HERD BEHAVIOUR IN EXTREME MARKET CONDITIONS: THE CASE OF THE ATHENS STOCK EXCHANGE

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Abstract

This paper examines herd behaviour in extreme market conditions using data from the Athens Stock Exchange. We test for the presence of herding as suggested by Christie and Huang (1995) and Chang, Cheng, and Khorana (2000). Results based on daily, weekly and monthly data indicate the existence of herd behaviour for the years 1998-2007. Evidence of herd behaviour over daily time intervals is much stronger, revealing the short-term nature of the phenomenon. When the testing period is broken into semi-annual sub-periods, herding is found during the stock market crisis of 1999. Investor behaviour seems to have become more rational since 2002, owing to the regulatory and institutional reforms of the Greek equity market and the intense presence of foreign institutional investors.

Keywords: Herd behaviour, Athens Stock Exchange, Cross-sectional dispersion of returns

JEL classification code: G15

I. Introduction

Herding can be defined as mutual imitation leading to a convergence of action (Hirshleifer and Teoh, 2003). A growing body of literature analyses herding in the stock market using measures of dispersion around the market return during periods of significant changes in stock prices (Christie et al., 1995; Chang et al., 2000; Caparrelli et al., 2004; Tan et al., 2008 etc). The rationale is that if during these periods of market pressure movements of stock returns have the tendency to be more clustered, this is evidence that there is co-movement of stock prices which is independent of their fundamental characteristics. According to Christie and Huang (1995), these periods are particularly informative because a "herd" is more likely to form under conditions of market stress, when individual investors tend to suppress their own beliefs and follow the market consensus. Cross-sectional dispersions of returns are predicted to be low when herd behaviour is present.

II. The Case of the Athens Stock Exchange

The Athens Stock Exchange (ASE) was founded in 1876. Until 1987, the ASE was almost exclusively a domestic market. In recent years the Greek equity market has undergone important regulatory and institutional reforms with significant growth in size and liquidity. Moreover, there has been increased attention from the international investors since 2001, when Morgan Stanley gave ASE the status of a developed market. The Greek equity market provides an interesting setting for the analysis of herd behaviour, especially during the period of crisis of the late 1990's. Between 1/1/1998 and 17/9/1999 (historic high) stock prices increased by 332.69%. The stock market crash that followed resulted in a fall in the ASE general index to 1467.30 in 31/3/2003, i.e. a 77.88% loss. The crash shook investor confidence and had major economic implications, especially for individual investors. Even now, some domestic investors continue to be uncertain about growth prospects for the ASE. The impressive rise of the stock market that ensued attracted thousands of new investors, especially domestic and small ones (Fig. 1). In September 1999 there were 145.817 new investor shares. The sharp upward and downward movements in returns could then be attributed to herd behaviour, reflecting the massive trading of new, inexperienced and uninformed individual investors. The present paper examines the stock market crisis of 1999 in the ASE providing a herding explanation, which has not been done before.

III. Methodology and Data

Christie and Huang (1995) and Chang, Cheng and Khorana (2000) argued that herding can be analysed using cross-sectional methods for asset returns, since a smaller cross-sectional dispersion of returns indicates parallel movement with the cross-sectional mean return, that is to say movement towards some type of market consensus. They used such measures to detect herding in special periods of extreme upward or downward movements in returns. However, it is not necessarily the case that herding is only present during such periods of turmoil, and restricting the analysis to them does not allow one to study how this phenomenon might evolve over time.

The type of herding that these particular measures examine is market-based and is quite different from the usual definition of herding, which refers to subgroups of investors behaving similarly, buying or selling the same assets simultaneously. In the latter case individual stock returns follow the market return. Both definitions are valid, though, and can lead to asset mispricing.

Christie and Huang (1995) estimated the cross-sectional standard deviation (CSSD) of single stock returns with respect to market returns, which is expressed as:

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

where $R_{i,t}$ is the observed stock return of firm i at time t, $R_{m,t}$ is the cross-sectional average return of the N returns in the market portfolio at time t, and N is the number of stocks in the market portfolio. The CSSD of returns was then regressed against a constant and two dummies in order to identify the extreme market phases, with $D^L = 1$ if the market return on day t lies in the extreme 1% and 5% lower tail of the distribution of market returns (and zero otherwise), and $D^U = 1$ if it lies in the extreme 1% and 5% upper tail of the same distribution (and zero otherwise):

$$CSSD_t = a + b_1 D_t^L + b_2 D_t^U + e_t \qquad (2)$$

where the α coefficient denotes the average dispersion of the sample excluding the regions corresponding to the two dummy variables. According to this model, statistically significant negative values for b_1 and b_2 indicate the presence of herd behaviour.

