



LUND UNIVERSITY
School of Economics and Management

Determinants of Cross-Sectional Stock Returns During a Turbulent Period: An Application to the Athens Stock Exchange

Master's Thesis
Corporate and Financial Management

Author: Konstantinos I. Leontis

Supervisor: Anders Vilhelmsson

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LUND UNIVERSITY
School of Economics and Management
Department of Business Administration
Tycho Brahes väg 1
223 63 Lund, Sweden

To my family

Abstract

With this study we attempt to shed some light in the existing literature concerning the determinants of cross-sectional stock returns. In our analysis we test a turbulent period for the Athens Stock Exchange which ranges from July/2007 to June/2012. The variables we examine as potential determinants are the market beta, the market value of equity, the book-to-market value of equity, Liu's liquidity measure over a prior six-month period, and a security's average past returns over three and six months. After employing Fama and French's (1992) portfolio analysis and Fama and MacBeth's (1973) cross-sectional regressions, we end up that although there are inter-correlations among the variables under examination, none of them is proven statistically significant in order to explain the cross-section of stock returns.

Keywords: cross-sectional regressions, portfolio analysis, determinants, Athens Stock Exchange

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List of Abbreviations

AMEX: American Stock Exchange

ASE: Athens Stock Exchange

b: Market Beta

BE/ME: Book-to-Market Value of Equity

CAPM: Capital Asset Pricing Model

CML: Capital Market Line

E/P: Earnings-to-Price Ratio

E-V Rule: Expected Returns - Variance of Returns Rule

GD: General Index of ASE (ATHEX Composite Share Price Index)

LMx: Liu's (2006) Liquidity Measure Over Prior x Months

ln: Natural Logarithmic Function

M3: Average Monthly Stock Returns Over The Previous Three Months

M6: Average Monthly Stock Returns Over The Previous Six Months

ME: Market Value of Equity

MSCI: Morgan Stanley Capital International Index

NASDAQ: NASDAQ Stock Market

NYSE: New York Stock Exchange

P/B: Price-to-Book Value of Equity

P/S: Price-to-Sales Ratio

SML: Security Market Line

S&P500: Standard & Poor's 500 Index

TSE: Tokyo Stock Exchange

Chapter 1: Introduction

1.1 Background

The *Capital Asset Pricing Model* (CAPM) is a model developed independently by Treynor (1961, 1962, 1963), Sharpe (1963, 1964), Lintner (1965a, 1965b) and Mossin (1966) based on Markowitz's (1952) earlier work on diversification and market portfolio theory. The model suggests that the expected returns of securities are a positive linear function of only their systematic risk (also known as non-diversifiable or market risk) denoted as *market beta* (β), and this figure represents the slope in the regression of a security's returns on the market portfolio's returns. It is also assumed that the market beta can explain a security's cross-sectional returns. However, despite its widespread use in the field of finance, the model has been judged both because of its unrealistic assumptions and its underperformance in many empirical tests.

These judgments have led to an increasing interest for other than market beta firm specific variables. Among them, Banz (1981) introduces the notion of *size effect* for common stocks traded at NYSE. Firms with low *market value of equity* (ME), a firm's stock price multiplied by the firm's total common shares outstanding, have on average higher returns than the ones with high market capitalization. Fama and French (1992) end up also at same inferences for firms traded, apart from NYSE, at AMEX and NASDAQ. Basu (1983) suggests that the common stock of NYSE firms with high *earnings-to-price ratio* (E/P) realizes on average higher returns than the common stock of firms with a low ratio. Rosenberg *et al* (1985) and Fama and French (1992) find that there is a positive relation between a firm's *book-to-market value of equity* (BE/ME) and its associated stock returns for the U.S. market. Chan *et al* (1991) conclude also at same results for stocks traded at TSE. Amihud and Mendelson (1986) claim that the expected returns for NYSE stocks are an increasing and concave function of their *bid-ask spread*. Senchack and Martin (1987) find evidence from a dataset of NYSE and AMEX stocks that stock returns are negatively correlated to *price-to-sales ratio*

(P/S). Finally, Jegadeesh and Titman (1993) support that a *momentum strategy*, meaning buying past “winners” (companies that have performed well in the past) and selling past “losers” (companies that have performed poorly in the past), can lead to significant positive returns for a dataset of NYSE and AMEX stocks.

All these variables that in the aforementioned studies help explain the cross-sectional stock returns are called *anomalies* because they violate the fundamentals of the CAPM. Several explanations have been stated concerning the existence of such anomalies. Two commonly used views are:

- i) Apart from a security’s systematic risk, there are also other risk factors which should be taken into account when determining a security’s expected returns. Thus, these variables are proxies for the additional risks and are consistent with a rational asset pricing procedure (e.g., Fama and French (1993)).
- ii) Mispriced securities can be detected by these variables, providing investors the opportunity to gain returns in excess of the required ones (e.g., Daniel and Titman (1997)).

1.2 Problem Discussion

Independently of the nature and the source of the aforementioned anomalies, it is sure that investors desire to know ex-ante whether and in what degree these anomalies exist at the market in place from both an investment and a speculative point of view. However, there are two main difficulties that arise from the process of identifying such phenomena. First, while there are common elements among the markets in the way they function, each one of them has its own unique characteristics. For instance, Harvey (1995) concludes that the emerging markets’ stock returns are more likely to be influenced by local information than the stock returns in developed countries. Second, the time period which is under consideration affects also the markets. During times of general economic growth, we expect stock indices to rise. The opposite holds when an economy is in a recession. These difficulties suggest that there is not a recipe which can be applied under all circumstances. Anomalies that have a significant

presence in one market, might not affect another one.

The studies that are mentioned in the sub-section 1.1 are all targeted at the U.S. and the Japanese markets. In general, the previous years a lot of attention had been paid to the developed markets. The interest towards the small and developing markets is a trend of approximately the last ten years because, as Harvey (1995) mentions, investors aim to gain from these markets abnormal returns as well as portfolio risk diversification. Also, the majority of the existing studies do not pay much attention to the selection of the examination period, or at least this is the outcome that derives from the fact that in most cases there is not documented any motivation for the examining period.

1.3 Purpose and Research Question

The purpose of this study is to contribute to the existing literature concerning the determinants of cross-sectional stock returns by analyzing the Athens Stock Exchange (ASE) during the period 2007-2012. Our goal is two-fold. First, we aim at providing insights for the function of a small market like ASE. In this way, we are contributing to the economic society's efforts of the last years for gathering valuable information about such markets. Second, by choosing this five-year period we aim at investigating the behavior of a small market's stock returns under a challenging economic environment. In our case, we justify the term *challenging economic environment* from two points of view: a theoretical and a technical one.

Indeed, from a theoretical point of view, in 2007 we have the collapse of the real estate market in the United States and the so-called subprime crisis. The result of this crisis is a general lack of trust among the investors and a subsequent increase in the interest rates. This increase in interest rates, however, makes highly leveraged countries to struggle in order to service their debt. Thus, we end up at the European debt crisis. The first "victim" of this crisis is Greece. In late 2009, the Greek bond yields are being increased significantly and the country is forced to its first bailout loan on May of 2010. Since then, Greece has not

managed to solve its sovereign issues.

Moreover, technically speaking, as it is indicated from *Figure 1.1*, the general index of ASE (GD) starts its downward trend in the middle of 2007. This trend persists during the whole period under examination. Also, *Figure 1.2* depicts the fact that the downward trend of GD's coincides with an increased volatility in the returns of the index.

