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**_Non linear diachronic effects between stock returns and
mutual fund flows: Additional empirical evidence from the
Athens Stocks Exchange._**

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Abstract

This short paper examines the nonlinear interaction between mutual fund flows and
stock returns in Greece. We investigate the possibility of a nonlinear causality
mechanism through which mutual funds flows may affect stock returns and vice versa.
The statistical evidence derived from linear and nonlinear causality tests indicate   that
there is indeed a bidirectional nonlinear causality between mutual fund flows and stock
returns. We also detect a unidirectional causality from the Dow Jones Index to the
domestic stock price index and the domestic mutual fund flows.

Keywords: Mutual fund flows; Stock returns; Linear and Nonlinear Granger Causality.

JEL classification: G14

1. Introduction.

During the last decade, the mutual fund industry has experienced remarkable growth because of the benefits it offers to individual investors. By investing in the appropriate mutual fund instead of creating and managing an individual portfolio, investors can achieve greater diversification and professional management at reduced cost. As a result of this trend, an increasing proportion of the liquidity that is directed in and out of stock markets is the result of the decisions of fund managers, rather than individual investors. The hypothesis then to be tested is whether institutional investor flows have a direct influence on the movements of the stock prices around the world.

This investigation has both a theoretical interest related to the efficient market hypothesis, as well as a practical one, from the standpoint of market stability and sound investment decisions, therefore a large number of papers has focused on such issues[1]. However, there has been relatively less research on the relationship, if any, between stock returns and mutual fund flows in the Athens Stock Exchange[2]. We may mention the papers of Caporale, Phillipas and Pitis (2004)[3] and Alexakis, Niarchos, Patra and Pshakwale (2004), which provide analytical evidence for a bidirectional linear causality between mutual fund flows and stock returns over a period of nine years, combining causality tests and generalized response analysis .

This paper examines the interaction between mutual fund flows and stock returns in the Athens Stock Exchange. More specifically, it investigates the existence of a nonlinear causality mechanism in which mutual funds may affect stock returns and vice versa.

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[1] The diachronic relations between stock returns and mutual funds flows has been analysed by several authors such as, Ippolito (1992), Patel, Zeckhauser and Hendrics (1994), Sirri and Tufano (1993), see Lee et al., 1991 ,Warther (1995), Fortune (1998) to mention but a few.

[2] There have been a number of studies on the performance and efficiency of the Athens Stock Exchange (ASE) e.g., see Alexakis & Petrakis, 1991, Alexakis & Xanthakis, 1995, Karathanassis & Fillipas, 1993,1988, Koutmos et al., 1993, Niarchos, 1972, Niarchos & Alexakis, 1998, Panas, 1990, Caporale, Phillipas and Pitis(2004) and Alexakis, Niarchos, Patra and Pshakwale(2004).

[3] According to the results of this paper, they identify bidirectional linear causality between mutual funds and the returns of the Athens General Index. Also their results suggest a unidirectional causality from Dow Jones Index to the domestic stock price index and the domestic mutual fund flows.

This paper confirms and extends the results of the above two mentioned papers by using a different methodology, a more extended time period and a different measure of mutual fund flows. Using the standard linear causality procedure of Hsiao's (1981) with the help of the Box-Cox transformation, we provide analytical evidence and formulate a bidirectional nonlinear causality between mutual fund flows and stock returns. Further, possible feedbacks from international capital markets have been taken into account by including in the analysis the Dow Jones Index. This is very important as the omission of relevant variables can bias causality inference.

The remainder of this paper is organized as follows. Section 2 provides an overview of the Greek Mutual Fund industry, section 3 describes the data sets and the methodology used in this study, while Section 4 presents the empirical results. Finally, Section 5 provides a summary of the main findings and presents the conclusions of this study.

2. An overview of the Greek Mutual Fund Sector and the theoretical background.

Mutual funds were introduced in the Greek capital market in 1972 with the establishment of two equity/mixed funds. However, in the mid-1970s, a recession caused by a series of economic and political events hampered the growth of the mutual funds industry. The next 17 years were characterized by stagnation since no new mutual funds were started. In 1989, due to institutional changes in the Greek capital market and the good performance of the stock market, the interest of financial institutions in the mutual funds industry began to grow (Milonas, 1999). The growing trend continued and picked up pace in the following years, resulting in increasing the number of mutual funds to 365 with an investment volume exceeding Euro 40 million by the end of 2005. The mutual funds in the Greek market are classified as Domestic, when their assets are invested in the Greek capital markets, or International, with assets invested in foreign markets. Further, depending on the type of instrument they primarily invest in, they are classified as (a) money market funds which invest mainly in the money market products; (b) bond funds, investing mainly in bonds; (c) equity funds, investing mostly in common stocks; (d) mixed funds, investing in bonds, stocks and money market instruments [4].

