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CAPM REGULARITIES FOR THE ATHENS STOCK EXCHANGE

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Abstract

The cross-sectional relationship between firm-specific characteristics and average stock returns has attracted a significant amount of attention in the financial literature, especially in the U.S. Because these patterns are not explained by the CAPM, they are called CAPM regularities or anomalies. This paper provides evidence on the role of size, book-to-market ratio and dividend yields on average stock returns in the ASE for the period from January 1991 to March 1997. Following Fama and MacBeth's cross-sectional regression methodology enhanced with Shanken's adjustments for the Errors In Variables problem, a statistically significant positive relationship between the book-to-market ratio, dividend yield and average stock returns is reported. The market capitalisation variable ("size effect") does not seem to explain a significant part of the variation in average returns.

1. Introduction

The EMH requires that efficient capital markets should be characterised by a lack of any ex-post regularities. These regularities consist of persistent departures from the strict set of assumptions underlying the CAPM, and they are often referred to as stock market anomalies.

Officer (1975) reported the first empirical regularities in the form of seasonals for the Australian stock market, while French (1980) found anomalies of returns around periods of non-trading at weekends. It was only in the early 1980's that theoretical evidence focused on firm characteristics as

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empirically important factors after the pioneering work of Basu (1977) who first detailed a price/earnings anomaly.

The most prominent of the CAPM regularities is the size effect of Banz (1981), who found that average returns on small market capitalisation stocks were too high given their β estimates, while the opposite occurred for large stocks [see also Reinganum (1981)]. Rosenberg *et al* (1985) reported that average returns on U.S. stocks were positively related to the ratio of a firm's book value of common equity to its market value. Finally, Litzenberger and Ramaswamy (1979) found that stocks providing high dividend yields (or no dividends at all) experience abnormally high returns, while those providing low dividend yields experience lower abnormal returns. The cross-sectional relationship between stock returns and variables like size, book-to market ratio, price-earnings ratio and dividend yield has been extensively studied for most of the world's developed stock markets.

The selection of such firm characteristics does not have its route from an explicit theoretical model, but it has been guided more by intuition and by their popularity among practitioners. Ball (1978) first argued that yield surrogates, such as the earnings yield or the dividend yield, are correlated with returns because they are both proxies for some other risks which underline stock returns and are not accounted for by market betas. Moreover variables like firm-size, book-to-market equity and dividend yields can be regarded as different ways to scale stock prices, thus redundant for describing average returns [see Keim (1988)].

So far, the empirical evidence seems to confirm that there is not a clear cut economic interpretation for these firm-specific characteristics. Many researchers have seeked a rational asset-pricing framework incorporating these types of variables [see, for instance, Fama and French (1996)]. An opposite view states that it is irrational pricing which causes the high premium for relative distress (the book-to-market effect). Proponents of this view include Lakonishok, Shleifer and Vishny (1994), Haugen (1995), and MacK-inlay (1995), who argue that the premium is due to investors' over-reaction. In particular, they conclude that investors do not like distressed stocks and so cause them to be underpriced. Finally, a last view supports that the CAPM holds and the premia associated with the various CAPM regularities are spurious results of survivor bias, data snooping or bad proxies for the market portfolio in tests of the CAPM [see Kothari, Shanken, and Sloan (1995), and MacKinlay (1995)].

The main objective of this paper is to examine whether the following firm characteristics, namely the size, the book-to-market ratio and the dividend yield can capture the cross-section variation in average ASE stock returns. For the ASE, there is only evidence for the size effect by Diacogiannis and Segredakis (f996) and Glezakos (1993) . We intend to fill this gap in the literature and shed some light on the significance of the main firm characteristics that have been extensively studied, especially for the U.S. market. Wherever possible, we attempt to draw parallels between our findings and those from similar studies using American data.

The paper is organised as follows. Section 2 describes the data and shows the correlation between the various explanatory variables. Section 3 describes the econometric methodology and gives details on the estimation procedure. The empirical results together with their implications and applications are displayed in Section 4. Finally, Section 5 concludes the paper.