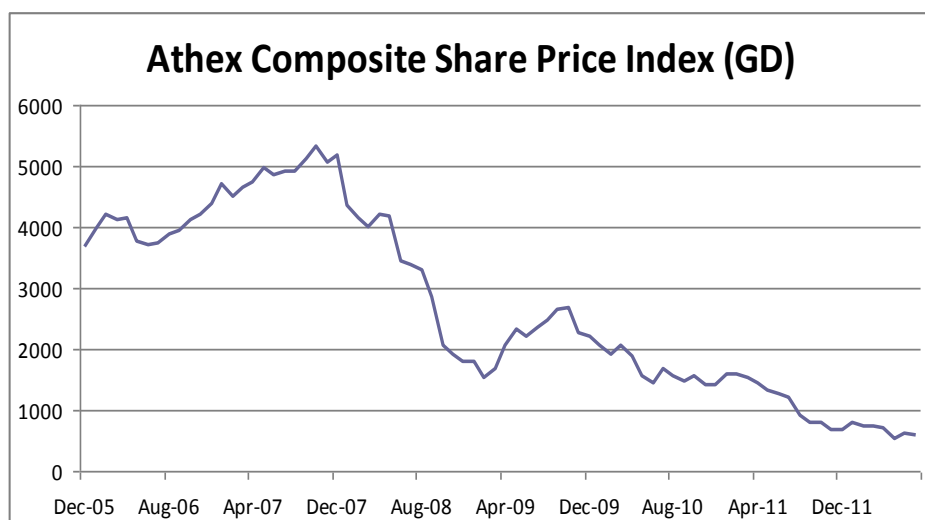


Figure 1.1, Source: Datastream

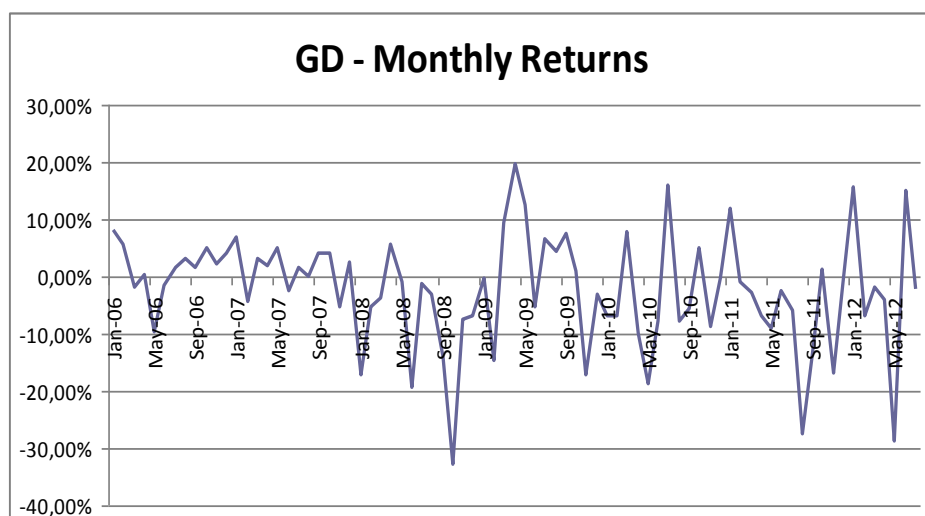


Figure 1.2, Source: Datastream

Furthermore, the variables we are going to examine as possible determinants of cross-sectional stock returns are chosen after careful consideration. As it can be derived from the sub-section 1.1, and since there is not a unified framework in the existing literature of ASE or the small markets in general, there is a series of potential candidates. Our approach is based on multiple criteria. First, we desire to use variables that are of high interest for the economic society, as it is indicated from the number of their presence in previous studies. In this way, we will be able to fulfill the society's implicit demands. Second, we wish to have variables that have turned out to be statistically significant for ASE during a different period of examination. As a result, we will be in a position to see whether these variables are persistently considered statistically significant or not. Third, we want to include variables that despite their minimal presence in previous studies of ASE, hence no secure results can be derived for them, can be justified a priori from a theoretical point of view that they are able to explain the cross-section of stock returns.

To the best of our knowledge, we end up at using five variables as possible determinants of cross-sectional stock returns that meet the above criteria. Concerning the first and the second criterion, we opt for market beta, ME, and BE/ME. With regards to our last criterion, we select the liquidity and the momentum factors.

Finally, with this study, we desire to provide with knowledge, apart from academics and the ones that are actively participating in capital markets, everyone who is interested in learning the way in which capital markets are operating.

1.4 Delimitations

This study is conducted for ASE during a turbulent period. The results do not mean neither that other small markets should behave in the same way, nor that ASE itself should adopt same pattern for analogous periods. As it has already been mentioned, little research has been conducted in this field. Consequently, instead of "facts", the results of this study should be taken as "indications". Further research should be conducted for analogous periods and small

markets in order for the economic society to create a unified framework.

In addition, the findings are limited only to the five variables that we are using as possible determinants. The fact that we disregard other potential candidates should not be taken as an indication that there are not other variables which can possibly explain the cross-sectional stock returns, but just as a mechanism we have to adopt in order to cope with the limits that time and our knowledge put us. Thus, further research should be made for other variables as well.

Furthermore, even for the variables we are using at this paper, we do not exhaust all the potential strategies that an investor can adopt. More specifically, we implicitly assume an investment holding period of one year. This period of course can be extended or shortened. Additionally, concerning the liquidity and the momentum factors, there can be alternative approaches of the time horizon we are looking at the past. Also, with regards to the liquidity factor, several other measures exist that can be investigated.

Finally, every effort was put in order to avoid biases that are mentioned in the existing literature. However, since data is not available for all the companies that participate in the current study, our results might be partially affected by what is called *sample selection bias*. Fortunately, in our subjective opinion, this lack of data applies only for a few companies.

1.5 Thesis Outline

The discussion that follows is structured in 6 additional chapters. *Chapter 2* provides the theoretical framework of the underlying literature which is necessary for the subsequent analysis. In *Chapter 3* we mention the existing empirical studies on ASE that are related to our study. *Chapter 4* describes the data we have chosen. In *Chapter 5* we describe the methodology we are using in order to reach at our results. *Chapter 6* provides an analysis of our results. Finally, in *Chapter 7* we summarize the findings of our study.

Chapter 2: Underlying Literature

2.1 Modern Portfolio Theory

Markowitz (1952) sets the fundamentals for the modern portfolio theory. As a starting point he considers that an investor should treat the expected returns as desirable, and at the same time the variance of returns as undesirable seeking to minimize it through diversification. This rule is known as the *expected returns - variance of returns* (E-V) rule. According to this rule, there is a trade-off between returns and their variance, and what Markowitz tries to do is to illustrate the relations between beliefs and choice of portfolio based on this rule.

The assumptions under which Markowitz develops his portfolio selection theory are that investors:

- Consider each investment alternative as being represented by a probability distribution of expected returns over some holding period.
- Maximize their one-period expected utility, and their utility curves demonstrate diminishing marginal utility of wealth.
- Estimate the risk of the portfolio on the basis of the variability of expected returns.
- Base their decisions solely on expected return and risk, and as a result their utility curves are a function of only the expected returns and their variance.
- For a given risk level, they prefer investments with higher expected returns to lower ones, and similarly, for a given level of expected returns, they prefer investments with lower variance to higher one.

Furthermore, using Uspensky's (1937) mathematical formulas, Markowitz ends up at the following relations for a given portfolio:

$$E = \sum_{i=1}^N X_i \mu_i \quad \text{and} \quad V = \sum_{i=1}^N \sum_{j=1}^N \sigma_{ij} X_i X_j, \quad \text{where}$$

E: expected returns of portfolio as a whole,
 N: number of securities included in the portfolio
 X_i : percentage of investor's assets allocated to the i^{th} security,
 μ_i : expected returns of the i^{th} security,
 V: variance of the portfolio,
 σ_{ij} : covariance of returns between i^{th} and j^{th} security,

and $\sigma_{ij} = \rho_{ij} \sigma_i \sigma_j$, where

ρ_{ij} : correlation coefficient of returns between i^{th} and j^{th} security,
 σ_i : standard deviation of returns for security i,
 σ_j : standard deviation of returns for security j.

Based on the aforementioned assumptions and formulas, as well as on the E-V rule, we can construct a set of *efficient portfolios*, meaning a set of portfolios with optimal E-V combinations such that for a given level of risk we will have the highest possible expected returns, and for a given level of expected returns we will have the lowest possible variance. By combining all these efficient portfolios, we end up at formulating what is called *efficient frontier*. Finally, an investor will choose one of these efficient portfolios, called *optimal portfolio*, based on his own preferences between risk-return.

2.2 Single-Index Model and Capital Market Line (CML)

Sharpe (1963) develops a *simplified model for portfolio analysis*. His paper is based on Markowitz (1952). His motivation is the fact that in order to develop the efficient frontier someone has to make numerous calculations. A single portfolio containing N number of securities demands, according to Markowitz's (1952) framework, N number of expected returns, N number of standard deviations, and $[N*(N-1)]/2$ covariances. What Sharpe (1963) tries to achieve, as the title of his paper indicates, is to develop a simplified model which

requires less calculations, and in order to do that he approaches the issue of capital asset valuation from the perspective of an individual investor picking stocks.

Sharpe (1963) ends up at developing a linear function between the returns of a security and an index. The formula is:

$$R_{it} = \alpha_i + \beta_i * R_{mt} + \varepsilon_{it}, \quad \text{where}$$

R_{it} : the returns of i^{th} security at time t ,

R_{mt} : the returns of the market portfolio's index at time t ,

α_i : the part of i^{th} security's returns which is independent from the returns of the market portfolio's index,

β_i : the coefficient (market beta) which measures the sensitivity of i^{th} security's returns to changes in the returns of the market portfolio's index ($\beta_i = \sigma_{im} / \sigma_m^2$)

ε_{it} : random error of i^{th} security's returns at time t .

