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Evaluation of efficiency and explanatory power of the CAPM and the Fama-French Asset Pricing Models: Evidence from the U.S. Equity Markets

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Abstract

CAPM model it is a linear relation between the risk, that is Beta and expected return from assets. This model assumes that it is possible to achievement high return from assets, if β is proportionally high. Additionally β is an only factor of the risk measure (Harry and Markowitz, 1952). However, there are many works which undermine the effectiveness of the CAPM. Fama & French (1992) conducted non-financial research of companies from period 1963 to 1990 US Stock Market, but didn't found the connection between beta and Stock return. Therefore, Fama & French (1993) inspired by previous studies created the Fama & French three factor model, which how authors research confirm: Daniel and Titman (1997), Drew and Veeraraghavan (2003) as well as Faff (2004) in the precise manner predicts and explains changes of the pace stock return. The specificity of this model consists on examining the sensitivity of three factors Fama French model to examine whether the return from portfolio may exceed return from investment risk-free e.g. T-bill. Above all focuses on the surplus of income from market as a whole, and SMB understood as differences from returns portfolio Small Stock and High Stock as well as the third HML factor, i.e. difference between portfolio of high-book-to-market stocks and small-book-to-market stocks. Therefore in order to estimate beta for each of described above factors, simple regression is used as well as estimated values are multiplied by risk premium for the individual factor. In such a result, we will receive estimated values for the given portfolio or its price. Petkova (2006) examined the sensitivity of SMB factors and HML on the example data from period 1963 – 2001. He examined, that these factors correlated positively explain the time-series variation concerning stocks rate of return, however better results achieved ICAPM while explaining cross-section return.

It is evidence of continued development of new research. In this work examines the behavior of the Fama French model during various stages of market growth and decline. Research performed using daily trading the S&P 500. Addition was tested the power of explanation the Fama French Model on the basis of 12

industrial portfolio of U.S. market. The data obtained are contrasted with the results of the effectiveness of CAPM conducted in the same manner.

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1. Introduction and research objectives

1.1 Introduction

Selections of methods which allow most precisely describe relations between the risk and possibly obtained profit in taken action is an immemorial dilemma of economists, financiers or investors. Moreover, constantly are seeking as well as studying methods which will enable in the precise way to manage investment portfolios. Popular method used for many years is the Capital Asset Pricing Model (CAPM). Sharpe (1964), Lintner (1965) and Black (1972) think that it is essential model applied in the financial practice. However, updated CAPM version drawn up by Fama and French triggered a lot of controversy as well as encouraged many scientists to carry research above the FF Model application.

There are several important publications concerning research of the FFM effectiveness for world stock exchanges, developed and developing markets. USA economy is one of the largest economies in the world, therefore analyzing S&P 500 recognized as barometer of the USA economy, included studies in the work will use to present the situation on stock-market. The last financial crisis, being an additional market experience, also encouraged to conduct new, unique research concerning the model situation and its testing during the fall, upturn or market consolidation. Moreover, puzzling is how in such cyclical market changes act the primitive model, i.e. CAPM.

Risk, desire to achieve the biggest profits, regards to every investor, therefore new methods of predicting risk which largely explains market situation, will find their supporters and scientists who will continue these research as well as improve the research process. The subject of this work considerably will influence on widening the practical knowledge concerning the chosen model situation. None of scientists conducted analysis and research on S&P 500 distinguishing the crisis time, consolidation and market expansion as well as didn't compare the FFM effectiveness with CAPM in described above periods. Therefore, conducted research will be unique and particularly important for

progress as well as ability of interpretation and widening criteria of using inspected models.

Homsud et al. (2009) conducted comparison CAPM and Fama French model on the Thai market. He used monthly data of 421 companies and obtains in results meaning support for FFM as the more precise model to explain stocks and portfolios returns. On many markets testing Fama French three-factor pricing model was conducted. Its effectiveness was compared on developed and developing markets.

1.2 Research Objectives

One of the first ideas will be present the Three-Factor Model and CAPM in practice based on the given data S&P 500 in chosen periods.

Another aim of the work is to examine the Fama and French Three-Factor Model during different market trends. Many research checking the effectiveness of this model arose during data analysis from the market expansion, therefore distinguishing different market trends during research is a crucial point of this work, granting its unique research form. Also the aim will be identification of its usefulness and interpretation of information, which we can obtain about investment in S&P 500 applying this model. Moreover, an additional aim is to understand the essence of applying FFM and present in what way the creation of this model contributed to development of the possibility using available information in order to increase income at minimization of the risk.

Conducting the same activities for CAPM model as for Fama and French Three-Factor Model will be the final stage of work, in order to objectively compare results and possibly explicitly state which model is more efficient as well as in accurate way explain changes in portfolios and most precisely predict changes in the pace of portfolio return. What's more, placing an additional criticism concerning analyzed models based on conducted appropriately research of constructed portfolios is also the aim.

As mentioned earlier, this paper is aim to test CAPM and Fama-French asset pricing models and they ability to explain returns on the US equity market between 1963 and 2011. Conducted empirical research are aimed to answer specific research questions which has not been explained previously by in the extensive literature review on those models. To construct practical, focused research questions, as well as ensure that designed research contribute to the scientific literature of the subject, it is essential to explore underlying theory (theory chapter) as well as most important and ground-breaking papers, and the latest discoveries (literature review chapter).

