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Stock market prices, 'causality' and efficiency: evidence from the Athens stock exchange

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During the last few years there has been growing evidence against the Efficient Market Hypothesis. In this study we investigate the hypothesis using stock prices of common and preferred stocks from the Athens Stock Exchange. In Greece, preferred shares are regarded as part of the equity capital of the Greek companies and they are not considered as part of the borrowed funds. Under the Efficient Market Hypothesis their price behaviour, as far as the speed of adjustment to news is concerned, should be the same. However, our empirical evidence contradicts the above proposition. It seems that in the Greek market there are factors, other than news, which influence the price behaviour of the two categories of stocks.

I. INTRODUCTION

According to Fama (1976), a market is efficient if prices fully and instantaneously reflect all available information and no profit opportunities are left unexploited. In an efficient market there is a large number of rational profit maximizing investors, actively competing with each other, trying to predict future market prices of individual securities while important current information is almost freely available to all participants in the market. In an Efficient Market the competing market participants reflect information rationally and instantaneously on prices, making past relevant information useless in predicting future prices. An Efficient Market should react only to new information ('news'), but since this is unpredictable by definition, price changes or returns in an efficient market, cannot be predicted.

Under the Efficient Market Hypothesis we have

$$P_t - P_t^*/I_{t-1} = u_t \tag{1}$$

where I_{t-1} is the information set available at time $t-1$, P_t^* is the expected price which is based on the information set I_{t-1}, so P_t^* is uncorrelated with u_t, and, additionally, the forecast error $P_t - P_t^*$ is uncorrelated with variables in the information set I_{t-1} so that

$$E[(P_t - P_t^*)/I_{t-1}] = 0 \quad \text{or} \quad E(u_t) = 0 \tag{2}$$

under the assumptions of a zero constant equilibrium return and risk neutrality.

Tests for market efficiency usually examine whether the forecast error is uncorrelated with variables in the information set I_{t-1}. According to the Efficient Market Hypothesis the best predictor of tomorrow's price, which can be made on the information set I_t, given today's price, is today's price. Thus, in an efficient market, the series of price changes, and consequently the series of stock returns, are uncorrelated with the variables in the information set I_{t-1}.

Fama (1970), distinguished three types of market efficiency. A market is said to be *weak form efficient* if past prices are useless in predicting future prices. A market is *semi-strong efficient* if all publicly available information like inflation, interest rates and earnings have no predictive power. Finally, a market is *strong form efficient* if all information is reflected on prices, including the inside information.

The main purpose of this study is to investigate whether it is possible to predict stock price changes or returns in the Greek Stock Market (i.e. Athens Stock Exchange) under the assumption of a constant equilibrium return. The Athens Stock Market (ASE) is an emerging small market with no adequate 'depth' and 'width' compared with other more developed stock markets worldwide. Further, this study was performed to shed more light on the workings of a small

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stock market, such as the Greek stock market. Thus, we will try to test the Efficient Market Hypothesis for the ASE by testing the validity of a predictive model, since a valid predictive model theoretically implies a violation of the Efficient Market Hypothesis.

In the international literature there is a wide variety of models that can be used for predictive purposes in stock market prices. The existing models extend from simple linear autoregressive ones, Cootner (1962), Osborne (1959, 1962) to the more sophisticated non-linear dynamic ones Peters (1989, 1991), Hiemstra and Kramer (1995). In this study the linear regression model was used. Our research started from the 'Granger causality' models which test whether a lagged explanatory variable, say X, can be used to predict the dependent, say Y, and then cointegration analysis was applied.

II. THE GREEK STOCK MARKET (ASE) ENVIRONMENT

The ASE is an emerging market with speculative characteristics as to the movement of stock prices and with erratic and sometimes unjustifiable price swings. The latter give an indication that market prices may not, at all times, rationally reflect all information existing in the market and it can be possible that other factors may affect security prices.

