THE CROSS-SECTION OF EXPECTED STOCK RETURNS
AN EMPIRICAL STUDY IN THE ATHENS STOCK EXCHANGE

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ABSTRACT

This paper explores the ability of the capital asset pricing model, as well as the firm specific factors, to explain the cross-sectional relationship between average stock returns and risk in Athens Stock Exchange (ASE). The objective of this study is to investigate the cross-section of stock returns in the Greek stock market for the period from July 1993 to June 2001. A methodology similar to that of Fama and French (1992) is employed, by taking into account the constraints imposed by a smaller sample both in time and in terms of number of stocks.

Our findings indicate that in the Greek stock market there is not a positive relation between risk, measured by β, and average returns. On the other hand, there is a "size effect" on the cross-sectional variation in average stock returns. (JEL G12)

Key words: CAPM, APT, beta, size, book-to-market ratio.

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1. INTRODUCTION

The Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), Lintner (1965), and Black (1972) specify that the expected return on a stock is affected by a function of the stock's sensitivity to the overall movements in the market, i.e. its beta coefficient. Empirical tests of the model, generally, supported its main prediction as beta being the only explanatory variable in explaining the cross-sectional variation across portfolios (e.g. Black, Jensen, and Scholes (1972), and Fama and MacBeth (1973)).

The validity of this model has been the subject of remarkable arguments since more recent empirical tests on asset pricing have identified a number of factors that help explain the cross-section of average returns in addition to the market risk factor and typically called anomalies of CAPM. Particularly, firm capitalization (Banz (1981), Keim (1983)), ratio of a firm's book value of common equity (Rosenberg, Reid, and Lanstein (1985)), leverage (Bhandari (1988)), earnings-price ratio (Basu (1983), Ball (1978)), and ratio of book-to-market equity Fama and French (1992), are among those variables that are found to have a significant explanatory power in asset pricing tests. In a previous research Chan, Hamao, and Lakonishok (1991) reach the same conclusion on book-to-market equity and Kubota and Takehara (1996) on size and book-to-market equity, in the Japanese market.

Fama and French (1993) suggest, as an alternative to the capital asset pricing model, a three-factor empirical model that can explain most of the empirical anomalies cited in the literature. Daniel and Titman (1997) argue that the three factors in Fama and French (1993) are not priced, hence they cannot be considered as risk factors.

The present research paper is inspired by the empirical test of Fama and French (1992). The area we are going to study is the Athens Stock Exchange during the period of 1993 to 2001. We use a rather similar methodology as Fama and French (1992) and our data collection includes all non-financial firms listed in ASE during the above mentioned time period.

In order to compare their findings with the current study, we summarize the results that Fama and French (1992) found. They practically reject the implications of the traditional capital asset pricing theory for two reasons. First, they found that betas are not associated with cross-sectional variations of expected stock returns. Second, the ratio of book-to-market equity and size are found to be the most significant variables that can account for the cross-section of expected stock returns.

Thus, they conclude that beta is neither a single relevant risk measure nor a subset of variables in a multivariate specification to explain cross-sectional stock returns' variations of U.S. firms. Consequently, the empirical evidence supporting the capital asset pricing theory is no longer valid.

The purpose of the present research is to find out whether the empirical tests of Fama and French (1992) have implementation in the Athens Stock Exchange (ASE).

The objective of this study is to investigate the cross-section of stock returns in the ASE. We are primarily interested in finding whether β is significantly related to the average stock returns and whether average returns are related with size and book-to-market equity ratio. These observations and our main interest into the workings of the traditional CAPM per se are the major motivations why we have chosen a research design similar to Fama and French (1992) and ranked stocks according to their size first and then on their β. Finally, we constructed portfolios based on size and BE/ME for comparison purposes.

The findings of this study are consistent with the results of Fama and French (1992) that there is a "size effect" in the cross-section of average stock returns. Our findings conflict with the predictions of the CAPM that beta is positively related to expected return and that it is the only explanatory variable. We find that β cannot explain the cross-sectional variations of average returns in the ASE. In contrast with the study of Fama and French (1992) we find that there is a "book-to-market effect" only in the case where it is the only explanatory variable in the cross-section of average stock returns. The significance of book-to-market ratio reduces when the influence of the other explanatory variables are added to the model.

The remainder of this paper is organized as follows: section 2 provides a brief theoretical review of the CAPM, section 3 describes the data and the methodology used in this research, section 4 presents the empirical results of our findings, and finally section 5 concludes the paper.

2. THEORETICAL LITERATURE REVIEW

The capital asset pricing model has an extensive history of theoretical and empirical study. Many writers have contributed to development and to improvement of a form explaining the pricing of capital assets under condition of market equilibrium.

The Sharpe (1964)-Lintner (1965) models are the extension of one period mean-variance portfolio models of Markowitz (1959) and Tobin (1958), which sequentially are constructed on the expected utility model of von Nuemann and Morgenstern (1953).

Early work on the Sharpe-Lintner Capital Asset Pricing Model (CAPM) tended to be broadly supportive. The classic studies of Black, Jensen, and Scholes (1972) and Fama and MacBeth (1973), for example, found that high-beta stocks tended to have higher average returns than low-beta stocks and that the relation was roughly linear. Although the slope of the relation was too flat to be consistent with the Sharpe-Lintner version of the CAPM, this could be explained by borrowing constraints of the sort modeled by Black (1972).