2. Theory

2.1 Modern portfolio theory Harry Markowitz (1959)

Ones of the first crucial research concerning possibility of maximizing investment returns at appropriate risk degree, appeared about 60 years ago by Harry Markowitz. Theories which he created and drew up, called the Theory of Portfolio Selection was awarded and recognized as huge step in the history of finances development by Von Neumann Prize in Operations Research Theory by the Operations Research Society of America and The Institute of Management Sciences. Summing up Markowitz published in “Selection Portfolio” (1952) and later more precisely developed in his book the Selection Portfolio: Efficient Diversification (1959) “theory of optimum investment in assets”, which contains the specificity of diversification portfolio investment in terms of the possibility to take risks in the relation to achieve maximum profit from investment.

Revitalization of American industry and increase in the armaments development as well as technology triggered by world war additionally contributed to the development of financial markets. Proper allocation of resources in production with the help of financial market enabled to control productivity of each country's economy areas. Such actions were in many other countries, because financial

markets are very sensitive for changes of economic demand, in particular it was possible to observe the significant change during the war world. Therefore, many researchers additionally analyzed capital markets in terms of the sensitivity to external factors.

Moreover, one fundamental assumption for the author was effectiveness of the market. Markowitz claims that capital markets are effective in the information meaning as well as thanks to that are very competitive for all its individual and institutional participants. Every investment on the capital market is measured by the rate of growth and level of risk. Markowitz specified this relation and established that at certain terms, two factors in the appropriate relation i.e. projected increase from the portfolio and its variance portfolio choice will be most effective. Moreover, reduced risk of the portfolio through diversifications as its variance must be measured also for individual rate of growth from assets and will be additionally dependent on the covariance of all assets. The Markowitz model found broad applied due to its simple structure and it constituted the base for many research in financial economics (Kaplan, 2006). The following model drawn up by Markowitz describes how it is possible to establish and empirically obtain Expected Return of Portfolio.

$RP = IRF + (RM - IRF)\sigma P/\sigma M$

RP = Expected Return of Portfolio

RM = Return on the Market Portfolio

IRF = Risk-Free rate of interest

σM = Standard Deviation of the market portfolio

σP = Standard Deviation of portfolio

Additionally this author used two ideas during the choice of effective portfolio for appropriate investors. Having to choose from portfolio about appropriate risk the investor will head to achieve the maximum profit for this level of risk. Therefore the investor at determined level of maximum profit wants to achieve it at minimally possible risk. Such relation determines finding “Efficient Set”. Drawn by Markowitz optimal combination of profit to risk presents on the following graph hyperbole called Efficient Frontier. Red point marked on the next graph is the most effective combination of assets bringing the biggest profits at the possibly minimal risk.

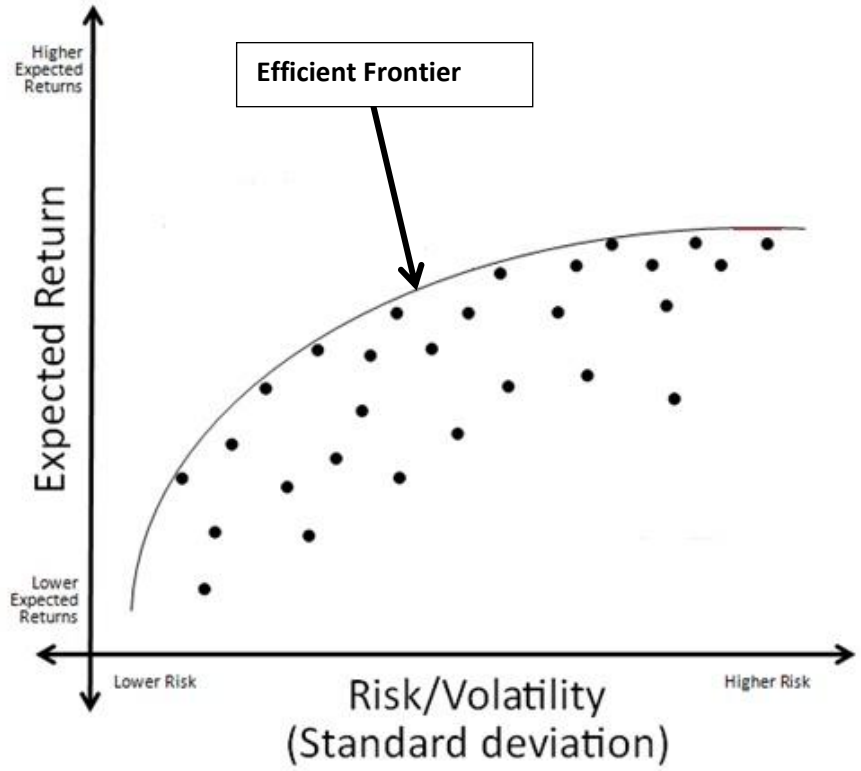


Figure 1 Efficient Frontier

The bottom curve frame presents the smallest rate of expected profit by appropriate level of risk. The following graph more precisely will be discussed in the analysis derivation of CAPM.