There have been several studies so far, testing the price behaviour in the ASE and performing tests of the efficient market hypothesis (Niarchos, 1972; Panas, 1990; Alexakis and Petrakis, 1991; Alexakis, 1992; Alexakis and Xanthakis, 1997). However, up to now there has been no research and subsequently no evidence as to the price performance of different categories of shares issued by the same company and their possible relationship.

In Greece, companies may issue three types of stocks, that is, (a) common stocks with voting rights; (b) preferred stocks with non-voting rights; and (c) preferred stock with voting rights. The main privilege granted to preferred stocks is (I) priority of its dividends over common stock dividends and (II) priority of its claim on assets over common-stock claims in the event of liquidation. With respect to dividend distribution, dividends on preferred stock are paid after bond interest and income taxes, but prior to payment of dividends on common stock. Preferred stocks are, sometimes, cumulative; i.e. a preferred dividend which is bypassed is still owed to the shareholders. If a firm does not make a profit, dividends to both the common and the preferred shareholders are not paid. However, the dividends that the cumulative preferred stockholders should have received will accumulate. When the firm makes profits again, the cumulative preferred shareholders are entitled to the current years' dividend as well as the dividends accumulated from prior years. In Greece, there are few cases of preferred stocks with voting rights and the same privileges as described above. According to the Greek legislation a company can issue preferred shares which cannot exceed 50% of common shares outstanding at the time of issue. It should be noted that, in Greece, preferred shares are issued as part of the equity capital of Greek companies and hence are not considered as part of the borrowed funds. Thus, their stock market price behaviour should be at least similar to the price behaviour of the common stocks with voting rights. Empirically though, this does not seem to be the case, at least, after 1987.

In this study we will use 'causality' models in order to test the price behaviour of these two types of shares in the market, i.e. whether the prices of one type of shares affect the prices of the other and vice versa. Our final aim is to determine any predictive factor that may arise from the price movements of any one type of shares concerning the other. Looking at the price series of common and preferred shares the evidence indicates that the price fluctuations of these two categories of shares correlate, although there is a large discrepancy between their respective prices which has increased after 1987. However, we do not know whether the prices of common shares influence the prices of preferred shares or vice versa, i.e. whether there is any predictive factor between them.

III. THE MODEL EMPLOYED

A very popular way to test the existence of any temporal statistical relationship with predictive value between two time series is the Granger 'causality' test, Granger (1969). Granger, in order to explain the notion of 'causality' – often referred to as 'Granger–Wiener causality' in recognition of the early work of Wiener (1956) – starts from the premise that the future cannot 'cause' the present or the past. Nevertheless, the term 'causality' is unfortunate; for instance the weather forecast occurs before the weather but it obviously does not cause the weather. Thus, when we test for 'causality' we in fact test for precedence, and for linear precedence in particular. Granger's definition for 'causality' is in terms of predictability: a variable X causes another variable Y, with respect to a given information set that includes X and Y, if present Y can be better forecasted by using past values of X than by not doing so.

The presence of 'causality' obviously implies market inefficiency of the weak form: as pointed out earlier for a stock, say j, under the Efficient Market Hypothesis (EMH), it is true that

$$E(\Delta P_{jt}/I_{t-1}) = 0 \qquad (3)$$

where $I_{t-1} = [P_{j,t-1}, P_{j,t-2}, P_{j,t-3}, \ldots\ P_{j,t-n}]$ and $P_{jt-1}, \ldots, P_{jt-n}$ the price history of the stock j. If it is also true that

$$E(\Delta P_{jt}/H_{t-1}) = 0 \qquad (4)$$

where $H_{t-1} = [P_{j,t-1}, P_{j,t-2}, P_{j,t-3}, \ldots, P_{j,t-n}, P_{k,t-1}, P_{k,t-2}, P_{k,t-3}, \ldots, P_{k,t-n}]$ and $P_{k,t-1}, \ldots, P_{k,t-n}$ the price history of a variable k different than j, then no 'Granger causality' exists and the market is still efficient with respect to the information set H_{t-1}. The opposite case implies that the price history of variable k can help to predict the price change of stock j (variable k 'Granger causes' stock j), and the market is inefficient with respect to the information set H_{t-1}.

