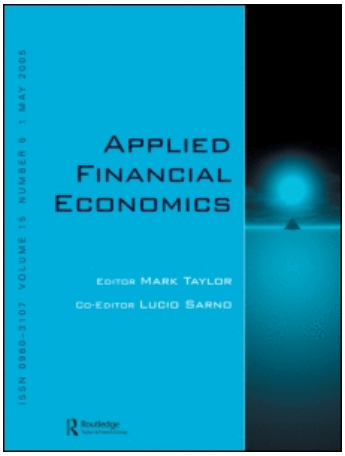

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Day of the week effect on the Greek stock market

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Day of the week effect on the Greek stock market

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Evidence is presented concentrating on the day of the week effect on the Greek stock market, which is currently in a transitory stage. The analysis carried out takes into account that the variance is dependent over time, while an EGARCH-M model investigates the volatility which is considered non-constant over time. During the period examined, January 1985 to February 1994 this market is divided into two subperiods, one in which it operated under backward statutory conditions and the recent one, that is since 1988, during which significant changes have been introduced affecting all market players. A positive return is found for Mondays when the total period is examined, as well as in the first subperiod. Tuesdays, on the other hand, show negative returns. The recent changes, however, since 1988 have established a new pattern of returns which comes closer to that of most other national stock markets. Factors relating to the degree of order established in this market in combination with human behaviour patterns are used to explain these findings. On the side of moments, both preliminary evidence and further investigation of the dependencies depict a changing pattern as well.

I. INTRODUCTION

The day of the week effect refers to the existence of a pattern on the part of stock returns, whereby these returns are linked to the particular day of the week. Such a relationship has been verified mainly in the USA. The last trading days of the week, particularly Friday, are characterized by positive and substantially positive returns, while Monday, the first trading day of the week, differs from other days, even producing negative returns (Cross, 1973; Lakonishok and Levi, 1982; Rogalski, 1984; Keim and Stambaugh, 1984; Hirsch, 1986; Harris, 1986a, b). Such an effect also seems to be present in the equity markets of other countries – Canada, Japan, Australia – where the same pattern is noticed, although in some of them – Japan and Australia – Tuesday also presents negative returns. For certain European countries mixed results are reported (Jaffe and Westerfield, 1985a, b; Hawawini, 1984; Solnik and Bousquet, 1990). The day of the week effect is also analysed using models based on alternative hypotheses, namely that expected returns are the same for each working day of the week while the expected returns for Monday are three times the expected returns for other days of the week. Even with this type of examination of the process generating stock returns, there is evidence for the existence of the day of the week effect, and the pattern of daily returns is such as to reject these hypotheses. The results indicate positive returns for Friday and negative returns for Monday, which runs counter to both of these hypotheses (French, 1980).

In general, the day of the week effect is present in the equity markets of many countries in the form of weeks ending strong and opening down.[1] Furthermore, in the above-mentioned studies an attempt is made to investigate the causes behind the pattern observed. Institutional features of the national stock markets, such as settlement procedures and, in particular, delays between trading and settlement in stocks, pricing misquotes and measurement errors, specialists' behaviour, or dividend patterns have been

[1]It is also present in other markets apart from the stock market, such as the futures market, the treasury bill market and the bond market (Flannery and Protopapadakis, 1988; Cornell, 1985).

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put forward as the main reasons for the presence of such an effect (Gibbons and Hess, 1981; Keim and Stambaugh, 1984; Jaffe and Westerfield, 1985a; Lakonishok and Levi, 1982; Smirlock and Starks, 1986; Cross, 1973). However, most of these reasons have been questioned by the researchers themselves.

It is also argued that the day of the week effect predates current settlement rules. It becomes stronger in cases where, according to the above approaches, it should be weaker, while other explanations based on interest rates, dividend patterns and inventory adjustments are also insufficient to explain the day of the week effect (Jacobs and Levy, 1988). This anomaly existed for very long time periods despite changing trading mechanisms, sale regulations, investment management methods and modes of communication. It is a phenomenon observed in many countries as well as in other assets. Market risks are also a doubtful explanation of the day of the week effect as this would mean high risk measurements for particular days of the week and especially for Monday, which presents a different pattern of returns as compared to the other days. In the light of all the above evidence, the day of the week effect would seem to be largely unexplained. Having examined the various approaches, Jacobs and Levy (1988) put forward the case for explanations based on human nature in combination with the tendency to announce good news quickly and to defer bad news. The good news, such as that on earnings, is announced quickly during the working days of the week, while most bad news is released after markets close so as to allow the market to absorb the shock over the weekend.