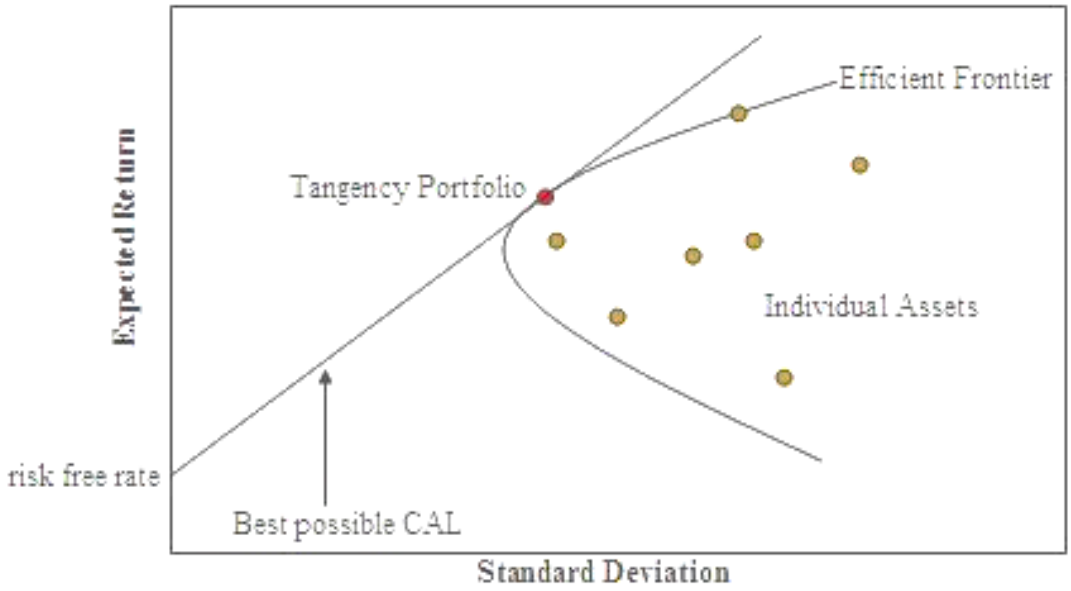


Figure 2Tangency Portfolio

Source: CAPM (Sharpe; 1964, Lintner; 1965)

USA government in period 1960-1965 was under the influence of the Keynesian school of economics.

Therefore, according to President Kennedy the economy needs to increase capital investment in the industry development to achieve much greater manufacturing capacity. Additional, stock exchanges in this department plays an important role, because it enabled in the simple way to raise additional capital for the development of enterprises effectiveness. Dynamic USA economic development also reflected with increase in the stock-market. From 1948 also stock exchange in Japan started to develop dynamically and note historically rapid growth. Willingness to development and commenced economic expansion brought to create new opportunities of the development financial markets and emergence of financial instruments. Therefore, an adequate move

for science was improving models, theory and research analyzing market situation, discovering new relations. New research regarding market equilibrium in the context of determination risk and market price as well as risk for individual asset was conducted (Black, 1972).

Based on Markowitz findings many research occurred. One of crucial achievements in the finances field was Capital Assets Pricing Model. This model was drawn up by few researchers individually. Significant creators of this model were Sharpe (1962, 1964), Treynor (1961), Mossin (1966) as well as Black (1972).

There are few basic assumptions concerning the ability and possibilities as well as rules from which investors use. Based on it CAPM was build and analyzed.

First from them concerns the avoidance of risk. It is quite clear rule because every investor tries to get the biggest profits at relatively low risk. Additional norm is appearance of risk-free investments. Taking into account the power of United States economy it is considered that treasury bonds of this state are risk-free, because the state guarantee is sufficient in order to reduce risk to a minimum. Next criterion regards assets (Copeland, 1992). It is assumed that all identified assets are the appropriate number, and there are no obstacles making them impossible. Moreover, access on the market to information has every investor in the same way. All information are published for all interested parties without any extra charges. What's more, the lack of impediments on the part of taxes or reduced short sale additionally has a positive effect on market effectiveness. However, must emphasize that these rules didn’t apply to all markets in the world. Relatively not long time ago, a short sale was enabled on the market in China, additionally it is to the certain ceiling dull (Pettis, 2010).

Nevertheless not all above mentioned assumptions are consistent with the current reality of all markets, but these findings simplify the market image, what allows on accurate concentration above CAPM development in order to simplify making financial decisions (Black, 1972).

2.2 The efficiency of the Market Portfolio

During investment the choice of effective portfolio is an important aspect. About selection of the investment portfolio mention above during analysis about theory to this model Theories according to Markowitz. The following graph presents those portfolios which are on the top parts of the minimum variance opportunity set graphed. Marked on the graph below blue points reflect decisions of the investors who are immune to high risk, like in case of the line no. II or in case of the set portfolio which contain smaller risk.

"Thus, in theory, when all individuals have homogeneous expectations, the market portfolio must be efficient. Without homogeneous expectations the market portfolio is not necessarily efficient and the equilibrium model of capital markets that is derived in the next section does not necessarily hold".

Thomas E. Copeland and J Fred Weston, 1992 Pp: 195

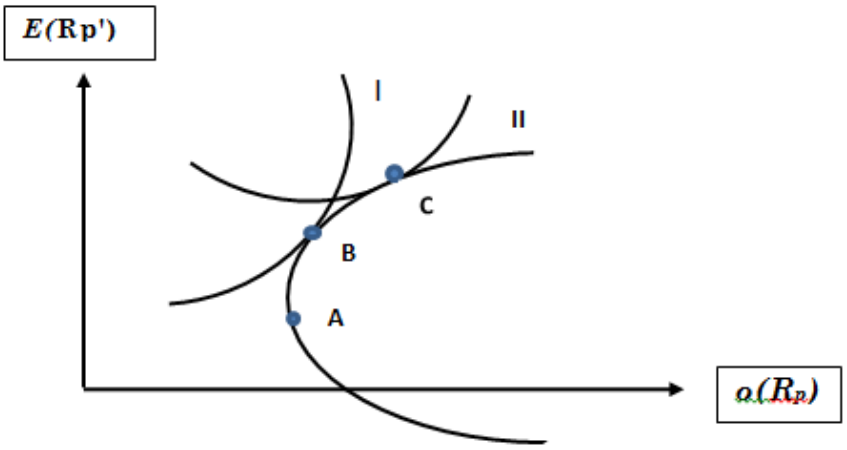


Figure 3All investors select efficient portfolios

Moreover, portfolio on the curve Efficient Frontier connects with the capital allocation line CAL. Line incipient from risk-free points passing through M-tangency portfolio point is also a line suitable for the capital allocation. Described situations it is possible to notice in Figure no. 2 "Tangency Portfolio".