The 'Granger causality' tests apart from the fact that they have been characterized as '*soft econometrics*' (Rowley and Jain, 1986), are usually performed on stationary data; and the first difference transformation, which is usually applied to achieve stationarity, filters out low frequency (long run) information. Cointegration and error correction models reintroduce, in a statistically acceptable way, the low frequency information. The basic idea of cointegration is that two or more series, say X and Y, move closely together in the long run, even though the series themselves are trended, and the difference between them is constant

$$Z_t = X_t - \alpha Y_t \qquad (5)$$

We may regard the cointegrating series as defining a long run equilibrium relationship and the difference between them to be stationary. The term equilibrium in this case suggests a relationship which, on average, has been maintained by a set of variables for a long period (Hall and Hendry, 1988).

If two variables are cointegrated then according to the Granger Representation Theorem (Engle and Granger, 1987), there must exist an Error Correction Representation of the following form

$$\Delta X_t = -\rho_1 \hat{z}_{t-1} + \sum_{j=1}^{n} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Y_{t-i} + \varepsilon_{1t} \qquad (6)$$

$$\Delta Y_t = -\rho_2 \hat{z}_{t-1} + \sum_{j=1}^{n} \gamma_i \Delta Y_{t-i} + \sum_{j=1}^{n} \lambda_i \Delta X_{t-i} + \varepsilon_{2t} \qquad (7)$$

where z_{t-1} is implicitly defined in Equation 5 and $\rho_1 + \rho_2 \neq 0$ and ε_{1t} and ε_{2t} are finite moving averages. Thus, changes in the variables X_t and Y_t are partly driven by the previous value of z_t.

An Error Correction model that incorporates errors from a cointegrating regression has some interesting temporal causality interpretations (Granger, 1988). Cointegrated variables in the bivariate case must possess temporal 'causality' in the Granger sense in at least one direction. For a pair of series to have an attainable equilibrium, there must be some causation between them to provide the necessary dynamics. It follows from this that since z_{t-1} must occur in at least one of the Error Correction equations, it must improve the forecasting ability of at least on one of X_t or Y_t. Thus, one important implication to emerge from the cointegration literature (Engle and Granger, 1987), is that prices in an efficient speculative market cannot be cointegrated. If they are, this implies in return the presence of a market inefficiency since there must be 'Granger causality' running in one at least direction: i.e. one price can be used to forecast the other price, even after taking into account the lagged values of the forecast price. Further, the temporal causality can emerge from two sources: the sum of the coefficients of the lagged change variables (the standard Granger test) or the coefficient of the lagged error correction term. Standard Granger 'causality' tests overlook the latter channel. Theoretically, temporal 'causality' can occur through the error correction term alone. Thus, the standard Granger test may overlook existing temporal 'causality'.

Engle and Granger (1987) point to the fact that vector autoregressive estimates, which are derived from differenced data, are misspecified in the case of cointegrated variables because the Error Correction Terms which appear in the Error Correction Models are excluded (MacDonald and Kearney, 1987). The point is that the models employed to test 'causality' are misspecified if the variables which are being tested for the direction of 'causality' are cointegrated.

Tests for 'causality' and consequently for market efficiency have been performed in many stock market efficiency studies, for example between different metal prices (McDonald and Taylor, 1988, 1989; Jones and Uri, 1989). In this study we will perform the above tests between the common and preferred stocks traded in the Athens Stock Exchange.

IV. THE DATA

To perform the above statistical analysis we used daily closing prices adjusted for stock splits, reverse splits and dividends, for 14 pairs of common and preferred stocks, of the most active stocks listed in the ASE, in order to avoid thin trading effects. The time period used is from 1 July 1991 to 4 April 1994 with a total of 703 observations for every stock. The data were extracted from the Profile S.A. and the Center of Financial Studies (University of Athens) databanks. In all cases we used the logarithmic transformation of the original price series.