2. Data

Our data are monthly closing prices of all the common stocks traded in the ASE. They are row prices in the sense that they do not include dividends but are adjusted for capital splits and stock dividends. The data were taken from Datastream data bank. The estimation covers the period from January 1991 to Marck 1997. The cross-sectional units of the sample consist of 100 stocks continuously listed on the ASE. The market return is obtained from the ASE Composite (General) Share Price Index. Returns are calculated using the logarithmic approximation.

$$R_{it}=\log(P_{i.t}/P_{i,t-1}) \qquad (1)$$

where $P_{i.t}$ is the end — of — month *t* price for asset *i*. Time-series of excess returns on the market and individual securities are taken over the three month government Treasury bill rate, which is considered to be the short-term interest rate.

* More recently, Diacogiannis *et al* (1998) examined the effect of the Price / Earnings (P/E) ratio and the Divident Yield (DY) on expected returns of ASE common stocks for the period 1990-95. They found that P/E is statistically significant variable explaining the cross-section variation of expected returns, while the explanatory power of DY was documented rather weak.

The time-series of the firm-size variable for each asset is obtained from Datastream [Market Value (MV)] files. MV is the market price of a common stock times the number of shares outstanding. It is calculated in millions of Greek Drachmas. Book values of common stocks are obtained from the Monthly Statistical Bulletins of the ASE. The book-to-market ratio is calculated as the book value of a common stock in month *t*, divided by its market price for the corresponding month. Finally, the dividend yield is defined as the sum of the dividends paid in the previous twelve months (normally Greek firms pay dividends once a year) divided by the stock price in month *t-l*, i.e.

$$DY_{it} = \frac{\sum_{T=t-12}^{t-1} d_T}{P_{t-1}} \qquad (2)$$

where DY_{it} is the dividend yield for month *t* for each asset *i*, and d_T is the dividend paid between month *t-12* and *t*. Dividends were obtained from the Monthly Statistical Bulletins of the ASE.

We use logarithms for the firm-size and book-to-market variables because it leads to a simpler interpretation of their impact on average returns and it is shown to be a better functional form in most of the relative empirical studies. Summing up, the explanatory variables used in the asset pricing tests are: $\log(ME_t)$, $\log(BM_i)$ and DY_i, where ME_t, stands for the total market capitalisation of common equity for month *t*, BM_t for the book-to-market ratio and DY_i for the dividend yield.

Although most previous studies have used returns on portfolios as regressors in the FM regressions, the current analysis has been conducted using data on individual stocks in the asset pricing tests. This has been commanded for two main reasons: (i) the small sample size (100 stocks) is quite restrictive in forming portfolios, (ii) there is no reason to smudge the information in variables like size, book-to-market ratio and dividend yield by using portfolios, since they are measured precisely for individual stocks. Furthermore, as Lo and MacKinlay (1990) suggest, grouping securities based on some empirically motivated fundamental variables (such as size or book-to-market ratio) may cause biases in the test statistics since it spuriously exaggerates the relationship between portfolio excess returns and the firm-specific characteristics.

To detect any possible effects of interdependence between the explanatory variables that might spuriously affect the results of estimation and the significance of the estimated coefficients, we estimate the averages of the cross-sectional correlations between market betas, size, book-to-market and dividend yield. These correlations are reported in Table 1.

TABLE 1

Correlation Matrix for the Independent Variables

This table shows the arithmetic averages of the monthly cross-sectional correlations between the explanatory variables in the cross-section regression equation

$$R_{it} = \gamma_0 + \gamma_\mu \beta_{im} + \gamma_{SIZE} \log(ME_i) + \gamma_{BM} \log(BM_i) + \gamma_{DY} DY_i + \eta_{it}$$

where ME_i denotes the total market capitalisation of common equity, BM_i the book-to-market ratio and DYi the dividend yield for asset i in month t, respectively.