What's more, risk premium is dependent on the risk of investment portfolio and from the level of accepted risk by investor. Moreover, the market awards for taken risk. The following model describes the relation of expected return from the investment E(Ri).

$$Risk\ Premium = r_a - r_f$$

$r_a = asset\ or\ investment\ return$
$r_f = risk\ free\ return$

Model 1. Expected return of the market

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

$E(R_i)$ is the expected return on the capital asset.

R_f is the risk-free rate of interest such as interest arising from government bonds, the one-month Treasury bill rate (Ibbotson Associates, 2012).

$E(R_m) - R_f$ is sometimes known as the market premium (difference between the expected market rate of return and the risk-free rate of return).

Must also emphasize the important information, which is possible to read out thanks to the indicator BETA. It contains information concerning the level of risk for appropriate portfolio, differently it is measure of the risk calculated by this model:

$$\beta_p = \frac{\sigma_{M,p}}{\sigma_M^2} = \sum_{i=1}^{n} \alpha_i \beta_i.$$

$$\overline{r}_p - r_f = \beta_p(\overline{r}_M - r_f),$$

This model is still over time and used by many investors. Like previous its models this is a model for next latest models, which greeted and still arise in the field of finances. It found wide application and became international. Additionally, there is still dispute concerning its effectiveness. Example of this are Fama and French research, which believe that on USA market the BETA clarifies the risk and level of returns, analyzing the economic situation of the market volatility there is no total reflection in practice. However, it isn't possible to omit the fact that on foundations of this model was built another important model in the field of theories about finances such as Arbitrage Pricing Theory (APT) in 1976 by outstanding author Stephen Ross. This researcher trying to prove that effectiveness of the investment portfolio is dependent on its prior analysis in terms of mean-variance, applying to this CAPM. Studying his concept built new ideologies written in Arbitrage Pricing Theory (APT).

2.3 Arbitrage Pricing Theory (APT) Stephen Ross (1976)

The first APT aspect is a need to bring the subject up Risk assets return. Its specificity is an important aspect in this theory. What's more APT as linear factor model structure found its application by managers dealing and examining commercial risk systems employed. Additionally, an important statement in the APT theory is that every factor is appropriately responsible for degree of expected profits, which the investor can expect, holding appropriate assets. The following model presents the described APT specificity:

$$E(r_j) = r_f + b_{j1}RP_1 + b_{j2}RP_2 + \cdots + b_{jn}RP_n$$

RP (1.2.3 …. k) - is the risk premium appropriately for each factors.

Rf - is the risk-free rate

The similarities between the APA and the CAPM model are numerous. First and foremost they are among the most main theories that are having a significant impact on the study of asset prices. Ability to explain the model of declaration of assets is an asset of APT method because it is not possible using statistical models (CAPM) (Rossman 1980). In addition, APT has two main goals. The first is a single price. Each financial instrument should have one price, the fact of its appearance on different markets, or in another country is not important. The same good can not be sold at two different prices (Shanken, 1985). Another important aspect is the recognition of the concept that each assets value is generated by multi-index or single-index models, this is done mechanically. This shows that the correlation between returns of each asset is formed by one or more factors, and therefore, the price can be formed similarly. However, this theory does not specify exactly which factors are exerting a major influence on price changes (Huberman, 1982).

2.4 Fama–French three-factor model

Fama and French developed an improved model based on CAPM, which consists of three systematic factors such as the ratio of the firm size to the value of book-to-market, as well as the relation to the market index. Fama and French have proved in their study, that using high ratios of book equity to market equity (B / M) data of small businesses, their average profits cross the line designated by the CAPM. Moreover, authors of this model believe that the source of systematic risk is not precisely exposed by BETA in the CAPM but a better

solution is to use the size or relationship book-to-market factors. During the study Davis, Fama and French sorted their portfolios by market size and proportions of book-to-market. Small businesses belonged to the group where capitalization was below the median and big ones were above the median. However, 3 groups were created and sorted according to the book-to-market ratio. The first is the low-ratio group, which contains the lowest 33% of B / M, another third is the average group and the following third of the group contains the remaining, highest B / M. In this way six portfolios were selected and were tested in six time series between 1929 and 1997. In addition, the annual change in the premium size was calculated in a simple way, as the difference between the two returns of two size groups of companies. Thus, the following equation shows the described SMB operations, small minus big.

SMB = 1/3 (Small Value + Small Neutral + Small Growth) - 1/3 (Big Value + Big Neutral + Big Growth).

The same method is used to calculate book-to-market effect, deduction of small value of B/M index from big one.

HML = 1/2 (Small Value + Big Value) - 1/2 (Small Growth + Big Growth).

The monthly return on the market portfolio was calculated from the value-weighted portfolio = Rm-Rf includes all NYSE, AMEX, and NASDAQ firms. SMB and HML for July of year t to June of t+1 include all NYSE, AMEX, and NASDAQ stocks for which we have market equity data for December of t-1 and June of t, and (positive) book equity data for t-1.(Fama;French, 2000).

