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ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

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CAPITAL ASSET PRICING MODEL AND ARBITRAGE RICING THEORY

AN ECONOMETRIC ANALYSIS IN EUROPEAN UNION BANKS

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ABSTRACT

The aim of this thesis is the study of the Capital Asset Pricing Model and the Arbitrage Pricing Theory model. More specifically, in chapter 1of this work, the reader is introduced to the basic concepts of Modern Portfolio Theory and the efficient market hypothesis, based on bibliography. After that, will follow the analysis of the CAPM and its assumptions. In chapter 2, will be examined the Arbitrage Pricing Theory and some empirical studies, in order to be presented the similarities and the differences with the CAPM. In chapter 3 an empirical analysis is done, for the capital asset pricing model before and in crisis based on the data collected. Afterwards, follows some empirical tests and examined how crisis affected the stock returns using dummy variables. In the 4 and last chapter, is examined the APT model and compared with the CAPM, in order to have accurate results. At the end of the research the econometric results are companied by more general conclusions if the research leads to expected results or not.

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Contents

ABSTRACT 4

1. INTRODUCTION 3

1.1 Portfolio Theory 4

1.2 Efficient Frontier 5

1.3 Capital Asset Pricing Model (CAPM) 8

CAPM Assumptions 11

CAPM Valuation (strengths and weakness points) 12

1.4 ROLL's critique (1977) 13

2. Arbitrage Pricing Theory Model (APT) 15

2.1 Empirical Studies 17

3. EMPIRICAL ANALYSIS 23

3.1 Capital Asset Pricing Model 23

3.2 DATA ANALYSIS 25

3.2 BEFORE &IN CRISIS ANALYSIS 28

3.3 TOTAL MODEL ANALYSIS 35

3.4 APPLICATION OF DUMMY VARIABLES IN THE CAPM 43

4. APPLICATION OF APT AND A COMPARISON WITH CAPM 45

4.1 Data Analysis: 46

4.2 APT and CAPM comparison 54

.4.3 CONCLUSION 55

BIBLIOGRAPHY 56

1. INTRODUCTION

The capital asset pricing model (CAPM), describes the relationship between the risk and the expected return. It is a wildly used financial model that estimates the expected return of securities, taking into account the assumptions an investor has made. In extend the capital asset pricing model, measures the difference between the expected rate of return on the market portfolio the risk-free rate.

Generally a portfolio is the total of the securities and the assets an investor owns and by using them he wants to maximize his return with a given level of risk (variance). Variance, or risk, is a measure of the volatility or the dispersion of returns. Variance is measured as the average squared deviation from the mean. Higher variance suggests less predictable returns and therefore a more risky investment (Sharpe 1964).Historical return is what was actually earned in the past, whereas expected return is what an investor anticipates to earn in the future. Expected return is based on the real risk-free interest rate, expected inflation, and an expected risk premium for the risk of the asset (Markowitz 1959). There is no guarantee that the actual return will be equal to the expected return. In fact, it is very unlikely that the two returns are equal for a specific time period being considered.

The aim of this study is to present and analyze as well, the capital asset pricing model, in order to estimate the stocks on the banking industry from twelve countries of the Eurozone (Austria, Belgium, Finland, France, Germany, Greece, Italy, Portugal, Spain, Ireland, Luxemburg and Cyprus) by comparing the variance of the stock prices in Greek and these foreign markets in order to find out how the financial crisis has influenced the return of the stocks in this sector. The banking industry is a common choice for the investors, both in Greek and foreign markets, therefore, through the capital asset pricing model, we want to investigate if the stocks of European banks have differences at the risk and the rate of return and from where these differences are caused, the time period before and during the financial crisis (2000-2015).

In the first part of this thesis the theory of the capital asset pricing model will be extensively presented. This part will also include the analysis of the efficient frontier, the CAPM assumptions and a valuation of the model is presented.

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The second part will include the analysis of the Arbitrage Pricing Theory Model andempirical studies throughout the years, critics about how accurate the estimation of the CAPM is and it is possible extensions

In the third part according to the presented theory there will be an empirical analysis of the econometric factors of this model and the statistical significance by using several econometric methods.

In the final part there is an application of the APT model and a comparison with the CAPM results of this estimation will be presented and analyzed and conclude by testing if the estimation suits the theory.

1.1 Portfolio Theory

The capital asset pricing model (CAPM) first founded from the American economist Harry Markowitz through his article “Portfolio Selection” (Markowitz 1952) and his book “Portfolio Selection: Efficient Diversification of Investments” (Markowitz 1959). In this theory Markowitz investigates the relationship between the portfolios expected return and the variance of the return (risk). More specifically, he says that the risk averse investors are interested in the minimum variance portfolios-the efficient portfolios-, in which the expected return and the variance are given. In other words investors are interested in getting the maximum return with a given level of risk or minimize the risk with a given level of return,by carefully choosing the proportion of various assets (Fama and French 2004).

Generally, Modern Portfolio Theory has some points that worth to mention. The first one is the theory of selecting a portfolio in which, the expected return and the variance of a portfolio are connected with the number of securities involved (Markowitz 1952). The second one is the diversification, which target is to accomplish a level of risk, lower than the risk of each security has (Markowitz 1959).

The Capital Asset Pricing Model is the extent of the modern portfolio theory and has founded by Sharpe (1964) and Lintner (1965). It describes the relationship between the expected return of an asset and the variance (risk) and it is used as a pricing model. The capital asset pricing model, in practice, shows that the expected return of

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an asset or a portfolio, is equal to the price of a risk free asset (risk premium), multiplied with the sustainable risk of the risk free asset.

1.2Efficient Frontier

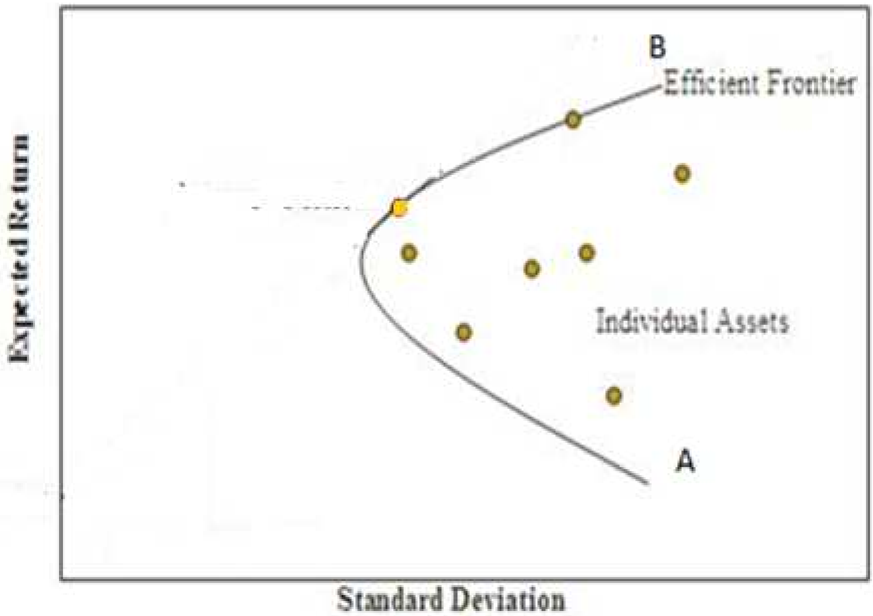

Figure 1: Total of the individual assets and the efficient frontier (without risk-free asset)

Harry Markowitz introduced efficient frontier as a part of modern portfolio theory. In the graph above we can see all the possible combinations of risk and expected return, in other words all the possible portfolios that can exist. The efficient frontier includes all the possible choices an investor can make. Beyond the line AB, there are all the possible combinations an investor can make.

From the diagram we can observe that all the individual assets existing above the frontier AB, have a higher return, with a level of risk given, or the lower risk. While we are moving towards the minimum variance line AB, it is a fact that the portfolios are becoming more and more efficient (the risk is minimized). So the portfolios in the upward part of the line are giving better expected return with the given level of risk, in comparison with the downward part of the line. The upward part of the line is called "efficient frontier" and an investor is choosing the portfolios which are included in this part (efficient portfolios).

The curve that represents the total of the efficient portfolios is arising through the equation:

$$E(Rp) = aE(x) + (1 - a)E(y)$$

$$Var(Rp) = a^2\sigma_\chi^2 + (1 - a)^2\sigma_y^2 + 2a(1 - a)\sigma_{xy}$$

There are three assumptions that Markowitz founded in his modern portfolio theory:

1. All investors have an aversion to risk and want the maximum expected return.
2. All investors are rational.
3. The decisions an investor is taking, are based in the theory that he wants to maximize the expected utility.

Security Market Theory has founded from Sharpe, Lintner and Mossin in the middle of the 60's and is the extend of Markowitz's modern portfolio theory. The main difference between these two theories is that in the second one, zero risk securities are included. That securities can be state bonds that are considered as risk free and that is because they have a stable return. This means that the investors knows for sure from the beginning the amount of money he is going to take from the investment because of the zero risk. The only essential risk in the state bonds and the securities is the inflation. So, in this theory are included "risk-full" and the "risk-free" assets.

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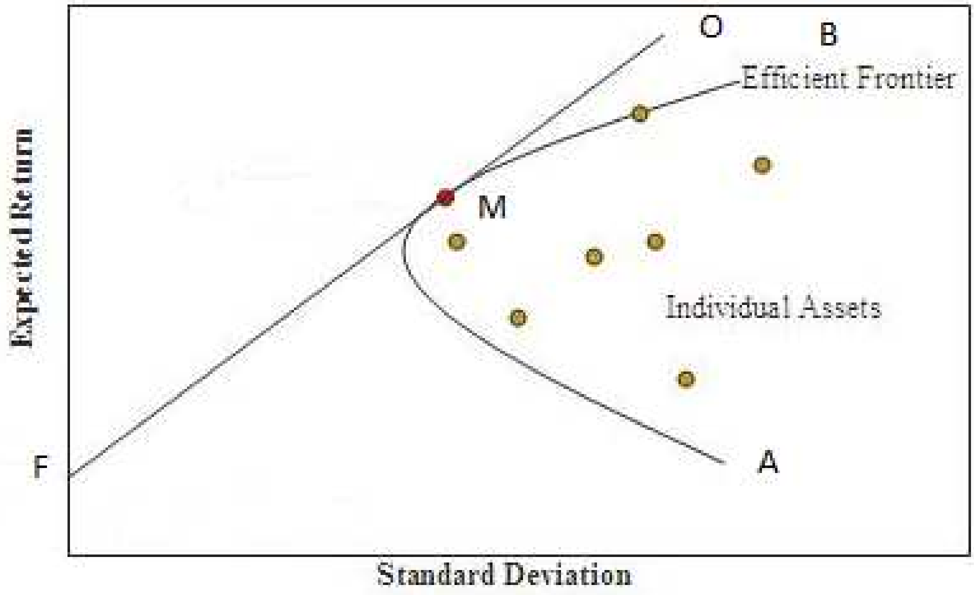

Figure 2: The efficient frontier and the Security Market Line

The risk free asset F, which has a return, is a well-known fact that should be put in the expected return side and apart from the efficient frontier. The combinations of the efficient portfolios and the risk free asset F that exists on the efficient frontier are represented with the line FO.

The best combination, of all the possible ones that exist in the line FO, the one that gives the higher expected return with the lower level of risk is the line FM. This line gives the investor the maximum utility from the investment and this means that on this line is the efficient portfolio,(the well diversified portfolio). Finally we can say tat all the efficient portfolios that combines the risk-free and risk-full assets are in the line FM, and this is why this line is called Security Market Line (SML).