The assumptions that he uses are:

- R_m and ε_i are random variables,
- the expected value of ε_i is equal to zero [$E(\varepsilon_i)=0$],
- the covariance of R_m and ε_i is equal to zero [$\text{cov}(R_m, \varepsilon_i)=0$],
- ε_i is independent of ε_j [$\text{cov}(\varepsilon_i, \varepsilon_j)=0$]
- the covariance matrix for the yield of the risky assets is singular.

Finally, with this model, he manages to achieve his initial aim of making the estimation of the efficient frontier simpler. The functions that are related to the model are:

$$E(R_i) = \alpha_i + \beta_i * R_{m\mu}, \quad \sigma_i^2 = \beta_i^2 * \sigma_m^2 + \sigma \varepsilon_i^2, \quad \sigma_{ij} = \beta_i * \beta_j * \sigma_m^2, \quad \text{where}$$

$E(R_i)$: expected returns of i^{th} security,

$R_{m\mu}$: mean value of returns of the market portfolio's index,

σ_i , σ_m , σ_{ε_i} : standard deviations of i^{th} security's returns, the market portfolio index's returns, and the random error of i^{th} security's returns respectively,
 σ_{ij} : covariance of i^{th} and j^{th} security's returns.

With these figures, a portfolio containing N number of securities requires $(3*N)+2$ calculations, much less than the number of estimations before, and assuming that there is enough number of securities in a portfolio, σ_{ε_i} approaches zero (diversification effect).

Sharpe (1964) continues Markowitz's (1952) work on the selection of the optimal portfolio. As it has been mentioned, the optimal portfolio is one of the efficient portfolios. However, it is the one which should be chosen from an investor with regards to his preferences between risk and return. According to Sharpe (1964), these preferences can be depicted by an investor's utility function in the form of indifference curves. The optimal portfolio (O, P, or S for three different individuals) will be the one that gives an investor the maximum utility given a certain efficient frontier, and it is determined as the portfolio where the highest indifference curve is tangent to the efficient frontier (*Figure 2.1*).

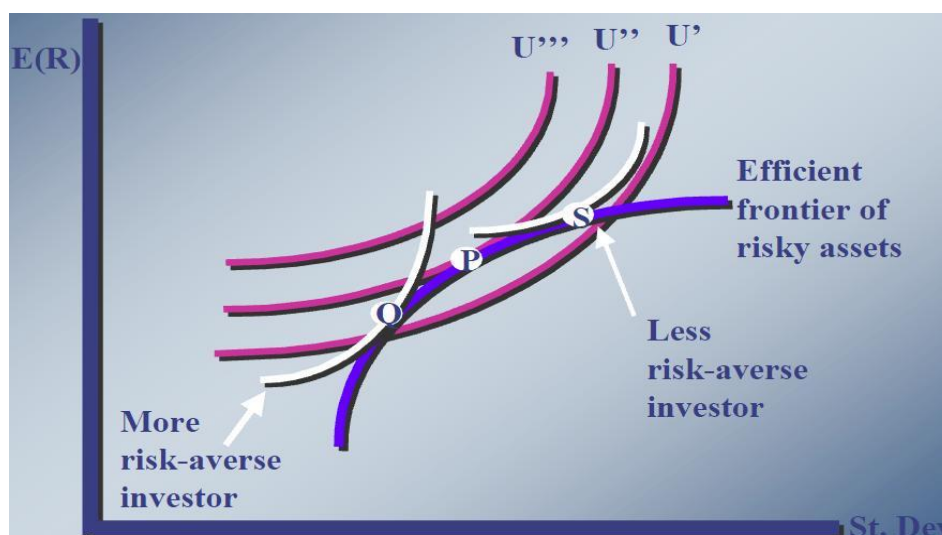


Figure 2.1, Source: Leledakis, G. (2008), *Portfolio analysis and management - Academic notes*, Athens University of Economics and Business

Furthermore, Sharpe (1964) defines what is called *market portfolio*. In order to achieve that, he uses the concepts of a riskless asset, the CML, and the efficient frontier. A CML does not only represent the existence of a risk-free and a risky price, but also represents the allocation of an investor's funds among a risk-free asset and a risky portfolio as well as the weighted average expected return and risk of the associated combinations. The market portfolio (M) will be the one determined by a line which: i) starts from the point on the vertical axis where we have the expected return of the risk-free asset (R_f), and ii) is tangent to the efficient frontier (*Figure 2.2*). This will be the case since any combination of the risk-free asset with a portfolio other than M in the efficient frontier is dominated by some combination of the risk-free asset with M in terms of higher expected returns for a certain level of risk (or lower risk for a certain level of expected returns).

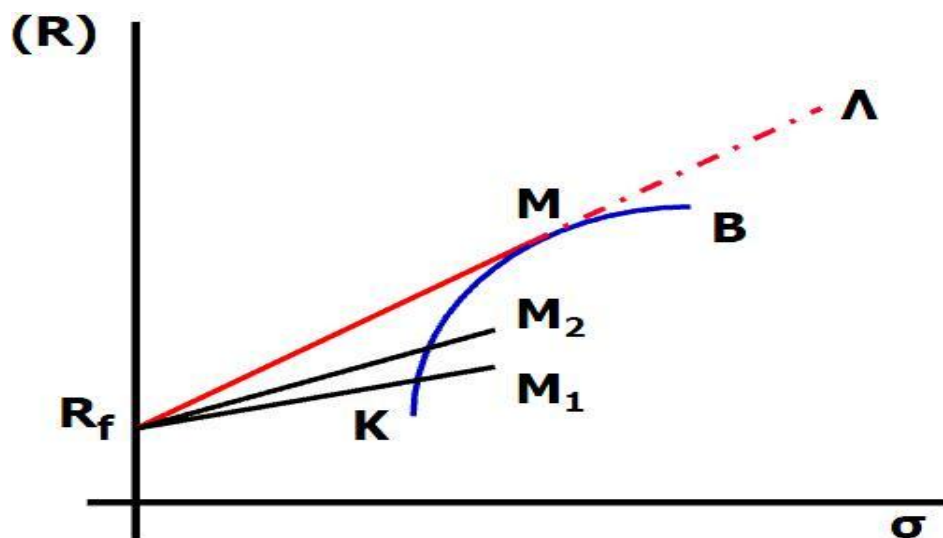


Figure 2.2, Source: Leledakis, G. (2008), *Portfolio analysis and management - Academic notes*, Athens University of Economics and Business

Concerning the CML, at M an investor puts all his funds only to the market portfolio, without investing to the risk-free asset. In addition, the points in the CML that are below M indicate an allocation of funds among both the risk-free asset and the market portfolio, with the R_f spot on the vertical axis indicating an investment of all the available funds only on the risk-

free asset. Also, the points that lie on the CML and exceed M (e.g., Λ) indicate that an investor borrows money at the cost of risk-free rate in order to invest at the market portfolio.

In addition, the slope of the CML, known as *Sharpe ratio*, determines the price of risk in the market and is equal to:

$$(E(R_m) - R_f) / \sigma_m, \quad \text{where}$$

$E(R_m)$: expected returns of the market portfolio,

R_f : risk-free rate,

σ_m : standard deviation of market portfolio's returns.

Finally, the CML for a given portfolio p (a combination of the risk-free asset with the market portfolio) is depicted algebraically as:

$$E(R_p) = R_f + \{[E(R_m) - R_f] / \sigma_m\} * \sigma_p, \quad \text{where}$$

$E(R_p)$: expected returns of the portfolio,

σ_p : standard deviation of portfolio's returns.

Moreover, Sharpe's (1964) assumptions in order to derive equilibrium in the capital market are:

- existence of a common pure interest rate with all investors able to borrow or lend funds on equal terms,
- homogeneity of investors' expectations (same expected returns, standard deviations, and correlation coefficients),
- rational behaviour among investors by holding portfolios of the efficient frontier,
- equal time horizons among all investors for their chosen investments,
- infinitely divisible assets,
- lack of taxes and transaction costs,

- tradability of all the available investments,
- totally competitive capital market, and
- allowance for changes in the shape of the efficient frontier as a result of the demand for the investments according to investors' preferences.

By using these assumptions and the concept of the market portfolio, Sharpe (1964) sets the fundamentals for the capital market theory and ends up at stating that an investor should put his position on the CML based on his indifference curves (level of risk aversion). The curve that is tangent to the CML will indicate this point (*Figure 2.3*). This conclusion is in line with Tobin's *separation theorem*, which mentions that an investment decision upon a portfolio is independent of the funds that will be invested at this portfolio.