Building on this last approach, this paper aims at providing evidence and an explanation of the day of the week effect – taking at the same time into account that the variance is time dependent – for another national market, namely the Greek stock market, which could be defined as a market with certain particular characteristics. Furthermore, due to these peculiarities, which were especially pronounced in the past, this market tended to be characterized by a different order as compared to that of the stock markets of other countries, a fact which, of course, increased its uncertainty and risk. As a result, while this market may render different stock returns across the days of the week, the pattern it presents would seem to differ to that already established in most of the stock markets of other countries. Accordingly, as the Greek stock market gradually eliminates these peculiarities, the daily stock returns would be expected to present a pattern closer to that already observed in the stock markets of the countries mentioned above.

II. THE GREEK STOCK MARKET

The behaviour of the Athens Stock Exchange (ASE) has recently been compared to other national markets. Papaioannou and Philippatos (1982) investigate the influence of the intervaling effect, under non-synchronous trading and price adjustment lags, upon beta estimates. They find that the direction and size of such bias is up to the type of the market index employed each time and the intertemporal short-term dependence of the return relatives. Koutmos, Theodossiou and Negakis (1993) examine the stochastic behaviour of the ASE employing an exponential GARCH-M model. They find that the series of returns are not i.i.d., that the positive shocks have a greater impact on volatility than the negative ones, and that the risk premium is significantly positive when returns are measured in terms of dollars. Theodossiou, Koutmos and Negakis (1993), examining the intertemporal relation between the US and the Greek stock market, note that the Greek market returns are predictable from past information violating the martingale hypothesis. The volatility of stocks in Greece is larger and more persistent to shocks than the volatility in the USA. Also, interestingly enough, innovations in the US stock market do not influence the volatility of the Greek shocks.

Referring to the characteristics of the Greek stock market, the evidence seems to indicate that the fluctuations in the stock price index have in the past been more influenced by sociopolitical factors, along with alternative investment opportunities, than by companies' profits and economic activity (Alexakis and Petrakis, 1991). While one might question whether such findings constitute a peculiar condition only of a small capital market, the analysis indicates that these factors are particularly pronounced for the Greek stock market due to the economic situation of the country, which favours investment activities in real estate, import commerce and the leakage of money abroad. Sociopolitical factors are related to political instability, the attitude of the parties towards the economy, changes in policy, the situation in the labour market, which suffers from rigidities in wages and redundancies and problems in organizing more than one work shift.

Hence, these factors add considerable uncertainty to a market which is lacking in terms of depth, width and resilience, given that the volume of trade that takes place is small. This lack of stability, however, is not present only on the sociopolitical front, but also on the macroeconomic and the microeconomic level of the economy. One can refer to the high and variable rates of inflation, the public sector deficit and the lack of any regularity with respect to government announcements on the course of such important variables. The same holds for the companies' accounting reports as the law was lax concerning the publication of such results, providing the companies with a time-period of six months, although they declare their profits to the tax authorities at the beginning of each year. Such announcements could come at any moment within this broad time-period. Another peculiar characteristic of the Greek stock market should be mentioned, namely, that the weight of the participating banks in the index approached 50% of the total for most of the period examined. Greek banks have

been very secretive as far as their accounts are concerned, which in any case were not informative enough. Furthermore, they seem to tamper with their results, while sudden changes are observed from one period to the next. The Greek market is dominated by state owned banks with frequent changes in their management and policy. As a result, these factors distort events in the stock market. One could also add the inherent problems and inefficiencies of the ASE which has lacked the equipment necessary for the new developments in information technology and telecommunications. In general, one could argue that the Greek stock market has lacked regularity and adequate and timely information, factors which added to uncertainty.