The slope of the security market line is given from the equation:

$$(E(Rm) - Rf))/\sigma m$$

Where:

E(Rm) is the expected return of the market portfolio

Rf is the return of the risk free asset

σm is the deviation of the market

The security market line is given from the equation:

$$E(Rp) = Rf + \frac{E(Rm) - Rf}{\sigma Rm} * \sigma Rp$$

1.3 Capital Asset Pricing Model (CAPM)

Before we start analyzing the model we should define the types of risk existing in a portfolio. The total portfolio riskconsists of two types of risk: 1) the systematic (non-diversifiable) risk,which has to do with the market and the changes that happen and the unsystematic (diversifiable) risk, which has to do only with the asset and the company who issued it (Diggs 2004). When our goal is the well diversified portfolio, this means that the diversified risk has been eliminated. The non-diversifiable risk, that relates the total of the transactions made in a market, cannot be eliminated. So if the diversifiable risk can be eliminated, then the investor should expect to receive an extra bonus for taking the gamble.

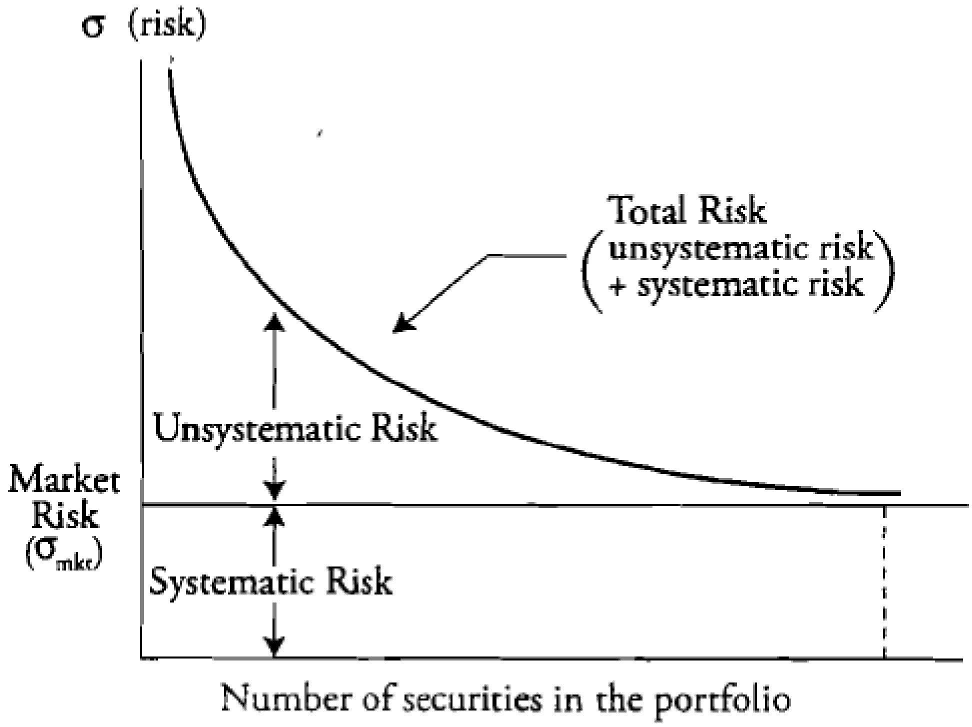

Figure 3 Systematic and Unsystematic risk in relation to the number of securities in a portfolio

(Source: financial-network.gr)

At this point, we can say that the non-diversifiable risk is the important one, and also the one that should be related with the expected return of an asset or a portfolio, or generally with an investment. The non-diversifiable risk of an asset, we usually symbolize it with the letter "b" and it is the beta coefficient, which is given through the equation (Brealey and Myers 2003)

$$b_p = \frac{Cov_{(Rp,Rm)}}{Var_{(Rm)}} = \frac{\sigma_{pm}}{\sigma_m^2}$$

Where,

$Cov(Rp, Rm)$is the covariance of the portfolio and the market

$Var\ (Rm)$is the variance of the market portfolio

The beta coefficient measures the volatility in the price of the asset for every 1% change will happen in the market return (Brealey and Myers 2003). Alternatively it

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can be said that through the beta coefficient, is measured the contribution of a security in the risk of a well-diversified portfolio (Brealey and Myers 2003, Bodie et al. 2008). According to the beta definition, about the market portfolio and the risk free asset:

$$b_m = \frac{\sigma_{mm}}{\sigma_m^2} = \frac{\sigma_m^2}{\sigma_m^2} = 1$$

$$b_{rf} = \frac{\sigma_{rf}\sigma_m\rho_{rfm}}{\sigma_m^2} = \frac{0\ \sigma_m\rho_{rfm}}{\sigma_m^2} = 0$$

It seems that the result is compatible to the definition. What is more, if an asset has a $b > 1$, it is more sensitive to changes of the market return than an asset with a $b < 1$. The return of assets with $b = 1$, follows the changes in the market return (Brealey and Myers 2003).

The risk-free asset has a zero beta and this is because the covariance with the market portfolio is zero.

The capital asset pricing modelis generally used to predict the expected return of assets that have not been traded yet to the stock market as well as to calculate the cost of equity in the business market (Fama and French 2004). Generally this model had been created to interpret the differences in the assets risk premium. Based on the beta coefficient William Sharpe (1964), John Lintner (1965), Jan Mossin (1966) and Jack Traynor (1961-1962) founded the linear function between the expected return and “b”,

$E(Rp) = Rf + b_p[E(Rm) - Rf]$	
$E(Rp)$	is the total expected return of an assets or a portfolio
$E(Rm)$	is the total expected return of the Market portfolio
Rf	is the risk-free rate of an asset

b_p	is the beta coefficient that measures the total systematic (non-diversifiable) risk of the asset or the portfolio

What is important here to observe is that in figure 2 above we can see that the beta coefficient represents the slope of the Security Market Line. What is more, through the equation above we can also observe the importance of the beta coefficient while it is a very crucial fact that represents the return of a risk free asset (risk free rate) and as we can see is the factor the portfolios expected return depends on (Diggs 2004). The difference E(Rm)-Rf multiplied with the beta coefficient is the return of the portfolio, in other words is the portfolios risk premium. Generally the security market line represents the capital assets pricing model and is a well-known fact that all the investors should be on the SML an all the expected returns should be given from the CAPM, having as an assumption that al the investors are rational and the markets are in equilibrium.

CAPM Assumptions

The capital asset pricing model is based on some assumptions about the investors' behavior, the capital assets and the perfection of the markets that make the analysis much more easier (Diggs 2004, Tsaklanganos 2000)

1. All the investors are rational and risk-averse, and they're trying to maximize the expected utility of their investment. The risk and the expected return are the two main factors that an investor takes into account.
2. All investors are price takers, while they cannot affect the level of the prices. This means that the market of the individual assets is always in equilibrium. Furthermore they all have the same expectations about the returns of the capital assets.
3. They have the opportunity to lend or borrow at the same riskless rate.
4. The quantity of the capital assets is given.
5. There are markets for all the capital assets existing.
6. The capital assets can be sold in perfect divisibility.

7. There are no transaction costs (something that is not true in reality).
8. The information has no cost and is immediately known to all investors.
9. Finally, all the investors are investing for one time period and they are not interested about what will happen in the end of this period.

According to all these assumptions the investors who are a part of the market, have the same information and no one has an advantage of an extra information for a security r an asset in comparison with the other investors. So if all the investors expect an investment of a high return as result we will have higher price of the security market and a decreasing expected return. The expectations of the investor, as far as the risk and the return are concerned, they have no difference.

CAPM Valuation (strengths and weakness points)

The CAPM is a theoretical valuation model of the return of a security or an asset. This is why it has an extremely huge utility, but in the other hand it has some weak points that make the model dysfunctional.

On the one hand we can say that this model is an easy understanding and simple to apply as well. What is more, this model takes into account only the systematic (non-diversifiable) risk, while the investors through, the portfolio diversification, can eliminate the unsystematic risk and as a result to minimize the total portfolio risk.

On the other hand, the disadvantages of this model do exist. At first, as a financial model is very restricted. CAPM assumes that the expected return of an asset depends on the systematic risk, in other words the beta coefficient, while is a well-known fact that the return of a security is a malty-factor function such as the international economic situation and the economic situation of the business sector.

Generally we can separate the disadvantages of this model in two categories: 1) All the problems that come of some non-realistic assumptions that the model is based on, and 2) how to define and calculate the parameters the model includes. Those from the second category are the following:

A) Define the market portfolio: a part of the calculation of the expected return of an asset or a portfolio through the CAPM, is the market portfolio, which is a theoretic portfolio. The main problem is that the market portfolio does not exist in reality. In practice, as a market we use the entire stock market index from the countries that we study the utility of the CAPM.

B) The calculation of the market expected return: this problems stems from the previous one. If the market portfolio does not exist in real, as the CAPM assumes, it is very hard to measure the market expected return. As a result, we assume that the market expected return is the general stock index of the country that we consider as a market. For the model's correct application, the return of the global market should be calculated, something very difficult to be done, taking into account all the difficulties, such as the exchange rates currency of each country that takes part in this global market portfolio.

C) The beta coefficient calculation: before measuring the beta coefficient, we should calculate the covariance of the assets with the return of the market portfolio. For this to be done, at first the expected return of the assets should be known,a very complex process because thecalculation of the expected returns is based on forecasts.

1.4ROLL's critique (1977)

Richard Roll (1977) after a long time investigation about the capital asset pricing model finally concluded that a portfolio is efficient if only there is an accurate relation between risk and return, where the risk is the beta.

The only real test about the credibility and the interpretative ability of the model is the expansion of the market portfolio efficiency to the relation risk-return. The CAPM will stand, only if the portfolio is above the efficient frontier. In case that the index that is used as a market portfolio is not efficient, the relation between the expected return and beta will not be satisfied as the model will expect.R.Roll (1977) claims that, as the market portfolio includes all the investments of the economy, there is nothing to be done to test the CAPM's application. After a long research, he finally concluded that the model has no practical value and he suggests the use of other models, such as the Arbitrage Pricing Theory (APT) for forecasting the returns.

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Roll (1977) starts his research about testing the model saying that every empirical analysis of the model has to presupposes the complete information about the assets are included in the market portfolio, because of the equilibrium between the risk and return and the efficiency of the market portfolio. As a result every asset should be included in a remarkable test. According to Roll (1977) there are the conclusions of his research:

1. There is only one testable assumption related with the Black's (1972) 2 factor model which is that the market portfolio is efficient as t the relation between risk and return.
2. All the "complications" of the model such as the linear relation between the expected return and beta, arising from the market portfolio efficiency cannot be independently tested.
3. There is an infinite number of efficient portfolios in every sample of returns.
4. The theory is not testable if the composition of the market portfolio is not accurate. This means that the testability of the theory supposes that all the individual assets are included in the sample.
5. The use of an index instead of a market portfolio is subject to some basic difficulties. At first the index might be efficient and the market portfolio wont. Secondly, the selected index might be ineffective, but obviously this means nothing about the market portfolio. What is more some indexes are shown strong correlation whether they are efficient or not. This gives the impression that the market portfolio configuration is not that much important.
6. Basically his is taking into account the Black, Jensen and Scholes (1972), Fama and Macbeth (1973) researches in order to reject the Sharpe and Linter model. Is proven that their results are totally compatible with the capital asset pricing model and there is an error determining the market portfolio.

As far as the econometric difficulties are concerned, Roll has concluded that a measurement of the index efficiency would be very difficult because the covariance matrix of the returns should be inverted and efficient frontier distribution is not known.

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2. Arbitrage Pricing Theory Model (APT)

In 1976 Stephen Ross first formulated this model, which as the capital assets pricing model, this is an asset pricing model, when the market is in equilibrium. At first Ross developed a theory that other models can be based on. This theory is based on arbitrage and has three basic assumptions:

1. The capital markets are perfectly competitive
2. Investors prefer more wealth with certainty
3. The return of the asset can be expressed as a function of K factors of risk.