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[4] Mutual funds were introduced in the Greek capital market in 1972 with the establishment of two equity/mixed funds. However, in the mid-1970s, a recession caused by a series of economic and political events hampered the growth of the mutual funds industry. The next 17 years were characterized by stagnation since no new mutual funds were started. In

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For the purpose of this paper, we focus on Equity Mutual Funds only. During the period of our analysis, equity mutual funds in Greece experienced tremendous growth. It is worth noting that at the beginning of the period, on 1/1/1997, 21 asset managers were managing 27 domestic equity funds with total funds under management of euro 467,5 divided into 68,2 million shares, representing 2,5% of the aggregate funds under management of all types. By the end of the period, on 31/12/2005, 25 companies were managing 61 domestic equity funds, totalling 5.9 billion of euro -a growth of 1,176% in nine years- representing 21% of all types of open ended funds under management. This trend indicates that the actions of fund managers have the potential to affect prices and the overall performance of the Stock Exchange, which during certain periods was characterized by lack of sufficient depth. The causality from stock prices to fund flows may be the result of the expectations of fund investors, who react to a certain upwards movement to stock prices by investing money into mutual funds shares, in the expectation that in the short run the upward stock price movement will continue. The opposite can be argued in the case of a market downturn. The opposite direction of causality can have as possible explanation the fact that most fund managers maintain a more or less pre-determined percentage of cash in their portfolios, mandated by regulations,[5] thus cash inflows are usually translated into new asset purchases, while outflows result in asset reduction. If most fund managers act in the same way, the prices of the stock market would be affected in the same direction. This phenomenon is frequently referred to as "momentum trading". Other explanations have been suggested in the literature, which in the case of Greece are less relevant.

1989, due to institutional changes in the Greek capital market and the good performance by the stock market, the interest of financial institutions in the mutual funds industry began to grow (Milonas, 1999). The growing trend continued and picked up pace in the following years, resulting in increasing the number of mutual funds to 365 with an investment volume exceeding Euro 40 million by the end of 2005. The mutual funds in the Greek market are classified as (a) money market funds which invest mainly in the money market products; (b) bond funds, investing mainly in bonds; (c) equity funds, investing mostly in common stocks; (d) mixed funds, investing in bonds, stocks and money market instruments; and (e) international funds, investing in foreign bonds and stocks. Depending on their investment objective, mutual funds are further classified into domestic (investing in Greece) and foreign (investing abroad). Additional information can be found in the papers of Caporale, Phillipas and Pitis(2004) and Alexakis, Niarchos, Patra and Pshakwale(2004).

[5] Equity mutual funds must at all times have between 50% and 90 % of their assets invested in stocks.

3. The data and methodology employed.

This study uses daily closing prices of the General Index (GI) of the Athens Stock Exchange (ASE). The General Index of the ASE is calculated by the Exchange itself and is intended to represent overall market trends. The GI includes 60 stocks, weighted according to their participation in total market capitalization and it is revised twice a year. Obviously, large cap stocks have a strong weight (the largest one has a 10% weight) and affect the index accordingly, however stocks from all industries and mid-cap stocks are included in the GI.

The aggregate net flow in equity mutual funds is expressed by the net change in the mutual fund units, as opposed to the change in Net Asset Value, utilized in other studies. In our view, this is a more appropriate measure of inflows into Mutual funds, given that the net Asset Value can change not only as a result of new flows but also according to the change in the value of the funds' assets, bearing by definition a high correlation with the evolution of stock prices measured by our other variable, the ASE index. The period under examination is from 07/01/1998 to 10/5/2005, giving us a total of 1835 observations for each series. The GI is adjusted for dividends, stock splits and reverse stock splits. Finally, in all cases, the logarithmic transformation of the original series is used. Although the time period we chose to investigate is somewhat arbitrary, it is long enough for the statistical techniques to be valid and it includes periods of strong growth, stagnation and decline.