During the 1980s and 1990s, researchers began to look at other characteristics of stocks besides their betas. Several deviations from the CAPM, or "anomalies," were discovered.

First, Banz (1981) reported the *size effect* that small (low-market-value) stocks have higher average excess returns than can be explained by the CAPM. Small stocks do have higher betas and higher average returns than large stocks, but the relation between average return and beta for size-sorted portfolios is steeper than the CAPM security market line. Fama and French (1992) drew further attention to the size effect by sorting stocks by both size and beta and showing that high-beta stocks have no higher returns than low-beta stocks of the same size. There is also a size-related “January effect” documented in empirical research by Keim (1983, 1986), Reinganum (1983), and Roll (1982-1983).

Second, several authors found a *value effect* that returns are predicted by ratios of market value to accounting measures such as earnings, the book value of equity (Basu (1983), Rosenberg, Reid, and Lanstein (1985), Fama and French (1992)), the book-to-market ratio (Lewellen (1999)), the dividend yield or payout ratio (Lamont (1998)), the share of equity in new finance (Nelson (1999), Baker and Wurgler (2000)), yield spreads between long-term and short-term interest rates and between low-and-high-quality bond yields (Campbell (1987), Fama and French (1989), Keim and Stambaugh (1986)), and the level of consumption relative to income and wealth (Lettau and Ludvigson (1999a)).

Third, Jegadeesh and Titman (1993) documented a *momentum effect* that stocks with high returns over the past three to twelve months tend to outperform in the future. This is related to the finding of DeBondt and Thaler (1985) that stocks with low returns over the past three to five years outperform in the future.

Empirically, these anomalies can be described, usually, using multi-factor models in which the factors are chosen either statistically or based on economic theory, or even atheoretically to fit the empirical evidence.

Fama and French (1993) introduced a three-factor model in which the factors include the return on a broad stock index, the excess return on a portfolio of small stocks over a portfolio of large stocks, and the excess return on a portfolio of high book-to-market stocks over a portfolio of low book-to-market stocks. Carhart (1997) augmented the model to include a portfolio of stocks with high returns over the past few months. These models broadly capture the performance of stock portfolios grouped on these characteristics, with the partial exception of the smallest value stocks.

There is considerable debate about the interpretation of these results. The first and most conservative interpretation is that they are entirely spurious, the result of "data snooping" that has found accidental patterns in historical data (Lo and MacKinlay (1990), White (2000)).

A second view is that the anomalies result from the inability of a broad stock index to proxy for the market portfolio return. Roll (1977) takes the extreme position that the CAPM is actually untestable, because any negative results might be due to errors in the proxy used for the market. In response to this, Stambaugh (1982) has shown that tests of the CAPM are insensitive to the addition of other traded assets to the market proxy, and Shanken (1987) has shown that empirical results can only be reconciled with the CAPM if the correlation of the proxy with the true market is quite low.

Recent research in this area has concentrated on human capital, the present value of claims to future labor income. Because labor income is about two-thirds of U.S. GDP and capital income is only one-third of GDP, it is clearly important to model human capital as a component of wealth. Jagannathan and Wang (1996) argue that labor income growth is a good proxy for the return to human capital and find that the inclusion of this variable as a factor reduces evidence against the CAPM. In a similar thinking, Liew and Vassalou (2000) show that excess returns to value stocks help to forecast GDP growth, and Vassalou (1999) introduces GDP forecast revisions as an additional risk factor in a cross-sectional model.

A third view is that the anomalies provide genuine evidence against the CAPM but not against a broader rational model in which there are multiple risk factors. Fama and French (1993, 1996) have interpreted their three-factor model as evidence for a "distress premium"; small stocks with high book-to-market ratios are firms that have performed poorly and are vulnerable to financial distress Chan and Chen (1991), and they command a risk premium for this reason.

Fama and French do not explain why distress risk is priced. Given the high price of distress risk relative to market risk, this question cannot be ignored. In fact MacKinlay (1995) expresses skepticism that any rational model with omitted risk factors can generate sufficiently high prices for those factors to explain the cross-sectional pattern of stock returns.

One possibility is that the distress factor reflects the distinction between a conditional and unconditional asset pricing model. The CAPM may hold conditionally but fail unconditionally. If the risk premium on the market portfolio moves over time, and if the market betas of distressed stocks are particularly high when the market risk premium is high, then distressed stocks will have anomalously high average returns relative to an unconditional CAPM even if they obey a conditional CAPM exactly. Jagannathan and Wang (1996) try to capture this by using a yield spread between low-and high-quality bonds as an additional risk factor proxying for the market risk premium. Cochrane (1996) and Lettau and Ludvigson (1999b) introduce additional risk factors by interacting the market return with the dividend-to-price ratio and long-short yield spread, and a consumption-wealth-income ratio. These approaches reduce deviations from the model, and Lettau and Ludvigson are particularly successful in capturing the value effect. Campbell and Cochrane (2000) take a more theoretical approach, showing that a model with habit formation in utility implies deviations from an unconditional CAPM of the magnitude found in the data even though the CAPM holds conditionally.