Variable	β_{im}	$\log(ME_i)$	$\log(RM_i)$	DY_i
β_{im}	1.000			
$\log(ME_i)$	0.406	1.000		
$\log(BM_i)$	-0.023	-0.392	1.000	
DY_i	-0.004	0.115	0.174	1.000

Table 1 shows that the average of the monthly cross-sectional correlations between *$\log(ME_i)$* and $\log(BM_i)$ is -0.39. This correlation implies that firms with small market capitalisation are more likely to have poor prospects, resulting in low stock prices and high book-to-market ratios. Conversely, large stocks are more likely to have stronger prospects, signalled here by higher stock prices, lower book-to-market ratios and lower average stock returns. The table also shows that the average of the monthly cross-sectional correlations between $\log(BM_i)$ and DY_i is 0.17. This could indicate that highly yielding stocks are about to have higher book-to-market ratios and hence poorer prospects, while the opposite occurs as well. To account for the relatively high correlations between market betas and size, size and book-to-market ratio, and dividend yields and book-to-market, the correlated variables were made orthogonal to each other, i.e. size was made orthogonal to the market, size to book-to-market and dividend yield to book-to-market. The orthogonalisation technique consists of substituting the value of the variable to be orthogonalised by the estimated residuals of the auxiliary regression of the orthogonalisation.

3. Econometric Methodology and Estimation Procedure

The asset-pricing tests performed in this paper use the cross-sectional regression methodology of Fama and MacBeth (1973). Its implementation involves two steps (passes) of estimation. In the first step, given T periods of observations, the least squares estimates of market betas, denoted by B_{iM}, are obtained by running the following regression equation for each i over the sample period (t=1,2,...T)

$$R_{it} = \alpha_{im}+\beta_{im}R_{mt}+\varepsilon_{it}, \quad i=1, ...,n \tag{3}$$

where R_{it} and R_{mt} are the excess return on asset i and the market at the end of month t, respectively, α_{im} is a constant, and β_{im} is the risk of asset i relative to the total risk of the market portfolio. E_{it} is a random disturbance that has expected value equal to zero and is independent of R_{mt} [see also Diacogiannis and Segredakis (1996) for the properties of the disturbance term and how they are met in the ASE].

In the second step, the above estimates together with the firm-specific characteristics enter into the following cross-sectional regression equation as explanatory variables

$$R_{it}=\gamma_o+\gamma_m \ \beta_{im}+\gamma_{SIZE} \ \log(ME_t)+\gamma_{BM} \ \log(BM_i)+\gamma_{DY} \ DY_i+\eta_{it} \tag{4}$$

where γ_j are the associated with each variable slope coefficients. For the case of market betas y_m is the market price of risk. In the present context, the firm characteristics are assumed to affect the mean return of security i as a regularity, hence the estimates of Y_{SIZE}, Y_{BM}, and Y_{DY} are not given the interpretation of prices of risk.

Since returns are normally distributed and temporally independently and identically distributed across time (IID), the γ_j coefficients will also be normally distributed and IID. Hence, the time-series means of the monthly regression slopes can be tested using the common t — test and inferences can be made in the usual fashion. The t — statistic is given by

$$t(\bar{\hat{\gamma}}_j)=\frac{\bar{\hat{\gamma}}_j}{\hat{\sigma}_{\hat{\gamma}j}/\sqrt{T}} \tag{5}$$

where $\bar{\hat{\gamma}}_j = \frac{\sum_{t=1}^{T} \hat{\gamma}_{jt}}{T}$ is the sample mean over time of the cross-section least squares estimates of the coefficients γ_j of equation (4), denoted by $\hat{\gamma}_{jt}$, and $\hat{\sigma}_{\hat{\gamma}j}$ is the standard deviation of $\hat{\gamma}_{jt}$. If successive values of γ_j are independent and identically distributed normal random variables, then the t-statistic of (5) follows a student distribution with n-l degrees of freedom. In addition, under the assumption that the disturbance term η_{it} is IID across t, the distribution of $t(\bar{\hat{\gamma}}_j)$ is asymptotically normally distributed.[7]

