast, if herding occurs, stock prices will be tightly clustered around the market aggregate. The methodologies applied are the Cross Sectional Standard Deviation (CSSD) suggested by Chang and Huang (1995) and the Cross Sectional Absolute Deviation (CSAD) suggested by Chang, Cheng and Khorana (2000). We find little evidence of herding behavior over the whole 1985-2004 period. However, when we restrict the sample to the 1998-2004 sub-period, a period of significant market advance followed by correction, we find strong evidence of herding in both up and down markets. When we split the testing period into yearly sub-periods we find evidence of herding in some years and of anti-herding (or exaggeration of differences) in others. Investor behavior appears rational for half the years in the sample. In addition, the empirical evidence suggests that firm size plays no role in herding behavior in ASE.

Keywords: herding behavior, cross-sectional standard deviation, cross-sectional absolute deviation.
JEL Classification: G15.

Introduction

The issue of whether investors, individual or institutional, follow the lead of other investors or herd when they trade is important in understanding the way information about securities is reflected in market prices. There is now evidence that institutional investors like mutual funds tend to herd in their buying decisions[1] and evidence of herding by foreign investors investing in emerging markets and futures traders[2]. There is also evidence of herding in financial analyst forecasts[3].

Another strand of the literature, more relevant for this paper, examines the herding behavior of individual investors. Christie and Huang (1995) argue that individuals are more likely to suppress their own beliefs and follow the market consensus during periods of market stress. Rational asset pricing suggests that given the exposure of stock prices to systematic factors, large market price increases or decreases will be associated with a larger dispersion of individual stock returns around the market aggregate. In contrast, if herding occurs, stock prices will be tightly clustered around the market aggregate. The testing methodology involves examining whether individual stock return dispersion around the market aggregate is actually lower during periods of abnormal price changes. Based on monthly and daily returns from the US market, Christie and Huang (1995) find little evidence of herding among US investors. Empirical results against herding are also reported by Gleason, Lee and Mathur (2003) in their study of thirteen futures contracts traded on three European exchanges. Chang, Cheng and Khorana (2000), using a variant of the methodology used by Christie and Huang (1995) and data from the US, Japan, Hong Kong, South Korea and Taiwan, find evidence of herding only for the two emerging stock markets. They argue that this could be due to more government intervention, the paucity of reliable company information and the presence of more speculators compared to long-term investors in those markets.

Academic research suggests that evidence of herding is likely to be observed during periods where information is poor or of low precision and where volatility is high. The behavior of investors and stock prices in the Greek stock market during the late nineties provides a suitable environment to examine whether investors herd or not. During the 1997-1999 period, the Greek stock market attracted a large number of first time private investors. Between January 1997 and August 1999 stock prices increased by 493%. The stock market crash that followed took the Athens Stock Exchange (ASE) general index from 5712.3 in November 1999 to 1467.3 in March 2003, a fall of 74.3%[4]. That behavior led many commentators in the popular and financial press to conclude that the meteoric rise of stock prices and the subsequent demise were the result of extreme herding by institutional and in particular individual investors.

This paper focuses on the behavior of the Athens Stock Exchange (ASE) over the 1985-2004 period, and examines whether herding behavior was a key

[1] Wermer (1997), Grinblatt, Tittman and Wermers (1995), Wylie (2000). Stronger evidence for mutual fund herding was obtained by Lobao and Serra (2006) for the Portuguese market.

[2] Choe, Kho, and Stulz (1999) and Borensztein and Gelos (2000). Kodres and Pritsker (1996) reported herding in daily trading by large futures market institutional traders.

[3] Welch (2000), and Graham (1999).

[4] The rise in stock prices was also accompanied by a significant increase in market volatility. Market volatility, which averaged 25% during 1990-1996, increased to 38% during 1998 and 39% during 1999 and 2000.

market characteristic. Using the testing methodology developed by Chang, Cheng and Khorana (2000), we find little evidence of herding behavior over the whole 1985-2004 period. However, when we restrict the sample to the 1998-2004 sub-period, a period of significant market advance followed by correction (see Figure 1), we find strong evidence of herding in both up and down markets.