When individual returns herd around the market consensus, dispersions are predicted to be relatively low. By contrast, rational asset pricing models predict an increase in dispersion because individual assets differ in their sensitivity to the market return.

Although the cross-sectional standard deviation of returns is an intuitive measure for capturing herding, it can be considerably affected by the existence of outliers. That is why Christie and Huang (1995) as well as Chang, Cheng and Khorana (2000) proposed the use of the cross-sectional absolute deviation, (CSAD), as a better measure of dispersion:

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

where $R_{i,t}$ is the observed stock return of firm i at time t, $R_{m,t}$ is the cross-sectional average return of N stocks in the portfolio at time t, and N is the number of stocks in the portfolio. The equation for the CSAD corresponding to Equ. (2) is the following:

$$CSAD_t = a + b_1 D_t^L + b_2 D_t^U + e_t \tag{4}$$

Chang, Cheng and Khorana (2000) proposed an alternative approach to the one suggested by Christie and Huang (1995), using the entire distribution of market returns, as in the following equation:

$$CSAD_t = a + \gamma_1 \left| R_{m,t} \right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \tag{5}$$

The relationship between $CSAD_t$ and $R_{m,t}$ is used to detect herd behaviour. According to Chang, Cheng, and Khorana (2000), in the presence of herding the relationship between $CSAD_t$ and the average market return is non-linear. A significantly negative coefficient γ_2 implies the presence of herd behaviour. This is likely to increase the correlation among individual asset returns, and the dispersion among asset returns will either decrease or increase at a decreasing rate. If market participants are more likely to herd during periods of large price movements, then there should be a less than proportional increase (or decrease) in the CSAD measure. In the absence of herding, the relationship is linear and increasing, that is the dispersion increases proportionately with the increasing returns of the market.

Moreover, the relationship between CSAD and market returns may be asymmetric. This hypothesis can be tested using two different models:

$$CSAD_t^{UP} = \alpha + \gamma_1^{UP} \mid R_{m,t}^{UP} \mid + \gamma_2^{UP} (R_{m,t}^{UP})^2 + \varepsilon_t \ , \qquad \text{if } R_{m,t} > 0 \qquad (6)$$

$$CSAD_t^{DOWN} = \alpha + \gamma_1^{DOWN} \mid R_{m,t}^{DOWN} \mid + \gamma_2^{DOWN} (R_{m,t}^{DOWN})^2 + \varepsilon_t \ , \ \text{if } R_{m,t} < 0 \qquad (7)$$

The absolute values $\mid R_{m,t}^{UP} \mid$ and $\mid R_{m,t}^{DOWN} \mid$ are used because we are concerned with the size of the return, not with its sign. This also makes a comparison between γ_2^{UP} and γ_2^{DOWN} possible.

In order to examine herd behaviour in the ASE, we use daily, weekly, and monthly stock percentage log-differenced returns in our herding tests from January 1, 1998, to December 31, 2007. The data include all the stocks available on day t (minimum 215 stocks, maximum 337 stocks).

IV. Empirical results

Table 1 contains summary statistics for $CSSD_t$, $CSAD_t$ and the equally weighted market return $R_{m,t}$. Tables 2 and 3 report the regression results for $CSSD_t$ and $CSAD_t$ respectively. For all the criteria used the estimated coefficients for b_L and b_U are positive and statistically significant, suggesting the absence of herding during the period under investigation.

However, using the methodology of Chang, Cheng, and Khorana (2000), results based on daily, weekly and monthly data indicate the existence of herd behaviour over the whole 1998-2007 period. Table 4 reports the total market regression results. The coefficient γ_1 is positive and statistically significant for all the time intervals, confirming the results of the test with the dummy ($CSAD_t$

increases with $R_{m,t}$). The coefficient γ_2 is negative and statistically significant, suggesting the existence of herding, i.e. as the average market return becomes large in absolute terms, cross-sectional return dispersion increases at a decreasing rate (Fig. 2). The evidence of herding over daily time intervals is much stronger, revealing the short-term nature of the phenomenon.