Under these circumstances the question remains as to how the Greek investor behaves in dealing with the stocks in the ASE. In Greece, too, it seems to be true that there are cases where some of the bad news is announced at the weekend. However, the Greek investor does not seem to have digested this sequence of events – good news in the course of the week and bad news at the weekend – and does not behave accordingly, as such a succession does not seem to be well established. The Greek investor seems to wait for the end of the weekend to feel, more than anything else, that nothing serious happened in the course of the previous week, both the five working days and the weekend, to the Greek economy and life, and/or that any shocks that may have happened have been absorbed by the market. Hence, just before the beginning of the new week, he acquires a feeling of relief.[2] It is this relief that leads him on Monday morning to engage in buying decisions pushing the stock prices further upwards on this day.[3]

It should also be mentioned that this lack of regularity in the Greek stock market has been gradually reduced since the end of 1988, when new statutes were introduced, tending to rationalize this market. Such measures included the autonomous functioning of the stock market, free of government intervention, the introduction of brokerage companies and dealers, the creation of a depository of titles, the creation of an over-the-counter market, the taking of measures in order to increase the transparency of the market and to computerize it, as well as the introduction of new transferable titles. As a result the public became more sensitive about investing in the stock market, while a large number of investors, both Greeks and foreigners, entered the market. New companies, also, entered the ASE. In the period 1989–90 more than 50 new stocks entered the market out of a total of 200 existing now. During the same period, the private sector managed to acquire almost one-third of its total finance through the ASE, while in the past this finance did not exceed 5% of the total. As a result, all players became more sensitive to the events in the stock market and more rational in terms of their behaviour. The authorities realized that they had to view the market functions in an orderly way as in the opposite case the impact would now be large. The companies became more regular in the publication of their accounts. The public, and particularly the investment companies which have flourished since the end of 1989, became more sensitive to the developments on the stock market. They continually analyse the current macroeconomic situation in Greece, the economic conditions of the firms in the ASE, together with world developments. The feeling is strong that the Greek stock market is gradually coming to acquire the characteristics found in developed capital markets.

In view of the above reasons, one could expect the day of the week effect to show two distinct patterns, depending on the period of reference. More specifically, while in the period before 1988 it would be expected that Mondays would show positive returns, after 1988 what would gradually tend to be established would be low or even negative returns for Monday, in line with developments in other markets.

III. METHODOLOGY

We test for the day of the week effect while taking into account that the variance is time dependent, which is modelled by an ARCH-type model. These types of models have the property of being MD (martingale difference) and therefore their unconditional mean is zero and serially uncorrelated. They are also WN (white noise) and yield observations with heavier tails than those of a normal distribution. Furthermore, because the disturbances are not strict WN a fully efficient estimator is obtained by maximum likelihood.

Different types of ARCH models have been suggested in the literature by Engle (1982), Engle, Lilien and Robins (1987), Engle and Bollerslev (1986) among others. However, these types of models have certain limitations (Nelson, 1991). Nelson (1991) overcame these limitations by introducing an exponential GARCH-M model which is used in this study.

The model employed can be written as:

$$R_t = b_1 D_{1t} + b_2 D_{2t} + b_3 D_{3t} + b_4 D_{4t} + b_5 D_{5t} + c\sigma_t + \sum_{s=1}^{K} \beta_S R_{t-s} + u_t \quad (1)$$

$$u_t = \sigma_t z_t \quad (2)$$

$$z_t \sim \text{i.i.d with } E(z_t)=0,\ \text{Var}(z_t)=1 \quad (3)$$

[2]This attitude on the part of the Greek investor has been noted by respected analysing bodies in Greece. Particularly, we owe our gratitude on this matter to Alpha Trust Company of Athens.

[3]This seems to be reinforced by the fact that the settlement period in Greece is too short, as the stocks have to be settled within two days after trading.

and, the conditional variance

$$\sigma_t^2 = \mathrm{Var}(R_t / I_{t-1}) \quad (4)$$

where the last term is the conditional variance based on the information set I_{t-1}.

Nelson (1991) specified the conditional variance as a log-linear function of past standardized returns and past conditional variance. Following Pagan and Schwert (1990) and Koutmos *et al.* (1993) the conditional variance is specified as:

$$\log(\sigma_t^2) = a_0 + \sum_{s=1}^{P} a_s h(z_{t-s}) + \sum_{s=1}^{q} \varphi_s \log(\sigma_{t-s}^2)$$

where

$$h(z_t) = |z_t| - E(|z_t|) + \delta z_t \text{ and } E(|z_t|) = \sqrt{2/\pi}$$

By construction the process z_t is zero-mean i.i.d. random sequence and the function $h(z_t)$ allows for the conditional variance process to respond asymmetrically to rises and falls in stock prices. So, if for example $\delta < 0$ then negative shocks increase the volatility more than positive ones. The log likelihood takes the following form:

$$-0.5\log(\sigma^2) - 0.5\left(\frac{u_t^2}{\sigma^2}\right)$$

which was maximized following the Berndt *et al.* (1974) algorithm.