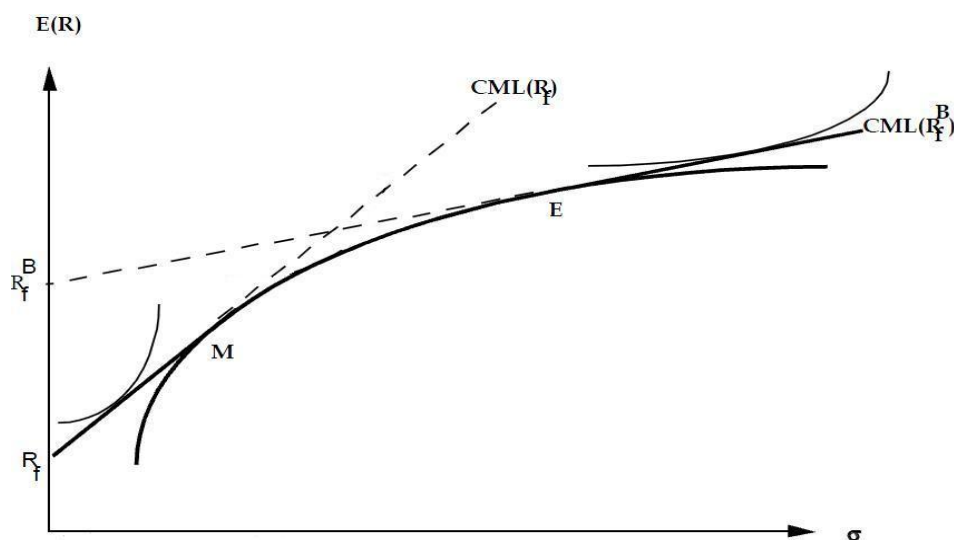


Figure 2.3, Source: Leledakis, G. (2008), *Portfolio analysis and management - Academic notes*, Athens University of Economics and Business

Treynor (1961, 1962, 1963), Lintner (1965a, 1965b) and Mossin (1966) make similar work to Sharpe's (1963, 1964) with slight differences in the assumptions they are using and the perspective they adopt concerning the capital asset valuation.

2.3 CAPM and Security Market Line (SML)

The previous discussion is necessary in order to understand the fundamentals of the CAPM. As it has been mentioned, the algebraic formula of the CML, which refers to a portfolio, is:

$$E(R_p) = R_f + \{[E(R_m) - R_f] / \sigma_m\} * \sigma_p.$$

A respective formula which refers to a single security is:

$$E(R_i) = R_f + \{[E(R_m) - R_f] / \sigma_m\} * \sigma_i * \rho_{im}, \quad \text{where}$$

ρ_{im} : correlation coefficient between the returns of the i^{th} security and the returns of the market portfolio [$\rho_{im} = \sigma_{im} / (\sigma_i * \sigma_m)$].

Finally, by combining the above formula with the formula of market beta presented in the Sharpe's (1963) single-index model ($\beta_i = \sigma_{im} / \sigma_m^2$), it is derived:

$$E(R_i) = R_f + \beta_i * [E(R_m) - R_f].$$

The last formula is the algebraic form of the CAPM and corresponds to the SML. The role of the market beta is very important for the model. As it is indicated, securities with higher market beta are expected to provide higher returns than securities with lower one, since the former are considered riskier than the latter. The market beta of the market itself is considered equal to 1, with the "riskier" and the "safer" securities having a figure which is higher and lower than 1 respectively.

Concerning the assumptions that apply to the model, they vary according to the assumptions used by each economist. Besides, after the ones that are reported above, there are also other economists who adjust the CAPM according to their own assumptions.

With regards to the SML, according to Jensen (1967), any deviation from this line can be considered as *abnormal returns*. These abnormal returns can be measured by *Jensen's alpha* which is simply the difference between the security's actual returns and the returns that this security is expected to have earned according to the CAPM.

At this point, it should be pointed out that the CML is different from the SML. The differences are summarized to the following points:

- The slope of the CML is the Sharpe ratio, while the slope of the SML is the difference between the expected rate of the market portfolio's returns and the risk-free rate.
- The CML refers to portfolios, whereas the SML to securities.
- The CML plots the relation between returns and standard deviation, contrary to the SML which depicts the relation between returns and beta coefficient.
- The CML defines the risk-free asset and the market portfolio. On the other hand the SML defines a security's risk factors.

2.4 Rational Explanations of Abnormal Returns

2.4.1 Fama-French Three-Factor Model

While Jensen (1967) characterizes any deviation from the SML as abnormal returns, Fama's (1970) efficient market hypothesis suggests that these abnormalities reflect different kinds of risk which are not captured by the market beta. Indeed, Fama and French (1992) examine a series of potential determinants of cross-sectional stock returns based on findings of previous studies. By using the Fama and MacBeth (1973) regressions, they conclude that the ME (negatively correlated) and the BE/ME (positively correlated) help explain much of the cross-sectional variation of these returns, whereas at the same time the market beta has little information. While, according to Banz (1981), there is not a theoretical framework which can explain the role of the ME concerning the returns, Chan and Chen (1991) argue that the BE/ME can be viewed as a relative distress factor. Firms which are perceived by the market

as having poor prospects, denoted with high BE/ME (value stocks), are penalized with higher cost of capital than firms with stronger prospects (growth stocks).

Fama and French (1993) extend the asset pricing tests of Fama and French (1992) by including, apart from common stocks, U.S. government and corporate bonds. Also, the methodological approach that is applied corresponds to the time-series regressions of Black, Jensen and Scholes (1972). Having constructed two portfolios in order to mimic risk factors of ME and BE/ME respectively and also by using the excess returns of the market portfolio in order to mimic the market risk, they conclude that these three factors help explain the average returns of stocks and bonds. Their results are summarized in the formula:

$$E(R_p) = R_f + \beta_p * [E(R_m) - R_f] + s_p * E(SMB) + h_p * E(HML) , \quad \text{where}$$

s_p : coefficient of E(SMB),

h_p : coefficient of E(HML),

E(SMB): difference between the returns of a portfolio with small stocks and the returns of a portfolio with large stocks

E(HML): difference between the returns of a portfolio with high BE/ME stocks and the returns of a portfolio with low BE/ME stocks.

However, Fama and French (1996) admit that their model is not able to explain any cross-sectional variation in momentum-sorted portfolio returns.

2.4.2 Liquidity Factor

According to Liu (2006), *liquidity* is described as the ability to trade large quantities quickly, at low cost, and with little price impact. This means that liquidity has at least four dimensions: i) the trading quantity, ii) the trading speed, iii) the trading cost, and iv) the price impact. The absence of liquidity when needed can be considered as a source of risk for investors. Thus, it seems reasonable from a theoretical point of view that less liquid securities

should provide higher returns to investors in order to compensate them for the additional risk of caring such assets.

The fact that liquidity is multidimensional has led to the development of different models in order to measure it. Amihud and Mendelson (1986) examine the effect of the *bid-ask spread* on asset pricing. This model is related to the trading cost dimension of liquidity. Datar *et al* (1998) use the *turnover rate* of a stock (number of shares traded as a fraction of number of shares outstanding). This model corresponds to the trading quantity dimension. Amihud (2002) employs an *illiquidity measure* (average daily ratio of absolute stock return to dollar volume), which captures the price impact dimension. Finally, Liu (2006) introduces his own *liquidity measure* (standardized turnover-adjusted number of zero daily trading volumes), which captures multiple dimensions of liquidity with particular emphasis on the trading speed.

All the aforementioned measures have turned out to explain the cross-section of stock returns at their respective studies. However, the liquidity factor has not gained much attention like the Fama-French three-factor model over the past years.

2.5 Behavioral Explanations of Abnormal Returns – Carhart Four-Factor Model

As it has been reported, Fama and French (1992, 1993, 1996) attribute the abnormal returns in other than market beta risk factors. However, according to behavioral finance, these abnormalities can be explained as the result of investors' behavior and their tendency to use *heuristic rules* (rules of thumb) in order to take decisions.

De Bondt and Thaler (1985) find that portfolios of past losers tend to outperform portfolios of past winners. This result suggests that investors *over-react* to current information and should adopt *contrarian strategies* in order to gain profits. On the contrary, Jegadeesh and Titman (1993) conclude at the exact opposite results. Their findings assume that investors

under-react to current information and should adopt *momentum strategies* in order to achieve substantial returns.