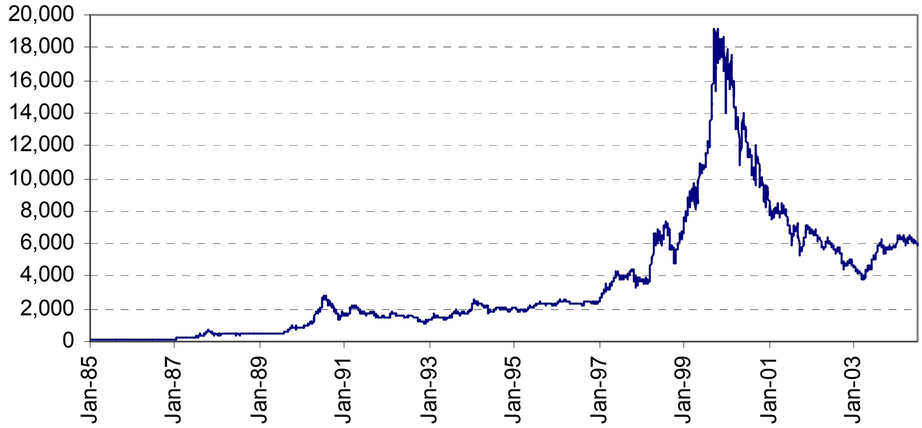

Fig. 1. Athens Stock Exchange (ASE) market index

To examine the possibility that herding might be concentrated in some periods and be absent or might even be reversed in others we apply the Chang, Cheng and Khorana (2000) methodology to annual sub-periods. The evidence from annual sub-periods shows that there are years where investor behavior is rational, years where investors herd in the sense that stock returns are much closer to the market average than the rational model predicts and years where the dispersion of stock returns actually increases with an increase in market returns. The evidence in favor of herding or anti-herding is not driven by either large or small capitalization stocks.

The paper is structured as follows. In section 1 we present the data and the research methodology. Section 2 contains the empirical results. And the last section concludes the paper.

1. Methodology and data

Christie and Huang (1995) argue that during periods of large price movements, individual investors may ignore their own information about stock prices and instead base their trading decisions on the behavior of the market. If investors herd, ex post, individual stock returns will tend to be clustered closely to the return of the market. Christie and Huang (1995) use the cross sectional standard deviation (CSSD) of individual stock returns as a measure of the degree of clustering around the market aggregate. CSSD is defined as:

$$CSSD_t = \sqrt{\frac{\sum_{i=1}^{N}(R_{it} - R_{mt})^2}{N-1}}, \qquad (1)$$

where R_{it} is the return of stock i at time t and R_{mt} is the equally weighted average return of the N stocks available on day t.

Rational asset pricing suggests that an increase in market returns will be associated with an increase in the cross sectional standard deviation of stock returns given the exposure of individual stock returns to the market portfolio. In contrast, in the presence of herding, $CSSD_t$ is expected to increase at a decreasing rate or it might even fall if herding is severe. Christie and Huang (1995) argue that herding will be stronger during the periods of extreme up or down market movements. To test herding during extreme market conditions Christie and Huang (1995) estimate the following regression model:

$$CSSD_t = a + b_L D_t^L + b_U D_t^U + e_t, \qquad (2)$$

where D_t^L (D_t^U) is a dummy variable that equals 1 when the market return at day t lies in the extreme lower (upper) x percent of observations, and 0 otherwise; x is defined as 1%, 5% and 10% of observations in the lower or upper tail of the market return distribution.

In the absence of herding, during extreme market movements, individual stock returns exhibit high volatility and the estimated coefficients b_L and b_U are positive. In contrast, negative estimates of coefficients b_L and b_U are consistent with the presence of herding behavior. Moreover, since short selling was prohibited in the ASE since June 2001 and thereafter is allowed only for hedging purposes to primary dealers in the derivatives exchange, in the presence of herding b_U would be expected to be more negative than b_L. Coefficient α captures the average dispersion of the returns in the sample excluding the periods covered by the dummy variables D^L and D^U.