Based on above stages and studies of I projection the Fama-French three-factor asset pricing model was butli:

$$\mathbf{E(r_i) - r_f} = a_i + b_i\,[E(r_M) - r_f] + s_i\,E(\mathrm{SMB}) + h_i E(\mathrm{HML})$$

Bi, ci, hi are appropriate values of beta that reflect the for individual risk factors. Referring to ai according to APT theory it should amount to zero, since a portfolio with zero loading on all three factors should have an expected excess return of. This equation is estimated as a first-pass regression for each portfolio over the 816 mow between 1929 and 1997 using the regression model:

$$r_i - rf = a_i + b_i (r_M - rf) + s_i SMB + h_i HML + e_i$$

Fama and French studied that to small businesses and high book-to-market have much greater rate of return. In addition, SMB and HML are factors whose specificity has a positive impact on the results of the model and the expectations arising from its use. Moreover, the authors of the model obtained significantly positive results for portfolios constructed according to the criteria: small businesses (S) and High goodwill (H).

2.5 Pastor-Stambaugh model (PSM) 2003

A debut step for Pastor and Stambaugh researchers was the creation of an additional factor to Fama-French model. According to these researchers marketwide liquidity worsens if the assets decrease in value which, according to their theory of liquidity risk, would mean additional risk (Fleming, Michael J., 2003). In addition, market-wide risk is treated as a systematic risk in the standard valuation models. In addition, systematic risk is often referred to as "as sensitivities of asset returns to fluctuations in market-wide liquidity factor" (Pastor, 2003).

Pastor-Stambaugh constructed a model focusing on the extent of intensity and size of liquidity during the flow of orders, mainly by analyzing the short-term changes (Pastor, Lubos, and Robert F. Stambaugh, 2003). Analyzing small movements of liquidity, one can see intense price changes the next day

following relevant orders on that day (O'Hara, Maureen, 2003). Therefore, following this course, the level of liquidity for sample assets in the case of bonds in a given month t should be constructed with the least possible squares πti. As the following regression:

$$r^{e}_{i,j+1,t} = \rho_0 + \rho_1 R_{i,j,t} + \pi_{i,t} sign(r^{e}_{i,j,t}) \cdot Vol_{i,j,t} + u_{i,j+1,t},$$

$R_{i,j,t}$ - is the return of bond i on day j

$r^{e}_{i,j,t} = R_{i,j,t} - R_{b,j,t}$ - is the bond return in excess of the equally weighted Treasury market return.

$R_{b,j,t}$, $sign(r^{e}_{i,j,t})$ -is the signed indicator which is equal to 1 if the excess return $r^{e}_{i,j,t}$ -is positive and -1 if it is negative.

$Vol_{i,j,t}$ - is the par volume (in millions of dollars) for bond.

Using broad market as a liquidity means in the next step we should estimate the risk of liquidity, β L, using the time-series regression, which are contained in the Fama French model as a risk factor and determine the premium. In the following formula all symbols are the same as in Fama French model.

$$R_{it} - R_{ft} = \alpha_{0i} + \beta_{iMKTt}(R_{mt} - R_{ft}) + \beta_{iMKTt-1}(R_{mt-1} - R_{ft-1}) + \beta_{iSMB} SMB_t + \beta_{iHML} HML_t + \beta_L L_t + \beta_{Term} TERM_t + v_t,$$

Pastor-Stambaugh (PS) model = Fama-French (three-factor) model (FFM) + liquidity factor. PSM = rf + (SMB * Beta) + (HML * Beta) + (Less Liquid - Highly Liquid portfolios) * Beta.

Any changes in the market, the development of financial instruments forces conducting ongoing research that will help to identify changes or to understand trends in the market. Therefore, in this direction, a new four-factorial model, was built by Pastor and Stambaugh. Before publishing the model world market was for a long time in intensive growing trend. In addition, a number of new financial instruments and derivatives such as CDOs have been created.

3. Literature Review

3.1 pioneer research

One of first questions during deliberations about financial investments always concerns the relative size of the risk to possible achieved profits. Capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) it is an early model, which helps to describe above relations. Black, Jensen, and Scholes research (1972) confirmed that it is an effective and largely explains the situation of market. These results achieved by analyzing the New York Stock Exchange in the period from March 1926 to 1966, taking into account strong expansions finished with the drastic market crash of American stock in 24 October 1929 year, called Black Thursday.

However, Banz (1981) proved in his work that this model wasn't effective during analysis of stocks and shares portfolios, sorted according to the market capitalization. Fama and French leading research on the CAPM created its improved versions by adding market capitalization factor and book-to-market factor. Fama (1992.1993, 1995, 1996, 1998) documents in his works that beta in a little extent or not at all reflect the changeability in capital incomes, but everything depends on the size and book-to-market value of equity. Publications of many authors, such as Grinold (1993) and Davis (1994) as well as He Ng (1994) confirm this research. Fama French model is used for many empirical research concerning stock of Canadian, Greek, in Malaysia etc.

Huffman, Makar and Beyer applied FF model for verification research “probability of appearance extreme foreign exchange-rate exposure (FXE) conditioning upon key firm factors and an expanded view of hedging”. One of few conclusions was fact that used FXE rates, which had significant correlations with FFM rates, gave clearer results than traditional models.

3.2 Analysis of range date

Next research concerning functionality of F-F in particular the profitability of book-to-market equity and size factors, Connor and Sehgal conducted (2001) studding within 10 months the Indian stock market shares. He used share price date consists of month – end adjusted share prices of 364 companies. He proved that with the use of F-F model it is possible to determine the average rate of return as well as reserved, that analyzing CAPM in the same research it isn't possible to notice unequivocal results. Moreover, in the analyzed period Indian stock exchange fluctuated around the 50%. There are several objections concerning research on the effectiveness of Fama French model.