V. THE RESULTS

The order of integration of a series (that is the number of times it must be differenced before attaining stationarity) may be ascertained by the application of a set of tests, commonly known as the test for unit roots. A number of tests are available for testing whether a series is stationary. We performed the Augmented Dickey–Fuller regression in order to ensure white noise residuals in the Dickey–Fuller regressions.

Table 1 presents the Augmented Dickey–Fuller statistics (ADF) for the series of the 14 companies used. It is clear

Table 1. *Unit root tests of the series*

Variable	D.F. statistic constant	D.F. statistic constant-trend	D.F. statistic constant	D.F. statistic constant-trend
	Levels		First Differences	
COMMON				
Balkan (c)	− 1.62	− 2.43	− 13.79**	− 13.80**
Barbastathis (c)	− 2.80	− 2.54	− 14.59**	− 14.63**
Bitros (c)	− 1.78	− 1.96	− 13.65**	− 13.70**
Boutaris (c)	− 0.76	− 2.43	− 13.23**	− 13.23**
Delta (c)	− 1.35	− 1.48	− 13.58**	− 13.60**
ETEBA (c)	− 1.64	− 1.34	− 11.90**	− 11.97**
Intarcom (c)	− 0.45	− 2.17	− 12.23**	− 12.30**
Kalpinis (c)	− 1.09	− 1.84	− 15.38**	− 15.10**
Metka (c)	− 0.83	− 1.60	− 12.90**	− 12.96**
Mouzakis (c)	− 0.67	− 0.81	− 12.80**	− 13.08**
Petsetakis (c)	− 1.78	− 2.09	− 13.07**	− 13.10**
Rokas (c)	− 0.13	− 1.72	− 11.72**	− 11.74**
Stegastiki (c)	− 2.21	− 3.10	− 13.23**	− 13.22**
Titan (c)	− 1.97	− 2.12	− 13.78**	− 13.77**
PREFERRED	–	–	–	–
Balkan (p)	− 1.51	− 2.16	− 14.08**	− 14.08**
Barbastathis (p)	− 2.36	− 1.96	− 15.01**	− 15.09**
Bitros (p)	− 1.26	− 1.47	− 13.35**	− 13.45**
Boutaris (p)	− 0.85	− 2.60	− 13.75**	− 13.76**
Delta (p)	− 1.06	− 1.85	− 13.70**	− 13.82**
ETEBA (p)	− 1.79	− 1.56	− 12.09**	− 12.13**
Intracom (p)	− 0.50	− 1.98	− 12.84**	− 12.89**
Metka (p)	− 0.59	− 1.62	− 12.41**	− 12.52**
Petsetakis (p)	− 1.10	− 1.57	− 12.98**	− 13.13**
Rokas (p)	− 0.03	− 1.64	− 11.92**	− 11.94**
Stegastiki (p)	− 1.96	− 3.03	− 12.75**	− 12.76**
Titan (p)	− 3.32	− 3.89	− 14.42**	− 14.41**
Kalpinis (p)	− 1.12	− 1.77	− 13.77**	− 13.85**
Mouzakis (p)	0.51	0.01	− 12.39**	− 12.70**

**Indicates significance at 95% confidence interval.

from this table that the null hypothesis that any of the prices have unit roots cannot be rejected. This is confirmed by the ADF statistics which test for unit roots in the first differenced series. In each case the null hypothesis is easily rejected. Together with the results in the level series, it strongly implies that each of the stock price series are integrated of order one $I \sim (1)$. Thus, the 'Granger causality' tests will be performed on the first logarithmic difference of the original price series, since they require stationary data. The results obtained from the 'Granger causality' tests are presented in Table 2. From the results in Table 2 it seems that the efficient market hypothesis is violated since the F statistics indicate that the lagged values of the explanatory variable can help to forecast the dependent variable. In most of the 'causality' cases it is revealed that the lagged values of the common stock price changes help predict the price change of the preferred stock. Nevertheless, in light of the possibility of cointegration between the price series of the common and preferred stocks, the above results may not be valid since, as mentioned above, we excluded the error correction term from the Granger tests.