The methodology developed by Christie and Huang (1995) aims to detect herding during extreme market movements. Chang, Cheng and Khorana (2000) suggest a variant of the Christie and Huang (1995) methodology which although similar in spirit could detect herding behavior in less extreme market movements. In place of the $CSSD_t$, Chang, Cheng and Khorana (2000) use the average cross-sectional absolute deviation ($CSAD_t$), defined as:

$$CSAD_t = \frac{\sum_{i=1}^{N} \left| R_{it} - R_{mt} \right|}{N}, \qquad (3)$$

where R_{it} and R_{mt} are defined as in $CSSD_t$ above. Chang, Cheng and Khorana (2000) show that under the CAPM assumptions, $CSSD_t$ should be a linear function of market returns. Any evidence that the relation is not linear could be interpreted as evidence in favor of herding behavior. To test for non-linearity Chang, Cheng and Khorana (2000) estimate the following regression:

$$CSAD_t = a + \gamma_1 \left| R_{mt} \right| + \gamma_2 \left(R_{mt} \right)^2 + e_t \,. \qquad (4)$$

Under rational asset pricing γ_1 is expected to be positive, reflecting the effect of stock exposures on the cross sectional absolute deviation, while γ_2 should be zero. If herding occurs, the coefficient of the non-linear term, γ_2 is expected to be negative indicating that after a market move, *CSAD* might be increasing at a decreasing rate or even falling if the absolute market return is large enough.

A positive γ_2 indicates that market movements cause more dispersion in stock returns than expected under rational pricing. A positive γ_2 is consistent with evidence of anti-herding or divergence in investment behavior[1].

To allow for the possibility that the degree of herding may be asymmetric in up and down markets, Chang, Cheng and Khorana (2000) estimate two more models:

$$CSAD_t^{UP} = a + \gamma_1^{UP} R_{mt}^{UP} + \gamma_2^{UP} \left(R_{mt}^{UP} \right)^2 + e_t \qquad (5)$$

and

$$CSAD_t^{DOWN} = a + \gamma_1^{DOWN} \left| R_{mt}^{DOWN} \right| + \gamma_2^{DOWN} \left(R_{mt}^{DOWN} \right)^2 + e_t \,, \qquad (6)$$

where R_{mt}^{UP} is the equally-weighted average return of the *N* stocks available on day *t* when this return is positive; $\left| R_{mt}^{DOWN} \right|$ is the absolute value of the equally-weighted average return of the *N* stocks available on day *t* when this return is negative; $CSAD_t^{UP}$ is the $CSAD_t$ for the day *t* where R_{mt} is positive; $CSAD_t^{DOWN}$ is the $CSAD_t$ for the day *t* where R_{mt} is negative.

To test whether herding or anti-herding was present in the Greek stock market during the 02.01.1985-30.06.2004 period we use daily continuous compounded returns for all the stocks (385) traded on the Athens Stock Exchange.

2. Empirical results

2.1. The cross-sectional standard deviation (CSSD). Figure 2 plots the statistic CSSD over the entire Jan 1985-Jun 2004 period. Table 1 gives the summary statistics for $CSSD_t$ and the equally weighted market return R_{mt} and the $CSAD_t$.