Handa (1989) stated that researches which analyze data from the period of one month are too short and not-reflected in a large extent the state of market in order to precisely estimate beta factor. Therefore, Kothari (1995) proved that the annual period of research was completely sufficient in order to strictly determine relations between beta and stock return. Appointing positive reaction of those factors is an important matter not only for statistics, but also for economics. Although, Kothari (1995) confirmed the above research by empirical analysis with the use of data concerning US Stock Exchange, Martikainen and Perttunen (1991) conducted the same attempt with the use of Scandinavian data, but they didn't receive the same results. Annual Beta does not explain the variations appearing in the market. Additionally, Fatt (2004) claims that analyzing risk premia using F-F model isn't convincing, in particular during analysis of the Australian Stock Exchange in years 1996 to 1999 using daily prices. Factor concerning the size of company generates much better results.

3.3 Importance of Accounting standards

Biscarri and Espinosa (2008) made an unusual discovery, which informs that lack of uniform standardization of provisions accountings in the considerable degree difficult as well as reduces the effectiveness of Fama French model (1993) three-factor pricing model. Research was conducted on the IASB Company. Gómez-Biscarri and López-Espinosa confirmed this thesis in their work published in 2008 "*Accounting measures and international pricing models: Justifying accounting homogeneity*". Moreover, Zhang (2004) proposes a few modernizing suggestions concerning F-F model by adding a few variables up from the base of accountings, which significantly may improve the estimation future returns from stock on developing markets. Among other these are indicators such as: stock prices trading volume and leading economic indicators (Zhang, 2004).

Effectiveness of the application Fama French model is a subject of many research based mainly on the American market, however only few research concerning Australian market occurred. One of the first Halliwel publication was published in 1999 year, which established 10-year period of research (1981-1991). Encountered problems with the access to data from accounting and stock exchange were published incomplete research from 1998 by Fama and French. Measurement was limited to a small number of companies as well as there were no information resources in order to examine size risk factor, therefore large companies were included with the measurement.

The insufficient flow of information is sometimes an obstacle preventing development of research on the models effectiveness and identification of their relation (Gaunt, 2004). For that purpose the International Accounting Standards Committee (IASC) organization was formed, which from the beginning of its activity i.e. from 1973 year publish principles which every state should obey. However, implementation of any changes is associated with the need of passing several years. From 2001 year IASC was transformed into International

Accounting Standards Board which consists of 91 countries with the obligation to apply the same principles of leading regulations in accounting.

3.4 Investment portfolio composition and results of the model

Wang Yuanchang (2010) during research conducted on the Fama-French model on Chinese market proved that portfolio created through relations of factors ME/BE as well as using additional factors, the F-F model isn't much effective than the primal, simplified version of this model. Additionally he proved, that beta portfolio about low market has considerable positive relations with profits, and the same relation occurs in the ratio of return rate to profits, as well as the low price of profits has a positive relation to the average return rate. Nevertheless, must pay attention that this author suggests that the portfolio structure should be changed, best twice a year about specified times. Additionally, for better effectiveness of empirical research affects the use of increased frequency of monthly return to weekly one. What's more, the specificity of Chinese market about dynamic rate of capitalization growth enables to apply the model with trading volume ratio and price/earnings ratio in order to improve prediction changes in the market. Wang Yuanchang research stood out with the fact that as mentioned above was applied trading volume ratio replacing the book/market value ratio. Introducing such slight modifications into the model, empirical research proved better reflected fluctuations of the Chinese market by applying FFM.

Nartea, Ward and Djajadikerta, (2009) proved in their research based on the market analysis in New Zealand that investment portfolios consisting of high BM brings greater profits compared with portfolios about low BM, analyzing also in terms of the companies size. However, smaller companies as the group achieve better return in this category what positive presents SMB. Strong momentum effect wasn't explicitly studied, and there was no adequate explanation concerning the researched NZ Stock market. Additionally, the publication of

above authors suggests that interpretation of such rates like BM or size is dependent on the analyzed market.

Fama and French (1992, 1993) identified the fact that greater profits from investment reaches investment portfolio consisting from actions, which are selected in terms of the value, than from the shares growth. Lakonishok, Schleifer and Vishny (1994) accepted this theory, because investing in undervalued stocks is risky, sometimes investors react in the unexpected way on undervalued stocks. The low share value not always can be interpreted, that it is cheap even from the consideration of small demand. However, the problem of its price may be in the foundations of company, character, structure or strategy as well as adverse reactions. Therefore, less risky is to choose strategy of share value with a better result than the development strategy, in spite of fact that there are expansions of the market or recession. In addition, important research were published by Fama and French (1995), which related analyses profitability of the invested capital and the relation between investment portfolio growth and its assets growth. Cohen, Polk and Vuolteenaho (2003) sanctioned speculations that "*using a present-value model, found that the variation in firms' expected returns causes only 20 to 25% of the variance of the book-to-market ratio, with the rest attributed to the expected profitability and persistence of valuation levels*". However, Berk (1995) thinks that portfolio built based on high book-to-market and size ratios should note high returns on investment regardless of how the specificity of economic relations interprets it.

Recalled earlier Drew and Veeraraghavan (2002) also made discoveries examining Malaysian market during the period 1991-1999. Mainly they focused on analysis the factor of size and value premium. Assumption was to create 6 portfolios divided according to the size and book-to-market. Their uniqueness consists on including in research mentioned earlier factors: size and value Premium, which CAPM didn't take into account in theory and practice. Drew and Veeraraghavan during research additionally ruled out the seasonality. Surprising was the fact that SMB and HML Portfolios obtain about 17.7 % of

profit, emphasizing that standard deviation was preserved within the limits of 5.3 % and 6.1 %. Thanks to such segregations portfolios achieved higher results than main index about 1.92 % obtaining higher risk premium directed to analyzed factors.