Table 5 reports the herding regression results under asymmetric market conditions. The results suggest that herding is stronger during periods of a rising market. In fact, when using weekly and monthly time intervals, there is evidence of herding only during such periods. The coefficients indicate that, beyond a certain threshold point, the $CSAD_t$ may decline as $|R_{m,t}|$ increases. When substituting the estimated coefficients for the rising market ($\gamma_1^{UP} = 0.5266$ and $\gamma_2^{UP} = -0.1470$ using daily data) into Equ. (6), it is calculated that $CSAD_t$ reaches a maximum when $R_{m,t}$ =1,791%. Similarly, using the values for the down market ($\gamma_1^{DOWN} = 0.3271$ and $\gamma_2^{DOWN} = -0.0480$) and daily data, it is found that $CSAD_t$ reaches a maximum when $R_{m,t}$ = -3,407%. This suggests that for large swings in the market return, above these threshold points, $CSAD_t$ has a tendency to decrease.

To investigate the presence of herding during the stock market crisis of 1999, we break the testing period into semi-annual sub-periods, using daily data. Table 6 reports the results. There is evidence of herding during the stock market crisis of 1999, since the coefficient γ_2 is negative and statistically significant during the whole 1999 and the first semesters of 2000 and 2001. However, in several semesters the sign of the coefficient γ_2 is positive and statistically significant (1st semester 2002, 2004, 2nd semester 2005, 2006). In this case individual returns tend to diverge from the market returns (anti-herding).

V. Conclusions

This paper has examined the existence of herd behaviour in the ASE. Results based on daily, weekly and monthly data indicate that it is indeed present. Evidence of herding over weekly and monthly time intervals is much weaker, suggesting that it is a short-term phenomenon. These results are similar to those reported by Tan et. al. (2008) for the Chinese stock markets. Moreover, herding is found to be stronger during periods of rising markets. Another interesting aspect is the identification of threshold market returns, above which herd behaviour is more likely to occur.

We show the existence of significant herd behaviour both during and after the stock market crisis of 1999. However, investor behaviour seems to have become more rational since 2002, as the estimates for several subsequent semesters are consistent with rational behaviour. This change in investment behaviour can be attributed to the regulatory and institutional reforms of the Greek equity market and the diffuse presence of foreign institutional investors (Fig. 3). These findings have important implications for stock market efficiency and offer an interesting insight into the behaviour of Greek investors.

Regarding future research, it would be interesting to adjust the individual stock returns for thin trading, since the trading volume is extremely low in many cases.

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Table 1. Descriptive statistics

(1998-2007)	Daily data CSSD	Daily data CSAD	Daily data $R_{m,t}$	Weekly data CSSD	Weekly data CSAD	Weekly data $R_{m,t}$	Monthly data CSSD	Monthly data CSAD	Monthly data $R_{m,t}$
Observations	2,501	2,501	2,501	521	521	521	120	120	120
Minimum	0.6245	0.3735	-4.3861	1.4208	1.0056	-11.6226	3.2171	2.4036	-14.7085
Maximum	5.1687	2.3356	3.6053	9.6035	5.2392	10.993	11.1747	7.7786	16.4059
Mean	1.2877	0.8826	0.0129	2.8571	1.9961	0.0471	5.8066	4.1557	0.1843
Median	1.2105	0.8098	0.0263	2.6371	1.8028	0.0262	5.4344	3.7091	0.1628
Standard deviation	0.4103	0.2597	0.8385	0.9800	0.7118	2.1568	1.7326	1.3588	5.1724

Table 2. Regression results for $CSSD_t$ - Christie and Huang (1995)

$$CSSD_t = a + \beta_1 D_t^L + \beta_2 D_t^U + e_t$$

	Daily data 1% criterion	Daily data 5% criterion	Weekly data 1% criterion	Weekly data 5% criterion	Monthly data 1% criterion	Monthly data 5% criterion
α	1.2834	1.2550	2.8172	2.7238	5.7277	5.5736
t-statistic	(75.08)*	(76.47)*	(35.13)*	(37.04)*	(20.99)*	(20.20)*
β_1	0.3492	0.3472	1.8808	0.9813	1.0785	1.7230
t-statistic	(6.09)*	(10.57)*	(4.35)*	(5.06)*	(2.18)**	(4.70)*
β_2	0.0840	0.3061	1.5874	1.6915	3.6525	2.9367
t-statistic	(1.01)	(5.80)*	(5.27)*	(9.21)*	(11.59)*	(9.30)*
Adjusted R^2	0.0068	0.0566	0.0675	0.1774	0.0634	0.1624