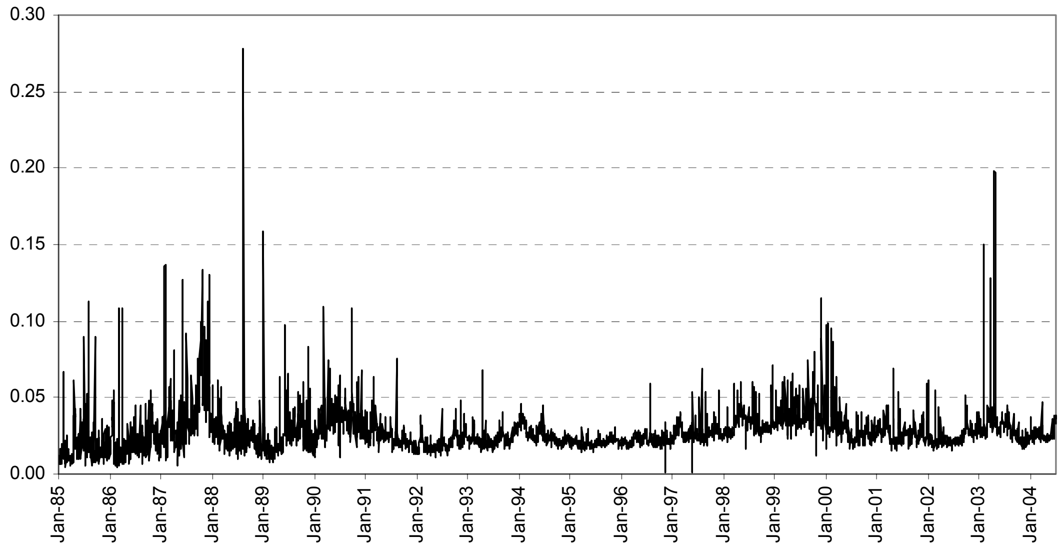

Fig. 2. Cross-sectional standard deviation (CSSD) in ASE

[1] The possibility of anti-herding is largely ignored in the herding literature. Intuitively it sounds as plausible as that of herding. Anti-herding or dispersion in investment behavior is discussed in Hirshleifer and Teoh (2003). Zitzewitz (2001) reports evidence of anti-herding behavior (exaggeration of differences) among financial analysts.

Table 1. Summary statistics for ASE (2/1/85 – 30/6/04)

	$CSSD_t$	R_{mt}	$CSAD_t$	$CSAD_t$ (UP)	$CSAD_t$ (DOWN)
Mean	0.0273	0.0008	0.0182	0.0190	0.0174
Maximum	0.2786	0.1576	0.1146	0.1094	0.1146
Minimum	0.0011	-0.1296	0.0002	0.0002	0.0010
Std. dev.	0.0137	0.0168	0.0085	0.0087	0.0082
Jarque-Bera P-value	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	4.846	4.846	4.846	2.541	2.305

Table 2 (Panel A) summarize the key results from the regression of equation (2) using the one percent, two percent, and five percent criteria for the selection of the dummy variables. The results from the ASE are similar to those reported from Christie and Huang (1995) for the NYSE and Amex. For all the criteria used the estimated coefficients are positive. In particular, the estimated coefficients for b_L and b_U are statistically significant different from zero and positive for the two percent and five percent criteria. The analysis failed to reject the null hypothesis of a zero coefficient for coefficient b_U at the one percent selection criterion. Overall, the empirical evidence suggests that herding behavior was not a driving force in the ASE over the entire 1985-2004 period.

In order to test whether herding was a temporary event that dominated the market behavior during the 1998-2003 period, Table 2 (Panel B) reports the regression results for this period. An important finding for sub-period of 1998-2003 is that coefficients b_L and b_U from positive become negative although not statistically significant. This evidence suggests that investment behavior in the latest period might be driven by factors that are not present throughout the entire sample period.

Table 2. Regression results for $CSSD_t$

	1 percent criterion	2 percent criterion	3 percent criterion
Panel A. (02.01.1985 - 30.06.2004)			
a	0.0272 (65.54)***	0.0271 (65.57)***	0.0266 (67.74)***
b_L	0.0090 (3.29)***	0.0081 (5.56)***	0.0758 (6.84)***
b_U	0.0067 (1.63)	0.0050 (2.23)**	0.0067 (4.82)***
Adj. R^2	0.2981	0.3009	0.3142
Durbin-Watson	2.14	2.14	2.13
Observations	4.845	4.845	4.845
Panel B. (1998 - 2003)			
a	0.0312 (47.21)***	0.0312 (47.21)***	0.0310 (45.43)***
b_L	-0.0018 (-0.81)	-0.0001 (-0.05)	0.0037 (3.24)***
b_U	-0.0010 (-0.11)	-0.0036 (-0.78)	-0.0008 (-0.41)
Adj. R^2	0.2550	0.2564	0.2595
Durbin-Watson	2.16	2.16	2.16
Observations	1.498	1.498	1.498

Notes: ***, ** stand for significance at the 1% and 5% levels, respectively. 1. Numbers in parentheses are t-statistics computed using the Newey-West (1987) covariance matrix that is consistent in the presence of both heteroscedasticity and autocorrelation. 2. An AR(1) variable is included to correct for autocorrelation.

2.2. The cross-sectional absolute deviation (CSAD). Figure 3 plots the statistic CSAD over the entire 1985-Jun 2004 period. Table 3 (Panel A) summarizes the regression results for equations (4), (5) and (6) over the entire period.

These results are similar to those reported by Chang, Cheng and Khorana (2000) for the US, Hong Kong and Japan markets. The coefficient γ_2 although negative is not statistically significant for the overall market and the up and the down markets. In addition, coefficient γ_1 is statistically significant and positive. These results support the linearity assumption implied by the CAPM and do not provide evidence in favor of the presence of herding behavior in the ASE over the entire sample period.