Alternatively, the CAPM may fail even as a conditional model, but the data may be described by an intertemporal CAPM of the sort proposed by Merton (1973). In this case additional risk factors may be needed to capture time variation in investment opportunities that are of concern to long-term investors.

A fourth view is that the anomalies do not reflect any type of risk but are "mistakes" that disappear once market participants become aware of them. Keim (1983) pointed out that the small-firm effect was entirely attributable to excess returns on small firms in the month of January. A seasonal excess return of this sort is very hard to relate to risk, and if it is not purely the result of data snooping it should be expected to disappear once it becomes well-known to investors.

The most radical view is that the anomalies reflect enduring psychological biases that lead investors to make irrational forecasts. Lakonishok, Shleifer, and Vishny (1994) argue that investors irrationally extrapolate past earnings growth and thus overvalue companies that have performed well in the past. These companies have low book-to-market ratios and subsequently underperform once their earnings growth disappoints investors. Supporting evidence is provided by La Porta (1996), who shows that earnings forecasts of stock market analysts fit this pattern, and by La Porta *et al.*. (1997), who show that the underperformance of stocks with low book-to-market ratios is concentrated on earnings announcement dates.

All these views have difficulties explaining the momentum effect. Almost any model in which discount rates vary can generate a value effect: stocks whose discount rates are high, whether for rational or irrational reasons, have low prices, high book-to-market ratios, and high subsequent returns. It is much harder to generate a momentum effect in this way, and Fama and French (1996) do not attempt to give a rational risk-based explanation for the momentum effect. Instead they argue that it may be the result of data snooping or survivorship bias (Kothari, Shanken, and Sloan (1995)). Psychological models also have difficulties in that momentum arises if investors underreact to news. Such underreaction is consistent with evidence for continued high returns after positive earnings announcements Bernard (1992), but it is hard to reconcile with the overreaction implied by the value effect.

3. RESEARCH METHODOLOGY

In the previous section an attempt was made to fully cover the theoretical and the empirical literature review concerning the capital asset pricing models. In this chapter we will describe the research methodology used and state the restrictions related to the collection and the analysis of our data. We will, then, proceed to the statistical analysis of the data collected and present the results from our research. This study concerns stocks traded in the Athens Stock Exchange during the time period of 1993-2001.

In the present study we will examine monthly return series of listed Greek non-financial firms. All data used in this study is obtained from the Athens Stock Exchange Data Bank. The sample selection includes all common stocks, which have been listed on the Athens Stock Exchange (ASE) for the period of July 1993 to June 2001 (96 months). These data do not include dividends but is adjusted to stock splits. The accounting variables, market equity and book-to-market ratio, were taken from the PROFILE company, an IT Greek company, which keeps a detailed data bank concerning the ASE and all listed companies.

Although, some researchers like Chan, Hamao, and Lakonishok (1991), used all firms in their sample, including financial and non-financial Japanese firms, in the current study we follow the methodology of Fama and French (1992) faithfully. Thus, financial firms-banks and insurance companies-are excluded from our sample because the expected high leverage in these firms, does not have the same value as for non-financial firms, where it is a likely indicator of financial distress. We include firms with common equity, but we exclude firms with preferred equity because for these firms we do not have market value.

For each period of 36 months we select our stocks according to the following procedure:

First step: We select all those stocks, for each investigation period, which have at least values for the last 24 monthly returns. Also, these stocks should have return values for the next twelve months (estimation period).

Second step: For all new stocks, entering the ASE for the first time, we delete their return values of the first three months, so as the share prices (and returns) to become more stable.

Third step: Initially, we start our analysis with daily closing prices from ASE. Then, we calculate the daily returns of each stock and then its excess return (stock return minus the risk free rate), using logarithmic approximation, and finally the monthly compounded returns. The same procedure is repeated for the calculation of the monthly market risk premium based on the closing price of the General-All Shares ASE Index. The risk free rate used is the 90-days Government Treasury Bill rate.

Fourth step: We regress the excess monthly returns of each stock on the market risk premium and find the pre-ranking betas, which will be used for portfolio ranking purposes. In the present study, the pre-ranking beta estimations of individual stocks are based on the 36 previous monthly excess returns of each stock.

Fifth step: Based on the F significance of each of the previous regressions we only select those stocks that have F sig < 0,05. We also exclude any shares, for which there was no BE/ ME ratio value available.

Sixth step: We estimate the size (ME) and the book- to- market ratio (BE/ ME) using logarithmic approximization. PROFILE'S files of balance sheet data, use a firm's market equity and book value of equity at the end of December of year t-1 to compute its book-to-market ratio, and use, also, its market equity for June of year t to measure its size. Thus, to be included in the return tests for July of year t, a firm must have a stock price for December of year t-1 and June of year t. It must also have monthly returns for at least 36 months preceding July of year t (for pre-ranking β estimates, discussed below). In the study of Fama and French

(1992), firms with a negative book value of equity are excluded. In our sample, none of the firms included had negative book value of equity, and therefore it was not necessary to exclude anyone.

Seventh step: We formed three portfolios according to size (ME) and, then, each of the portfolios was divided to three more, according to the estimated pre- betas of each stock. Thus, we formed 9 portfolios in total.