Notes: Numbers in parentheses are t-statistics based on Newey–West (1987) consistent standard errors. *, ** and *** stand for statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Regression results for $CSAD_t$ - Christie and Huang (1995)

$$CSAD_t = a + \beta_1 D_t^L + \beta_2 D_t^U + e_t$$

	Daily data 1% criterion	Daily data 5% criterion	Weekly data 1% criterion	Weekly data 5% criterion	Monthly data 1% criterion	Monthly data 5% criterion
α	0.8787	0.8493	1.9584	1.8743	4.0820	3.9423
t-statistic	(66.88)*	(69.58)*	(32.43)*	(34.85)*	(19.07)*	(18.78)*
β_1	0.2900	0.3640	1.7773	0.9554	1.2613	1.6248
t-statistic	(4.59)*	(15.72)*	(4.66)*	(6.01)*	(3.12)*	(6.33)*
β_2	0.1040	0.3030	1.4914	1.4842	3.1624	2.6431
t-statistic	(1.78)***	(11.08)*	(4.70)*	(11.28)*	(11.20)*	(10.07)*
Adjusted R^2	0.0130	0.1491	0.1164	0.2754	0.0872	0.2250

Note: See notes for Table 2.

Table 4. Total market regression results - Chang, Cheng & Khorana (2000)

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

	Daily data	Weekly data	Monthly data
α	0.7093	1.4882	2.8468
t-statistic	(57.60)*	(25.84)*	(25.07)*
γ_1	0.3992	0.3772	0.3905
t-statistic	(13.64)*	(8.73)*	(6.28)*
γ_2	-0.0819	-0.0121	-0.0079
t-statistic	(-6.43)*	(-2.01)**	(-1.76)***
Adjusted R^2	0.2666	0.4153	0.5537

Note: See notes for Table 2.

Table 5. Up & Down market regression results - Chang, Cheng & Khorana (2000)

Panel A: Up market regression results

$$CSAD_t^{UP} = a + \gamma_1^{UP} \mid R_{m,t}^{UP} \mid + \gamma_2^{UP} (R_{m,t}^{UP})^2 + \varepsilon_t \quad , R_{m,t} > 0$$

	Daily data (1,306 observations)	Weekly data (266 observations)	Monthly data (64 observations)
α	0.7034	1.5278	2.8342
t-statistic	(45.97)*	(19.85)*	(20.17)*
γ_1^{UP}	0.5266	0.4954	0.5133
t-statistic	(13.51)*	(8.85)*	(6.05)*
γ_2^{UP}	-0.1470	-0.0297	-0.0146
t-statistic	(-8.81)*	(-3.71)*	(-2.45)**
Adjusted R^2	0.2762	0.4125	0.6067

Panel B: Down market regression results

$$CSAD_t^{DOWN} = a + \gamma_1^{DOWN} \mid R_{m,t}^{DOWN} \mid + \gamma_2^{DOWN} (R_{m,t}^{DOWN})^2 + \varepsilon_t \, , R_{m,t} < 0$$

	Daily data (1,195 observations)	Weekly data (255 observations)	Monthly data (56 observations)
α	0.7000	1.4464	2.7814
t-statistic	(44.13)*	(24.15)*	(15.41)*
γ_1^{DOWN}	0.3271	0.2687	0.3149
t-statistic	(9.96)*	(7.29)*	(5.24)*
γ_2^{DOWN}	-0.0480	0.0005	-0.0059
t-statistic	(-3.62)*	(0.09)	(-1.43)
Adjusted R^2	0.2924	0.4905	0.5746

Panel C: Wald Test H_0: $\gamma_2^{UP} - \gamma_2^{DOWN} = 0$

$\gamma_2^{UP} - \gamma_2^{DOWN}$	-0.0990	-0.0302	-0.0087
t-statistic	(-5.45)*	(-3.235)*	(-1.11)
Chi-square	[29.65]*	[10.47]*	[1.24]

Note: See notes for Table 2.