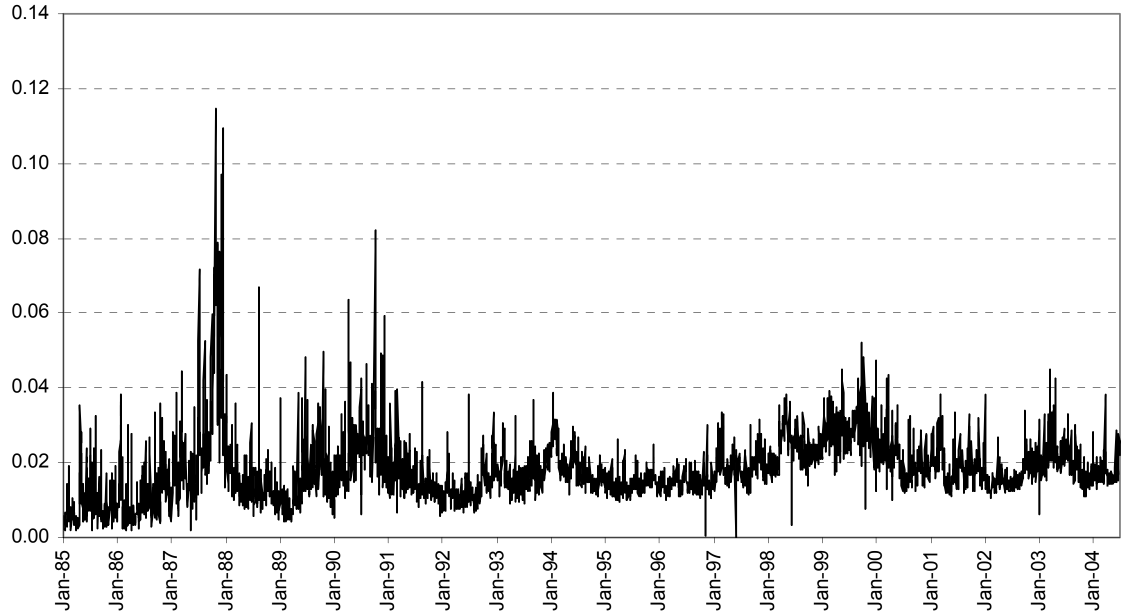

Fig. 3. Cross-sectional absolute deviation (CSAD) in ASE

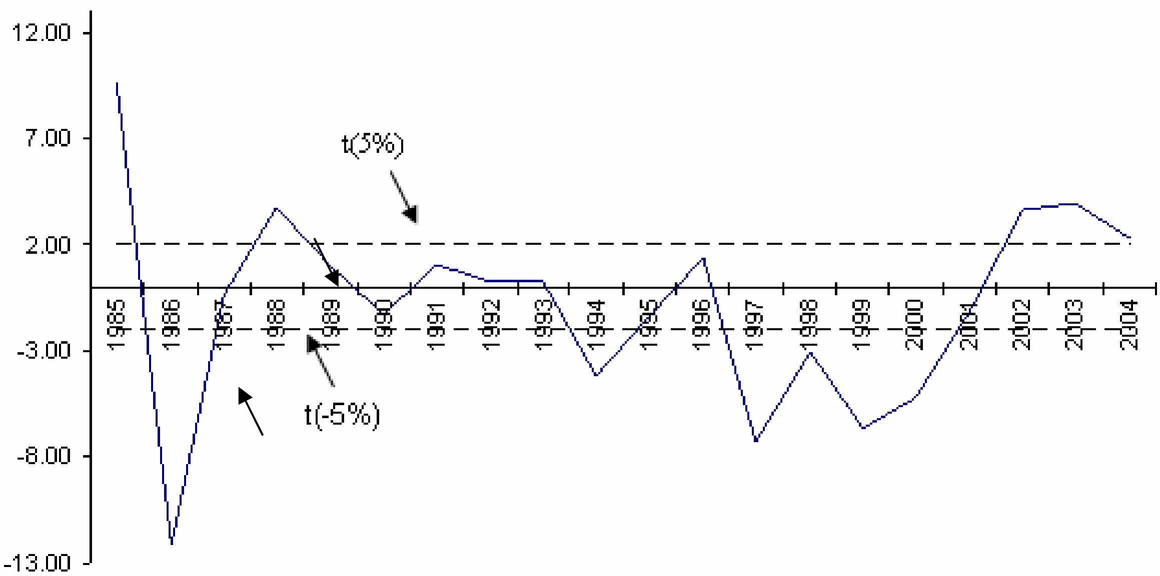

Fig. 4. T-statistic for coefficient Y_2

Table 3. Regression results for $CSAD_t$

	Total market (Eq. 4)	US market (Eq. 5)	Down market (Eq.6)
Panel A. (02.01.1985 - 30.06.2004)			
a	0.0154 (32.67)***	0.0134 (23.58)***	0.141 (23.13)***
γ_1	0.2772 (4.91)***	0.5476 (6.38)***	0.3384
γ_2	-0.5786 (-0.47)	-1.8297 (-0.91)	-1.0309 (-0.68)
Adj. R^2	0.6532	0.4165	0.6182
Durbin-Watson	2.43	0.97	2.30
Observations	4.845	2.540	2.304

Table 3 (cont.). Regression results for $CSAD_t$

Panel B. (1998 - 2003)			
	Total market (Eq. 4)	US market (Eq. 5)	Down market (Eq.6)
a	0.0193 (33.84)***	0.1099 (29.36)***	0.0177 (24.66)***
γ_1	0.2560 (6.48)***	0.3190 (8.85)***	0.2910 (7.29)***
γ_2	-3.2680 (-3.75)***	-5.0104 (-5.73)***	-3.0586 (-3.81)***
Adj. R^2	0.5624	0.5495	0.5646
Durbin-Watson	2.51	2.38	2.33
Observations	1.499	779	718

Notes: *** stand for significance at the 1% level. 1. Numbers in parentheses are t-statistics computed using the Newey-West (1987) covariance matrix that is consistent in the presence of both heteroscedasticity and autocorrelation. 2. An AR(1) variable is included to correct for autocorrelation.

However, the results of the 1998-2003 sub-period provide evidence against the linearity assumption implied by the CAPM and suggest the presence of herding. For both the up and down markets as well as the total market, coefficient γ_2 is negative and statistically significant. This suggests that as the average equally-weighted market return increases in absolute terms, the cross-sectional absolute deviation (CSAD) increases but at a decreasing rate[1]. These results are similar to those reported by Chang, Cheng and Khorana (2000) for the South Korea and Taiwan markets.

Table 4. Regression results for $CSAD_t$