In this model, R_t is the rate of return in period t computed in the logarithmic first difference, $R_t = \log(P_t/P_{t-1})^*100$, where P_t is the value of the stock price index at the end of period t. $D_{1,t}$ is a dummy variable for Monday, which takes the value of one if the observation falls on Monday and zero in all other cases. $D_{2,t}$ is a dummy variable for Tuesday where similar estimations hold and so on for the other days of the five-day business week of the Greek stock market. The disturbance term is depicted by u_t. The coefficients b_1 to b_5 of Equation 1 are the mean returns for the five Greek trading days.

The period examined is from January 1985 to February 1994. In the Greek Stock Exchange only about 200 stocks are traded, issued by 120 firms. The general price index provided by the Athens Stock Exchange is an arithmetic mean (base year 1980) weighted by the market value of the shares included (49 shares, 11 of the banking sector, 3 of insurance/investment companies and 35 industrial commercial firms). Although the stocks participating in the index represent a high percentage of the total market capitalization, due to the fact that the index includes all the banks which even now account for more than 40% of the total transactions value, the index used becomes increasingly less representative of the market through time. During the last three years, 21 shares have ceased trading, while more than 50 new shares were introduced with significant participation in transactions but for the moment a limited representation in the index.

For these reasons in this work, and in order to avoid the shortcomings of the ASE market index, a stock price index was used formulated by the Centre for Financial Studies of the University of Athens (CFS). This index measures the total market capitalization of all shares traded through time taking into account the weight of each stock. Shares of firms going bankrupt or non-traded are excluded from the calculation back to the base year 1980. Thus, a representative index of the Athens Stock Exchange has been acquired with explanatory power and minimum defaults.

Furthermore, the period 1985–94 is examined both as a whole, as well as in terms of two subperiods, the first three year period 1985–87 and the subsequent 1988–94 period. The reason for dividing the entire period at the beginning of 1988 is related to the above-mentioned changes which took place in the ASE. Hence it is interesting to see whether differences can be noted in the results of these two subperiods. Finally, we have excluded from the analysis the major impact of the international crash of October 1987, which began affecting the ASE in October, by omitting 20 working days following the first day of the impact in the running of the tests.

It should be noted that tests for differences in mean returns have also been used by researchers such as French (1980), Gibbons and Hess (1981), Keim and Stambangh (1984) and Jaffe and Westerfield (1985b).

IV. THE RESULTS

Table 1 presents the mean returns and the standard deviation for each day of the week. It can be seen that the means for the whole period are positive except for Tuesday.

The same holds true for the first subperiod examined, while for the second subperiod the mean return for Monday also becomes negative. It can also be seen that the standard deviation is larger for the first day of the week, in accordance with experience elsewhere. The hypothesis used in the analysis of the stock markets in various countries is that because the Monday closing price entails the events of three days, the standard deviation should be higher compared to that of the other days, while only a significantly higher dispersion for this day would also indicate the effect of risk in determining daily returns (Jacobs and Levy, 1988). At the same time, evidence selected from other countries seems to indicate that the standard deviation for Monday is the highest of all days, although only slightly above the average. For the case of the ASE the high level of the dispersion for Monday seems to point out the risk effect on daily returns. There are also a few markets where the standard deviation for Monday is smaller than that for other days (Solnik and Bousquet, 1990). While in most of these studies it is implicitly assumed, along with the high standard deviation for Monday and the low one for Friday, that the Monday returns are very low or negative as compared to the Friday returns – which seems also to be the case for the ASE – a more appropriate measure of dispersion of returns would be

Table 1. *Mean and standard deviation of the returns by day of the week, 2 January 1985–25 February 1994*

	Period: 1985–94		Period: 1985–87		Period: 1988–94	
Day of the week	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Monday	0.029	1.215	0.075	1.357	−0.009	1.139
Tuesday	−0.003	0.801	−0.019	0.859	−0.004	0.771
Wednesday	0.044	0.618	0.009	0.669	0.0002	0.592
Thursday	0.023	0.722	0.022	0.812	0.023	0.673
Friday	0.067	0.604	0.091	0.718	0.056	0.571

one which smooths the latter through the estimation of the risk per unit of return. Hence, the estimation of a coefficient of variation – standard deviation divided by mean return – would indicate that for the Greek case, on the basis of the results of Table 1, Monday returns and generally those of the first days of the week entail higher risk as compared to the other working days.