Eighth step: For each portfolio we estimate: (a) the average monthly returns, (b) the size (ME) and (c) the BE/ ME.

Ninth step: We repeat steps 1 to 8 for all overlapping periods under investigation, according to Fama and McBeth, (1973), in order to create the time series for the whole period under investigation (1993-2001).

Tenth step: Based on the time series we estimate: (a) the mean value of the returns, (b) the post- ranking betas, (c) the average size (ME) and (d) the average BE/ ME for each portfolio and for the whole period under investigation.

Eleventh step: Based on the above estimated variables we proceed on the cross- section regression analysis.

Before the cross- section regression analysis we proceeded in a whole series of time series analysis, according to the Fama and French (1992) and Kubota and Takehara (1996), using various sorting methods for the portfolio formation, i.e., pre-beta, ME, BE/ ME, pre-beta and ME, pre-beta and BE/ ME, and ME and BE/ ME.

Black, Jensen and Scholes (1972) state that the accuracy of portfolio betas is higher than that of individual securities. They argue that skewness in the underlying return distribution, sampling errors and misspecification will provide a biased estimation. Assigning stocks to portfolios, based on the previous period's estimated beta, can reduce this bias. After regressing the portfolio excess returns on the market portfolio excess returns (risk premium), the bias left will be insignificantly small.

The sorting procedure takes place as follows: In June of each year these stocks of ASE that have also the required data from PROFILE, are allocated into 3 size portfolios equally weighted. The portfolio formation according to size is done because of the evidence of Chan and Chen (1988), that size produces a wide spread of average returns and betas. However, using only size portfolios we will have a high correlation between size and βs of the size portfolios (Fama and French, 1992).

For this reason, we follow the methodology proposed by Fama and French (1992) and we further divide the 3 size portfolios into 3 sub-portfolios on the basis of estimated individual βs computed from pre-testing period to allow for variation in beta that is not related to size. Thus, we finally have the creation of 9 equally weighted portfolios over the 8 years sample (or investigation) period. This grouping processing would give portfolios with reduced estimated errors in β than originally estimated at the individual firm level. Based on these sample portfolios we examine the explanatory power of β, as well as each one of the other financial variables (size, BE/ME ratio).

4. DATA RESULTS

4.1. Time-Series Regressions

In the time-series regressions the estimated equal-weighted monthly excess returns for each portfolio are regressed on the market premium (the excess return on the market), which was calculated for the full sample period. From these regressions we take the full-period post-ranking βs of each portfolio. These are the βs that we use in the Fama and MacBeth (1973) cross-sectional regressions later on.

Table II shows post-ranking average returns from July 1993 to June 2001 for portfolios formed according to size alone. Arranging portfolios on size alone, the post-ranking βs range from 0,88 for the smallest ME1 portfolio to 0,92 for the largest ME3 portfolio. This spread of post-ranking βs across the 3 portfolios is smaller than the spread of βs produced by the 9 size and pre-ranking βs portfolios (Table I, Panel B). For example, the post-ranking βs for the 3 portfolios in the smallest size (ME1) sorting range from 0,82 to 0,94 (0,94-0,82 = 0,12). Through out all 9 size-β portfolios, the post-ranking βs range from 0,82 to 1,08 (1,08-0,82 = 0,26), a spread larger than the spread obtained from size portfolios alone (0,88-0,92 = 0,04) in Table II.

When we construct portfolios on size alone (Table II) we cannot say that our tests meet the predictions of Sharpe (1964), Lintner (1965), and Black (1972) ─SLB─ according to which average returns are positively related to β. In fact, the average returns of the common stocks in ASE are negatively correlated with β and the average values of ln(ME) are also negatively correlated with average returns. Only the average values of ln(BE/ME) are positively correlated with average returns. Regarding the relation of β and ln(ME) we can say that there is a positive correlation between them.

The findings of Banz (1981), that there is size effect on average returns, are confirmed by this research. He found that size adds to the explanation of the cross section of average returns provided by βs and that small size firms have high average returns while large size firms have low average returns. Tables II, III, and IV show the time-series averages of the 96 monthly observations for portfolios formed on size alone (ME), pre-ranking βs alone, and BE/ME ratio alone, respectively. The average returns fall (Table II) from –0,43 for the smallest ME portfolio to –2,04 for the largest one (a spread of 1,61). The return differences in the case of estimated βs (Table III) between the smallest (-0,50) and the largest (-2,04) pre-βs portfolios are 1,54, while in the case of BE/ME classification (Table IV) the return spread is 0,65 (= -1,55-0,90). In fact, the two variables, size and estimated βs, are the only ones that generate return differences of more than one percent, while the BE/ME generates only 0,65 percent in return difference.

Another remarkable observation can be found in the relationship between size and estimated βs on portfolios formed on size alone. As we can see from Table II, the smaller firms have smaller estimated β values, which is completely opposite to previous findings of Fama and French (1992) on U.S. firms, while there is a rise that is higher when someone looks at the middle portfolio. So, as we have already said, in our investigation the negative relation between β and average return is established.