Before we applied the causality tests, we investigated the order of integration using the Augmented Dickey Fuller test (ADF) for unit roots.

ADF test of the series

Variable	Levels	First difference
Stock index	-1,57	-12,67**
Fund flows	-1,97	−12,50**
Dow Jones	-1,97	−12,50**

Notes: The table reports the ADF test of the null hypothesis of nonstationarity (H_0). The numbers in brackets report the number of lags in the ADF regressions, determined on the basis of the Akaike Information Criterion (AIC). * Denotes rejection of the (H_0) at the 5% level. Double asterisks (**) indicate significance at 99% confidence interval The 5% critical value of the ADF test is −3.36. The results of this test showed that there is no

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cointegrated relationship for the examined variables.   Consequently, there is no long-run relationship between these three variables.

To test series for nonlinear causality, a transformation of   Hsiao's (1981) linear causality test was used in our analysis. The test is based on a trivariate VAR representation   for two stationary series x_t , y_t and z_t. The suggested   procedure for non linear causality is based on the trivariate VAR representation:

$$x(\lambda))_t = \alpha_0 + \sum_{i=1}^{n_1} \alpha_i x(\lambda)_{t-i} + \sum_{j=1}^{q_1} \beta_j y(\lambda)_{t-j} + \sum_{j=1}^{p_1} \gamma_j z(\lambda)_{t-j} + \varepsilon_{x,t} \tag{1}$$

$$y(\lambda))_t = \alpha_0 + \sum_{i=1}^{n_2} \alpha_i y(\lambda)_{t-i} + \sum_{j=1}^{q_2} \beta_j x(\lambda)_{t-j} + \sum_{j=1}^{p_2} \gamma_j z(\lambda)_{t-j} + \varepsilon_{y,t} \tag{2}$$

$$z(\lambda))_t = \alpha_0 + \sum_{i=1}^{n_3} \alpha_i z(\lambda)_{t-i} + \sum_{j=1}^{q_3} \beta_j x(\lambda)_{t-j} + \sum_{j=1}^{p_3} \gamma_j y(\lambda)_{t-j} + \varepsilon_{z,t} \tag{3}$$

with

$$y_t(\lambda) = \frac{y_t^{\lambda} - 1}{\lambda} \quad \kappa\alpha\iota \quad x_t(\lambda) = \frac{x_t^{\lambda} - 1}{\lambda} \quad z_t(\lambda) = \frac{z_t^{\lambda} - 1}{\lambda} \tag{4}$$

$$\lambda \in (0, +1) \tag{5}$$

and

$$y_{(\lambda)} = \log y \quad \kappa\alpha\iota \quad \chi_{(\lambda)} = \log \chi \quad \kappa\alpha\iota \quad z_{(\lambda)} = \log z \quad \lambda => 0 \tag{6}$$

where $x_t(\lambda)$, $y_t(\lambda)$ and $z_t(\lambda)$ are stationary variables and n and q are the lag lengths of $x_t(\lambda)$ and $y_t(\lambda)$ respectively. The null hypothesis in the Granger causality test is that $y_t(\lambda)$ does not cause $x_t(\lambda)$ which is represented by $H_0 : \beta_1 = \cdots \beta_q = 0$, and the alternative hypothesis is $H_1 : \beta_i \neq 0$ for at least one j in Equation (1). The test statistic has a standard F distribution with (n, T-n-q-1) degrees of freedom, where T is the number

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of observations. Akaike (1969) final prediction error (FPE)[6] is used to find the optimal lag lengths for both $x_t(\lambda)$ and $y_t(\lambda)$.

Following Hsiao (1981), we suggest a sequential procedure for testing non linear causality, for different values of the parameter λ, that combines Akaike's final predictive error criterion (FPE) and the definition of Granger causality. To test for causality from $y_t(\lambda)$ to $x_t(\lambda)$, the procedure consists of the following steps:

First, suppose n^* is the optimum lag length for the controlled variable $x_t(\lambda)$, then calculate $FPE^{x(\lambda)}(n^*,0,0)$. Add unit lags of the manipulated variable $y_t(\lambda)$ cumulatively to the autoregressive process of $x_t(\lambda)$ and calculate its $FPE^{x(\lambda)}(n^*,q^*,0)$ where q^* is the optimum lag length of $y_t(\lambda)$. Again, add unit lags of the manipulated variable of $z_t(\lambda)$ cumulatively and calculate $FPE^{x(\lambda)}(n^*,q^*,p^*)$ where p^* is the optimum lag length of $z_t(\lambda)$.