Year	Estimated coefficient γ_2	Estimated t-statistic for γ_2	Level of significance
1985	1.53	9.61	***
1986	-4.14	-12.05	***
1987	-0.48	-0.32	
1988	0.37	3.78	***
1989	0.50	1.00	
1990	-1.21	-1.27	
1991	0.57	1.06	
1992	0.29	0.26	
1993	0.16	0.26	
1994	-2.51	-4.15	***
1995	-0.84	-1.30	
1996	0.47	1.34	
1997	-4.75	-7.22	***
1998	-2.72	-3.02	***
1999	-8.22	-6.61	***
2000	-5.84	-5.20	***
2001	-4.34	-1.07	
2002	2.39	3.61	***
2003	3.29	3.99	***
2004	3.39	2.34	**

Notes: ***, ** and * stand for significance at the 1%, 5% and 10% levels, respectively. 1. Numbers in parentheses are t-statistics computed using the Newey-West (1987) covariance matrix that is consistent in the presence of both heteroscedasticity and autocorrelation. 2. An AR(1) variable is included to correct for autocorrelation.

To further investigate the behavior of CSAD over shorter periods, equation (4) is estimated in each year and the results are presented in Table 4 (Figure 4 plots the estimated annual t-statistics). The yearly estimates of coefficient γ_2 are negative and statistically significant for 1986, 1994 and the entire 1997-2000 period. During these years there is clear evidence of herding in the behavior of investors in the ASE.

The strong evidence of herding during the 1997-2000 period coincides with major institutional and regulatory reforms. The number of companies listed on the Athens Stock Exchange increased from 190 companies in 1995 to over 300 ones at the end of 2000. With the introduction of electronic trading, liquidity was improved greatly while the number of individual investors participating in the market increased significantly. Many commentators attribute the rise and fall in prices during this period to the trading activity of new and uninformed individual investors. The period was also characterized by an increase in the volume of stocks traded[2] and volatility.