The APT model is expressed as the following function:

$$R_i = E(R_i) + b_{i1}\delta_1 + b_{i2}\delta_2 + b_{i3}\delta_3 + \cdots + b_{ik}\delta_k + \varepsilon_i,$$

$$i = \{1, \ldots, n\}$$

Where:

R_i: is the real return of the asset i for a time period $i = \{1, \ldots, n\}$

$E(R_i)$: is the expected return of the asset$i$, $i = \{1, \ldots, n\}$

b_{ij} : is he correlation between the asset i and the parameter of risk j.

δ_k : All factors and indexes with zero return.

ε_i: the standard error

The parameter δ_k reflects all the risk factors that can affect the return of the assets. These factors can be the inflation, an increase inthe Gross Domestic Product (GDP), changes in the interest rates. The APT model, shows that many of these factors exist, in contrast to the CAPM, where the only risk measure is the covariance between the return of the asset and the return of the market portfolio (in other words every asset's beta).

Taking into account all these common factors, the parameters b_{ij} define the reaction of every asset i in the common factor$j$. The reaction in a factor like this one will be different, under the assumption that all the assets can be affected by a change in the

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GDP. Additionally, it is worth to mention that every stock can be affected from the interest rates, but it has been observed that many stocks show bigger changes in contrast to the others. This means that some stock are more sensitive to the interest rates fluctuations and some others not. Some other examples of these common factors are the unemployment rate or the exchange rate.

The APT model, assumes that the standard error's results (ε_i) are independent and will diversify over time in a large portfolio. Specifically, APT is required to bring balance, in other words a portfolio with zero systematic risk and a standard error equal to zero, where the results are well diversified. This assumption means that the expected return can be written as:

$$E(R_i) = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \cdots + \lambda_k b_{ik}, \text{ (APT)}$$

Where:

λ_0:is the expected return of a risk-free asset

λ_k: isthe risk premium

b_{ik}: is the pricing relationship between the risk premium and the asset.

This function represents the APT model. It is very useful to have the comparison with the capital asset pricing model

$$E(R_i) = R_f + b_i[E(R_m) - R_f], \text{ (CAPM)}$$

Comparing the two models, according to Brown and Reilly (2009), we have the following results:

	APT	**CAPM**
Type of function	Linear	Linear
Risk factors	$k \geq 1$	1
Risk premium	b_{ik}	b_i

Zero beta return	λ_0	R_f

Table 1: Comparison of APT and CAPM

The main difference between the two pricing model is in the way that the systematic risk is defined. Something very important to mention is that the two theories, define the linear equations, based on the common sense that the investors want to have compensation as to risk. What is more the APT theory suggests a function that is similar with the Security Market Line, which is related with the CAPM.

2.1 Empirical Studies

A basic disadvantage of the capital asset pricing model, as we've mentioned before, is that is based on some unrealistic assumptions that make the model not to give the required results. At this part we are going to analyze some empirical researches based on how the model works in case some of the assumptions undone.

These studies started right after themodel created. In 1969, J. Lintner started to analyze the model under the assumption of same expectations, trying to figure out how the CAPM is affected, if the investors have heterogeneous expectations. What he found is that the model retains its original form, but it's impossible to determine exactly the efficient frontier because the calculations of the expected returns and the covariance are very complicated.

Bierman in 1970, considered the case of a tax existence in the investors transactions. In the end of his research he finally concluded to the result that the main change in the model's function is the addition of a dividend factor, because of the transaction tax.

In 1972, Mayers investigated the assumption about the restricted investment, only in tradable assets. He tested the assumption taking into account the fact the investors except from the tradable assets they can have and non-tradable such like wealth, bringing in the human capital factor. Through his research he proved that the relationship between the expected return and the beta coefficient maintains, despite the fact that the portfolio is not optimal. According to Myers, every asset i has a security market line which is given from the equation:

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$$E(R_i) = E(R_m)\frac{\sigma_{im} + \frac{P_H}{P_m}\sigma_{im}}{\sigma_m^2 + \frac{P_H}{P_m}\sigma_{mH}}$$

Where,

P_H: value of the total human capital

P_m:total market value of tradable assets

R_H: excess rate of return of total human capital.

From the function above. It seems to be clear that in Mayer's model, the CAPM's beta coefficient is being replaced from a modified beta coefficient, which is taking into account the covariance between the asset i and the total human capital portfolio.

Another CAPM's assumption that became a subject of research was the existence of a risk free asset and the investors ability to borrow and lend with a interest rate equal to the assets return. In 1972 Black researched this assumption by testing how the capital asset pricing model changes if there is not a risk free asset. According to Black.every asset's expected return can be written as a linear function of the expected returns of both portfolios P and Q: (Bodie et al. 2008)

$$E(R_i) = E(R_Q) + \left[E(R_P - E(R_Q)\right]\frac{\sigma_{iP} - \sigma_{PQ}}{\sigma_P^2 - \sigma_{PQ}}$$

For every portfolio at the efficient frontier, there is a portfolio in the extension of the efficient frontier (that is inefficient), to which are uncorrelated. Due to this fact, this portfolio is called a "zero beta portfolio". If we assume that the market portfolio is "M", and the zero beta portfolio is "Z", the equation above is being:

$$E(R_i) = E(R_M) + [E(R_M - E(R_Z)]\frac{\sigma_{iM}}{\sigma_M^2} = E(R_Z) + [E(R_M) - E(R_Z)]b_i$$

This equation is the result of Black's research and is called the "Zero-beta CAPM" and is the extension of the capital asset pricing model. In the new model, the risk free asset is being replaced from the zero beta portfolio and all the portfolios are a linear function of the market and the zero beta portfolio.

Another extension of the CAPM, is the Intertemporal Capital Asset Pricing Model-ICAPM. This model is the result of Merton's research in 1973, where he assumes that the investors are not only care about the wealth their portfolio is going to bring up, as the classic CAPM does (Fama and French 2004). In contrast to Fama and French, Metron assumes that except from the classic factors there are and others that influence the portfolio's expected return. In order to address these additional factors, investors can invest in assets or portfolios, that can balance all these risk factors. Assuming that there are n risk factors k, the ICAPM equation that Merton has developed is:

$$E(R_i) = E(R_M)b_i + \sum_{k=1}^{n} E(R_k)\, b_{ik}$$

b_{ik}: is the beta coefficient of the hedged portfolio

$E(R_k)$: is the expected return of the hedged portfolio, for the risk factor k

(Bodie et al. 2008)

Additionally, in 1973 Fama and MacBeth, carried out a research in which they test the basic assumptions of the model, such as:

1. If the return and the risk of a portfolio are linear related.
2. If the beta is the only risk factor in the model.
3. Assuming that the investors are risk averse, if they are willing to take a higher level of risk in order to have a higher return.

In 1976 S. Ross, developed the Arbitrage Pricing Theory Model (APT), which is an alternative model that investigates the relationship between the return of an asset and the risk. According to this theory, the return of an asset doesn't depend only on one factor (market risk) as the CAPM does. The return of an asset is being influenced by many macroeconomic factors that cannot eliminate the risk through the diversification, and many other factors as well that can eliminate the risk through the diversification (Brealey and Myers 2003). Ross's mathematic equation is the following:

$$E(R_i) = R_f + b_{i1}\left[E(R_1) - R_f\right] + b_{i2}\left[E(R_2) - R_f\right] + \cdots + b_{im}\left[E(R_n) - R_f\right]$$

Where,

n: is the number of the macroeconomic factors

b_{im}: is the beta coefficient of the asset i

$E(R_n) - R_f$: is the risk premium related to the factor n. (Ross 1976)

Subsequently, in 1977 Roll, through his article "A Critique of the Asset Pricing Theory's Tests' Part I: On Past and Potential Testability of the Theory", mentions that the model has not been tested and it cannot be in the future. And that is based on the fact that the market portfolio cannot theoretically exist in practice. This is why every in every test approaches are used and according to Roll these tests does not offer a useful information about CAPM (Fama and French 2004).

In 1979, D. Breeden based on Merton's research, derived a new extension of CAPM known as the Consumption Capital Asset Pricing Model (CCAPM). This is a timeless model, such as the ICAPM, because it refers to a large time period, not only one as the classic CAPM does. In contrast to the ICAPM, the CCAPM is a single beta model:

$$E(R_i) = R_f + b_{iC}\left[E(R_C) - R_f\right]$$

Where,

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ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

C: is the consuming portfolio

b_{iC}: is the beta coefficient of the security i (it counts how sensitive the security is to the consumption's changes).

The main advantage of this model in contrast to the ICAPM is that it includes one beta and one specific factor (consuming) so it can be more easily tested, in contrast to the ICAPM which has many beta coefficients and lots of undefined factors.

Generally, except from the beta coefficient of the capital asset pricing model, there were and other factors tested about how they affect the securities' expected return. Some f these factors are (Fama and French 1992): a)the market equity (Banz 1981), b) the Earnings/Price ratio (Bazu 1983), c) the leverage ratio (Bhandari 1988) and d) the Book to Market equity BE/ME (Stattman 1980).

In 1992 Fama and French, in their research "The Cross Section of expected returns", they test the role of the beta coefficient and the other factors in relation to the variance of the stock returns. The results of the research are that the beta coefficient doesn't give full information about the securities' expected return. As far as the other factors are concerned, they have an explanatory role. What is more, in their research it's said that the combination of the capitalization factors and the book-to-market ratio (BE/ME) can absorb the leverage effect and the ratio E/P effect too (Fama and French 1993). Taking into account the results of their research, Fama and French added two new coefficients in their first model, that reflect the capitalization factor and the ratio BE/ME, and in that way they developed the article "Common Risk Factors in the Returns on Stocks and Bonds" known as the three factor model. The mathematic function is the following:

$$E(R_i) = R_f + b_i\left[E(R_M) - R_f\right] + S_i E(SMB) + h_i E(HML)$$

Where:

$E(SMB)$: is the expected excess return of a portfolio that includes small cap stocks in relation to the return of a portfolio that includes large cap stocks.

UNIVERSITY OF ECONOMICS & BUSINESS ATHENS ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

$E(HML)$: is the expected excess return of a portfolio with high ratio BE/ME in relation to a portfolio with low ratio BE/ME.

s_i, h_i: are the factors that show how sensitive is the expected return of a security i, in the capitalization and the ratio BE/ME too (Fama and French 1996, Brealey and Myers 2003).

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3. EMPIRICAL ANALYSIS

3.1 Capital Asset Pricing Model

The capital asset pricing model, as we've mentioned before, will examine the relationship between the securities' expected return and the Market risk premium. The purposeof this chapter is to represent the analysis of the static model among twelve countries of the Eurozone. In the following table, we present the chosen stocks and the countries we are about to examine and the indexes of each stock market.

EUROPEAN BANKS	INDEX
Banks Bank of Austria	Austria- DS Market (General stock index)
Dexia Bank of Belgium	Belgium- DS Market
National Bank of Paris, BNP Paribas	France- DS Market
Deutsche Bank	Germany- DS Market
General Bank of Greece	Greece -DS Market
Alandsbanken 'B'- Bank of Finland	Finland -DS Market
Banka Popolare di Milano (Italy)	Italy -DS Market
Banco Commercial Portuges 'R'	Portugal -DS Market
Banco Popular Espanol	Spain -DS Market
Bank of Ireland	Ireland -DS Market
Espirito Santo Financial Group	Luxemburg -DS Market
Bank of Cyprus	Cyprus -DS Market

Table 2: Total of European Banks and stock indexes

The time horizon is being examined is from 31/12/1999 until 30/09/2015, the data are used in the study are monthly, and the number of the observations is 190. Our source was DataStream.At first we have calculated the stock returns by using the percentage changes of the total return, which includes all the dividends the stocks are paying. In the same way, the returns of the general indexes were calculated. As a risk free interest rate, the Euribor rate, which we have converted in order to be suited to the monthly returns we use.