In order to test whether our variables are cointegrated we estimated the cointegrating regression

$$X_t = a + bY_t + z_t \tag{8}$$

by OLS and tested whether the cointegrating residuals series z_t is $I \sim (0)$.

Engle and Granger (1987), suggest a number of alternative tests for determining if z_t is $I \sim (0)$. One of the tests is the Durbin–Watson statistic from the cointegrating equation (CRDW) and the DF statistic for the residuals from the cointegrating regression. The CRDW test '*might be used for a quick approximate result*' (Engle and Granger, 1987). Under the null hypothesis of non-cointegration, the CRDW statistic should be close to zero, and so the null hypothesis is rejected if the statistic exceeds the tabulated critical values.

Table 2. *Granger causality results*

Name	Dependent variable: Common F Statistic	Dependent variable: Preferred F Statistic	Causality direction
Balkan	1.40	9.00**	Common 'cause' Preferred
Barbastathis	3.38**	4.02**	Bi-directional 'causality'
Bitros	1.99*	3.18**	Bi-directional 'causality'
Boutaris	1.19	1.87*	Common 'cause' Preferred
Delta	2.65**	2.77**	Bi-directional 'causality'
ETEBA	2.66**	1.75	Preferred 'cause' Common
Intracom	1.81	1.39	No 'causality'
Kalpinis	2.12**	4.53**	Bi-directional 'causality'
Metka	1.30	6.02**	Common 'cause' Preferred
Mouzakis	0.37	6.04**	Common 'cause' Preferred
Petsetakis	1.45	4.02**	Common 'cause' Preferred
Rokas	3.46**	2.89**	Bi-directional 'causality'
Stegastiki	1.68	4.59**	Common 'cause' Preferred
Titan	1.03	5.16**	Common 'cause' Preferred

*Denotes significance at 90% confidence interval and **denotes significance at 95% confidence interval.

Table 3. *Tests for cointegration*

Variables	R^2	CRDW	DF statistic
Balkan (k) – Balkan (p)	0.98	0.43**	− 5.52**
Barbastathis (k) – Barbastathis (p)	0.84	0.29**	− 4.52**
Bitros (k) – Bitros (p)	0.89	0.11	− 3.64**
Boutaris (k) – Boutaris (p)	0.97	0.14*	− 4.02**
Delta (k) – Delta (p)	0.79	0.05	− 2.38
ETEBA (k) – ETEBA (p)	0.96	0.16*	− 3.90**
Intracom (k) – Intracom (p)	0.97	0.10	− 3.30*
Kalpinis (k) – Kalpinis (p)	0.95	0.32**	− 5.93**
Metka (k) – Metka (p)	0.97	0.16*	− 3.58**
Mouzakis (k) – Mouzakis (p)	0.93	0.21**	− 4.72**
Petsetakis (k) – Petsetakis (p)	0.84	0.08	− 2.63
Rokas (k) – Rokas (p)	0.97	0.06	− 2.53
Stegastiki (k) – Stegastiki (p)	0.88	0.17*	− 4.05**
Titan (k) – Titan (p)	0.66	0.12	− 3.95**

*Denotes significance at 90% confidence interval and **denotes significance at 95% confidence interval.

In Table 3, the Durbin–Watson statistic in most of the cases is below the critical value, leading us to accept the null hypothesis of no cointegration. Nevertheless, the ADF statistic as a more robust test for cointegration contradicts the CRDW statistic. Thus, when the ADF statistic leads us to reject the null of no cointegration we will form the error correction models and examine the significance of the error correction term in order to investigate the existence and the nature of possible 'causality'. This is because the Representation Theorem discussed above implies that if two variables X_t and Y_t are both integrated of order one and there is an error correction model representation with the properties stated above then X_t and Y_t are necessarily cointegrated. Thus, the validity of an error correction model with the described properties can be used as an alternative test for cointegration.