The portfolios formed on the basis of pre-βs (Table III) produce a wider range of βs (from 0,88 for portfolio β1 to 1,02 for portfolio β3) than the portfolios formed on size. In the pre-ranking βs portfolios there is a strong negative correlation between β and average returns. Again, a similar tendency can be found by reading through each column from top to bottom: the smaller firms (with smaller In(ME)) have smaller estimated β values than larger firms.

The only case that we notice a strong positive relationship is the one between average return and ln(BE/ME) in the case of portfolio formation based on BE/ME alone (Table IV): average return rise from –1,55 for the lowest BE/ME portfolio to –0,90 for the highest, whereas In(BE/ME) rise from -16,64 to –13,69.

In sum, by using one-way classification scheme, we find that BE/ME does not produce strong and systematic variations in average returns, while size and pre-β rankings explain wider variations in returns. Thus, as size and *β* are highly associated with, we further rank portfolios by a two-way classification scheme and continue our analysis.

In Table I the portfolios are formed yearly according to size and pre-ranking *βs*. Average returns are shown in Panel A of Table I, post-ranking βs in Panel B, and the average of size distributions ─*ln(ME)*─ in Panel C. In any size portfolio (Table I, Panel C), the average values of *ln(ME)*, which are the time-series average of monthly averages of *ln(ME)* for stocks in the portfolio at the end of June of each year, are similar across the *β*-sorted portfolios. On the other hand, the values of *ln(ME)* are quite different across the size sorting of portfolios.

When we subdivide size portfolios according to pre-ranking *βs* (Table I), we find again a strong negative relationship between size and average return in all size portfolios. By reading through the columns in each β classification (Panel A), we find that the size differences from ME1 through ME3 uniformly explain the differences in returns for every β classification from β1 through β3 portfolio. On the other hand, by reading through rows for each size classification horizontally we notice that the differences in pre-βs do not necessarily produce uniform differences in average return on these portfolios. Thus, on the basis of these casual observations of the two-way classification portfolios, we could say that time series behavior of portfolio returns are related to size variables, but not so much to βs.

Finally, we also constructed another set of 9 portfolios, as cross-examination sample. Panel A of Table V shows average returns of the two-way classification. Stocks sorted, first based on size, on 3 portfolios, and then each portfolio is subdivided into 3 portfolios, based on ranked values of BE/ME for individual stocks. We proceeded to this classification because this variable showed relative weakness in explaining Greek average returns, as pointed out above, contrary to many previous findings, for example, Fama and French (1992), for the US stock market, and Kubota and Takehara (1996), for the Japanese market. When top panels in Table I and V are compared pair wise, the difference is quite remarkable. By reading through every row, one finds that the differences in BE/ME (Table V) produce smaller differences in average returns than β (Table I). For example, for the smallest size portfolio grouping (ME1), between the lowest BE/ME 1 portfolio and the highest BE/ME 3 portfolio (TableV, panel A), the return difference of 0,68 (=0,17-(-0,51)) percent is generated and, similarly, for the largest size portfolio group (ME3), the difference is 1,04 (=1,42-2,46), while the corresponding numbers for size-β classified portfolios (Table I, panel A) are 1,22 and 1,42 percent, respectively. Similarly, looking down the columns of the average returns matrix (Table I and V, Panel A) we notice a clear negative relationship between average return and size. Also, by looking across the rows of Table V (Panel A) we notice another negative relationship between average return and book-to-market equity.

4.2.Cross-sectional Regressions

In order to estimate the relationship between size, beta, and book-to-market, the Fama-MacBeth (1973) procedure is employed. This involves estimating different specifications of the following full empirical model:

$$R_{it} - R_{ft} = \gamma_{0t} + \gamma_{1t}\beta_{it} + \gamma_{2t}\ln(ME) + \gamma_{3t}\ln(BE / ME) + e_{it}$$

The following seven specifications of this model are estimated in order to assess the explanatory power of each individual variable, as well as its interrelationship with the other independent variables.

<u>Model</u>

1. $R_i - R_f = \gamma_0 + \gamma_1\beta_i + e_i$

2. $R_i - R_f = \gamma_0 + \gamma_2 \ln(ME)_i + e_i$

3. $R_i - R_f = \gamma_0 + \gamma_3 \ln(BE / ME)_i + e_i$

4. $R_i - R_f = \gamma_0 + \gamma_1\beta_i + \gamma_2 \ln(ME)_i + e_i$

5. $R_i - R_f = \gamma_0 + \gamma_1\beta_i + \gamma_2 \ln(BE / ME)_i + e_i$

6. $R_i - R_f = \gamma_0 + \gamma_2 \ln(ME)_i + \gamma_3 \ln(BE / ME)_i + e_i$

7. $R_i - R_f = \gamma_0 + \gamma_1\beta_i + \gamma_2 \ln(ME)_i + \gamma_3 \ln(BE / ME)_i + e_i$

where R_i and R_f are the monthly returns on asset *i,* and the risk free rate on month *t*, respectively, β_i is the yearly-allocated beta estimated (using monthly data) for stock *i*., *ln(ME)* is the log of the market capitalization., *ln(BE/ME)* is the log of the book-to-market equity ratio, as used by Fama and French (1992). To ensure that accounting data is known when returns are calculated, from July to June sample period each year, the BE/ME ratio used is that available at December of the previous year, e_{it} is the residual error term.