The allow for the Errors In Variables (EIV) problem[8] which is inherent in the estimation of the second step regressions, we apply Shanken's (1992) adjustment of $t(\bar{\hat{\gamma}}_j)$ which corrects the standard deviation $\hat{\sigma}_{\hat{\gamma}j}$ in equation (5) to explicitly deal with the bias introduced by the EIV.[9]

4. Empirical Results

This section is divided into two parts. In the first one, the role of size, book-to-market equity and dividend yield is evaluated in two-variable regressions using market betas and each of the firm-specific characteristics separately. This analysis will reveal if the well-documented CAPM regularities exist in the ASE. In the second part, we examine the joint role of the firm-specific characteristics on expected returns using multi-variable regressions. This procedure enables us to disentangle the impact of these variables on stock returns.

4.1. CAPM Regularities in the ASE

In this section, the cross-sectional regression models that are estimated are:

$$E(R_{it}) = \gamma_o + \gamma_m \beta_{im} + \gamma_{SIZE} \log(ME_i) \tag{6}$$

$$E(R_{it}) = \gamma_o + \gamma_m \beta_{im} + \gamma_{BM} \log(BM_i) \tag{7}$$

$$E(R_{it}) = \gamma_o + \gamma_m \beta_{im} + \gamma_{DY} DY_i \tag{8}$$

If there is no relationship between $\log(ME_i)$, log(BMi), DY_i and the expected returns, equations (6) to (8) collapse to the known two-parameter model. Thus, these tests can be regarded as robustness tests of the two-parameter model against the above variables. We assume a linear relationship between expected returns and $\log(ME_i)$, $\log(BM_j)$ and DY_i. Linearity is assumed only for reasons of convenience, since there is no theoretical reason why the relationship should be linear.

Estimates of equations (6) to (8) are presented in Table 2. The table shows the time-series averages of the coefficients $\gamma_0, \gamma_m, \gamma_{size}, \gamma_{BM}$ and γ_{DY}, denoted $\bar{\hat{\gamma}}_0, \bar{\hat{\gamma}}_m, \bar{\hat{\gamma}}_{size}, \bar{\hat{\gamma}}_{BM}$, and $\bar{\hat{\gamma}}_{DY}$, respectively, and their associated unadjusted and adjusted t-values. All the $\overline{R}^2$ and the estimates of the average slopes are reported as percentages.

With respect to the size effect (see panel A), the results of the table show that there is evidence of a size effect but it is not very strong. The adjusted *t*-value of $\bar{\hat{\gamma}}_{size}$ is -1.60, which provides weak evidence of an existence of a size effect in the Greek stock market, contrary to the evidence from more developed capital markets. The sign of $\bar{\hat{\gamma}}_{size}$ is negative which means that the shares of firms with large market values have the tendency to earn smaller risk adjusted returns, on average, than similar shares for smaller firms over the entire six-year period. It may also be a relative-prospects effect, as the earnings prospects of distressed firms are more sensitive to economic conditions. In this sense, small firms tend to be riskier than large firms and the risk of smaller firms is not likely to be captured by a market index heavily weighted towards large firms [see Chan and Chen (1991)]. Our results are in line with the evidence provided by Diacogiannis and Segredakis (1996), who also found an insignificant size effect for the ASE for the period 1990-1994.

With respect to the book-to-market effect (see panel B), the results clearly indicate that there is a strong cross-sectional relation between average returns and book-to-market ratio. The high t — statistics (asjusted or not) show that this effect is more powerful than the size or the dividend yield effect. Our results are compatible with previous evidence from U.S. studies. The most prominent justification of the relation between stock returns and the book-to-market ratio is that it captures the relative distress factor affecting stock returns. Chan and Chen (1991) provided evidence that there is covariation in returns related to relative distress which is not captured by the market return and is compensated in average returns. Furthermore, low book-to-market equity is typical of firms that have persistently strong earnings, while a high ratio is associated with persistently low earnings and higher expected stock returns, since these firms are penalised with a higher cost of capital [see Fama and French (1995)].