Carhart (1995) fills the gap between rational and behavioral explanations of abnormal returns by developing a four-factor model. He is using the Fama-French three-factor model plus an additional factor which captures Jegadeesh and Titman's (1993) one-year momentum anomaly. Carhart (1997) finds that his four-factor model can explain considerable variation of returns. Carhart (1997) also mentions that in tests not reported at his paper, his four-factor model substantially improves the average pricing errors of the CAPM and the Fama-French three-factor model.

Chapter 3: Empirical Studies on ASE

3.1 Presence of Abnormalities

Using monthly data of 72 companies for the period 1988-1994, Dockery *et al* (2001) conclude that the *random walk hypothesis* for ASE stock returns is rejected. Kavussanos and Dockery (2001) examine the same period (1988-1994) using monthly data of 64 companies, but by employing different methodology. They conclude at same results with Dockery *et al* (2001). Panagiotidis (2005) tests also the efficient market hypothesis concerning ASE after the introduction of Greece to the euro zone. The five different statistical tests that he uses suggest that ASE behaves inefficiently.

3.2 CAPM

Concerning the CAPM, Theriou *et al* (2004) find that a conditional CAPM, which differentiates positive and negative market excess returns, turns out to have significant explanatory power. More specifically, after using daily returns of all common stocks traded during 1991-2002, it is derived that the market beta is related positively to stock returns in an up market and negatively in a down market. This significance is lost for an unconditional CAPM. Milionis and Patsouri (2011) end up with similar results to Theriou *et al* (2004) after examining the period 1999-2004.

3.3 Fama-French Three-Factor Model

As far as the variables of the Fama-French three-factor model is concerned, there are contradictory findings. Using monthly returns of a twelve-year period (1970-1981) for almost all quoted companies, Glezakos (1993) finds that ME is not robust in explaining ASE stock

returns after controlling for firm-specific factors. Having examined several potential variables for the period 1990-2000 and by using monthly data, however, Leledakis *et al* (2003) conclude that ME is the only determinant of cross-sectional stock returns. Among other variables, the market beta does not have any predictive power and BE/ME is not proven robust in combination with other variables. A similar study is conducted by Theriou *et al* (2003). They investigate the period 1993-2001 using monthly data with a sample of 327 non-financial listed firms and conclude at same results with Leledakis *et al* (2003). Karanikas *et al* (2006), who examine the period 1991-2004, also find the presence of a size effect. On the contrary, Alexakis *et al* (2010) argue that, from their sample of 47 listed companies being traded during 1993-2006, all the financial ratios they are using (including BE/ME) turn out to have significant information concerning the cross-section of stock returns. However, in their study they involve a one-factor model, leaving doubts about their variables' robustness in combination with others. To conclude with, Manolakis (2012) tests the Fama-French three-factor model over a ten-year period (2001-2011) and suggests that the variables of the model, either alone or combined, have explanatory power. However, his results might be subject to survivorship bias since he excludes "dead" stocks.

3.4 Liquidity Factor

Concerning the liquidity factor, Patra and Poshakwale (2006) argue that the trading volume has both a short and a long run equilibrium relation with stock prices. In addition, Andrikopoulos (2007) examines the relationship of stock return volatility with five liquidity measures during 1993-2005. He ends up that all of them help explain the variance of stock returns, with the most robust being Datar's *et al* (1998) turnover rate of a stock.

3.5 Momentum Factor

Finally, with regards to the momentum factor, Antoniou *et al* (2005) use weekly price observations for all stocks listed on ASE during 1990-2000. They find that contrarian

strategies provide significant returns in the short-run and that the Fama-French 3-factor model does not fully capture overreactions. On the contrary, Alexakis *et al* (2010) suggest that for the overlapping period 1993-2006 a momentum strategy produces higher than average returns.

3.6 Conclusions

As it is depicted at these studies, ASE stock returns are not subject to the random walk hypothesis. It seems that the market beta does not have explanatory power over the cross-sectional stock returns, but there is not a consensus concerning the other variables, apart from the liquidity factor. However, even for this factor, the fact that the existing studies are very few does not allow us to derive secure conclusions.

Also, it can be derived that variables which are considered potential determinants of the cross-section of stock returns are inter-correlated, since findings show that in many cases they lose their initial statistical significance when they are included in multifactor models.

Chapter 4: Data Collection

4.1 Testing Period

The first step of data collection is the definition of the testing period. In our study it ranges from July of 2007 to June of 2012 (5 years). Our choice to start from July has to do with the availability of the accounting information, as we are going to mention in the following discussion. Also, as it has been written in the sub-section 1.3, this month coincides with the peak of GD's units and the initiation of high volatility in the returns of the index.

4.2 Listed Companies

The next step is to search for the listed companies on ASE. Our source is ASE's website. We decide to include all the companies that have been listed, independently of whether they are being traded for the whole period or not, in order to avoid a potential *survivorship bias*. Also, while many economists exclude financial firms stating that their normal high leverage probably does not have the same meaning as for non-financial firms, we decide to include them in our sample because banks in ASE capture a significant portion of the total market and much investment interest is shown to them. *Table 4.1* provides a brief summary of our sample. Of course, the companies under examination are subject to their availability of data.

Total Listed Companies	259
Continuously-traded Companies	232
Later-listed Companies	4
Suspended Companies	23
Total Delisted Companies	45
Total Number of Companies	304

Table 4.1, Source: *www.ase.gr*

4.3 Companies' Data

We examine companies' securities that are traded in the form of common stocks. Our source is Datastream. The data we collect are monthly and daily closing figures. Concerning stock prices, we retrieve monthly closing prices which are adjusted for capital actions. They are denoted in Datastream as *price (adjusted-default)*. ME is taken also using monthly closing figures denoted as *market value (capital)*. BE/ME is retrieved indirectly. First, we find monthly closing data for the *price-to-book value (P/B)*. After that we calculate BE/ME as the inverse of P/B. We should note at this point that there is also a data type called *market-to-book value*, but we realize after a cross-section with the companies' annual reports that this ratio is imprecise in some occasions comparatively to the chosen one. Finally, with regards to the liquidity factor, we find daily closing figures of the *turnover by volume*. In addition, in order to calculate the total number of common shares outstanding on a daily basis, we divide daily closing figures of ME with their associated daily closing stock prices. We decide to make this calculation instead of extracting immediately the data because Datastream provides several data types that correspond to outstanding shares. After a cross-section with the companies' annual reports we realize that there is an inconsistency in the way that Datastream presents this kind of data.

4.4 Market Portfolio

We consider GD as the proxy for the market portfolio's index, and we also take monthly closing prices. However, before concluding to this choice, we also take into account the existence of other well-known market indices such as S&P500, NYSE, or even the aggregate world index created by the Morgan Stanley Capital International (MSCI). Concerning S&P500 and NYSE, the common sense supports that a typical American prefers to invest in a domestic market rather than in foreign financial markets and especially these that are under financial crisis such as Greece. As a result, these two indices lose the concept of a diversified market portfolio. With regards to MSCI, we decide to reject it since Greece captures only a small amount of the index.

Chapter 5: Methodology

5.1 Approaches

This study is based primarily on two methodologies. The first is the *portfolio analysis*, similar to that presented by Fama and French (1992). According to this approach, portfolios (10) are formed on the basis of a key variable, and after that the relationship of this variable with others is investigated. The second is the deployment of *cross-sectional regressions* introduced by Fama and MacBeth (1973). According to this approach, we run month-by-month cross-sectional regressions among the companies' examined variables and their respective stock returns for the whole examining period (except for the market beta which is limited to the last three years as we describe later). The result is to take sixty estimations (twelve months * five years) for each slope of the independent variables (thirty-six for the market beta). Having these estimations, we calculate their time series mean and standard deviation, and we perform tests based on *t-student distribution*. As we understand, the approach of cross-sectional regressions is focused on individual stocks rather than portfolios. For both approaches, we use the same market beta estimates, which are calculated using Fama and French (1992) approach. Finally, since the other variables can be calculated precisely, we estimate only market betas based on the formation of portfolios. This allows us to use individual stocks in Fama and MacBeth (1973) regressions, and according to Berk (2000) permits us to avoid rejecting a fundamentally correct asset pricing model due to a wrong decision of the key variable with which we sort.

5.2 Returns

Stock returns are calculated using the natural logarithmic function (\ln). This formula corresponds to continuously compounded returns, and indicates the true but unobservable

stock returns (Dimson (1979)). We employ the same approach for the calculation of GD's returns.

5.3 Market Beta

Particular attention is paid for the estimation of companies' market beta. First of all, in the end of June of year t , we estimate each company's market beta by regressing its monthly returns on the returns of GD. In order to do this estimation, companies are required to have at least twenty-four months of past record on ASE. Since our period extends to five years, companies are expected to have a time series of maximum (due to potential delistings, suspensions, or later-listings) three market beta estimates. These are the values of *pre-ranking market betas*.