A major decision emerges in the choice of the lag length used in the error correction model. We used Hendry's general to specific modelling strategy to eliminate lags with insignificant parameter estimates, taking into account model selection criteria as the Akaike criterion. Following the above method we obtained the results from the error correction models presented in Table 4. From Table 4 there is statistical evidence that, in most cases, the price changes of common shares precede the price changes of preferred shares, as the statistical significance of the error correction terms indicates.

Table 4. *Error correction models results*

Dependent variable	E.C.T estimate	Heteroscedastic consistent *t* ratio	R^2	Causality
Balkan(c)	− 0.03	− 1.41	0.03	
Balkan(p)	− 0.09	− 3.12**	0.12	common 'cause' preferred
Barbastathis (c)	− 0.08	− 3.54**	0.08	
Barbastathis (p)	− 0.03	− 2.12**	0.05	bi-directional 'causality'
Bitros (c)	− 0.009	− 0.63	0.01	
Bitros (p)	− 0.04	− 3.77**	0.10	common 'cause' preferred
Boutaris (c)	− 0.02	− 1.34	0.01	
Boutaris (p)	− 0.04	− 2.16**	0.01	common 'cause' preferred
ETEBA (c)	− 0.02	− 1.30	0.05	
ETEBA (p)	− 0.03	− 1.87	0.05	no 'causality'
Intracom (c)	− 0.02	− 0.89	0.03	
Intracom (p)	− 0.06	− 2.04**	0.03	common 'cause' preferred
Kalpinis (c)	− 0.03	− 1.23	0.03	
Kalpinis (p)	− 0.09	− 4.18**	0.07	common 'cause' preferred
Metka (c)	− 0.01	− 0.52	0.01	
Metka (p)	− 0.04	− 2.45	0.08	common 'cause' preferred
Mouzakis (c)	− 0.03	− 1.90	0.01	
Mouzakis (p)	− 0.04	− 2.30**	0.08	common 'cause' preferred
Stegastiki (c)	− 0.03	− 1.90	0.02	
Stegastiki (p)	− 0.04	− 2.95**	0.06	common 'cause' preferred
Titan (c)	− 0.002	− 0.022	0.001	
Titan (p)	− 0.06	− 3.59**	0.06	common 'cause' preferred

**Denotes significance at 95% confidence interval.

VI. CONCLUSIONS

From the statistical analysis of price sequences of common and preferred shares there is evidence that the price movements of preferred shares follow the price movements of common shares in the Greek market and that the latter can be forecast from the former, contrary to the prediction of the Efficient Market Hypothesis.

A possible explanation of the above results is that the market for the preferred shares has not the necessary 'depth', due to the limited number of preferred shares outstanding. This happens because the number of preferred shares is fixed by law to be 50% of the common shares outstanding at maximum. The above restriction by itself makes the market for preferred shares thinner than the market for common shares and the observed inefficiency may be a thin trading effect in the following sense. If the returns of two stocks, *A* and *B*, are independent, but *B* trades less frequently than *A*, then the price of *A* will respond more quickly when news affecting both stocks arrives. As a consequence, the return on *B* will appear to respond with some lag to the return on *A*, i.e. there will be cross-correlation between the returns on *A* and *B*.

Table 5 shows the number of outstanding common and preferred shares together with the marketability of each category of shares, during the period under investigation (1991–94). As seen from Table 5 the number of common shares outstanding for each company is, in most cases, more than four times the number of preferred shares. This indicates that the market for preferred shares is thinner than the market for common shares. However, the marketability of the preferred shares is much higher than that of common shares due to the small number of preferred shares outstanding, giving a false picture as to the liquidity of the market for preferred shares.