With respect to the dividend yield effect (see panel C), the results of the table reveal that dividend yields can also capture the cross-section variation of average stock returns in the ASE. $\bar{\hat{\gamma}}_{DY}$ is 6.209 per cent per month and is 2.09 standard errors away from zero. Its positive sign implies that holding beta risk constant, higher yielding stocks have higher average returns than lower yielding stocks. A positive relation between dividend yields and average stock returns was also reported by Diacogiannis *et al* (1998). However, the significance of the dividend yield coefficient at the 10 percent level in only two out of the five periods that they tested, led them to conclude that the dividend yield effect was rather vague and insignificant for the period 1990 - 1995. In tests of the after-tax version of the CAPM [see Brennan (1970), and Litzenberger and Ramaswamy (1979)], a positive dividend yield coefficient is regarded as an implied tax rate induced by the disparity in tax rates of dividends and capital gains. From this perspective, $\bar{\hat{\gamma}}_{DY}$ implies an annual tax rate of 74.5 per cent, which is too large to be interpreted as a marginal tax bracket. However, given the evidence that the market price of risk is not significant, our results should not be viewed as a formal test of the after-tax CAPM, but they should emphasise the cross-sectional predictive content of dividend yields for asset pricing.

Note that until the period that this paper was written, income from dividends was not taxed in Greece, while income from capital gains was. In this case, the positive coefficient could reflect the difference in taxation between these two sources of income. Thus, the results pose an interesting question as whether the dividend yield effect is, in fact, tax-related or it is generated by some other factor (e.g. size). Miller and Scholes (1982) suggested that the explanatory power of dividend yields may be due to the price in the denominator, rather than the dividend in the numerator of the ratio [see also Berk (1995)].

Finally, Table 2 shows that market betas have no role in explaining average returns in the ASE.[11] $\bar{\hat{\gamma}}_{m}$ is negative and insignificant for all the two-variable cross-sectional regressions. In short, our tests do not support the central prediction of the Sharpe-Lintner-Black model, that average stock returns are positively related to market β\$. These results are not surprising. Reinganum (1981), Chen *et al* (1986), and Lakonishok and Shapiro (1986), among others, provide evidence of market betas' inefficiency to describe the cross-variation of average returns.

TABLE 2

CAPM Regularities for the ASE

This table gives the estimates of the following two-variable cross-sectional regressions

$R_{it} = \gamma_0+\gamma_m \beta_{im} + \gamma_{SIZE} \log(ME_i) + \eta_{it}$

$R_{it} = \gamma_0+\gamma_m \beta_{im} + \gamma_{BM} \log(BM_i) + \eta_{it}$

$R_{it} = \gamma_0+\gamma_m \beta_{im} + \gamma_{DY} DY_i + \eta_{it}$

The coefficient estimates and $\hat{s}_F^2$ are reported as percentages

Coefficient	$\bar{\hat{\gamma}}_0$	$\bar{\hat{\gamma}}_m$	$\bar{\hat{\gamma}}_{SIZE}$	$\bar{\hat{\gamma}}_{BM}$	$\bar{\hat{\gamma}}_{DY}$	$\overline{R}^2$
PANEL A	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{SIZE} \log(ME_i)+\eta_{it}$					
Estimate	-0.819	-0.861	-0.296			6.50
t-statistic	-1.62	-0.81	-1.61			
adjusted-t	-1.61	-0.81	-1.60			
PANEL B	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{BM} \log(BM_i)+\eta_{it}$					
Estimate	-0.037	-0.619		0.715		6.05
t-statistic	-0.06	-0.59		3,22*		
adjusted-t	-0.06	-0.58		3.21*		
PANEL C	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{DY} DY_i+\eta_{it}$					
Estimate	-1.067	-0.887			6.209	5.80
t-statistic	-1.92	-0.82			2.21*	
adjusted-t	-1.90	-0.82			2.20*	

NOTES: 1) $\bar{\hat{\gamma}}_j$ is the average over time estimate of $\hat{\gamma}_j$ while $\overline{R}^2$ is the average coefficient of determination corrected for the degrees of freedom.