The time-series averages of the slopes of these 96 month-by-month cross-sectional regressions are the estimates of the risk premiums associated with these risk factors or firm characteristics. Regressions are not estimated for subperiods of the full eight-year sample period, as in the study of Fama and French (1992), due to the small size of the sample period.

It might be useful to explain the hypotheses that we are testing. Although most conclusions will be extracted from examining the behavior of the coefficients across the seven specifications of the model, the general hypotheses, which can be tested for model 7, are listed below:

$$R_i - R_f = \gamma_0 + \gamma_1 \beta_i + \gamma_2 \ln(ME)_i + \gamma_3 \ln(BE/ME)_i + e_i$$

Hypothesis 1 $H_0: \gamma_0 = 0 \;\; H_1: \gamma_0 \neq 0$

Hypothesis 2 $H_0: \gamma_1 = 0 \;\; H_1: \gamma_1 > 0$

Hypothesis 3 $H_0: \gamma_2 = 0 \; H_1: \gamma_2 < 0$

Hypothesis 4 $H_0: \gamma_3 = 0 \; H_1: \gamma_3 > 0$

Given that the model is estimated using excess returns, the CAPM would imply that the intercept term, γ_0, should be zero, while the coefficient on beta, γ_1, should be positive and should also be expected to equal the excess return on the market, thus hypotheses 1 and 2.

Hypotheses 3 and 4 refer to the empirical evidence on the *size* and *book-to-market* effects.

The size effect predicts that γ_2 should be negative, while the book-to-market effect predicts that γ_3 should be positive.

The hypotheses being tested for each variable in model 7, can be applied to any of the models which incorporate those variables. It should be noted that the other six models need also to be incorporated to assess whether the size of the particular coefficient is due to a relationship with another variable.

Table VI shows the average slopes and their *t*-statistics from month-by-month regressions of stock returns on β, size, and book-to-market ratio for July 1993 till June 2001.

The adjusted R^2 is described in order to define the proportion of dependent variable, which is explained by the variations of the independent variable. In cross-sectional regressions the dependent variable is always the average excess returns on portfolios and the independent variables are β, *ln(ME)*, *ln(BE/ME)*, separately, or in combination between them.

As it can be seen, the intercept coefficient, γ_0, of all the seven models is significantly different from zero. Therefore, null hypothesis 1 must be rejected, as well as null hypothesis 2 because the slope coefficient, γ_1, is negative. This is the most remarkable result in our study because we find a significantly negative risk premium on beta, in contrast with SLB model where there is a positive relation between risk, measured by β, and expected return.

On the other hand, the results appear to be consistent with the "size effect". The return premium on firm size –*ln(ME)*– for models that include the size coefficient, γ_2, is negative as predicted and significantly different from zero (only in models 2 and 4, table VI). Under all specifications of the model, the "size effect" is observed and therefore, hypothesis 3 is accepted.

Concerning the explanatory power of book-to-market ratio, γ_3, we find that the premium on firm book-to-market ratio –*ln(BE/ME)*– is positive with an average slope of *0,72* and *p-value* of *0,058* only in the case that the γ_3 coefficient is the only explanatory power, which is in accord with the empirical evidence of Fama and French (1992). Due to positive γ_3 coefficient of *ln(BE/ME)* in model 3, we would say that the alternative hypothesis 4 is accepted.

As it is mentioned, the average slope from the monthly regressions of returns on *ln(BE/ME)* alone is *0,72* with a p-value of *0,058*. However, this book-to-market relation is much stronger than the size effect, which produces an average slope of –0,56 and a p-value of 0,03 in the regressions of returns on *ln(ME)* alone (Model 2).

A comparison of the slope coefficients, throughout all seven models, can show whether the premium of beta is associated with other variables. An examination shows that the average slope of γ_1 coefficient increases but is still negative (from *–6,596* to *–5,39*), the coefficient of *ln(ME)*, γ_2, decreases slightly (from *–0,56* to *–0,44*), and the coefficient of *ln(BE/ME)* decreases impressively (from *0,72* to *–0,05*).

When we look the adjusted R^2 in the regressions that only one explanatory variable is assessed (model 1, 2, and 3), we find the following: the adjusted R^2 explains satisfactorily the dependent variable in all cases by 42,2*%* and 34*%* and *30%*, respectively.

Models 6 and 7 are rejected because of high p-values and F significance> 0,05.

To summarize, it becomes obvious that the first three models containing each of the beta, size and book to market variables separately are valid; nevertheless, their predictive power is rather low. In the next step, an attempt was made to combine these three models by introducing the beta coefficient as independent variable in the other two models (2 and 3). The results are shown in models 4 and 5, where p-values for each independent variable (including the intercept) are much lower, F significance for each of the two models is also lower, and more significant, and the predictive power for both models has increased considerably (65% for each model). Finally, two more tests were executed, where two new models were created combining size and book to market (model 6) and size, book to market and beta variable (model 7). The predictive power of these two new models was lower than the ones of models 4 and 5 and both models are rejected because the p-values for each independent variable in each model was significantly higher than 0.05.