In the next step, at the end of June of the years 2009-2011, we sort companies into ten portfolios based on their pre-ranking market betas. While Fama and French (1992) sort first by ME and after that by pre-ranking market betas, we decide to omit sorting by ME because we do not have evidence that for our testing period size can produce wide spread of returns and market betas. Besides, Fama and MacBeth (1973) also sort only on pre-ranking market betas. The allocation of stocks at the portfolios is based on Fama and MacBeth's (1973) formula. The middle 8 portfolios contain: $\text{int}(N/20)$ stocks, where N is the total number of stocks in our sample, and int is the largest integer equal to or less than $N/20$. If N is even, each of the first and last portfolios has: $\text{int}(N/20) + 0,5 * [N - 20 * \text{int}(N/20)]$ stocks. In case N is odd, the portfolio with the highest pre-ranking market betas gets an additional stock.

The reason we allocate companies in portfolios is the fact that, according to Fama and MacBeth (1973), and other economists, estimates of market betas for portfolios can be much more precise instead of estimates for a single security. However, this portfolio grouping should not be done by chance. The first portfolio should contain companies with the lowest pre-ranking market betas, and so on, up to the last portfolio which includes companies with

the highest pre-ranking market betas. This sorting is done in order to cope with the *errors-in-the-variables* problem, first noticed by Blume (1970), which is the fact that the process of grouping shrinks the range of the variables and reduces the statistical power of a model. Thus, this sorting achieves a higher differentiation among the portfolios.

After assigning companies to portfolios in the end of June, we calculate the equally-weighted monthly returns of the portfolios for the next twelve months. In case a company is delisted, its returns are substituted by GD's returns. In the end, we have thirty-six monthly returns (Jul/2009-Jun/2012) for each one of the ten portfolios.

In the final step, we use Dimson's (1979) method in order to control for potential *thin* (or *non-synchronous*) trading. We employ his method because of his comprehensive argumentation that his model is superior to the existing ones, including Scholes and Williams' (1977). According to him, we regress each portfolio's returns on GD's lag, current, and lead (by one month) returns. The portfolios' market beta is the sum of the slopes of these three regressions. After that, we allocate each portfolio's market beta to the stocks of which is consisted. These are the *post-ranking market betas* which we are going to use in our analysis.

At this point we should mention that the drawback of our approach concerning the market beta's estimation is that it does not cope with the *regression phenomenon*, also noticed by Blume (1970), which states that within the portfolios we might have bunching of highly-positive and highly-negative estimations of market betas comparatively to the true ones. While Fama and MacBeth (1973) solve this issue by using two sets of periods, we are not able to do that since our testing period is rather small. However, Fama and French (1992) also do not occupy with this issue.

5.4 ME and B/E

For each year t , we use ME at the end of June of this year, and we link it to a firm's stock returns during the period Jul_t - Jun_{t+1} .

Concerning BE/ME, for each year t we use values at the end of December of year $t-1$, which are linked to the firms' stock returns during the period Jul_t - Jun_{t+1} . We decide to use monthly returns with a minimum gap of six months from the accounting figures because in Greece the annual financial statements should be released at least twenty days before the annual stockholder's meeting. The latter should take place within six months after the financial year ends. As a result, we ensure that the last accounting data are publicly available before the return period, and in this way we avoid a possible *look-ahead bias* as it is described by Banz and Breen (1986). Finally, in case a company has negative BE/ME, it is excluded from both the portfolio analysis and the cross-sectional regressions.

5.5 Liquidity Factor

The estimation of the liquidity factor requires more scrutiny. This is because, as it has been mentioned, liquidity has at least four dimensions. In our case, we decide to use Liu's (2006) liquidity measure (LM). We end up at this choice because this measure manages to capture three of the alternative dimensions (trading quantity, speed, and cost). Also, Liu (2006) argues that his measure is correlated negatively with ME and positively with BE/ME. The formula is:

$$LMx = \{number\ of\ 0\ daily\ volumes\ in\ prior\ x\ months\ +\ [(1 / x\text{-month}\ turnover) / deflator]\} * (21 / NoTD), \quad \text{where}$$

x-month turnover: turnover over the prior x months, calculated as the sum of daily turnover over the prior x months (daily turnover is the ratio of the number of shares traded on a day to the number of shares outstanding at the end of the day),

NoTD: total number of trading days in the market over the prior x months,

deflator: a chosen number such that $0 < [1 / (\text{x-month turnover})] / \text{deflator} < 1$.

Since the number of trading days in a month can vary from 15 to 23, Liu uses the multiplication by the factor $21/\text{NoTD}$ in order to standardize the number of trading days in a month to 21.

LM implies that we can use several past time horizons. However, Liu (2006) reports that a short past time horizon of his measure does not have the ability to detect variation in returns of some illiquid NYSE/AMEX (NASDAQ) stocks. Thus, he proposes the use of LM12 (twelve-month past time horizon). In our study we employ LM6 (six-month past time horizon). We end up at this choice for two reasons. First, six months are considered a medium term time horizon, thus it copes with Liu's (2006) concerns. Second, and more important, LM12 requires from stocks to have been traded over a one-year period, while LM6 only for half of it. In this way, we achieve to maintain more companies in our analysis. Consequently, at the end of June of each year t we estimate LM6, which is linked to a firm's stock returns during the period $\text{Jul}_t\text{-Jun}_{t+1}$, and we arbitrarily use a deflator of 100.000.

5.6 Momentum Factor

The momentum factor is another special case. Jegadeesh and Titman (1993) employ strategies based on several time horizons concerning the calculation of past returns. These horizons range from three to twelve months. Since we do not have any clue to support a priori which of these time horizons must have the most chances of explaining stock returns, we decide to concentrate only on a short (three-month) and a medium (six-month) term. In this way, we also achieve to maintain more companies in our analysis than employing a one-year time horizon, since in the last case we would demand from companies to have been

traded over a longer period. To conclude with, at the end of June of each year t we estimate the equally-weighted average monthly returns of each stock during the past three (M3) and six (M6) months, and we link these returns to a firm's stock returns during the period Jul $_t$ -Jun $_{t+1}$.

5.7 Adjustments to Variables

While for the portfolio analysis there is no need to make any adjustments to the variables, the same does not apply for the cross-sectional regressions. In order to avoid potential issues related to skewness or heteroskedasticity, we transform ME, BE/ME, and LM to their respective natural logarithmic form using the \ln function.

Concerning the momentum factor, since average past returns can be zero or negative we are not able to use the \ln function. Thus, we employ a different approach which should be done twice (one for past three-month and one for past six-month returns). At the end of June of each year t we create ten portfolios and we sort stocks according to their past returns. The number of stocks allocated to each portfolio is given by Fama and MacBeth's (1973) formula described in sub-section 5.3. After that we create a dummy variable. We attribute the figure 0 for "losers" (stocks which are in the portfolio with the lowest past returns), and the figure 1 for "winners" (stocks which are in the portfolio with the highest past returns), and we use only these stocks at Fama and MacBeth (1973) cross-sectional regressions.

Chapter 6: Data Analysis

6.1 Portfolio Analysis

We start our analysis using Fama and French's (1992) portfolio analysis. First, *Table 6.1* provides some summary statistics of the data.

Summary Statistics	Number of Stocks	Mean	Median	Stand. Dev.
Post-ranking β	262	0,453	0,453	0,001
ME (in mn of €)	276	355,21	299,59	177,12
BE/ME	266	1,75	1,98	0,97
LM6 (in days)	267	20,78	20,91	8,98
M3	276	0,39%	-2,11%	7,69%
M6	276	-1,47%	-2,26%	4,40%
Average Number of Stocks	270			

Table 6.1

Notes: The summary statistics represent the time-series averages of the annual cross-sectional values of the variables over 5 years (2007-2012). The results of post-ranking β refer to the period 2009-2012. For each return period ranging from t to $t-1$: Post-ranking β , ME, LM6, M3, and M6 are estimated at the end of June of year t ; BE/ME refers to the end of December of year $t-1$.

Our next step is to examine the properties of portfolios which are sorted according to a key variable. *Table 6.2* presents the properties (returns and relationships among the variables) of the portfolios.

Concerning the returns, the first thing that can be observed easily is the fact that there is not any portfolio which provides positive returns. All the portfolios have losses, something which depicts the difficulties that the Greek economy faces and justifies the title of this study which characterizes the examining period as turbulent.