2) The adjusted t-statistics are computed using Shanken's (1992) adjustment scalar c. This is given by $c \equiv \hat{\Gamma}'\Omega^{-1}\hat{\Gamma}$ where $\hat{\Gamma}$ is a column vector of the estimated risk premia and Ω is the factor's variance-covariance matrix. Given a single-factor portfolio c is just the squared value of the Sharpe measure of performance, $c = \left[\frac{\bar{\hat{\gamma}}m}{s(Rm)}\right]^2$, where $S(R_m)$ is the

standard deviation of the return on the market index. For market betas, the correct t — statistic is given by:

$$t^{o}(\bar{\hat{\gamma}}m)=\frac{\bar{\hat{\gamma}}m}{\sqrt{\hat{\sigma}^{2}\gamma m}} \quad \text{with} \quad \hat{\sigma}^{2}\gamma m=(1+c)\left[(s(\bar{\hat{\gamma}}m))^{2}-\frac{\hat{s}f^{2}}{T}\right]+\frac{\hat{s}f^{2}}{T}$$

where $\hat{\sigma}^{2}_{\gamma m}$ denotes the adjusted variance, $s(\bar{\hat{\gamma}}_{m})$ is the unadjusted standard error of the sample mean, and $\hat{s}_{f}^{2}$ is the variance of the corresponding to the coefficient factor sample mean (for market betas, $\hat{s}_{f}^{2}$ is the variance of the return on the market index). For the constant term, $\hat{\gamma}_{o}$ and the average slopes of the firm-specific characteristics, $\bar{\hat{\gamma}}_{size}$, $\bar{\hat{\gamma}}_{BM}$, and $\bar{\hat{\gamma}}_{DY}$, the correct t-statistic is given by:

$$t^{o}(\bar{\hat{\gamma}}_{j})=\frac{t(\bar{\hat{\gamma}}_{j})}{\sqrt{1+c}}$$

3) *Significant at the 5% level

4.2. The Joint Role of Firm-Size, Book — To — Market Ratio and Dividend Yields on Expected ASE Returns

Recall that the evidence in Table 1 showed that the explanatory variables in (4) are, to a degree, correlated. To control for any effects of multicolinearity on the estimates of (4), a stepwise estimation procedure is followed where a sequential estimation of (4) is conducted. If there is inter-dependence across the explanatory variables, the stepwise estimation procedure is a convenient tool to assess the marginal explanatory power of each of the firm-specific characteristics as it can reveal which variables play the most important role in explaining the cross-section variation of expected returns.

The stepwise estimates of equation (4) are summarised in Table 3. Several interesting conclusions can be drawn from this table. First, the reliable positive relation between the book-to-market ratio and average stock returns persists no matter which other explanatory variables are used in the regressions. γ_{BM} is always around three or more standard errors from 0 for all the cross-sectional regressions which are estimated. The book-to-market ratio is thus the most powerful variable in explaining the cross-section variation of average returns in the ASE. Its influence is so strong, that when it is included with other variables in a regression, their average slopes become less significant (see panels B, C, and D).

TABLE 3

The Joint Role of β, Size, Book-to-Market and Dividend Yields on Average Stock Returns (Multi-Variable Regressions)

This table gives stepwise estimates of the cross-sectional regression model

$R_{it}=\gamma_0+\gamma_m\ \beta_{im}+\gamma_{SIZE}\ \log(ME_i)+\gamma_{BM}\ \log(BM_t)+\gamma_{DY}\ DY_i\ +\ \eta_{it}$

The coefficient estimates and $\overline{R}^2$ are reported as percentages.