Table 6. Semi-annual regression results - Chang, Cheng & Khorana (2000)

	α	t statistic	γ_1	t statistic	γ_2	t statistic	Adjusted R-squared
A 1998	0.9384	14.91*	0.2963	2.57*	-0.0314	-0.52	18.63%
B 1998	0.9364	26.56*	0.1703	2.72*	-0.0201	-0.88	15.01%
A 1999	1.2166	27.68*	0.2888	4.77*	**-0.1394**	**-6.78***	17.34%
B 1999	1.2930	21.77*	0.2759	3.32*	**-0.1382**	**-5.24***	25.72%
A 2000	0.7936	18.62*	0.3919	5.45*	**-0.1008**	**-4.93***	18.87%
B 2000	0.6283	29.51*	0.1637	3.03*	0.0219	0.90	59.16%
A 2001	0.6424	15.93*	0.3121	6.85*	**-0.0284**	**-2.25****	39.63%
B 2001	0.6267	28.71*	0.2387	6.43*	-0.0180	-1.61	57.44%
A 2002	0.5770	39.93*	0.0176	0.51	**0.1645**	**9.76***	76.05%
B 2002	0.6392	32.39*	0.2377	3.87*	0.0201	0.58	57.57%
A 2003	0.7819	28.08*	0.2330	3.66*	0.0310	1.02	60.67%
B 2003	0.6309	17.20*	0.3167	4.07*	-0.0171	-0.37	41.00%
A 2004	0.6358	42.64*	0.2319	3.45*	**0.0556**	**2.19****	69.62%
B 2004	0.6895	31.92*	0.1705	1.77***	**0.2171**	**3.36***	59.61%
A 2005	0.6866	30.82*	0.5317	4.05*	-0.1020	-0.85	53.06%
B 2005	0.7212	40.72*	0.2380	3.06*	**0.1651**	**3.22***	52.39%
A 2006	0.7972	38.44*	0.2276	5.46*	**0.0334**	**2.16****	69.75%
B 2006	0.6747	42.75*	0.0938	1.09	**0.3299**	**2.94***	48.52%
A 2007	0.6857	71.14*	0.2629	4.13*	-0.0368	-1.00	32.89%
B 2007	0.6257	36.47*	0.2256	3.76*	0.0227	0.65	49.06%

Note: See notes for Table 2.

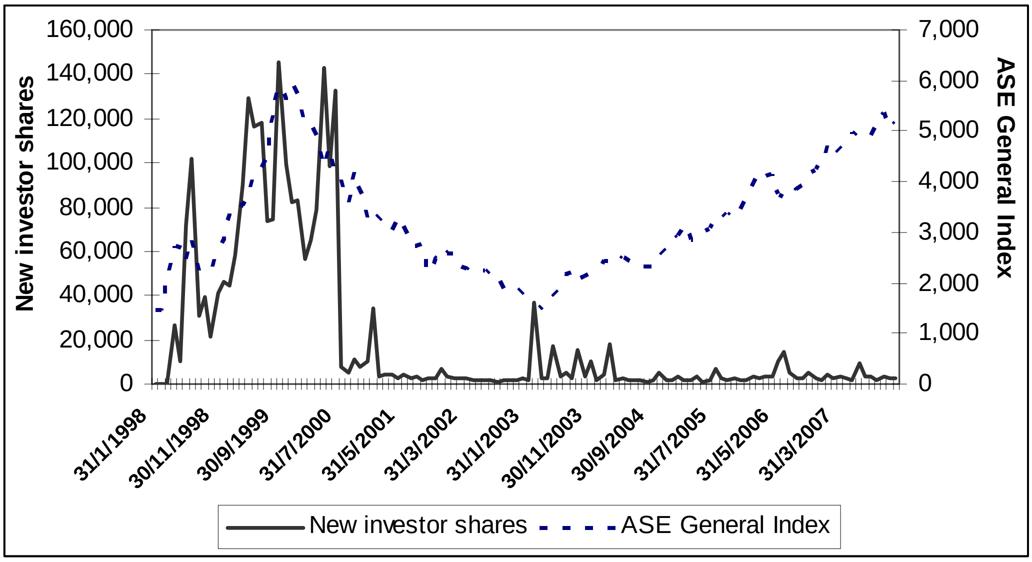

Fig. 1. ASE General Index and new investor shares (monthly data, 1998-2007). Sources: Thomson Datastream, ASE Monthly Statistics Bulletins