Mirza and Shahid (2008) examining the power of Fama French model they used data from Karachi Stock Exchange. They used 6 segregated portfolios according to size and book-to-market ratio. Applied data concerning daily stock return from period 2003 - 2007. They used additionally six-month T-bill rate as risk free rate. According to research, the FF three-factor model has significant meaning for KSE. In the published article “Are the Fama-French Factors Proxying Default Risk?” Gharghori, Chan and Faff (2007) proved during their research of Fama French three factor model that the risk of insolvency above recalled isn't evaluated with the capital incomes. Additionally, they proved that F-Fare factors aren’t proxying for default risk. Moreover, additional factors used for the risk analysis support FFM accuracy as well as increase the advantage over CAPM.

3.5 Individual influenzas factors on the effectiveness of the FFM. Correlation between factors and macroeconomic indicators.

Furthermore, Black (2006) in his work “Macroeconomic risk and the Fama-French three-factor model” with the use of quarterly data from period 1923 to 2002 concerning US economies, studied variances of every FFM factor affecting the macroeconomic risk. Fama and French during the creation of model distinguish additional elements, which take the risk of insolvency into account, these are SMB and HML. Every investor wants to reduce to the lowest level such a risk, which is additionally changeable. In spite of such function these factors, it isn’t the only reason for which they are applicable to the capital evaluation. The risk of insolvency is also connected with remaining F-F factors model, such as size and book to market. Moreover, SMB and HML provide additional information concerning the pricing equity returns, which do not

include the risks. Gharghori (2007, 2009) proved on the Australian stock exchange research that risk associated with insolvency wasn't located as the systematic phenomenon, and what's not priced in equity returns. However, the important determinants of equity returns are additional variables informing about macroeconomic situation. Lettau and Ludvigson (2000) conducted among others research which concerned the relations between macroeconomic variables and asset returns. Moreover, they thought how it is possible to examine correlations between macroeconomic variables such as labor income or consumption and surplus return from the investment concerning common shares. They proved relevant fact that "*expected returns on common stocks appear to vary within business cycles and that the consumption aggregate wealth ratio proxies for investors' expectations of future returns on the market portfolio*" (Lettau and Ludvigson 2000).

Jagannathan and Wang (1996) studied the susceptibility of changing beta and size of expected profits for macroeconomic information, to which investors have access. Research was positively, concluding additionally that the size of company didn't have a significant importance. Liew and Vassalou (2000) wanted additionally to verify whether SMB and HML profitability is in the close relation with the future level GDP. It turned out that such positive correlation appears in the majority of countries. However, in Australia this rate is significant if SMB is also positive with the small exception, and HML must have a negative value. Summing up in order to predict Australia GDP value must use the SMB rate. They also approved suggestion that smaller companies during the intense development of the economy had a greater plausibility to generate bigger profits than large companies. They concluded that "*high book to market firms and small capitalization stocks are better able to prosper during periods of high economic growth and the reverse occurs during periods of low economic growth*" (Liew and Vassalou, 2000). Moreover, Kelly (2003) studied correlations between SMB and inflation in eighteen countries. Such a result was surprising that SMB negatively correlated with inflation, not omitting the fact that HML at

that time was positively associated with GDP but not subject of the inflation influences.

Claessens (1995) conducted very interesting research concerning returns and assets on the rising markets, analyzing data of 18 countries from the period of 1986-1993 from the International Finance Corporation (IFC). The aim was to examine the risk factor except beta factor. Analysis completed with the explicit conclusion that two main factors are determinants: trading volume and size. In the smaller number of countries the most important decision-makers were earning-to-price ratio and surprisingly dividend yield. Moreover, they proved that exchange rate risk also is a crucial factor which shouldn’t be omitted during research. Debut research concerning the Italian stock exchange may boast Aleati et al. (2000). He studied relations between the risk and rate of return from Italian Stock, using the individual data referring to return from the stock exchange in the period 1981-1993 proved that interest rate, SMB and HML, changes in the main index as well as oil prices considerably affect the formation of expected assets returns from the Italian stock exchange.

Beltratti and Di Tria (2002) also conducted research concerning multifactorial models on the Italian stock exchange but in the period from 1991 to 2000. Their research focused mainly on the subject of “*which financial variables can be used as proxies for macroeconomic risk and their relation with the business risk*”. The cross section of return most precisely is explained and analyzed by Fama French model, as well as best explains the situation of Italian stock exchange. However, during research didn't state any significant relation between SMB and HML with main macroeconomic indicators. Additionally, authors propose to apply other local rates, which would better reflect the variability in returns.

3.6 Analysis of the model during clear trends.

Czapkiewicz and Skalna studied the usefulness of FF model on Polish market during the upturn and fall. Research contained the period from 2002 up to 2010. Experience divided into three stages, first is upturn, next is fall – time of financial crisis, and last are previous years of upturn. Data contains the main quotation indices of Polish WIG stock exchange.

Proposed by the FAME and French (1993) model has the form

$$E\left(R_t\right) = \gamma_{RM}\beta_{RM} + \gamma_{SMB}\beta_{SMB} + \gamma_{HML}\beta_{HML}$$

γ_{RM}, γ_{SMB} and γ_{HML} parameters represent the expected risk premium related with the linked factor.

$E(R_t)$ - N-dimensional vector of the expected value, the excess rate of return on portfolios.

In results:

$$R_t = \alpha + \beta_{RM}\left(R_{Mt} - r_{ft}\right) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \varepsilon_t, \quad t = 1, \ldots, T$$

FF model verification was performed in two stages. At the first stage of the multi-model parameters were estimated equations (2), i.e. the vector of systematic risk and the vector α. In the second stage was the estimate of the risk premium vector.