5. CONCLUSIONS-MANAGERIAL IMPLICATIONS

This study investigated the cross-section of average stock returns in the Greek stock market. The methodology adopted in the present study was similar to Fama and French (1992). The aim here is to provide a further insight into the existence of the anomalies, mentioned above, in the Greek stock market.

We examined the impact of market risk measured by beta as well as the explanatory power of size and book-to-market equity ratio on monthly stock returns. Our findings strongly contrast with the predictions of the CAPM. We find that β cannot explain cross-section variations of average returns of the Athens Stock Exchange non-financial firms, for July 1993 till June 2001, even when beta is the only explanatory variable. The cross-section of monthly returns indicate that average returns vary inversely with firm size and so the "size effect" is confirmed, as in the study of Fama and French (1992).

In contrast, evidence of "book-to-market effect" indicates that average returns vary directly with book-to-market ratio but it is found only in the model that this is the only explanatory variable. Our findings are similar with those of Rosenberg *et. al* (1985).

To conclude, both size and book- to- market variables can explain excess returns, however, the predictive power of these models increase significantly when the beta coefficient is included. These findings imply that the beta coefficient t alone can not provide us with an efficient mechanism of examining and predicting excess returns, but when it is combined with either size or book- to- market it enhances the quality of the model in terms of increased predicting power.

The capital asset pricing model is still widely used by many practitioners. Although the theoretical problems with CAPM have been well documented, it is still one of the common approaches employed for valuation purposes. CAPM is widely taught in most undergraduate corporate finance classes. Even though its weaknesses have been documented, practitioners are typically left with no easy alternative to replace it with. Therefore, almost by default it is generally accepted.

The use of Fama and French model can be used in the management and the evaluation of portfolios. Many brokerage firms, financial institutions, and financial consulting firms can develop their own model to aid their investment decision making process. These models have become increasingly popular because they allow risk to be more tightly controlled and they allow the investor to protect against specific types of risk to which he or she is particular sensitive or to make specific bets on certain types of risk.

It is important to know that the major reason that we test the model of Fama and French (1992) is to analyze the relation between systematic risk and average returns of portfolios as well as the relation between unsystematic risk, measured by the firm size and book-to-market equity ratio, and average returns.

Due to our findings, which indicate that there are variables -others than beta- that explain better the cross-section of average stock returns, we believe that the model of Fama and French can be used widely.

In this survey, we attempted to be as precise as it was possible. However, during the data collection we faced some drawbacks. For an improved and more completed examination of the Greek stock market a larger sample period is needed. The lack of information from the Athens Stock Exchange databank is due to the fact that the most data are not computerized. This is the main reason for the restriction of our sample period to 8 years.

It is obvious that much has yet to be done to understand the nature of stock returns. As a first step, additional variables like earnings-price ratio, leverage, and cash flow-price ratio can be included in a similar analysis. Then proposed reasons for anomalous findings can be further elaborated. Depending on the availability of data, investigation of investor profile in different time periods and stocks may yield interesting clues.

Furthermore, the application of different data intervals to monthly data, and the different time periods between sampling the variables and using them to test returns could also be used. The possible influence of sampling bias cannot be ignored here, especially in light of the fact that the search criteria give a sample that may be too small to be truly reflective of the entire market. So, a further research could involve analyzing a longer sample period although that Chan, Hamao, and Lakonishok (1991) argue that a sample period of twenty to thirty years may not be long enough to justify the use of ex post data as proxies for market expectations.

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APPENDIX

TABLE I

Portfolios formed according to ME (size) and then according to Pre-Ranking *β* from July 1993 to June 2001.

In June of each year *t*, 9 portfolios are formed on the basis of ME and pre-ranking *βs* of individual stocks. ME1 is the smallest size portfolio and ME3 is the largest size portfolio, while *β*1 and *β*3 are the smallest and the largest pre-ranking *β* portfolios, respectively (here and in all other tables). Panel A presents the average monthly returns which are the time-series average of the monthly equal-weighted portfolio returns, in percent. Panel B shows the post-ranking *βs* estimated from time-series regressions of the full sample period from July 1993 to June 2001. Panel C presents the average size which is the time-series average of monthly averages of ln(ME) for stocks in the portfolio in June of each year. ME denominated in million of drachmas.

PANEL A: Average Monthly Returns			
	***β*1**	***β*2**	***β*3**
ME1	-0,14	0,21	-1,36
ME2	-1,06	-0,96	-2,52
ME3	-1,27	-2,16	-2,69

PANEL B: Post ranking βs			
	***β*1**	***β*2**	***β*3**
ME1	0,82	0,88	0,94
ME2	0,92	0,95	1,07
ME3	0,88	0,82	1,08

PANEL C: Average Size ln(ME)			
	***β*1**	***β*2**	***β*3**
ME1	15,33	15,37	15,49
ME2	16,87	16,81	16,89
ME3	18,39	18,28	18,21

TABLE II

Properties of Portfolios formed on Size

In June of each year *t* we form 3 portfolios according to ME. The average return is the time-series average of the monthly equal-weighted portfolio returns, in percent. ln(ME) and ln(BE/ME) are the time-series averages of the monthly average values of these variables. *β* is the time-series *βs* of the monthly portfolios.