However, the sign of the coefficient of the non-linear term, γ_2, is positive and statistically significant in 1985, 1988 and during the 2002-2004 pe-

[1] The empirical findings for the 1998-2003 period do not change when the coefficient γ_2 is estimated using rolling OLS (Figure 5).

[2] During the 1985-2004 period, on average, the value of stocks traded monthly represented 5.7% of total market capitalization. During 1999 the monthly value traded was in excess of 20% of market capitalization.

riod. During these years investors seem to diverge rather than converge to the market average (anti-herding). For 9 of the 20 years in the sample, there is little evidence of herding or anti-herding.

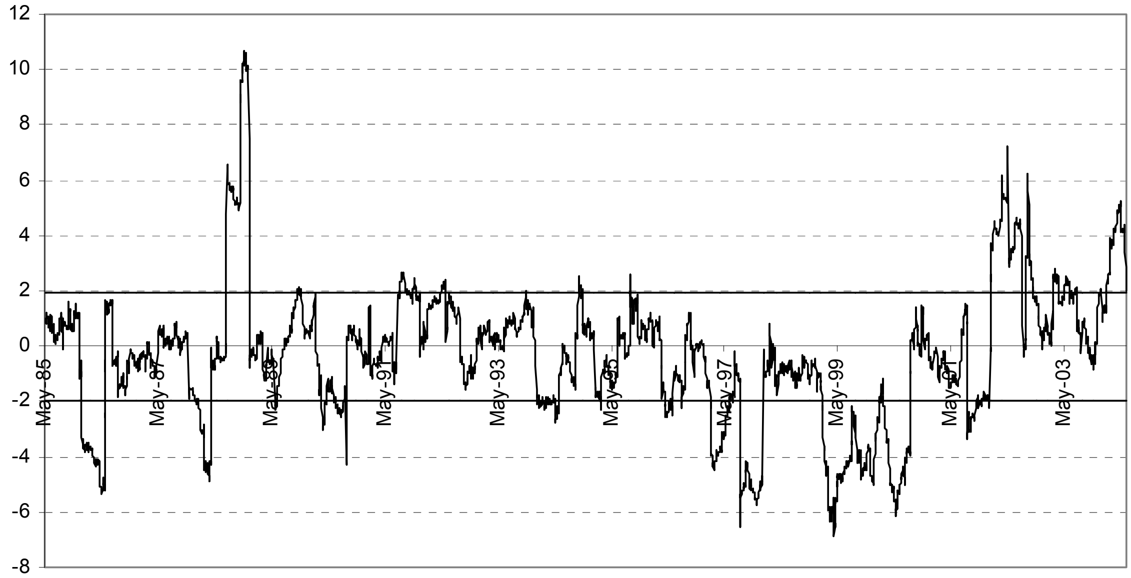

Fig. 5. T-statistic for γ_2 using rolling OLS

2.3. Herding behavior and size. The evidence presented above is based on the stocks traded on the ASE. However, small stocks have quite different characteristics than large stocks. Small stocks on the ASE have higher volatility than large stocks, less information, fewer analysts covering them and tend to be preferred by private rather than institutional investors. Most of their shares tend to be held by the founding shareholders (small free float). It is therefore possible that the herding or anti-herding behavior observed earlier might be dependent on size (Wermers (1999) finds that herding is greater in small, growth stocks). To test whether investors in large versus small stocks have different behavior we split the sample in three size groups according to the year end total market capitalization of each company and re-estimate equation 4. Tables 5 and 6 show the results from the estimation of equation 4 over the entire period, the 1998-2003 sub-period and the yearly periods. The empirical results indicate that there isn't any evidence to suggest that company size played a particular role within the period.