Coefficient	$\bar{\hat{\gamma}}_0$	$\bar{\hat{\gamma}}_m$	$\bar{\hat{\gamma}}_{SIZE}$	$\bar{\hat{\gamma}}_m$	$\bar{\hat{\gamma}}_{BM}$	$\overline{R}^2$
PANEL A	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{SIZE}\ \log(ME_i)+\gamma_{BM}\ \log(BM_i)+\eta_{it}$					
Estimate	-0.712	-0.012	-0.279	0.640		6.95
t-statistic	-1.41	-0.95	-1.52	3.07*		
adjusted-t	-1.40	-0.95	-1.51	3.05*		
PANEL B	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{SIZE}\ \log(ME_i)+\gamma_{DY}\ DY_i+\eta_{it}$					
Estimate	-1.103	-0.851	-0.342		6.309	7.11
t-statistic	-2.02*	-0.79	-1.87		2.22*	
adjusted-t	-2.01*	-0.78	-1.86		2.21*	
PANEL C	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{BM}\ \log(BM_i)+\gamma_{DY}\ DY_i+\eta_{it}$					
Estimate	0.036	-0.722		0.717	5.131	6.52
t-statistic	0.06	-0.67		3.24*	1.84	
adjusted-t	0.06	-0.67		3.22*	1.83	
PANEL D	$R_{it}=\gamma_0+\gamma_m\beta_{im}+\gamma_{SIZE}\ \log(ME_i)+\gamma_{BM}\ \log(BM_i)+\gamma_{DY}\ DY_i\ +\ \eta_{it}$					+
Estimate	-0.695	-1.035	-0.335	0.609	5.123	7.38
t-statistic	-1.37	-0.96	-1.85	2.93*	1.82	
adjusted-t	-1.36	-0.95	-1.83	2.90*	1.80	

NOTE: * Significant at the 5% level.

Secondly, the dividend yield effect itself does not show up to be significant at the 5% level in all the different regression specifications considered. When log(BMi) is included in the regression, it appears insignificant at the 5% level (see panels C and D). The same is true for the size effect (see panel A). However, under various alternative regression specifications, $\bar{R}^2$ becomes significant at around the 10% level (see panels B and D).

Finally, another point of interest is that the value of $\bar{R}^2$ does not increase significantly with the inclusion of additional firm-specific characteristics into the cross-sectional regressions. Quite surprisingly, when all the variables are included, the value of $\bar{R}^2$ increases less than 1% compared to the value of 6.5% reported in panel A, Table 2.

4.3. Implications and Applications of the Results

The tests which have been conducted in this paper, both based on two-variable and multi-variable regressions, presume a rational asset-pricing framework on the relation between size, book-to-market and dividend yields. Our results show that there are firm-specific characteristics which can explain about 8% of the cross-section variation in ASE returns. We do not claim that these characteristics are consistent with the multi-factor asset-pricing models of Merton (1973) and Ross (1976). A necessary condition for these models is multiple common sources of risks, but we have not identified the state variables of special hedging concern to investors which are necessary in a multi-factor ICAPM or APT, if they are not to collapse to the CAPM.[13] Nevertheless, our findings have important applications for portfolio formation and performance evaluation, especially by investors who are primarily interested in long-term average returns. The size effect could contribute a great deal to the description of the returns on small-stock funds, while the book-to-market ratio could be crucial in describing the returns on growth-stock funds. Furthermore, the performance of pension or mutual funds could be evaluated by comparing their average return with the average return on a benchmark portfolio with similar size, book-to-market and dividend yield characteristics.

5. Summary and Conclusions

This paper examines whether the well-documented CAPM regularities exist in the ASE. Several empirical studies have reported anomalies in average returns related to the firm-size, the book-to-market ratio and the dividend yields. Our selection of firm characteristics is motivated mainly by their availability for the Greek firms and the existing empirical evidence. Since there is no theoretical foundation about the correct relationship between the above variables and stock returns, our results are based on a linear relationship. We do not, of course, claim that the list of explanatory variables employed in the tests is exhaustive, but the set of variables which was chosen performed well against some alternative candidates (e.g. the price-earnings ratio). The Fama and MacBeth cross-sectional procedure is enhanced with Shanken's corrections to allow for the EIV problem. Data on individual securities are used in order to keep our inferences safe from biased test statistics. This procedure prevents us from making arbitrary decisions on the order of grouping securities into portfolios, and so all the explanatory variables are assigned equal importance before each test.