Portfolios Formed on Size			
	ME1	**ME2**	**ME3**
Return	-0,43	-1,51	-2,04
beta	0,88	0,98	0,92
ln(ME)	15,40	16,86	18,29
ln(BE/ME)	-14,27	-15,35	-16,33

TABLE III

Properties of Portfolios formed on Pre-Ranking *βs*

Pre-ranking *βs* are estimated for each stock using monthly data for the previous 36 months and then stocks are ranked according to these estimated betas for each month. The ranked stock sample is divided into 3 portfolios in June of each year *t*. The average return, β, ln(ME), and ln(BE/ME) have the same meaning as in Table II.

Portfolios Formed on Pre-Ranking *βs*			
	***β*1**	***β*2**	***β*3**
Return	-0,50	-1,31	-2,04
beta	0,88	0,86	1,02
ln(ME)	16,68	16,76	16,94
ln(BE/ME)	-15,24	-15,27	-15,32

TABLE IV

Properties of Portfolios formed on BE/ME ratio

At the end of each year *t-1*, 3 portfolios are formed on the basis of ranked values of book-to-market equity ratio. The accounting ratio is measured using market equity (ME) in December of year *t-1*. Firm size ln(ME) is measured in June of year *t*, with ME denominated in million of draxmas. We calculate each portfolio's monthly equal-weighted return from July of year *t* to June of year *t+1*, and then reform the portfolios at the end of year t. The average return is the time-series average of the monthly equal-weighted portfolio returns, in percent. Ln(ME) and ln(BE/ME) are the time-series averages of the monthly average values of these variables. *β* is the time-series *βs* of the monthly portfolios.

Portfolios Formed on BE/ME			
	BE/ME1	**BE/ME2**	**BE/ME3**
Return	-1,55	-1,31	-0,90
beta	0,89	0,94	0,92
ln(ME)	17,77	16,82	15,62
ln(BE/ME)	-16,64	-15,29	-13,69

TABLE V

Portfolios formed according to ME (size) and then according to BE/ME ratio from July 1993 to June 2001.

In June of each year *t*, 9 portfolios are formed on the basis of ME and BE/ME ratio. BE/ME1 and BE/ME3 are the smallest and the largest book-to-market equity portfolios, respectively. The average monthly return (Panel A) is the time-series average of the monthly equal-weighted portfolio returns, in percent. The post-ranking *βs* of the size-BE/ME portfolios (Panel B) are estimated from time-series regressions of the full sample period from July 1993 to June 2001. Panel C presents the average size which is the time-series average of monthly averages of ln(ME) for stocks in the portfolio in June of each year.

Panel A: Average Monthly Returns

	BE/ME1	BE/ME2	BE/ME3
ME1	0,17	-0,78	-0,51
ME2	-1,14	-1,77	-1,65
ME3	-1,42	-2,34	-2,46

Panel B: Post- Ranking βs

	BE/ME1	BE/ME2	BE/ME3
ME1	0,81	0,95	0,90
ME2	0,98	0,92	1,03
ME3	0,91	0,96	0,92

Panel C: Average Size ln(ME)

	BE/ME1	BE/ME2	BE/ME3
ME1	15,73	15,43	14,96
ME2	16,97	16,84	16,75
ME3	18,66	18,10	17,97

TABLE VI

Average Slopes, (*t*-statistics), and (p-values) from Month-by-Month Regressions of Stock Returns on β, Size, and Book-to-Market Equity from July 1993 to June 2001.

Cross-sectional regressions of stock returns on beta, size, and book-to-market equity are run for each month in the period of 1993-2001. The average slope is the time-series average of the monthly regression slopes and the *t*-statistic is the average slope divided by its time-series standard error (t-statistics are in parentheses). The adjusted R^2 is the proportion of dependent variable, which is explained by the variations of the independent variable.

Model	Intercept	Beta	ln(ME)	ln(BE/ME)	R^2 adjusted	F significance
1	4.79	-6.596			0.2995	0.07
t-statistics	(1.63)	(-2,10)				
p- value	**(0.14)**	**(0,07)**				
2	8.08		-0.56		0.422	0.03
t-statistics	(2.24)		(-2.61)			
p- value	**(0.06)**		**(0.03)**			
3	9.63			0.72	0.34	0.06
t-statistics	(1.98)			(2.26)		
p- value	**(0.09)**			**(0.06)**		
4	11.72	-5.35	-0.48		0.65	0.02
t-statistics	(3.68)	(-2.37)	(-2.85)			
p- value	**(0.01)**	**(0.06)**	**(0.03)**			
5	14.22	-5.97		0.65	0.65	0.02
t-statistics	(3.61)	(-2.67)		(2.81)		
p- value	**(0.01)**	**(0.04)**		**(0.03)**		
6	-0.13		-2.33	-2.48	0.47	0.06
t-statistics	(-0.02)		(-1.63)	(-1.25)		
p- value	**(0.99)**		**(0.15)**	**(0.26)**		
7	11.93	-5.39	-0.44	0.05	0.58	0.06
t-statistics	(1.21)	(-1.64)	(-0.25)	(0.02)		
p- value	**(0.28)**	**(0.16)**	**(0.81)**	**(0.98)**		