Properties

Sort by:

Post-β (26)	Mean Returns	Post-β	ME	BE/ME	LM6	M3	M6
1 (Lowest)	-1,66%	0,208	67,17	1,91	34,08	-1,73%	-2,42%
2	-3,14%	0,211	115,73	2,09	58,72	1,10%	-1,56%
3	-2,20%	0,239	315,56	1,79	34,54	-1,06%	-2,04%
4	-3,29%	0,325	351,06	2,71	27,34	-1,68%	-1,66%
5	-4,23%	0,463	228,18	2,44	24,49	-0,84%	-1,91%
6	-4,39%	0,467	79,33	3,29	24,66	-2,01%	-2,04%
7	-3,36%	0,522	283,34	2,55	17,91	-1,75%	-1,90%
8	-3,39%	0,595	215,62	2,27	17,16	-0,86%	-0,94%
9	-4,68%	0,714	188,91	2,38	14,64	-1,39%	-2,21%
10 (Highest)	-5,53%	0,781	519,02	2,66	15,05	-0,97%	-2,25%

ME (27)	Mean Returns	Post-β	ME	BE/ME	LM6	M3	M6
1 (Lowest)	-1,93%	0,367	4,01	3,59	40,86	-1,06%	-2,81%
2	-3,42%	0,457	8,71	2,24	35,47	1,28%	-1,71%
3	-3,12%	0,417	13,88	2,02	23,83	1,01%	-1,82%
4	-4,18%	0,459	19,31	2,11	21,79	0,68%	-1,34%
5	-3,70%	0,528	27,59	1,85	17,70	0,39%	-1,62%
6	-4,37%	0,472	41,40	1,71	20,13	2,06%	-1,74%
7	-4,04%	0,462	71,03	1,46	14,46	1,13%	-0,45%
8	-4,33%	0,430	152,77	1,20	13,76	0,39%	-1,18%
9	-3,37%	0,443	370,70	0,87	13,51	0,11%	-0,45%
10 (Highest)	-4,27%	0,507	2642,74	0,91	8,88	-1,80%	-1,60%

BE/ME (26)	Mean Returns	Post-β	ME	BE/ME	LM6	M3	M6
1 (Lowest)	-3,73%	0,393	773,65	0,26	20,47	-1,05%	-2,82%
2	-3,57%	0,429	875,64	0,52	21,55	-0,77%	-1,56%
3	-3,68%	0,405	696,01	0,74	22,38	-1,30%	-2,38%
4	-3,74%	0,453	340,00	0,98	20,23	-0,08%	-1,77%
5	-3,29%	0,462	322,34	1,20	18,28	-0,18%	-2,04%
6	-3,84%	0,458	174,96	1,44	18,88	0,18%	-1,14%
7	-4,64%	0,478	134,66	1,80	19,50	0,53%	-1,57%
8	-3,19%	0,453	125,31	2,25	19,43	1,17%	-1,20%
9	-3,12%	0,525	64,09	3,07	20,21	2,26%	0,46%
10 (Highest)	-3,72%	0,468	57,51	6,96	27,07	2,23%	-0,87%

Table 6.2

Notes: Stocks are grouped in 10 portfolios based on Fama and MacBeth's (1973) formula described in subsection 5.3 (the number in each parenthesis denotes the average number of stocks grouped at portfolios) by a different variable (Post- β , ME, BE/ME, LM6, M3, M6). The grouping process is repeated every year at the end of June over 5 years (2007-2012). The results of post-ranking β refer to the period 2009-2012. For each return period ranging from t to $t-1$ the portfolio formation is based on: Post-ranking β , ME, LM6, M3, and M6 estimated at the end of June of year t ; BE/ME estimated at the end of December of year $t-1$.

Properties**Sort by:**

LM6 (26)	Mean Returns	Post-β	ME	BE/ME	LM6	M3	M6
1 (Lowest)	-5,20%	0,604	991,65	1,36	7,79	1,05%	-1,50%
2	-4,87%	0,586	532,08	1,49	7,79	1,15%	-1,14%
3	-3,69%	0,489	670,26	1,58	7,89	-0,46%	-1,60%
4	-4,49%	0,474	336,69	1,71	8,52	-0,83%	-2,34%
5	-3,95%	0,479	249,77	1,65	10,09	-1,23%	-2,17%
6	-3,26%	0,469	186,28	1,78	13,61	0,76%	-1,21%
7	-2,80%	0,403	214,38	1,72	19,31	0,21%	-1,48%
8	-3,66%	0,393	205,07	1,76	28,36	0,98%	-0,93%
9	-2,66%	0,336	103,46	1,85	43,56	1,63%	-1,13%
10 (Highest)	-2,95%	0,317	81,02	1,70	74,27	0,64%	-1,21%

M3 (27)	Mean Returns	Post-β	ME	BE/ME	LM6	M3	M6
1 (Lowest)	-3,57%	0,467	551,52	1,40	21,08	-13,47%	-8,42%
2	-3,56%	0,472	382,96	1,93	21,68	-7,08%	-6,01%
3	-4,20%	0,472	642,26	1,50	16,48	-4,63%	-3,51%
4	-3,19%	0,436	739,56	1,38	19,92	-2,40%	-2,76%
5	-3,77%	0,449	201,08	1,44	19,28	-0,58%	-1,62%
6	-3,16%	0,464	262,82	1,69	19,10	1,28%	-0,70%
7	-3,41%	0,439	207,82	1,54	17,69	2,89%	0,27%
8	-3,32%	0,443	267,70	2,23	27,26	4,88%	0,81%
9	-4,07%	0,403	182,30	2,29	25,01	7,52%	2,24%
10 (Highest)	-4,23%	0,479	133,75	2,15	23,50	13,68%	4,41%

M6 (27)	Mean Returns	Post-β	ME	BE/ME	LM6	M3	M6
1 (Lowest)	-4,06%	0,471	197,33	1,58	22,62	-9,69%	-11,40%
2	-4,30%	0,469	337,62	1,50	20,89	-5,54%	-6,36%
3	-3,04%	0,457	486,82	1,44	19,46	-3,51%	-4,51%
4	-4,00%	0,457	611,50	1,43	18,23	-1,90%	-3,26%
5	-3,66%	0,478	391,22	1,81	21,30	0,53%	-1,96%
6	-3,49%	0,442	495,24	1,65	18,39	0,91%	-0,67%
7	-3,03%	0,392	314,83	1,90	21,44	2,16%	0,37%
8	-3,53%	0,444	301,28	1,69	20,28	3,76%	1,71%
9	-3,01%	0,427	233,27	2,28	23,48	6,14%	3,50%
10 (Highest)	-4,31%	0,490	213,21	2,35	23,40	9,99%	7,23%

Table 6.2 (Continued)

Notes: Mean returns are the time-series averages of 60 (36 for portfolios formed on post-ranking β) monthly equally-weighted portfolio returns. In case a company is delisted, its returns are substituted by GD's returns. The figures concerning Post- β , ME, BE/ME, LM6, M3, and M6 are the time-series averages of the annual values of these variables in each portfolio. ME is expressed in mn of €, and LM6 in days.

Moreover, it turns out that sorting by post-ranking market betas gives a wide spread of returns. The average monthly returns of the portfolio with the lowest post-ranking market betas are -1,66%, while the respective returns for the portfolio with the highest post-ranking market betas being -5,53%. Thus, we derive that there is a negative correlation between returns and market betas, something that is in line with previous studies.

Same results we have also for ME. The portfolio with the lowest ME yields average monthly returns of -1,93%, with the respective returns for the portfolio with the highest ME being -4,23%. Thus, we also conclude that there is a negative correlation between returns and market betas, which is a result similar to previous studies.

Sorting by BE/ME does not provide us any indication that this variable can explain stock returns. All the portfolios formed on BE/ME appear to have similar average monthly returns.

Concerning the liquidity measure, the results suggest that LM6 might be a reliable candidate of predicting stock returns since it gives a spread of 2,25% on a monthly basis between the portfolios with the highest and the lowest figures. It also turns out that stocks which are considered more illiquid (higher LM6 values), thus have higher risk, provide a higher compensation to their investors, something which is in line with the common sense.

Finally, it seems that neither M3, nor M6 serve as good indicators of stock returns. Despite the fact that M3 performs slightly better than M6 in the differentiation of average monthly stock returns, its spread between the highest-M3 and the lowest-M3 portfolios is significantly low (0,66%).

Having examined the relations between variables and returns, we can proceed with the examination of the relations among the variables. We find indications that the variables are inter-correlated. First, as it seems natural, ME is negatively correlated to BE/ME, and M3 is positively correlated to M6. Furthermore, apart from these expected correlations, the stronger relations seem to be the ones between market beta and LM6 (negative correlation), and ME

and LM6 (negative correlation). This indicates that the argumentation of Liu (2006) concerning the multidimensional orientation of his measure is valid.