Our findings reveal a significant positive cross-sectional relationship between the book-to-market ratio, dividend yields and average stock returns in two-variable regressions. A separate "size effect", although documented in most developed stock exchanges, is not detected in purely statistical terms for the Greek stock market

In an attempt to unravel the separate influences of the firm-specific characteristics on returns, multi-variable regressions are also run. Perhaps the most impressive result from this procedure is that inferences are slightly sensitive to the regression specification. The performance of the book-to-market ratio is not altered in the inclusion of other variables; this variable has a consistently reliable performance and it proves to be the most important of the firm characteristics considered, either in statistical or economic terms. Conversely, the market capitalisation and dividend yield coefficients are more sensitive to the regression specification. The size and dividend yield effects appear to be subsumed by the influence of the book-to-market ratio. Whatever the underlying economic causes for such interaction effects, our main result is still quite straightforward: three firm-specific characteristics, namely the book-to-market ratio, the dividend yields and the firm-size, provide an ample characterisation of the cross-section variation of average stock returns for the 1991-1997 period for the ASE.

In accordance with prior studies in this area, our results do not provide adequate justification whether the predictability in returns is a result of rational or irrational asset pricing, or a result of market inefficiency. However, if assets are priced rationally, our results suggest that stock risks are multidimensional; one dimension of risk is proxied by size, another by the ratio of a stock's book value to its market value, and another by its dividend yield. This could have serious practical implications on the formation and performance evaluation of managed portfolios (e.g. pension funds and mutual funds).

NOTES

1. The existence of a market regularity would imply that the EMH does not hold and the markets are not informationally efficient. For example, an agent could use such a regularity (e.g. seasonals in returns) to devise a trading strategy that would yield supernormal returns. The only observed regularities that are compatible with the CAPM are those caused by institutional constraints (such as transaction costs) or other market imperfections (such as taxes).

2. See, among others, Brown *et al* (1983) for Australia, Berges *et al* (1981) for Canada, Nakamura and Terada (1984), and Chan *et al* (1991) for Japan, Reinganum and Shapiro (1983), and Bulkley and Harris (1997) for UK, and Litzenberger and Ramaswamy (1979), Debondt and Thaler (1987), Fama and French (1992), and Davis (1994) for US.

3. For an asset to be included in the initial sample, it is required that there must be data from the first month of a testing period until the last. This is why many stocks that were listed on the ASE in January 1991 are not included in the initial sample.

4. Note that this book-to-market ratio refers to a single stock and not to the whole amount of equity, since it is not multiplied by the number of shares outstanding. However, our conclusions are not altered by this specification.

5. The logarithmic transformation was not applied in the case of dividend yields since many firms in the ASE do not pay dividends.

6. The use of Shanken's adjusted standard errors overcomes the problem associated with the loss of precision in the estimation of market betas in (i).

7. For a discussion of the robustness of the tests to deviations from normality assumptions see Karanikas (1997), chapter 3.

8. This problem occurs because market betas are not known, so betas estimated from the data must be used instead.

9. He argued that when estimating the *ex ante* price of risk (estimates of the $\hat{\gamma}_{jt}$ coefficients in the cross-sectional regressions), the factor-related variation in the *ex post* price should also be considered. He proposed an asymptotic adjustment of the *t*-statistic of (6) by a scalar c. The adjustment reflects the fact that the variance of the beta estimates is directly related to residual variance and inversely related to the associated variable (factor) variability.

10. Brown, Kleidon and Marsh (1983) have observed that the relation between the realised "excess return" (from CAPM) and log(ME) is linear.

11. Fama and French (1992) argued that the non-explanatory power of beta may be due to the fact that the true betas are correlated with the firm-specific characteristics. This obscures the relation between average returns and measured betas if market betas are estimated with big errors.

12. As Fama and French (1992) argue, the FM intercept is constrained to be the same for all stocks, thus FM regressions always impose a linear factor structure on returns and expected returns.

13. Fama and French (1996) showed that their three-factor model could capture most of the CAPM anomalies. They argued that their factors like the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB, small minus big) and the difference between the return on a portfolio of high book-to-market stocks and the return on a portfolio of low b-t-m (HML, high minus low) mimic combinations of two underlying risk factors or state variables of special hedging concern to investors.

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