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ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

After the returns calculation, the difference $(r_i - r_f)$ is being determined, which is going to be the dependent variable of the capital asset pricing model, and the difference$(r_m - r_f)$, which is going to be the independent variable of the model.

Consequently, the model is about to estimate for each country, is the linear model

$$R_{it} - R_{ft} = \alpha_i + b_i\left(R_{mt} - R_{ft}\right) + \varepsilon_{it}$$

Where:

R_{it}: is the dependent variable, in this case is the return of the security i in the time t.

R_{ft}: The return of the risk free asset in time t.

R_{mt}: The independent variable, the general index return of each country, in time t.

b_i: The beta coefficient of the security i.

ε_{it}: The residuals, the standard error of the security i

α_i: The constant of the security i.

Before every regression, it's necessary to test the time series for stationarity, in other wordsfor a unit root existence, such for the securities and the general indexes of the market as well. The unit root test will be done with the Augmented Dickey-Fuller test (ADF). The hypothesis' of the test are:

$$H_0: Has\ a\ unit\ root$$

$$H_1: \neq H_0$$

Indicatively the following unit root test for the case of Greece is shown:

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.20209	0.0000
Test critical values:	1% level	-3.465202	

UNIVERSITY OF ECONOMICS & BUSINESS ATHENS
ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

5% level	-2.876759
10% level	-2.574962

Table 3: General Bank of Greece.

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.213006	0.0000
Test critical values:	1% level	-3.465392	
	5% level	-2.876843	
	10% level	-2.575006	

Table 4:General Index of Greece.

As we can see from the tables 3 and 4 above, according to the data, the P-value< 1%, 5%, 10%. As a result the null hypothesis is rejected, and that means there is no unit root. From this result we have the outcome that both time series are stationary.

The augmented Dickey-Fuller test was performed for every one of the twelve countries we are examining, and the results of the unit root test proved that in every case does not exist a unit root and all the time series are stationary.

3.2 DATA ANALYSIS

Before any form of estimation, it is worth to mention some of the data that are relating to the stock returns and the returns of the general indexes as well. These data are about the average return, the maximum and the minimum rate of return and the standard deviation for all the years are being under examination as well.

In the table below, there are shown all the data concerning the bank stock returns for each country.

Name	AUSTRIA	BELGIUM	FRANCE	GERMANY	GREECE	FINLAND	ITALY	PORTUGAL	SPAIN	IRELAND	LUXEMBURG	CYPRUS
average	0.19	-3.05	0.38	-0.38	-4.41	0.36	-0.27	-1.70	-0.62	-1.02	-1.20	-1.89
min	-7.47	-93.18	-36.61	-51.81	-116.24	-25.16	-48.29	-37.04	-39.31	-113.92	-80.15	-67.80
max	8.65	91.33	25.73	39.93	88.66	26.92	27.19	27.81	33.89	110.94	17.11	49.40
std	1.80	19.08	8.80	10.69	22.44	5.86	11.19	10.93	9.55	21.33	9.82	13.98

Table 5: Estimation of average, minimum and maximum return and standard deviation based on the cross-section data about the bank returns for each country.

As we can observe from the table above, the largest average of returns is presented in the bank of France 0.38%, then follows the bank of Finland with an average of 0.36% and third is the bank of Austria with an average up to 0.19%. All the other banks are presenting a negative average return, with the lowest average in the bank of Greece which is about -4.41%.

Afterwards, we can see when the bank of each country shows the minimum and the maximum return. At first, we have Greece which presents the minimum return up to -116.24% in July 2013 something that is very clear to us that is the time period in the financial crisis. Ireland follows with a minimum return up to -113.92%, in February 2009, a period in the starting years of the crisis. Next are following and the other countries with the bank of Belgium having the minimum return in July 2011 (-93.18%). At this point it is worth to mention that this is right after the large recession the country of Belgium had faced, because of the big financial deficit which surged in 2011.Belgium had faced many borrowing difficulties from the financial markets at this period as well. Additionally in the table, the Bank of Cyprus is shown to have a minimum return, about -67.80%, in the early crisis years (2011). In the summer of 2011, Cyprus was excluded from the international financial markets, because of the negative valuation from the international rating agencies. Taking into account the deficit the country was facing, that was main reason why the bank securities are presenting the minimum rate. Generally is observed from the estimations in the table 5, that all the countries in the period of the financial crisis have a big amount of reduction in their returns.

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On the other hand, we cannot omit to mention that the maximum return is observed in Ireland in 2009 (110.94%). Then follows Belgium with 91.33% and third the case of Greece with 88.66%.

Finally, the standard deviation is calculated as the squared root of the variance and it is a measure of dispersion from the mean. At this part we use the standard deviation to measure the expected volatility of the bank stock Here we can see that the largest volatility is presenting in the case of Greece (22.44%). This fact indicates the economic instability the country is going through the last years and how it has influenced the financial and the banking sector as well.

	AUSTRIA	BELGIUM	FRANCE	GERMANY	GREECE	FINLAND	ITALY	SPAIN	IRELAND	LUXEMBURG	CYPRUS	PORTUGAL
Average	0.49	0.59	0.32	0.31	-1.24	-0.01	0.12	0.36	0.38	0.48	-1.70	0.91
min	-31.70	-28.82	-17.82	-23.90	-34.67	-32.71	-16.56	-15.30	-22.84	-32.04	-35.49	-17.04
max	13.01	12.67	13.19	15.42	18.58	25.82	17.05	15.50	18.23	18.51	28.39	15.26
std	5.59	5.11	5.12	5.57	9.19	7.59	5.56	5.54	5.96	5.55	10.28	4.99

Table 6: Estimation of average, minimum and maximum return and standard deviation based on the cross-section data about the general market index of each country.

In the table 6, are presenting the estimations about the general indexes returns from all the twelve countries. The higher average of return introduced in the market of Portugal (0.91%). As we can see, Greece shows the lowest average of returns (-1.24%), something very expected taking into account the economic instability the market faces.

As in the case of the bank stock returns, so in the case of the general market indexes, is observed which time period the returns are of the minimum and the maximum point. For instance, in the case of Greece, is shown that the market return drops to -34.67% in August 2015. From 2000 until 2015, is the biggest drop of the market and that is maybe due to the political situation and instability which was very intense that exact period. For the same reasons as the previous ones we have the other countries presenting the lowest market returns in the financial crisis period, a general situation that influenced all the European financial markets.

At this part it is worth to mention the calculation of the standard deviation of the general indexes. The volatility relative to the market, also known as beta, is one way to look at risk. So in this way we can examine the stock market of each country about how aggressive it is. As we can see in the table 6, the market of Cyprus shows the largest volatility (10.28%). Then Greece follows with 9.19%. In both cases the result it’s fully justified, taking into account the economic and political instability the last years predominates. The rest of the countries present volatility about 5% and at last we have Portugal presenting the lowest one up to 4.99%.

3.2 BEFORE &IN CRISIS ANALYSIS

Before analyzing the total model, according to the data collected in order to estimate the CAPM, is observed that our model can be separated in two different periods: at first we have the period before-crisis which covers the time period from 1999 until the end of 2007.and at the second part we have the time period from 2008 till 2015 which is called the in-crisis model.

In the table below are presented the estimated equations for the before crisis model as they were examined:

Country	Before crisis CAPM estimated equations
Austria	Riaus=-0.006074+0.605133Rmaus
Belgium	Ribg=-0.001605+1.336678Rmaus
Cyprus	Ricy=0.004091+0.135222Rmcy
Finland	Rifin=0.006737+0.153505Rmfin
France	Rifr=0.005836+1.043628Rmfr
Germany	Riger=0.002230+1.147930Rmger
Greece	Rigr=-0.013085+1.550310Rmgr
Ireland	Riir=0.004794+0.438366Riir
Italy	Riit=0.003385+0.973838Rmit
Luxemburg	Rilux=0.003908+0.359837Rmlux
Portugal	Ripor=-0.002729+0.441633Rmpor
Spain	Rispain=-0.005850+0.851943Rmspain

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Table 7:Before crisis estimated equations for the 12 countries.

For instance is presenting the output for the General Bank of Greece:

Dependent Variable: RIGR
Method: Least Squares
Date: 12/21/15 Time: 19:12
Sample: 2000M01 2007M12
Included observations: 96

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.013085	(0.007875)	-1.661455	0.1000
RMGR	1.550310	(0.110503)	14.02961	0.0000

R-squared	0.676787	Mean dependent var	-0.015231
Adjusted R-squared	0.673349	S.D. dependent var	0.134985
S.E. of regression	0.077148	Akaike info criterion	-2.265557
Sum squared resid	0.559477	Schwarz criterion	-2.212133
Log likelihood	110.7467	Hannan-Quinn criter.	-2.243962
F-statistic	196.8299	Durbin-Watson stat	2.057336
Prob(F-statistic)	0.000000		

$$R_{igr} = \underset{(0.007875)}{-0.013085} + \underset{(0.110503)}{1.550310} R_{mgr}$$

With an R-squared=0.676787 and Number of observations=96. As we can see from the equation above, the value of the intercept (alpha) is -0.013085. According to the Jensen's theory (1968), it gives the excess return obtained when deviating from the benchmark. This indicator represents the part of the fund that cannot be explained from the systematic risk exposure to market variations. At this point it is worth to mention the significance of the Jensen's alpha. As we mentioned α= -0.013085, which is almost equal to zero. Now we can test the coefficient for statistical significance:

$$H_0: \alpha = 0$$

$$H_1: \neq H_0$$

From the output 1 above we can see that the P-value= 0.1000 > 0.05 level of statistical significance and it means that we not reject the null hypothesis and the coefficient is not statistically significant.

What is more, from the results above we can see the beta coefficient of the stock of General bank of Greece, which is 1.550310. This means that if the market risk premium increases 1% then the total return of the security will increase about 1.1550310%. Also this gives us the sensitivity the stock has in the market changes. A beta equals to 1.1550310>1, make us sure that the stock can be described as aggressive related to the market and as a result we don't prefer the stock. If we test the beta for statistical significance the results will be the following:

$$H_0: b \ = 0$$

$$H_1: \neq \ H_0$$

Using the P-value= 0.000 < 0.05 level of statistical significance, this means we reject the null hypothesis and the beta coefficient is statistically significant.

In the output above it's also presented the R-squared which indicates the level of the regressions adjustment to the data. More specifically, it shows the percentage of risk interpreted from the regression. Here we have an R-squared= 0.676787 which means that the 67.67% of the model interpreted from the independent variables. The rest 32.33% interpreted from exogenous factors.

In the following table, are presented the results of the beta coefficients, the intercept alpha of the twelve countries examined and the R-squared of each regression for the before crisis model.

Country	Alpha	p-value of Alpha	Beta		p-value of Beta	R-squared	p-value of F
Austria	-0.00607	0.0511	0.6050	<1	0.0000	0.541998	0.0000
Belgium	-0.00161	0.7393	1.3367	>1	0.0000	0.6852	0.0000
Cyprus	0.004091	0.5831	0.1352	<1	0.09	0.0302	0.09
Finland	0.006737	0.1629	0.1535	<1	0.0056	0.0787	0.0056
France	0.005836	0.2286	1.0436	>1	0.0000	0.591058	0.0000
Germany	0.00223	0.7093	1.1479	>1	0.0000	0.579976	0.0000
Greece	-0.01309	0.1	1.5503	>1	0.0000	0.676787	0.0000
Ireland	0.004794	0.3156	0.4384	<1	0.0000	0.237247	0.0000
Italy	0.003385	0.5879	0.9738	<1	0.0000	0.436988	0.0000
Luxemburg	0.0039	0.6349	0.3598	<1	0.0023	0.09425	0.0023
Portugal	-0.00273	0.77	0.4416	<1	0.0017	0.0996	0.0017
Spain	-0.00585	0.4313	0.8519	<1	0.0000	0.3223	0.0000

Table 8: Beta coefficients, alpha and R-squared with the corresponding P-values for the before crisis model..