Indeed, *Table 6.3* which derives from Fama and MacBeth's (1973) cross-sectional regressions proves that there is a strong negative connection between LM6 and the variables of market beta and ME. The average cross-sectional correlation coefficient is in both cases approximately -0,40. Concerning the other variables, like with the portfolio approach, we have significant correlations between ME and BE/ME (negative), as well as between M3 and M6.

6.2 Cross-Sectional Regressions

Correlations

<i>Mean Values</i>	Post- β	ln(ME)	ln(BE/ME)	ln(LM6)	Dummy-M6	Dummy-M3
Post- β	1,00	-	-	-	-	-
ln(ME)	0,11	1,00	-	-	-	-
ln(BE/ME)	0,16	-0,40	1,00	-	-	-
ln(LM6)	-0,40	-0,44	0,06	1,00	-	-
Dummy-M6	0,04	0,11	0,22	0,03	1,00	-
Dummy-M3	0,00	-0,05	0,28	0,06	0,97	1,00

Table 6.3

Notes: The correlation coefficients represent the time-series averages of the annual cross-sectional correlation coefficients between the variables over 5 years (2007-2012). The results of post-ranking β refer to the period 2009-2012. For each return period ranging from t to $t-1$: Post-ranking β , ME, LM6, M3, and M6 are estimated at the end of June of year t ; BE/ME refers to the end of December of year $t-1$. The prefix "ln" denotes that the variable is used in natural logarithmic form. The term "dummy" denotes that the variable is used in a dummy form and is equal to 0 for a past "loser" and equal to 1 for a past "winner".

From the portfolio analysis we derive that there are inter-correlations among the variables we employ. These inter-correlations are proven robust after being examined by the cross-sectional regressions' approach. Also, the portfolio analysis indicates that the post-ranking

market betas, ME, and LM6 are highly regarded as potential determinants of cross-sectional stock returns. However, we should also check for their robustness under the framework of Fama and MacBeth's (1973) cross-sectional regressions.

The model we employ has the form:

$$R_{it} = \alpha_{0t} + \gamma_{it} * X_{it}, \text{ where}$$

R_{it} : i^{th} security's returns at month t ,

α_{0t} : intercept of the regression,

γ_{it} : coefficient of exposure of i^{th} security's returns to security's variable X at month t ,

X_{it} : variable of security i which corresponds to month t (it can take the form of: post-ranking β , $\ln(\text{ME})$, $\ln(\text{BE}/\text{ME})$, $\ln(\text{LM6})$, dummy-3, or dummy-6).

The results that we receive from the cross-sectional regressions are summarized at *Table 6.4*. According to them, all the variables that are considered at this study as potential determinants of the stocks' cross-sectional returns turn out to be statistically insignificant.

More specifically, despite the fact that a change in post-ranking β produces a 4,9% change at a stock's returns, it is the high volatility of the slope that diminishes any potential connection. Apart from the post-ranking β , which is close to the critical value, every other variable is clearly away from that point. Furthermore, the results suggest that there is no size effect, but also no reward for investing in stocks with high BE/ME. Un-reportedly, even when we adjust for the 0,5% of extreme BE/ME values like Fama and French (1992) propose we have no changes in our inferences.

Concerning the liquidity factor, we would expect that LM6, which is a measure having multiple dimensions, something that is also indicated in our study through its correlation with post-ranking β s and ME, would have statistical significance in a market which is characterized by high volatility. However, this is not the case.

Regressions	Post-β	ln(ME)	ln(BE/ME)	ln(LM6)	Dummy-M6	Dummy-M3
Mean	-0,049	-0,002	0,001	0,008	-0,003	-0,007
Sd	0,160	0,015	0,018	0,040	0,070	0,068
n	36	60	60	60	60	60
Mean/Sd	-0,305	-0,166	0,036	0,202	-0,050	-0,099
t-value	-1,828	-1,286	0,277	1,566	-0,383	-0,768
tcrit(59/95%): 2,001						
tcrit(59/99%): 2,662						

Table 6.4

For each return period ranging from t to $t-1$: Post-ranking β , ME, LM6, M3, and M6 are estimated at the end of June of year t ; BE/ME refers to the end of December of year $t-1$. The prefix “ln” denotes that the variable is used in natural logarithmic form. The term “dummy” denotes that the variable is used in a dummy form and is equal to 0 for a past “loser” and equal to 1 for a past “winner”. The average slope (denoted as mean) is the time-series average of the monthly regression slopes for July 2007 (July 2009 for the post-ranking β) to June 2012, and the t -value is the: [average slope (mean) divided by its time-series standard deviation] multiplied by the squared root number of n monthly figures. The numbers in parentheses are the degrees of freedom (on the left) and the level of statistical significance (on the right).

With regards to the momentum factor, we considered reasonable to exist a relation between past stock returns and future ones. Since we examine a turbulent period investors might have higher motivation to use rules of thumb in deciding for investments. However, this is also not true.

In addition, concerning the signs of the variables, if there was any connection, then we would find that stock returns are negatively correlated to all the alternatives, apart from the cases of BE/ME and LM6.

To conclude with, from an efficient hypothesis point of view, our results suggest that ASE behaves efficiently at its weak form, and because we also employ an accounting-based variable (BE/ME), we find also evidence of semi-strong efficiency. From a random walk hypothesis point of view, we conclude that the null hypothesis, meaning random walk in stock prices, is not rejected.

Chapter 7: Conclusions

The CAPM suggests that the expected returns of securities are a positive linear function of only their systematic risk. However, the model has been judged both because of its unrealistic assumptions and its underperformance in empirical tests. Many studies have been conducted examining other potential variables which could explain the cross-section of stock returns. The findings suggest that there are anomalies which can be detected by variables other than a security's market beta. Among the models that have been developed in order to explain these anomalies there are Fama and French's (1993) three-factor model and Carhart's (1995) four-factor model. Either these abnormalities are explained as sources of additional risk or as rules of thumb, the facts suggest that they exist.

Despite the fact that there is an extensive literature concerning the determinants of cross-sectional returns in the developed markets, little research has been conducted with regards to the small and developing ones. Among these small markets we find the Greek one. Also, it seems from the existing studies that there has not been paid much attention to the selection of the time period under consideration, since in many cases there is not adequate motivation.

Our aim with this study was to examine potential determinants of a stock's cross-sectional returns for ASE during a period which is characterized by challenges in the macroeconomic environment and high volatility in stock returns. The choice of the determinants that were used was based on i) findings from the existing literature concerning their significance and ii) an a priori and theoretically reasonable explanation of why they could serve as determinants. We ended up at using: i) market beta, ii) market value of equity, iii) book-to-market value of equity, iv) Liu's (2006) six-month liquidity measure, and v) a security's average of three- and six-month past returns.

Particular attention was paid on the potential issues that have been reported in the existing literature and can affect the results either in favor or against a model's efficiency. Among them, we controlled for survivorship bias, look-ahead bias, errors-in-the-variables problem, skewness, and heteroskedasticity.

Our methodology was based on Fama and French's (1992) portfolio analysis and on Fama and MacBeth's (1973) cross-sectional regressions. While we find robust inter-correlations among the variables we are using, we end up that none of our alternatives has explanatory power over cross-sectional stock returns. More specifically, while, according to the portfolio analysis, post-ranking market betas, market value of equity, and Liu's (2006) six-month liquidity measure seem to have the ability to create a wide spread of stock returns, when we employ the cross-sectional regressions these variables do not remain robust.

The findings suggest that from an efficient hypothesis point of view, ASE seems to be efficient at a weak and semi-strong form. Alternatively, from a random walk hypothesis point of view, the null hypothesis that ASE stock prices are move randomly cannot be rejected.

In our opinion, our findings should not be considered as "facts", but rather as "indications". Further studies should be conducted in order to be developed a unified framework. Among the available alternatives to the existing study, someone can work with a holding period different from one year. Also, our examining period can be considered as rather small. An extension to that period can be employed provided that ASE will maintain high levels of volatility on its returns. By expanding the examining period someone can also cope with the regression phenomenon in order to estimate market betas. In our study we were not able to do that since our time framework was not big enough. Several alternatives there are also with regards to the past time horizon that is decided for the liquidity and the momentum factors. Besides, liquidity itself has multiple ways of measurement. In addition, other potential variables can be tested. Finally, someone can also make use of a conditional CAPM like in the cases of Theriou *et al* (2004) and Milionis and Patsouri (2011).

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