If $FPE^{x(\lambda)}(n^*,q^*,p^*) \leq FPE^{x(\lambda)}(n^*,0,0)$ or $\dfrac{FPE^{x(\lambda)}(n^*,q^*,p^*)}{FPE^{x(\lambda)}(n^*,0,0)} \geq 1$

then $y_t(\lambda), z_t(\lambda) \rightarrow x_t(\lambda)$

For different values of $\lambda \in (0,+1)$ we estimate the function $\dfrac{FPE^{x(\lambda)}(n^*,q^*,p^*)}{FPE^{x(\lambda)}(n^*,0,0)}$ and

we choose the value of λ in which maximizes $\dfrac{FPE^{x(\lambda)}(n^*,q^*,p^*)}{FPE^{x(\lambda)}(n^*,0,0)}$.

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[6] The FPE criterion is specified as follows: FPE=[(T+k)/(T−k)] (SSR/T) where T is the number of observations, k is the number of parameters estimated, and SSR is the sum of squared residuals.

4. The Results.

In Table 1 we present the results of applying the linear[7] and nonlinear causality tests based on the specifications (1)-(4). As can be seen, using the suggested causality procedure we detect a bidirectional linear causality from the GI to the Fund Flows and a unidirectional causality from Dow Jones Index. Using the same data set and different values of the Box-Cox coefficient, we detect a bidirectional nonlinear causality effect from the Mutual Fund flows to the GI Stock Index and a unidirectional nonlinear causality from the Dow Jones Index. According to our results there exists a nonlinear causality effect from the Stock Index to the Fund Flows and visa versa. This bidirectional nonlinear effect may be partially[8] explained by the fact that in Greece, equity mutual funds are obliged by law to invest a certain percentage of their cash in stocks. Thus, inflows of cash into equity funds are at once translated into higher demand for stocks, causing increased stock prices, while outflows of cash are translated into stock sales from the funds' portfolio, causing a drop in stock prices.

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[7] Assuming $\lambda=1$.

[8] A detailed discussion of the explanation of the bidirectional causality between mutual fund flows and stock returns for the case of Greece , is given in of Caporale, Phillipas and Pitis(2004) and Alexakis, Niarchos, Patra and Pshakwale(2004),

Table 1. Direct Granger-causality test
between the ATHEX GI and Equity MF flows, including Dow Jones as a relevant third variable.(FPE Results).

		LINEAR CAUSALITY		NONLINEAR CAUSALITY	
Controlled Variable	**Manipulated Variable**				
FUND	**GEN**	**DJIA**		**GEN**	**DJIA**
	$\dfrac{FPE^{FUND(\lambda=1)}(n_1,{}^*0^*)}{FPE^{FUND(\lambda=1)}(n_1{}^*,q_1)}=1.00542$	$\dfrac{FPE^{FUND(\lambda=1)}(n_1{}^*,0,0)}{FPE^{FUND(\lambda=1)}(n_1{}^*,q^*{}_1,p^*{}_1)}=1.06307$		$\dfrac{FPE^{FUND(\lambda=0.54)}(n_1,{}^*0^*)}{FPE^{FUND(\lambda=0.54)}(n_1{}^*,q_1)}=1.0046$	$\dfrac{FPE^{FUND(\lambda=0.54)}(n_1{}^*,0,0)}{FPE^{FUND(\lambda=0.54)}(n_1{}^*,q^*{}_1,p^*{}_1)}=1.06576$
GEN	**FUND**	**DJIA**		**FUND**	<mark>**DJIA**</mark>
	$\dfrac{FPE^{GEN(\lambda=1)}(n_2,{}^*0^*)}{FPE^{GEN(\lambda=1)}(n_2{}^*,q_2)}=1.0024$	$\dfrac{FPE^{GEN(\lambda=1)}(n_1{}^*,0,0)}{FPE^{GEN(\lambda=1)}(n_1{}^*,q^*{}_1,p^*{}_1)}=1.06400$		$\dfrac{FPE^{FUND(\lambda=0.54)}(n_1,{}^*0^*)}{FPE^{FUND(\lambda=0.54)}(n_1{}^*,q_1)}=1.01203$	$\dfrac{FPE(q^*,n^*,p^*)}{FPE(n^*,0)}=1.08638$
DJIA	**GEN**	**FUND**		**GEN**	<mark>**FUND**</mark>
	$\dfrac{FPE^{DJIA(\lambda=1)}(n_3,{}^*0^*)}{FPE^{DJIA(\lambda=1)}(n_3{}^*,q^*{}_3)}=0.9990$	$\dfrac{FPE^{GEN(\lambda=1)}(n_1{}^*,0,0)}{FPE^{GEN(\lambda=1)}(n_1{}^*,q^*{}_1,p^*{}_1)}=0.99815$		$\dfrac{FPE^{FUND(\lambda=0.54)}(n_1,{}^*0^*)}{FPE^{FUND(\lambda=0.54)}(n_1{}^*,q_1)}=0.99898$	$\dfrac{FPE(q^*,n^*,p^*)}{FPE(n^*,0)}=0.99933$