As we can observe from the table above, four bank stocks from the twelve examined have a beta coefficient >1. These stocks are from the Dexia Bank (Belgium), BNP Paribas (France), Deutsche Bank (Germany) and General Bank of Greece. That means that the 33.33% of the bank stocks will be more volatile than the market, which is offering the possibility of a higher rate of return, but also posing more risk. What is more, almost all the beta coefficients are statistically significant taking into account the fact that the P-values < 0.05.the exception in our model is Cyprus which has a $P - value = 0.09$ which is statistically significant only in 1%level of statistical significance. Also, in table, are presented the Jensen's alpha which as we can see we have P-value >0.05 which means that the intercept alpha are not statistically significant.

As far as the R-squared is concerned, from the table above, appears to be well enough, if we consider that the higher number is in the case of Greece which is 0.676787 and that means that the 67.67% of the model interpreted from the independent variable and the 32.33% interprets from exogenous factors. The lower R-squared is in the case of Ireland about 0.0302 which means that the independent variable doesn't interpret the model.

In the table below are presented the estimated equations for the in-crisis model as they were examined:

Country	In crisis CAPM estimated equations
Austria	Riaus=0.004321+0.924049Rmaus
Belgium	Ribg=-0.013661+1.193918Rmaus
Cyprus	Ricy=0.001554+0.893685Rmcy
Finland	Rifin=-0.001079+1.001721Rmfin
France	Rifr=0.001352+1.000160Rmfr
Germany	Riger=-0.006923Rmger
Greece	Rigr=-0.008967+0.983694Rmgr
Ireland	Riir=-0.017964+0.997281Riir
Italy	Riit=-0.002849+1.047093Rmit
Luxemburg	Rilux=0.007380+1.084502Rmlux
Portugal	Ripor=-0.027095+0.909277Rmpor
Spain	Rispain=-0.026407+1.029772Rmspain

Table 9: In crisis estimated equations for the 12 countries.

For instance is presenting the output of the Alandsbanken 'B'-Bank of Finland:

Dependent Variable: RIFIN
Method: Least Squares
Date: 12/21/15   Time: 19:34
Sample: 2008M01 2015M09
Included observations: 93

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001079	(0.008447)	-0.127715	0.8987
RMFIN	1.001721	(0.032000)	31.30383	0.0000

R-squared	0.915027	Mean dependent var	0.028936
Adjusted R-squared	0.914093	S.D. dependent var	0.276138
S.E. of regression	0.080936	Akaike info criterion	-2.169055
Sum squared resid	0.596102	Schwarz criterion	-2.114591
Log likelihood	102.8611	Hannan-Quinn criter.	-2.147064
F-statistic	979.9297	Durbin-Watson stat	2.005672
Prob(F-statistic)	0.000000		

The estimated equation: $\underset{(0.008447)}{R_{ifin} = -0.001079} + \underset{(0.032000)}{1.001721 R_{mfin}}$

With an R-squared=0.915027 and Number of observations=93. As we can see from the equation above, the value of the intercept (alpha) is -0.001079. According to the Jensen's theory (1968), it gives the excess return obtained when deviating from the benchmark. This indicator represents the part of the fund that cannot be explained from the systematic risk exposure to market variations. At this point it is worth to mention the significance of the Jensen's alpha. As we mentioned α= -0.001079, which is almost equal to zero. Now we can test the coefficient for statistical significance:

$$H_0: \alpha = 0$$

$$H_1: \neq H_0$$

From the output 1 above we can see that the P-value= 0.8987> 0.05 level of statistical significance and it means that we not reject the null hypothesis and the coefficient is not statistically significant.

What is more, from the results above we can see the beta coefficient of the stock of General bank of Greece, which is 1.550310. This means that if the market risk premium increases 1% then the total return of the security will increase about 1.1550310%. Also this gives us the sensitivity the stock has in the market changes. A beta equals to 1.1550310>1, make us sure that the stock can be described as aggressive related to the market and as a result we don't prefer the stock. If we test the beta for statistical significance the results will be the following:

$$H_0: b = 0$$

$$H_1: \neq H_0$$

Using the P-value= 0.000 < 0.05 level of statistical significance, this means we reject the null hypothesis and the beta coefficient is statistically significant.

In the output above it's also presented the R-squared which indicates the level of the regressions adjustment to the data. More specifically, it shows the percentage of risk

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ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

interpreted from the regression. Here we have an R-squared= 0.915027 which means that the 91.5% of the model is interpreted from the independent variables. The rest 8.5% is interpreted from exogenous factors.

In the following table, are presented the results of the beta coefficients, the intercept alpha of the twelve countries examined and the R-squared of each regression for the in-crisis model.

Country	Alpha	p-value of Alpha	Beta		p-value of Beta	R-squared	p-value of F
Austria	0.004321	0.508	0.924079	<1	0.0000	0.941555	0.0000
Belgium	-0.04366	0.1071	1.1939	>1	0.0000	0.608263	0.0000
Cyprus	0.001554	0.8964	0.8937	<1	0.0000	0.82239	0.0000
Finland	-0.001079	0.8987	1.001721	>1	0.0000	0.91503	0.0000
France	0.00135	0.86	1.00016	>1	0.0000	0.9267	0.0000
Germany	-0.0069	0.48	1.01182	>1	0.0000	0.89165	0.0000
Greece	-0.00897	0.747	0.9837	<1	0.0000	0.5206	0.0000
Ireland	-0.01796	0.1365	0.9973	<1	0.0000	0.8421	0.0000
Italy	-0.00285	0.8	1.04709	>1	0.0000	0.86966	0.0000
Luxemburg	0.00738	0.8288	0.0845	<1	0.0000	0.428511	0.0000
Portugal	-0.0271	0.1622	0.909277	<1	0.0000	0.63776	0.0000
Spain	-0.026407	0.0219	1.029772	>1	0.0000	0.864626	0.0000

Table 10: Beta coefficients, alpha and R-squared with the corresponding P-values for the in crisis model.

As we can observe from the table above, six bank stocks from the twelve examined have a beta coefficient >1. These stocks are from the Dexia Bank (Belgium), BNP Paribas (France), Deutsche Bank (Germany), BancaPopolare di Milano (Italy), Alandsbanken 'B'-Bank of Finland and Banco Popular Espanol(Spain).. That means that the 50% of the bank stocks will be more volatile than the market, which is offering the possibility of a higher rate of return, but also posing more risk. What is more, all the beta coefficients are statistically significant taking into account the fact that the P-values < 0.05. Also, in table, are presented the Jensen's alpha which as we can see we have P-value >0.05 which means that the intercept alpha are not statistically significant.

As far as the R-squared is concerned, from the table above, appears to be well enough, if we consider that the higher ne is in the case of Austria which is 0.9415and

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that means that the 94.15% of the model interpreted from the independent variable and the 5.85% interprets from exogenous factors. The lower R-squared is in the case of Luxemburg about 0.428511 which means that the independent variable doesn't interpret the model.

3.3 TOTAL MODEL ANALYSIS

Before analyzing the empirical test, here are presenting in the table belowthe estimated equations of all countries as they examined:

COUNTRY	CAPM estimated equations
AUSTRIA	Ria = -0.002259 + 0.91349 Rma
BELGIUM	Rib = -0.022048 + 1.189585 Rmb
FRANCE	Rifr = 0.003625 + 1.000935 Rmfr
GERMANY	Riger = -0.002361 + 1.016456 Rmger
GREECE	Rigr = -0.011609 + 1.019430 Rmgr
FINLAND	Rifin = 0.004643 + 0.911340 Rmfin
ITALY	Riit = 0.000395 + 1.042646 Rmit
PORTOGAL	Ripor = -0.019776 + 0.927887 Rmpor
SPAIN	Risp = -0.006134 + 0.984214 Rmsp
IRELAND	Riir = 0.004963 + 1.159394 Rmir
LUXEMBURG	Rilux = -0.012567 + 0.932820 Rmlux
CYPRUS	Ricyp = 0.002353 + 1.038383 Rmcyp

Table 11: Estimated equations for the 12 countries of the total model.

1. Test for Autocorrelation

In order to ascertain the existence of autocorrelation, we apply the Lagrange-Multiplier criterion and in particular the Breusch - Godfrey Serial Correlation LM Test.

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This control uses data as residuals of simple linear regression. The following are the results of the autocorrelation test in the case of Germany:

$$H_0:\ \nexists\ Autocorrelation$$

$$H_1: \exists\ Autocorrelation$$

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.142524	Prob. F(2,185)	0.1203
Obs*R-squared	4.278595	Prob. Chi-Square(2)	0.1177

Table 12: Godfrey Serial Correlation LM test for the stock return of Deutsche Bank of Germany.

As we can see in table above the probability Chi-Square (2) is 0.1177 which is bigger than 0.05 (95% confidence interval). This means that there is no first order autocorrelation and the null hypothesis is accepted.

The Breusch- Godfrey Serial correlation LM test, applied in all the bank stock returns and the results were no serial autocorrelation. Only in the case of Portugal, Austria, Finland, Italy, Portugal, and Ireland observed the existence of autocorrelation, which was corrected in all cases.

2. Heteroskedasticity Test

In order to test the residuals of the model for heteroskedasticity we use the White test. In the table below there are the results from the White test in the case of Italy.

$$H_0: \exists\ Homoskedasricity$$

$$H_1: \nexists\ Homoskedasticity$$

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Heteroskedasticity Test: White

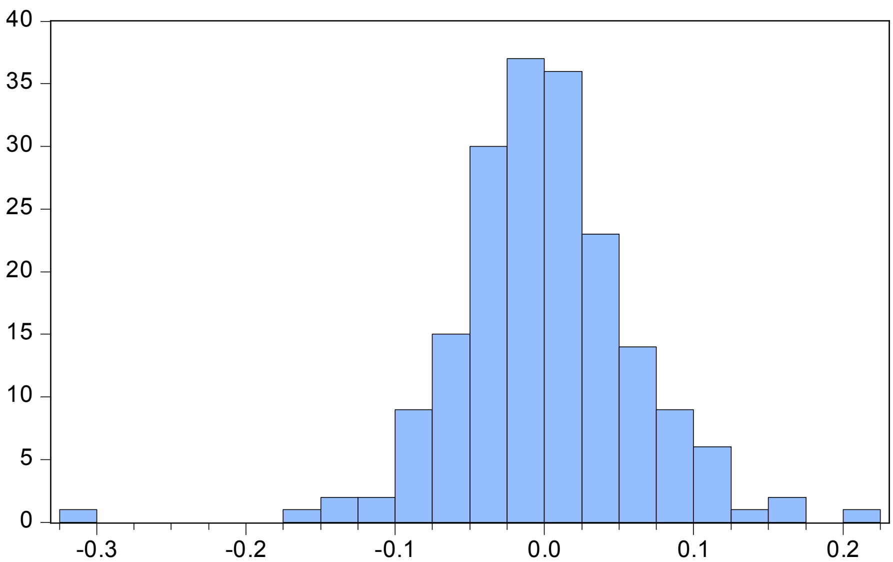
F-statistic	0.215095	Prob. F(2,186)	0.8067
Obs*R-squared	0.436119	Prob. Chi-Square(2)	0.8041
Scaled explained SS	2.015670	Prob. Chi-Square(2)	0.3650

Table 13: White Heteroskedasticity test for the stock returns in the bank of Italy.

Because the number of Chi-Square (2) is 0.8041 which is bigger in the three levels (1%, 5%, 10%), we accept the null hypothesis and we assume that the residuals are homoskedastic. The same process followed for the rest countries stock returns and the results were that in the case of Austria, Belgium, Finland and Cyprus we reject the null hypothesis in the 95% confidence interval and the stocks are presenting heteroskedasticity problem.