A further explanation of our results is based on the appearance of foreign investors in the Greek market during the last few years (since 1987). These investors tend to invest mostly in common shares, partly because of the larger number of common shares outstanding (they can buy or sell more easily common shares) and partly because they are not familiar with the Greek notion of preferred shares, as explained above. We must note here that the foreign investors have much more experience and expertise in modern security markets than the domestic investors; since the modernization of the Greek Stock Market is a relatively recent event. The foreign investors (in most cases big investment Houses) due to their size, expertise and experience, may have better and cheaper access to new information in comparison with the domestic investors. Because of these competitive advantages and their preference to common shares, these investors reflect information quickly on common share prices. The information is then reflected with a delay onto the prices of preferred shares, probably by the

Table 5. *Number of common and preferred shares outstanding and their marketability*

Name of Company	Year	Number of Common shares outstanding	Marketability %	Number of Preferred shares outstanding	Marketability %
Balkan S.A.	1991	6 919 176	14.43	1 739 724	15.14
	1992	6 919 176	21.56	1 739 724	16.20
	1993	6 919 176	56.39	1 739 724	37.45
	1994	6 919 176	128.44	1 739 724	63.46
Barbastathis S.A.	1991	2 353 190	26.94	269 810	60.26
	1992	2 823 830	11.99	356 170	53.85
	1993	2 823 830	16.63	356 170	71.60
	1994	2 823 830	30.67	356 170	138.91
Bitros S.A.	1991	2 576 000	4.93	336 000	23.86
	1992	2 576 000	1.60	336 000	5.37
	1993	2 576 000	10.13	336 000	19.24
	1994	2 576 000	26.49	336 000	37.03
Boutaris S.A.	1991	1 600 000	16.24	385 000	26.29
	1992	1 600 000	32.28	385 000	25.76
	1993	1 600 000	25.55	770 000	70.23
	1994	6 072 000	23.64	770 000	47.56
Delta S.A.	1991	8 930 000	13.37	3 530 000	21.31
	1992	9 823 000	4.63	3 883 000	11.40
	1993	10 805 300	9.39	4 271 300	18.88
	1994	12 966 360	16.49	5 125 560	22.51
ETEBA S.A.	1991	1 649 598	12.47	615 999	19.77
	1992	1 649 598	8.71	615 999	26.35
	1993	1 649 598	17.04	615 999	31.74
	1994	3 299 196	12.75	1 231 998	17.04
Intracom S.A.	1991	3 044 500	20.78	923 560	77.02
	1992	8 514 600	28.02	1 865 120	94.36
	1993	8 514 600	33.57	1 865 120	230.97
	1994	8 514 600	36.14	1 865 120	256.41
Kalpinis S.A.	1991	6 050 000	5.67	1 350 000	16.45
	1992	6 050 000	8.36	1 350 000	36.76
	1993	6 050 000	5.60	1 350 000	14.38
	1994	6 050 000	5.10	1 350 000	15.73
Metka S.A.	1991	2 629 190	32.76	415 850	44.94
	1992	2 629 190	30.03	415 850	41.56
	1993	2 629 190	105.34	415 850	180.39
	1994	4 348 110	94.29	415 850	193.28
Mouzakis S.A.	1991	7 354 440	10.08	534 810	43.17
	1992	7 354 440	3.36	534 810	11.13
	1993	7 354 440	6.77	534 810	25.72
	1994	12 876 915	35.90	534 810	113.45
Petsetakis S.A.	1991	4 452 000	31.16	1 113 000	10.31
	1992	4 452 000	22.09	1 113 000	30.35
	1993	4 452 000	81.48	1 113 000	57.58
	1994	5 565 000	73.20	1 391 250	42.71
Rokas S.A.	1991	1 500 000	7.87	220 000	34.54
	1992	2 100 000	6.05	308 000	42.43
	1993	2 946 000	86.51	568 000	329.01
	1994	4 031 400	79.20	739 440	156.56
Stegastiki S.A.	1991	1 196 052	3.23	338 052	4.34
	1992	1 197 132	6.89	338 052	20.33
	1993	2 051 682	13.65	405 662	15.82
	1994	2 054 796	4.29	405 662	7.68
Titan S.A.	1991	4 730 606	19.66	476 060	33.66
	1992	9,461 912	25.77	946 120	33.18
	1993	9 461 912	30.72	946 120	25.21
	1994	9 461 912	14.59	946 120	12.34

domestic investors, which have slower access to information, but they are also familiar with the notions of common and preferred shares in Greece and consequently they do not distinguish between them.