Table 5. Regression results for $CSAD_t$ based on size

	Total market (Eq.4.)	Large (Eq. 4)	Medium (Eq. 4)	Small (Eq. 4)
Panel A. (02.01.1985 - 30.06.2004)				
a	0.0154 (32.67)***	0.0120 (41.16)***	0.0153 (34.16)***	0.0155 (23.06)***
γ_1	0.2772 (4.91)***	0.0619 (10.36)***	0.2501 (5.20)***	0.4869 (5.03)***
γ_2	-0.5786 (-0.47)	-0.1288 (-0.26)	0.1655 (0.19)	-3.3445 (-1.74)
Adj. R^2	0.6532	0.5991	0.5480	0.5179
Durbin-Watson	2.43	2.34	2.34	2.32
Observations	4845	4882	4882	4882
Panel B. (1998 - 2003)				
a	0.0193 (33.84)***	0.0137 (36.60)***	0.0186 (34.18)***	0.0232 (33.91)***
γ_1	0.2560 (6.48)***	0.2886 (10.69)***	0.2774 (7.56)***	0.2358 (6.96)***
γ_2	-3.2680 (-3.75)***	-3.6586 (-5.79)***	-3.9297 (-4.95)***	-3.6663 (-5.41)***
Adj. R^2	0.5624	0.5622	0.5110	0.5275

Table 5 (cont.). Regression results for $CSAD_t$ based on size

	Total market (Eq.4)	Large (Eq. 4)	Medium (Eq. 4)	Small (Eq. 4)
Durbin-Watson	2.51	2.41	2.47	2.49
Observations	1498	1498	1498	1498

Notes: ***, ** and * stand for significance at the 1%, 5% and 10% levels, respectively. 1. Numbers in parentheses are t-statistics computed using the Newey-West (1987) covariance matrix that is consistent in the presence of both heteroscedasticity and autocorrelation. 2. An AR(1) variable is included to correct for autocorrelation.

Table 6. Regression results for $CSAD_t$ based on size

Year	Large		Medium		Small	
	γ_2	t-stat level	γ_2	t-stat level	γ_2	t-stat level
1985	5.22	0.40	-0.13	-0.05	0.31	0.19
1986	-6.35	-4.12***	0.20	0.04	-13.81	-3.81***
1987	-1.31	-4.59***	-1.48	-5.22***	-2.06	-2.69***
1988	-2.32	-1.18	-4.98	-1.00	-2.18	-0.91
1989	-0.24	-0.22	-2.31	-0.73	-3.15	-0.77
1990	-1.06	-1.39	-0.75	-0.31	-0.40	-0.19
1991	-0.32	-0.23	-0.97	-0.34	4.08	1.67*
1992	0.01	0.08	0.49	0.38	1.52	0.25
1993	-1.22	-1.01	-2.75	-2.00**	-0.65	-0.16
1994	-4.31	-2.62***	-4.89	-2.94***	-9.95	-3.27***
1995	-2.79	-1.93*	-1.17	-0.56	-3.80	-1.97**
1996	-0.93	-0.57	-2.88	-0.70	-3.16	-0.65
1997	-6.64	-7.83***	-6.41	-3.55***	-10.16	-6.16***
1998	-6.25	-6.12***	-3.95	-3.40***	-4.74	-2.12**
1999	-5.28	-7.13***	-7.82	-9.70***	-9.00	-11.46***
2000	-3.69	-3.57***	-4.71	-5.09***	-4.26	-5.16***
2001	-1.02	-1.75*	-1.52	-4.59***	-1.92	-2.48**
2002	2.12	0.87	2.81	2.21**	0.73	2.17**
2003	3.54	3.25***	3.08	3.24***	2.27	2.63***
2004	5.84	4.68***	2.33	4.24***	-0.12	-0.18

Notes: ***, ** and * stand for significance at the 1%, 5% and 10% levels, respectively. 1. Numbers in parentheses are t-statistics computed using the Newey-West (1987) covariance matrix that is consistent in the presence of both heteroscedasticity and autocorrelation. 2. An AR(1) variable is included to correct for autocorrelation.

Conclusions

Using the testing methodologies suggested by Chang and Huang (1995) and Chang, Cheng and Khorana (2000) we find that herding was not a dominant behavior in the ASE over the whole 1985-2004 period. However, when we test for herding in the 1998-2004 sub-period, a period of significant market advance followed by correction, we find strong evidence of herding behavior. The dispersion of individual security returns around the market increases at a decreasing rate and in some cases falls as the absolute return on the market portfolio changes. Tests for evidence of herding behavior within individual years reveal that in some years security returns are clustered closely to the market portfolio returns (herding) and in some years returns are more dispersed around the market aggregate compared with rational behavior (anti-herding). Almost in half the years in the sample investment behavior is consistent with rational behavior. Herding or anti-herding is not a permanent feature of investor behavior. Capitalization does not appear to play a particular role in the herding behavior.

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