Preliminary statistics for the returns are presented in Table 2. It includes the mean, the variance, the skewness, the kurtosis, the Ljung–Box statistics and a unit root test of the Dickey and Fuller. The skewness and kurtosis measures indicate that the series for the first subperiod are positively skewed and highly leptokurtic relative to the normal distribution. The signs of the first subperiod are also consistent with the whole period. In the second subperiod the skewness of the data distribution is negative which means that, now, the lower tail is longer than the upper tail. However, it remains highly leptokurtic. Ljung–Box statistics reject the hypothesis of first and second-order independencies, which means that the conditional mean is a function of past returns and/or past errors and the conditional variance of returns is time-dependent and heteroscedastic. Table 2 includes the augmented Dickey and Fuller (1981) statistics in order to test for a unit root in the return process. The hypothesis for a unit root is strongly rejected and a stationarity is implied for the returns although they are not i.i.d.

Finally, the result of the regression are presented in Table 3. It shows high positive returns on Thursday and Friday. The largest mean return is on Friday. These high returns at the end of the week are in keeping with evidence selected from other markets, although the Greek case seems to present particularly high returns, especially during the first subperiod examined. These returns are lower when the analysis refers to the total time period, while the last subperiod presents even lower returns which come closer to those observed in other markets.

What seems to be more important, however, in the above findings concerns the returns observed for Monday, which are non-negative for the total period examined, but become particularly high for the first subperiod. This latter period is the one in which the Greek stock market exhibited most of the important structural problems mentioned above, which led to a particular behaviour on the part of the investors in the ASE. On the other hand, the results of the second subperiod seem to indicate that a new pattern has been established which is more or less common in most of the developed stock markets. In particular, the returns for Monday tend to be low and negative, the negative returns on Tuesday get smaller, the returns on Wednesday become higher, while all returns in general are more normal when taking into account the changes which have occurred in the Greek stock market since 1988. This now seems to have become more rational in terms of the behaviour of the investors, the companies and the authorities, and its useful and significant role is recognized by all sides. In fact these results indicate that, as time passes, the day of the week effect tends to be 'normalized', in the sense that this anomaly follows the familiar world pattern.

Moreover, the results indicate a negative mean return for Tuesday, although it seems to have become smaller in recent years. In any case, this negative return on Tuesday has also been noted in other markets, such as in Singapore and France, while in Australia and Japan, both Tuesday and Monday reveal negative returns.[4] In trying to explain such findings for the Greek case, using the same line of reasoning as in Section II above, it could be argued that investors, while starting the week in an optimistic mood, exhaust their buying decisions on Monday particularly as they engage in similar transactions over three consecutive days of the previous week. At the same time, they are confronted with the realities of the Greek economy, though they seem to recover after Tuesday. However, these negative Tuesday returns have shown a tendency recently to be reduced, while Monday has become the day for negative returns.

Table 3 also reports that β is significant which means that past returns influence the current returns, violating the martingale hypothesis. However, it must be taken into account that this may be due to non-synchronous trading which is likely to characterize the less developed markets. The coefficient (c) which measures the effects of the

[4]See Jaffe and Westerfield (1985a), Condoyanni *et al.* (1987) and Solnik and Bousquet (1990).

Table 2. *Preliminary statistics*

Statistics	2 January 1985–25 February 1994	2 January 1985–31 December 1987	4 January 1988–25 February 1994
Mean return	0.00119	0.00227	0.00065
Variance	0.00351	0.00045	0.0003
Skewness	0.37771	1.81821	−0.945335
Kurtosis	22.55273	24.90519	17.78801
LB(6)	147.2681	102.2580	55.7260
LB(12)	181.5779	124.0067	69.9428
LB(24)	196.2812	138.2736	86.8961
LB(36)	232.9474	155.4301	120.7372
$LB^2(6)$	157.7667	73.6828	57.4050
$LB^2(12)$	193.9567	87.0288	80.3770
$LB^2(24)$	333.3958	165.3203	111.2773
$LB^2(36)$	454.0859	235.6145	144.2313
Unit root tests for (R_t) augmented Dickey–Fuller (ADF)	−30.7230	−16.7230	−26.49862

Note: All values are statistically significant at the 1% significance level.