Source : Our Results

Using the nonlinear causality test, in Figure 1 we present the diachronic impulse responses between   Index Returns and Fund flows using the linear and Box-Cox nonlinear estimation procedures. It is obvious that the diachronic effects between Index returns and Fund flows are positive and have a duration of 3-4 days and are quite different, depending on the method of causality we are using. Εξήγηση:

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The impulse responses.

Diachronic Effects of Dow Jones Index on   Fund flows Using Linear and
Nonlinear Causality Tests.
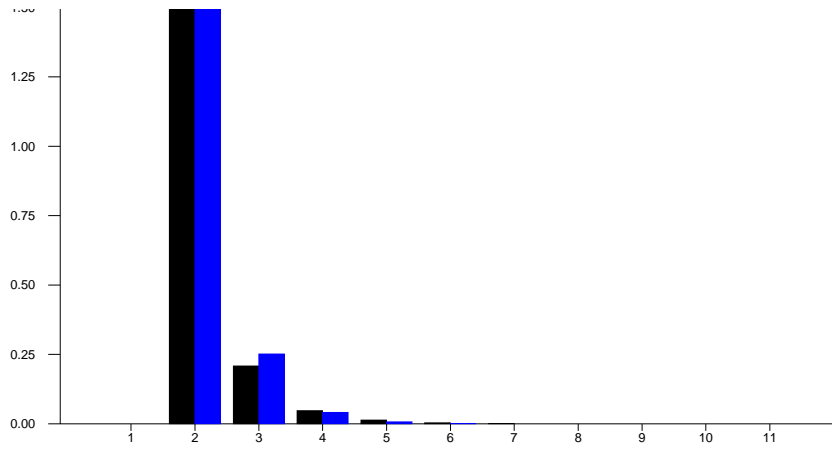
Figure 1.   Diachronic Reaction of Fund flows   to a standard deviation of Dow Jones values
using Linear and Nonlinear Granger Causality procedures

Diachronic Effects of Dow Jones Index on   General Index returns   Using Linear
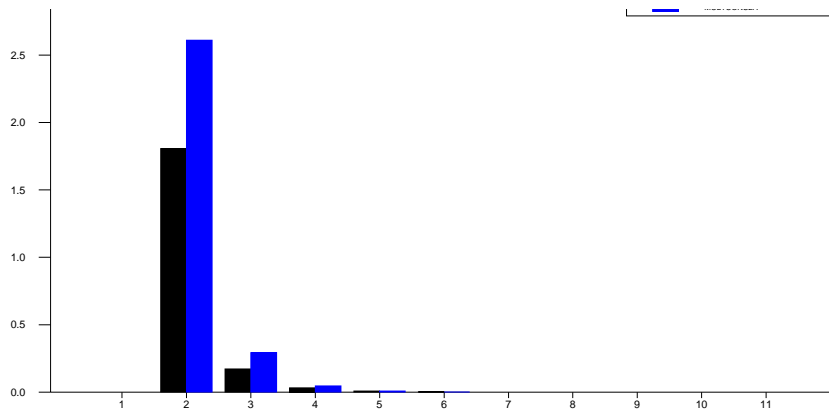and Nonlinear Causality Tests.