In addition to the above, domestic investors' trades refer to substantially lower number of shares than foreign investors' trades. Thus, the thin market of preferred shares is not a matter for serious consideration for the domestic investors.

If the above hypothesis is true then the Athens Stock Exchange can be regarded as a segmented market, i.e. smart money (foreign investors) is one group, and noise traders (domestic investors) is the other.

At this point we must note that there is another 'anomaly' related to the common and preferred shares in Greece. The preferred shares sell at a discount in comparison to the common shares, which sometimes reaches 35–50%. However, it should be said that this substantial difference between the prices of common and preferred shares cannot be justified, taking into account the characteristics of the two categories of shares. Hence, there is a need for further investigation of the matter, since it is difficult to accept that the differences in voting rights and the number of outstanding shares can give such a difference in favour of the price of common shares. We also believe that this big price discrepancy is not easily explained by the privileges of preferred shares, on distributed dividends and on the company's assets in the case of insolvency.

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REFERENCES

Alexakis, C. (1992) An empirical investigation of the Efficient Market Hypothesis: The case of the Athens Stock Exchange. PhD Thesis, University of York.

Alexakis, P. and Petrakis, P. (1991) Analysing stock market behaviour in a small capital market, *Journal of Banking and Finance*, **15**, 471–83.

Alexakis, P. and Xanthakis, M. (1997) Day of the week effect in the Greek Stock Market, *Applied Financial Economics*, under publication.

Cootner, P. H. (1962) Stock prices: random walk vs systematic changes, *Industrial Management Review*, **3**, 24–45.

Engle, R. and Granger, C. W. S. (1987) Cointegration and error correction: representation estimation and testing, *Econometrica*, **55**, 251–76.

Fama, E. (1970) Efficient capital markets: a review of the theory and empirical work, *Journal of Finance*, **25**, 383–416.

Fama, E. (1976) Efficient capital markets: reply, *Journal of Finance*, **3**, 143–45.

Granger, C. W. (1969) Investigating causal relations by econometric methods and cross spectral, *Econometrica*, **37**, 24–36.

Granger, C. W. (1988) Some recent developments in the concept of causality, *Journal of Econometrics*, **39**, 194–211.

Hall, S. G. and Henry, S. G. B. (1988) *Macroeconomic Modeling*, Chapter 2, North Holland, Amsterdam.

Hiemstra, C. and Kramer, C. (1995) Nonlinearity and endogeneity in macro-asset pricing. International Monetary Fund Working Paper, March 1995.

Jones, J. and Uri, N. (1989) Market efficiency, spot metal prices and cointegration. Evidence from the U.S. 1964–1987, Unpublished Paper.

McDonald, R. and Taylor, M. P. (1988) Metal prices, efficiency and cointegration: some evidence from the London metal exchange, *Bulletin of Economic Research*, **40**, 235–39.

McDonald, R. and Taylor, M. P. (1989) Rational expectations, risk and efficiency in the London metal exchange: an empirical analysis, *Applied Economics*, **21**, 143–53.

Niarchos, N. (1972) *The Greek Stock Market*, Athens Stock Exchange Publications.

Osborne, M. F. M. (1959) Brownian motion in the stock market, *Operations Research*, **7**, 145–73.

Osborne, M. F. M. (1962) Periodic structure in the Brownian motion of stock prices, *Operations Research*, **10**, 345–79.

Panas, E. (1990) The behaviour of Athens stock prices, *Applied Economics*, **22**, 1715–27.

Peters, E. E. (1989) Fractal structure in capital markets, *Financial Analyst Journal*, July/August.

Peters, E. E. (1991) *Chaos and Order in Capital Markets, a New View of Cycle Prices and Market Volatility*. John Wiley & Sons Inc, New York.

Rowley, R. and Jain, R. (1986) Sims on causality: an illustration of soft econometrics, *Scottish Journal of Political Economy*, **19**, 417–42.

Wiener, N. (1956) *Modern Mathematics for Engineers, Series 1*. McGraw-Hill, New York.