Table 3. *The day of the week effect – regression results*

Period	Monday (b_1)	Tuesday (b_2)	Wednesday (b_3)	Thursday (b_4)	Friday (b_5)	(β)	(a_0)	a_1	δ	c	φ	Log F
2 January 1985–	0.102	−0.005	0.040	0.118	0.331	0.123	0.672	0.224	0.472	0.351	0.630	−3079
25 February 1994	(1.85)	(−1.71)	(1.91)	(2.01)	(3.83)	(6.25)	(6.8)	(3.37)	(3.21)	(2.92)	(19.4)	
Number of observations	441	465	461	464	443							
2 January 1985–	0.456	−0.007	0.003	0.143	0.878	0.201	0.585	0.407	0.281	0.214	0.515	−3257
31 December 1987	(1.78)	(−1.69)	(1.76)	(1.89)	(2.74)	(3.14)	(1.99)	(3.27)	(4.3)	(2.8)	(12.2)	
Number of observations	144	150	151	151	148							
4 January 1988–	−0.071	−0.004	0.062	0.130	0.278	0.114	0.495	0.19	0.190	0.490	0.720	−8761
25 February 1994	(−1.92)	(−1.74)	(1.97)	(1.92)	(2.78)	(2.15)	(3.2)	(3.82)	(1.82)	(1.81)	(15.97)	
Number of observations	297	315	310	313	295							

Notes: Numbers in parentheses depict t statistics.
The model specified is the following:

$$R_t = b_1 D_{1t} + b_2 D_{2t} + b_3 D_{3t} + b_4 D_{4t} + b_5 D_{5t} + \beta R_{t-1} + c\sigma_t + u_t$$

Conditional variance:

$$\log(\sigma^2) = a_0 + a_1\{|z_{t-1}| - E(|z_{t-1}|) + \delta z_{t-1}\} + \varphi \log(\sigma_{t-1}^2)$$

The lags were determined on the basis of the Shwartz criterion which selects the lag length by minimizing the function over different choices for the length of the lag. It takes the form $T\log(RSS) + K(\log(T))$, where K = number of regressors and T = number of observations.

EGARCH-M is statistically significant for the whole period and for the first subperiod, while in the second subperiod the influence is insignificant leading to the conclusion that there is no substantial risk premium.

The estimated degree of volatility persistence as measured by the φ coefficient is significant for the whole period and for the two subperiods as well. However in the second subperiod the persistence has bigger duration than the first subperiod.

Finally the assymetry (δ) coefficient is positive and statistically significant for the whole period and for the two subperiods as well. As it was said before, the positive sign of the assymmetry coefficient means that volatility increases more when returns shocks are positive.

V. CONCLUSIONS

This study has presented evidence concentrating on the day of the week effect on daily stock returns in the Athens Stock Exchange under the consideration that the variance is time-dependent. Moving from its traditional functioning to that required by the opening of the money and capital markets, in accordance with the European Community developments and regulations, the Greek stock market, has presented different patterns of stock returns and proved the validity of the day of the week effect. The period examined, 1985–94, renders results which are not observed in most stock markets. In particular, evidence indicates rather high positive returns for Monday, particularly during the period before 1988, when significant statutes and measures were absent from the Greek market. Furthermore, Tuesday renders negative returns. This confirms what has been found in other national stock markets. An attempt has been made to explain these developments on the basis of an approach related to human nature, as evidence indicates that various other causes suggested do not seem to give an adequate explanation. The results also indicate the recent trend in the Greek stock market to show negative returns for Monday, while those for Tuesday tend to be reduced. Under these recent developments, which are related to significant changes which occurred in the Greek market, the day of the week effect now seems to conform to the familiar pattern, according to which the market has a tendency to end each week strong and start weak on Mondays. Furthermore it has been found, in line with other studies, that the MD is violated and the assymmetry coefficient is positive.

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