Figure 2.   Diachronic Reaction of General Index Returns to a standard deviation of Dow Jones
values using Linear and Nonlinear Granger Causality procedures.
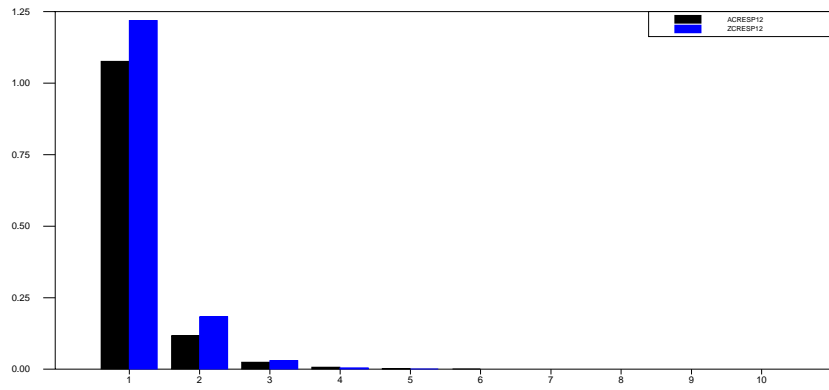
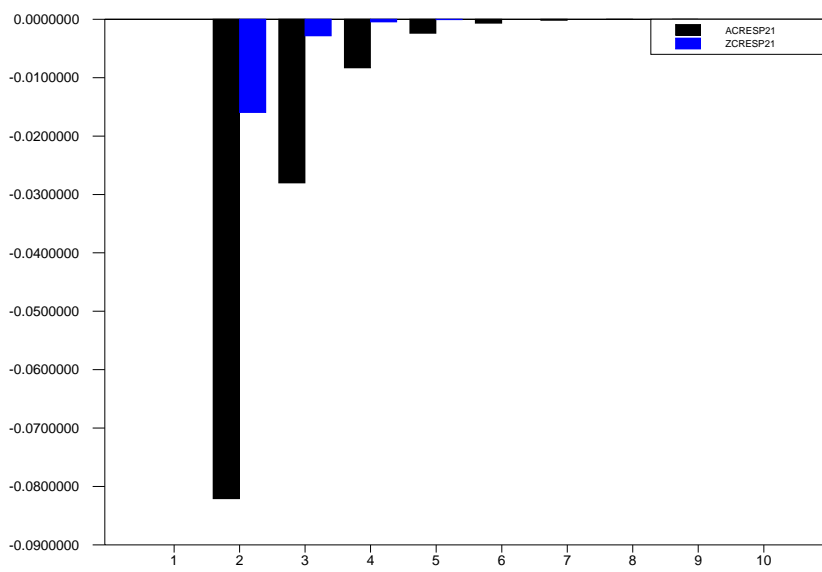Figure 3. Response of mutual fund flows to one standard deviation in ATHEX GI values.

Figure 4. Response of ATHEX GI to one standard deviation in mutual fund flows.

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4. Conclusions.

In this study, we examined the possibility of a causal relationship between mutual fund flows and stock returns for the Greek market. The statistical evidence indicates that there is a bidirectional nonlinear causality between mutual fund flows and stock returns; that is, the lagged stock returns cause, in a nonlinear Granger sense, the mutual fund flows and vice versa. This result is derived from an extension of the Hsiao's (1981) linear causality test using a Box-Cox transformation in order to test for nonlinear Granger causality.

This bidirectional nonlinear effect may be explained[9] by the momentum trading phenomenon, described in section 2, above. Part of the effect is certainly due to the fact that, in Greece, equity mutual funds are obliged by law to invest a certain percentage of their cash in stocks. Thus, inflows and outflows of cash in equity funds are almost automatically directed to the Stock Market and are reflected in market prices.

Finally our findings are in line with and extend the results of already published work (Caporale, Phillipas and Pitis(2004) and Alexakis, Niarchos, Patra and Pshakwale(2004).), for the diachronic interaction between mutual fund flows and stock returns in Greece.

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[9] A detailed discussion of the explanation of the bidirectional causality between mutual fund flows and stock returns is given in of Caporale, Phillipas and Pitis(2004) and Alexakis, Niarchos, Patra and Pshakwale(2004).

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