3. Normality Test for the dependent variable.

In order to examine the normality of the dependent variable we applied the Jarque-Bera test. In the table below the results of the test are shown for the stock return in the bank of France.



Series: Residuals	
Sample 2000M01 2015M09	
Observations 189	
Mean	-6.31e-18
Median	-0.004175
Maximum	0.201152
Minimum	-0.300041
Std. Dev.	0.061737
Skewness	-0.274300
Kurtosis	5.988320
Jarque-Bera	72.69428
Probability	0.000000

Table 14:Jarque-Bera normality test for the BNP Paribas stock.

The probability under the Jarque-Bera value is 0.000000. As a result, because it is smaller than 0.05 (95% confidence interval), the dependent variable does not have a normal distribution.

In the same way we examined all the stock returns and most of the samples were not normally distributed. The exception is the returns of the bank of Portugal which as we can see in the table below (Probability=0.289639 > 0.05) is almost normally distributed.

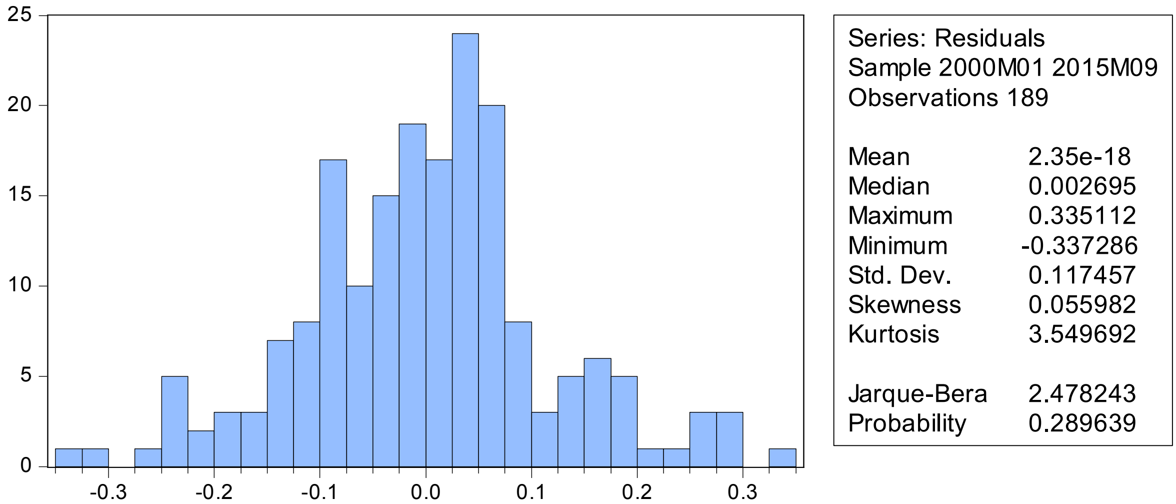


Table 15:Jarque-Bera normality test for the Bank Commercial Portuges 'R' stock.

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	Normality test (Jarque-Bera Prob.)	Breusch-Godfrey Serial		Heteroskedasticity Test: White
		P-value c	P-value b	P-value a
	0	0.0007	0	0.2143
	0	0.5164	0	0.1008
	0	0.5095	0	0.301
	0	0.1177	0	0.3335
	0	0.1973	0	0.1723
	0	0.0119	0	0
	0	0.0067	0	0.732
	0.255639	0.0003	0	0.3091
	0	0.2999	0	0.2339
	0	0.0005	0	0.3571
	0	0.0514	0	0.5041
	0	0.4077	0	0.2068

Table 16: total results of the empirical tests for the 12 countries.

After analyzing all the statistical information calculated from the model and completed all the necessary empirical tests, we can move on to the presentation of the regressions done for all the twelve European countries are being under examination.

For instance, here is presented the output for the country of Greece:

Dependent Variable: RIGR

Method: Least Squares

Date: 12/10/15 Time: 21:36

Sample: 2000M01 2015M09

Included observations: 189

Variable	Coefficient	Std. Error	t-Statistic	Prob.

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C	-0.011609	0.014295	-0.812111	0.4178
RMGR	1.019430	0.070339	14.49308	0.0000

R-squared	0.529026	Mean dependent var	-0.007263
Adjusted R-squared	0.526507	S.D. dependent var	0.285537
S.E. of regression	0.196480	Akaike info criterion	-0.405987
Sum squared resid	7.219021	Schwarz criterion	-0.371682
Log likelihood	40.36573	Hannan-Quinn criter.	-0.392089
F-statistic	210.0495	Durbin-Watson stat	1.766000
Prob(F-statistic)	0.000000		

The estimated equation is the following:

$$R_{igr} = \underset{(0.014295)}{-0.011609} + \underset{(0.070339)}{1.019430} R_{mgr}$$

With an R-squared=0.52926 and Number of observations=189. As we can see from the equation above, the value of the intercept (alpha) is -0.011609. According to the Jensen's theory (1968), it gives the excess return obtained when deviating from the benchmark. This indicator represents the part of the fund that cannot be explained from the systematic risk exposure to market variations. At this point it is worth to mention the significance of the Jensen's alpha. As we mentioned α= -0.011609, which is almost equal to zero. Now we can test the coefficient for statistical significance:

$$H_0: \alpha = 0$$

$$H_1: \neq H_0$$

From the output above we can see that the P-value= 0.4178 > 0.05 level of statistical significance and it means that we not reject the null hypothesis and the coefficient is not statistically significant.

What is more, from the results above we can see the beta coefficient of the stock of General bank of Greece, which is 1.019430. This means that if the market risk

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premium increases 1% then the total return of the security will increase about 1.019430%. Also this gives us the sensitivity the stock has in the market changes. A beta equals to 1.019430>1, make us sure that the stock can be described as aggressive related to the market and as a result we don't prefer the stock. If we test the beta for statistical significance the results will be the following:

$$H_0: b \ = 0$$

$$H_1: \neq \ H_0$$

Using the P-value= 0.000 < 0.05 level of statistical significance, this means we reject the null hypothesis and the beta coefficient is statistically significant.

In the output above it's also presented the R-squared which indicates the level of the regressions adjustment to the data. More specifically, it shows the percentage of risk interpreted from the regression. Here we have an R-squared= 0.529026 which means that the 52.9% of the model interpreted from the independent variables. The rest 47,09% interpreted from exogenous factors.

In the following table, are presented the results of the beta coefficients, the intercept alpha of the twelve countries examined and the R-squared of each regression.

Country	Alpha	P-value	Beta		P-value	R-squared
AUSTRIA	-0.002259	0.5392	0.913491	<1	0.0000	0.92494
BELGIUM	-0.022048	0.1015	1.189585	>1	0.0000	0.605827
FRANCE	0.003625	0.42335	1.000935	>1	0.0000	0.903816
GERMANY	-0.002361	0.6776	1.016456	>1	0.0000	0.861576
GREECE	-0.011609	0.4178	1.01943	>1	0.0000	0.529026
FINLAND	0.004643	0.4441	0.91134	<1	0.0000	0.822586
ITALY	0.000395	0.9502	1.042646	>1	0.0000	0.838966
PORTOGAL	-0.019776	0.023	0.927887	<1	0.0000	0.699423
SPAIN	-0.006134	0.2999	0.984214	<1	0.0000	0.843637
IRELAND	0.004963	0.7502	1.159394	>1	0.0000	0.516953
LUXEMBURG	-0.012567	0.0524	0.93282	<1	0.0000	0.800179
CYPRUS	0.002353	0.6481	1.038383	>1	0.0000	0.899768

Table 17: Beta coefficients, alpha and R-squared with the corresponding P-values for the total CAPM model.

As we can observe from the table above, seven bank stocks from the twelve examined have a beta coefficient >1. These stocks are from the Dexia Bank (Belgium), BNP Paribas (France), Deutsche Bank (Germany), BancaPopolare di Milan (Italy), General Bank of Greece, Bank of Ireland and Bank of Cyprus. That means that the 58.33% of the bank stocks will be more volatile than the market, which is offering the possibility of a higher rate of return, but also posing more risk. What is more, all the beta coefficients are statistically significant taking into account the fact that all the P-values < 0.05.Also, in table 11, are presented the Jensen's alpha which as we can see only in the case of the Bank of Portugal is statistically significant because P-value = 0.0230< 0.05. In the rest countries we have P-value >0.05 which means that the intercept alpha are not statistically significant. As a consequence, both CAPM conditions are valid.

As far as the R-squared is concerned, from the table above, appears to be well enough, if we consider that the higher ne is in the case of Austria which is 0.924940 and that means that the 92.49% of the model interpreted from the independent variable and the 7.51% interprets from exogenous factors. The lower R-squared is in

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the case of Ireland about 0.516953. Generally what is worth to mention at this point, is that the bank securities move as the general index.

3.4 APPLICATION OF DUMMY VARIABLES IN THE CAPM

Dummy variables are binary variables that take the value 1 if a characteristic of the population which we are interested in happens and the value 0 if it doesn't happen (Tzavalis 2008). Based on the analysis above, in our sample is observed that there is a big fluctuation from the first month of 2008 and after. Based on this characteristic of our data, we can separate our data in two parts before crisis (until the last month of 2007) and in crisis from 2008 till 2015.

Therefore we determine the dummy variable:

$$d = crisis = \begin{cases} 1, if\ the\ slope\ affects\ the\ return. \\ 0, if\ it\ does\ not. \end{cases}$$

The model is about to examine for all the countries is the following:

$$\left(R_i - R_f\right) = \alpha + b_1\left(R_m - R_f\right) + b_2 crisis + \varepsilon_t$$

Where:

R_{it}: is the dependent variable, in this case is the return of the security i in the time t.

R_{ft}: The return of the risk free asset in time t.

R_{mt}: The independent variable, the general index return of each country, in time t.

b_i: The beta coefficient of the security i.

ε_{it}: The residuals, the standard error of the security i

α_i: The constant of the security i.

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The regressions made for all the twelve countries, gave the following results:

Country	Coefficient cri	p-value of cri	Alpha	p-value of Alpha	Beta	p-value of Beta	R-squared
Austria	0.013555	0.0639	-0.008898	0.0825	0.911817	0.0000	0.9263
Belgium	-0.042568	0.112	-0.001281	0.945	1.199266	0.0000	0.6111
Cyprus	-0.00688	0.5055	0.005738	0.4286	1.038695	0.0000	0.9
Finland	-0.005971	0.6234	0.007564	0.3741	0.912557	0.0000	0.8228
France	-0.004558	0.6154	0.00585	0.3565	1.001969	0.0000	0.9039
Germany	-0.009354	0.411	0.002207	0.7811	1.018606	0.0000	0.86208
Greece	0.004496	0.8756	-0.01382	0.4927	1.019118	0.0000	0.5291
Ireland	0.005121	0.8698	0.002463	0.9102	1.158243	0.0000	0.51702
Italy	-0.00664	0.6275	0.00341	0.7011	1.04396	0.0000	0.83917
Luxemburg	-0.031236	0.0148	0.00266	0.7646	0.940592	0.0000	0.806473
Portugal	-0.010827	0.5296	-0.014485	0.2309	0.929467	0.0000	0.70006
Spain	-0.017942	0.1284	0.002635	0.7489	0.987766	0.0000	0.8455

Table 18: Beta coefficients, alpha, dummy variable and R-squared with the corresponding P-values for the total CAPM model..

According to the table above is observed that the crisis coefficient is statistically significant in the case of Austria in 10% level of statistical significance and in the case of Luxemburg for 5% and 10% level of statistical significance. In the other countries the crisis coefficient is not statistically significance.

This means that in the crisis period, the returns of the stocks in the bank of Austria increased about 0.0135% and in the case of Luxemburg decreased about 0.031236%. For the rest of the countries, the financial crisis didn't have any affection on the bank stock returns.