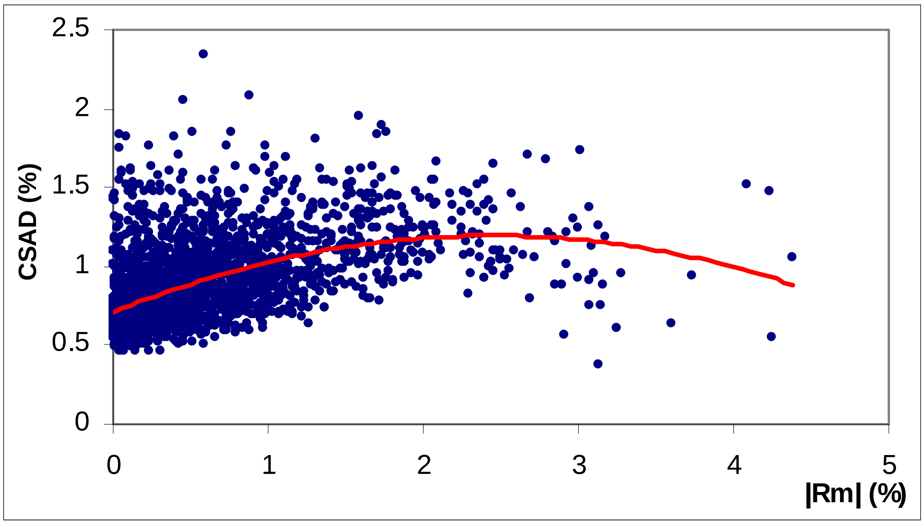

Fig. 2. Relationship between the daily cross-sectional absolute deviation ($CSAD_t$) and the corresponding equally-weighted absolute market return ($|R_{m,t}|$) for the ASE (January 1998-December 2007).

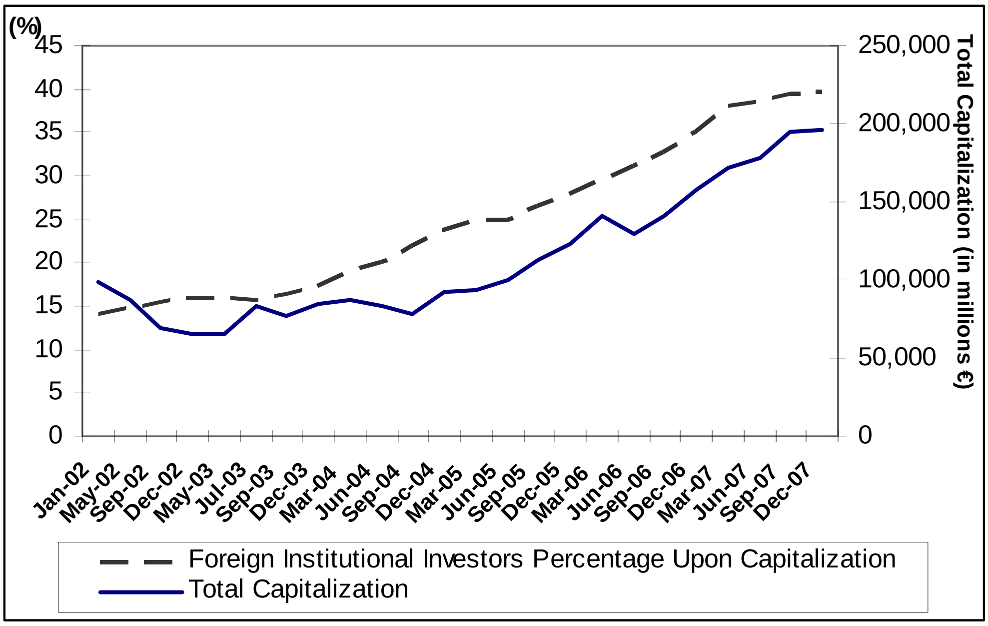

Fig. 3. Total market capitalization in the ASE and foreign institutional investors percentage upon capitalisation (quarterly data, 2002-2007).
Source: ASE Monthly Statistics Bulletins