As we can see the beta coefficients in all cases are statistically significant while $P - value = 0.0000 < 0.05$In the case of intercept alpha we observe that it still remains statistically not significant because in almost all cases $P - value > 1\%, 5\%, 10\%$. Only in the country of Luxemburg as it is shown, in table above, the alpha coefficient is statistically significance$P - value = 0.0148 < 5\%, 10\%$ levels of statistical significance

In all regressions made for each bank stocks of our sample, all models are statistically significant because we have$Prob(Fstat) < 1\%, 5\%, 10\%$.

4. APPLICATION OF APT AND A COMPARISON WITH CAPM.

The Arbitrage Pricing Theory, as it's said in previous chapter, according to S. Ross (1976) is presented as an alternative generalized CAPM version. It refers to the fact that the reaction return of a security depends not only on the market risk premium but there are other important systematic factors that can affect it such as the macroeconomic factors: GDP and Interest Rate.

- **Gross Domestic Product – GDP**: it is an index of the total growth of each country. A rise in the GDP leads to a higher level of economic activity and as a consequence a higher demand for domestic currency.
- **Interest Rate- Int_Rate**: it is the interest rate of the central bank of each country

The equation of the multiple regression is the following:

$$R_{it} - R_{ft} = \alpha_i + b_{1i}\left(R_{mt} - R_{ft}\right) + b_{2i}GDP_{it} + b_{3i}Int\_Rate_{it} + \varepsilon_{it}$$

Where:

R_{it}: is the dependent variable, in this case is the return of the security i in the time t.

R_{ft}: The return of the risk free asset in time t.

R_{mt}: The independent variable, the general index return of each country, in time t.

α_i: The constant of the security i.

b_{1i}: The beta coefficient of the security i, the sensitivity of the security i related to the market portfolio.

b_{2i}: The sensitivity of the security i in the Gross Domestic Product.

GDP_{it}: Independent explanatory variable, gross domestic product in period t.

b_{3i}: The sensitivity of the security i in the interest rate of the central bank.

Int_Rate_{it}: Independent explanatory variable, the interest rate of the central bank of each country in period t.

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ε_{it}: The residuals, the standard error of the security i in period t.

The main reason of the APT application is to ascertain if the stock returns get affected from other factors and there are any differences with classic CAPM model.

In order to have a proper comparison between the results of the two models, the CAPM model will be calculated again using quarterly data too. In both models period covered by the data is from 1999-2015.

4.1 Data Analysis:

<u>The Gross Domestic Product (GDP)</u>: is an index presenting the total economic growth of the country. This means that the positive changes of GDP, is an indication if the economy is healthy or not. In the following graphs are presenting the GDP in Austria, Germany, France and Finland:

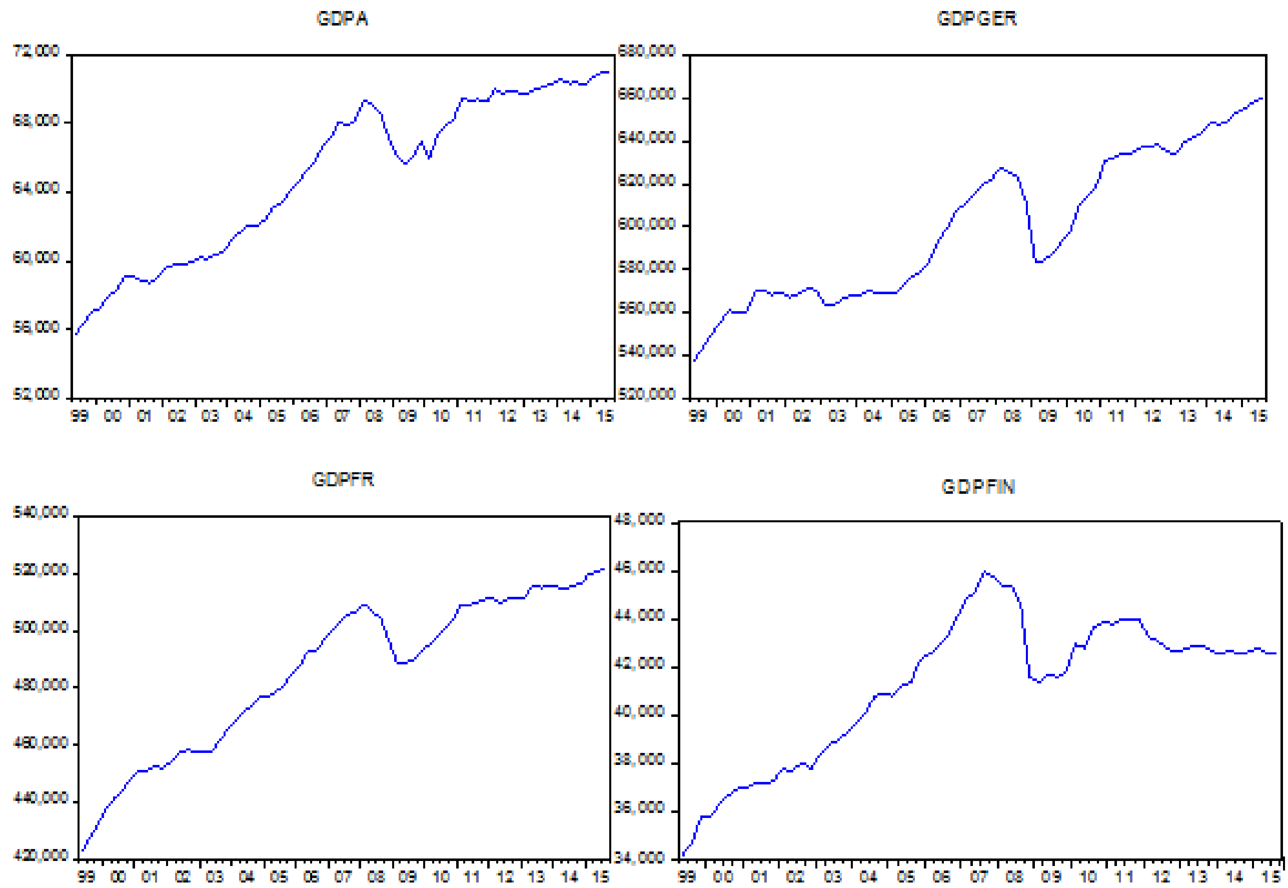

Figure 4: GDP in Austria, Germany, France and Finland (quarterly data).

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As we can observe from the figure 4, the gdp of Austria, seems to have an upward trend until the first quarter of 2008 with the highest value to be at 69.322 units. After this period it presents a vertical drop because of the financial crisis. The lowest price seems to be at the second quarter of 2009, at 65.617 units, while from the second quarter of 2010 and after it shows an improvement and an upward slope, which means that Austria has overcame the economic crisis. The picture presented by Germany seems to be almost the same with the higher and lower prices appearing in the same periods, with the only difference that the first quarter of 2001 till first quarter of 2005, the gross domestic product to be almost stable. Only the second quarter of 2003 it presents a small reduction.

According to figure for Greece we can see that the GDP has a positive movement and it seems to be till the last quarter of 2007 and the first quarter of 2008 up to 54.877 units. From the third quarter of 2008 until now the movement is absolutely disappointing because there is a sharp decline which indicates the bad economic situation of the country. This economic situation seems to be stable from 2013 and after but the level is very low.

The case of France seems to be almost the same with Austria's and is observed that from the first quarter of 2010 and then there is an improvement in the domestic economy, GDP rises and the data are very satisfying. Finally till 2007 Finland has a rise in GDP which touches the 45929 points, while the downtrend continues until 2009, where the economy stabilized.

Consequently from the analysis above the outcome is that from 2008 until 2009, every country had experienced a very bad economic situation. The improvement in GDP begins from 2010, with the only exception to be Greece with a disappointing economic situation until 2015.

<u>The interest rate:</u>The control of the interest rate is the mechanism determining the monetary policy of each country. The economic growth creates inflationary pressures. The interest rates in all the previous countries presentsignificant fluctuations in all years. In figure 5 there are presented the graphs of the interest rate of all countries:

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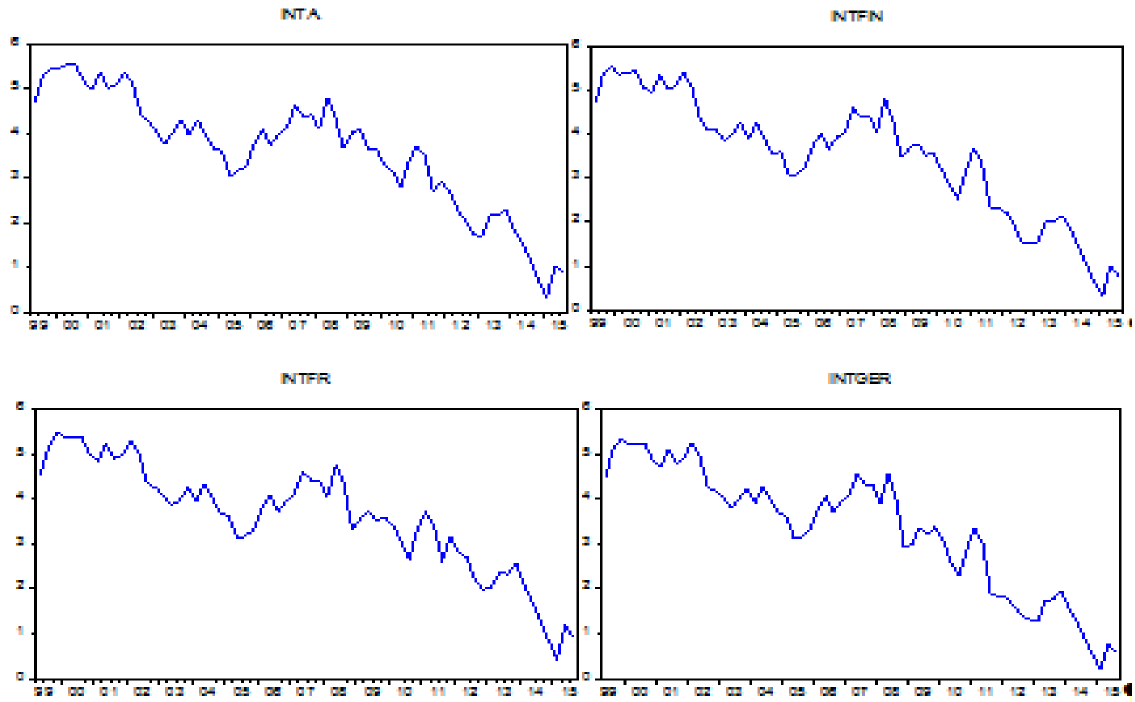

Figure 5:Interest Rate in Austria, Germany, France and Finland (quarterly data)

These fluctuations can be observed from the graphs above. As we can see the total picture of the series is downward, with the lower interest rate to be at 0.4% at the first quarter of 2015.

Before every regression, it's necessary to test the time series for stationarity, in other words for a unit root existence, such for the securities, the general indexes of the market, the Gross Domestic Product and the Interest Rate as well. The unit root test will be done with the Augmented Dickey-Fuller test (ADF). In the quarterly data used for the capital asset pricing model and the application of the APT, GDP and Interest Rate of all the countries were not stationary. In all cases the ADF test is used and the P-value> 1%,5%, 10%, which has been corrected taking first and second differences in order to be the series stationary.

In table 19 and 20, are presented the results of the APT and CAPM regressions with quarterly data:

Country	APT estimated equations
AUSTRIA	Ria= 0.757446+0.032517Rma+0.001801GDPa+3.408497INTa
FINLAND	Rifin= 1.087219+0.117394Rmfin+0.003091GDPfin+3.838597INTfin
FRANCE	Rifr= 1.556363+1.103977Rmfr-0.000275GDPfr+5.214950INTfr
GERMANY	Riger= -0.801294+1.081880Rmger+0.000571GDPger+256124INTger
GREECE	Rigr= -1.278753+1.405799Rmgr+0.02128GDPgr+0.744313INTgr
BELGIUM	Ribg=2.018330+0.183169Rmbg-0.011011GDPbg+22.39277INTbg
SPAIN	Risp=-2.085157+0.791244Rmsp+0.004282GDPsp-3.281769INTsp
IRELAND	Riirel=-1.463161+2.297964Rmirel+0.000131GDPirel-8.48348INTirel
CYPRUS	Ricyp=-0.453464+1.053617Rmcyp+0.024541GDPcyp-2.560189INTcyp
ITALY	Riit=-0.326488+1.168878Rmit-0.000345GDPit-8.790705INTit
PORTUGAL	Riport=-3.782942+1.525799Rmport+0.010924GDPport-5.202586INTport
LUXEMBURG	Rilux=-2.884160+0.391015Rmlux+0.009193GDPlux+5.040596INTlux

Table 19: APT estimated equations for the 12 countries, with quarterly data.

Country	CAPM estimated equations
AUSTRIA	Ria= 0.944207+0.076897 Rma
FINLAND	Rifin=1.136935+0.166691Rmfin
FRANCE	Rifr=0.646616+1.138883Rmfr
GERMANY	Riger=-0.704068+1.180106Rmger
GREECE	Rigr=-1.370986+1.329936Rmgr
BELGIUM	Ribg=-2.3664914+0.064467Rmbg
SPAIN	Risp=-1.865346+0.898624Rmsp
IRELAND	Riirel=-0.897594+2.263072Rmirel
CYPRUS	Ricyp=-0.019678+1.063798Rmcyp
ITALY	Riit=-0.091132+1.154945Rmit
PORTUGAL	Riport=-3.1634535+1.652421Rmport
LUXEMBURG	Rilux=-2.657250+0.42489Rmlux

Table 13: CAPM estimated equations for the 12 countries, with quarterly data.

For instance is presented the output of APT application in the country of France:

Dependent Variable: RIFR
Method: Least Squares
Date: 12/19/15 Time: 17:59
Sample (adjusted): 1999Q3 2015Q3
Included observations: 65 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.556363	1.663144	0.935796	0.3531
RMFR	1.103977	0.140015	7.884677	0.0000
DGDPFR	-0.000275	0.000575	-0.478834	0.6338
DINTFR	5.214950	3.900503	1.336994	0.1862

R-squared	0.565816	Mean dependent var	2.803313
Adjusted R-squared	0.544463	S.D. dependent var	16.29846
S.E. of regression	11.00040	Akaike info criterion	7.693304
Sum squared resid	7381.537	Schwarz criterion	7.827112

Log likelihood	-246.0324	Hannan-Quinn criter.	7.746100
F-statistic	26.49781	Durbin-Watson stat	2.394490
Prob(F-statistic)	0.000000		

The estimated equation is the following:

$$\underset{(1.663144)}{\text{Rifr}= 1.556363}+ \underset{(0.140015)}{1.103977\text{Rmfr}} \underset{(0.000575)}{-0.000275\text{GDPfr}} + \underset{(3.900503)}{5.214950\text{ Intfr}}$$

With an R-squared=0.565816 and Number of observations=65.

As we can see from the equation above, the value of the intercept (alpha) is 1.556363. According to the Jensen's theory (1968), it gives the excess return obtained when deviating from the benchmark. This indicator represents the part of the fund that cannot be explained from the systematic risk exposure to market variations. At this point it is worth to mention the significance of the Jensen's alpha. The P-value=0.3531 > 0.05 which means that the intercept alpha is not statistically significant at all levels of statistical significance.

What is more, from the results above we can see the beta coefficient, which is 1.103977. This means that if the market risk premium increases 1% then the total return of the security will increase about 1.103977%. Also this gives us the sensitivity the stock has in the market changes. A beta equals to 1.103977>1, make us sure that the stock can be described as aggressive related to the market and as a result we don't prefer the stock. If we test the beta for statistical significance the results will be the following:

$$H_0: b1 \;= 0$$

$$H_1: \neq \; H_0$$

Using the P-value= 0.000 < 0.05 level of statistical significance, this means we cannot reject the null hypothesis and the beta coefficient is not statistically significant.

What is more, the coefficient of the Gross Domestic Product is -0.000275 which means that if the GDP increases 1 point, then the return of the stock will decrease about 0.275%. Also it has a P-value=0.6338 >0.05. This means that it's not statistically significant. The same applies to the coefficient of Interest Rate which is equal to 5.214950 and has a positive effect to the total return of the stock. More specifically if the interest rate increases 1 unit then the total return of the stock will increase about 5.21%. As far as the statically significance is concerned, the P-value is 0.1862> 0.05 and it is not statistically significant.

In the output above it's also presented the R-squared which indicates the level of the regressions adjustment to the data. More specifically, it shows the percentage of risk interpreted from the regression. Here we have an R-squared= 0.565816 which means that the 56.58% of the model interpreted from the independent variables. The rest 43.41% interpreted from exogenous factors.

In the following table, are presented the results of the beta coefficients, the intercept alpha and the rest coefficient of the countries examined and the R-squared of each regression as well.

Country	Alpha	P-value	Beta1		P-value	b2	P-value b2	b3	P-value b3	R-squared
AUSTRIA	0.757446	0.2038	0.032517	<1	0.5115	0.0018	0.0941	3.408497	0.0279	0.166413
FINLAND	1.087219	0.3941	0.117394	<1	0.1119	0.0031	0.2009	3.838597	0.2626	0.139486
FRANCE	1.556363	0.3531	1.103977	>1	0.0000	-0.0003	0.6338	5.214950	0.1862	0.565816
GERMANY	-0.801294	0.5896	1.08188	>1	0.0000	0.0009	0.0279	2.561247	0.5493	0.625943
GREECE	-1.278753	0.8169	1.405799	>1	0.0008	0.0021	0.7316	0.744313	0.6491	0.189302
BELGIUM	2.01833	0.7729	0.183169	<1	0.7593	-0.0110	0.4218	22.392770	0.1580	0.035889
SPAIN	-2.085157	0.2208	0.791244	<1	0.0000	0.004282	0.1050	-3.281690	0.3841	0.360245
IRELAND	-1.463161	0.7086	2.29796	>1	0.0000	0.000131	0.9671	-8.483480	0.1039	0.462189
CYPRUS	-0.453464	0.7866	1.053617	>1	0.0000	0.024541	0.5633	-2.560189	0.3096	0.850252
ITALY	-0.326488	0.8747	1.168878	>1	0.0000	-0.000345	0.6674	-0.326488	0.0567	0.391027
PORTUGAL	-3.782942	0.029	1.525799	>1	0.00000	0.010924	0.0316	-5.20259	0.0143	0.673837
LUXEMBURG	-2.88416	0.1444	0.391015	<1	0.0211	0.009193	0.4814	5.040596	0.3477	0.117401

Table 21: Beta coefficients, alpha and R-squared with the corresponding P-values from the APT application.

As we can observe from the table 14, the 7 of 12 bank stocks have a beta>1. This makes us clear that the 58.12% of the banks stocks are more volatile than the market, which is offering the possibility of a high rate of return and posing more risk.

Also the beta coefficients of the most of banks are statistically significant as shown from the column of the P-value. Only in the case of Austria Finland and Belgium the betas have P-value=0.5115>0.05, 0.1119>0.05, 0.7593>0.05, which means that they can be characterized as statistically not significant. If we take a look at the R-squared we'll see that none of the stocks have an R-squared higher than 85%, which means that the model doesn't interpreted from the variables.

In the following table are presented the results of the CAPM regressions with quarterly data:

Country	Alpha	P-value	Beta		P-value	R-squared
AUSTRIA	0.944207	0.0907	0.076897	<1	0.1263	0.036145
FINLAND	1.136935	0.3506	0.166691	<1	0.0164	0.086757
FRANCE	0.646616	0.6387	0.138883	<1	0.0000	0.548067
GERMANY	-0.70407	0.632	1.180106	>1	0.0000	0.581312
GREECE	-1.37099	0.7955	1.329936	>1	0.0003	0.187807
BELGIUM	-2.36491	0.6746	0.064467	<1	0.9083	0.000209
SPAIN	-1.86535	0.2645	0.898624	<1	0.0000	0.323269
IRELAND	-0.89759	0.8131	2.263072	>1	0.0000	0.43802
CYPRUS	-0.01968	0.9898	1.063798	>1	0.0000	0.850265
ITALY	-0.09113	0.9647	1.154945	>1	0.0000	0.351009
PORTUGAL	-3.163435	0.758	1.652421	>1	0.0000	0.621371
LUXEMBURG	-2.65725	0.1411	0.420489	<1	0.0120	0.094659

Table 22: Beta coefficients, alpha and R-squared with the corresponding P-values from the CAPM application with quarterly data.

4.2 APT and CAPM comparison

If we take a quick look at the two tables above, we'll understand immediately the differences and the same points between the two models. At first we have the beta coefficients. At the table of the CAPM (table 15), we can observe that the coefficients which measure how sensitive the stocks are at the market changes are about 58.13% aggressive. Taking a look at the same coefficients at the APT model, we can see that almost the same percentage of the stocks are aggressive (50%) and the prices of betas have small differences, where at the APT model are formed at a lower level.

For instance we have the country of Germany and the stock of Deutsche Bank. At the simple CAPM we have a beta equal to 1.180106>1 (aggressive stock) and the APT model the beta is 1.08188. The stock can still characterized as aggressive in contrast to the market, but the beta at the APT is lower. What is more at both models the beta coefficients are statistically significant as the P-value is equal to 0.0000 lower than any level of statistical significance (1%, 5%, 10%).

Generally if we take a look at the column of R-squared in both tables we'll ascertain that in APT model is much better than in simple CAPM. More specifically in our example, we observe that in CAPM we have an R-squared=0.581312 and in APT the R-squared improves up to 0.625943. We see that is much more improved, although the difference is not satisfying taking into account that in order for the model to be interpreted from the variables the level of R-squared must be higher than 85%. What we conclude is that when taking account more systemic factorssuch as the GDP and Interest Rate, then the percentage of the risk explained from the regression increases. So the APT model is more preferred than the simple CAPM model.

.4.3 CONCLUSION

Summarizing, the capital asset pricing model (CAPM), describes the relationship between the risk and the expected return. Expected return is based on the real risk-free interest rate, expected inflation, and an expected risk premium for the risk of the asset (Markowitz 1959) The capital asset pricing model is generally used to predict the expected return of assets that have not been traded yet to the stock market as well as to calculate the cost of equity in the business market (Fama and French 2004). Generally this model had been created to interpret the differences in the assets risk premium. Based on the beta coefficient William Sharpe (1964) higher variance suggests less predictable returns and therefore a more risky investment (Sharpe 1964)), John Lintner (1965), Jan Mossin (1966) and Jack Traynor (1961-1962). The Arbitrage Pricing Theory according to S. Ross (1976) is presented as an alternative generalized CAPM version. It refers to the fact that the reaction return of a security depends not only on the market risk premium but there are other important systematic factors that can affect it.

After analyzing and estimating the two pricing models, if we compare the rates R-squared of securities between CAPM and APT models (both estimation with quarterly data) we see that rates increased with the application of the model APT. This increase is not sufficient, so that the R-squared to become more than 85% and have such a significant degree of adjustment of the regression line in our data. But it’s clearly seen that the multivariable model interpreted better because it takes more factors into account.

The purpose of a multivariate model such as APT is the effort of a better valuation of the assets of a univariate model as the CAPM by increasing systemic factors, which may perhaps affect yields of securities. If, however, through the implementation of the regressions the betas of systematic factors are statistically insignificant, there is no reason to keep in our model these factors, because the value of their coefficients becomes almost zero.

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