The verification method used in the empirical study was conducted using a standard representation of the K-factor, i.e.:

$$E(R_t) = \gamma_0 + \gamma_1\beta_1 + \ldots + \gamma_K\beta_K$$

Where components of the vectors Beta (1, 2... k) are estimated from a multi-variable model:

$$R_{it}=\alpha+\beta_{i1}f_{1t}+\ldots+\beta_{iK}f_{Kt}+\varepsilon_{it},\quad t=1,\ldots,T,\quad i=1,\ldots,N$$

For the estimation of model parameters, linear regression is commonly use.

Time is not required to adopt earlier assumption about the distribution of random disturbances. Vector estimation of systematic risk can make a generalized method of moments (GMM). This method except that it requires no assumptions about the distribution, also allows presence of heteroskedasticity and autocorrelation of contact in the model.

$$E(g_t(\varphi))=E\left[\varepsilon_t\otimes\begin{pmatrix}1\\F_t\end{pmatrix}\right]=0$$

$$F_t=(f_{1t},\ldots,f_{Kt})^T,\ \varphi=(\alpha^T,\ \beta_1^T,\ldots,\beta_K^T)$$

At this stage of the study also considered two approaches: the classical, which require assumptions about the distribution of random disturbances, lack of autocorrelation and heteroskedasticity contact model and the GMM method. If one considers the earlier assumption of normality and independence of random errors, in order to estimate the unknown vector

Γ can be used two-stage approach (Fama, MacBeth 1973). First, the matrix is determined by the parameters β and then built a regression model where the observation matrix is a matrix $\hat{X}=[1_N:\hat{\beta}]$, a vector of observations on the dependent variable vector arithmetic terms of T, calculated for N portfolios. Estimator of the vector Γ is obtained by applying method of least squares or generalized least squares method.

$$\hat{\Gamma} = (\hat{X}^T \hat{X})^{-1} \hat{X}^T \hat{\mu} \quad \text{lub} \quad \tilde{\Gamma} = (\hat{X}^T \hat{\Sigma}^{-1} \hat{X})^{-1} \hat{X}^T \hat{\Sigma}^{-1} \hat{\mu}$$

Testing was twelve portfolios that were formed by the following algorithm. At the beginning of each month, all the companies are sorted in ascending order against the logarithm of the capitalization of the four groups, so that in each group were companies of similar size. Only in the last group, most companies have failed to achieve the desired effect. Then companies in each subgroup was divided into three sub-quotient of the index which book value to market value of BV / MV. Thus were created equinumerous 3 portfolios of similar sized companies and similar values of BV / MV. Portfolios were rebuilt at the beginning of each month. In this way takes into account the fact that the investor, when deciding to buy stake in, has the latest information.

Conducted analysis showed that during the upturn Fama French model in 90% explains the changeability of average surplus rates of return portfolios formed with the use of fundamental data. However during the fall model in much lesser extent explains the situation on market. Analyzing HML factor, the rate was negative as well as pointed that large value of BV/MV for the company being in the investment portfolio brought higher losses than portfolio with low ratio BV/MV.

3.7 The diversity of efficiency test of Fama French Model.

Fama and French (2003) proved in other research that CAPM isn't sufficiently efficient in order to develop correctly cost of the equity for individual companies. Additionally confirms relation that "too high cost of equity for high beta stocks and too low cost of equity for low beta stocks". However, Qi results of research are puzzling (2004), he analyzed situation on the United States market the period of 80 recent years. Evaluating prognostic power of CAPM and Fama-French model, author confronted historical data concerning twelve diversified industrial groups. Summarization of this research was a conclusion that none of

studied models have significant advantage during thorough forecasting of returns sector.

Moreover Cao, Parry and Leggio (2009) studding Shanghai Stock Exchange (SHSE) in the period 1999-2008 didn't confirm previous research conducted by Drew et al. (2003). Wang and Di Iorio (2007) as well as Wong et al. (2006) also analyzed prognostic differences of the CAPM and F-F model on the same market. Such a result appeared not only analyzing individual portfolios Fama French but also for general collected data. It wasn’t presented like in previous research that variations of the Chinese share market were closely connected with the size of companies and book-to-market value. However, in research emphasized that current beta value and B/M as well as size of the company in considerable degree conditions in next period Stock return. In previous research simultaneous included relations between exchanged rates.

The F-F model was created during research of the American market. Australian large companies are very connected with this market, therefore Durand, Limkriangkrai and Smith (2006) decided to examine F-F model based on these companies. They confirmed that if analysts will evaluate assets by indigenous CAPM it won't bring expected results.

Additionally CAPM assumes that beta, which describes the risk, is proportional to expected profits. This relation refers to homogeneous horizons of investors, who expect so that the risk was appropriately static, linear. However, the risk of cash flows in the company often changes as the cycle of economic situation. In addition, drastic decreases in the rate of economy grow caused by e.g. bad monetary policy, increases the risk associated with expected profits. In particular smaller companies are in the large degree susceptible to recessions. Another indication is risk averse, participants of dynamic markets try to predict unwanted situations, which may negatively affect the expected profits; therefore investors search for the most beneficial securing and methods in order to predict risk. On the other hand, investors participate in the uncertain market, e.g. during the recession will expect higher Premium and beta during macroeconomic developments will change (Nguyen, Faff and Gharghori, 2009).

Weimin Liu (2005) noticed gaps in the Fama French model, which by the introduction of new element into the model will explain relatively all asset returns. Risk flow has large influence on the development of evaluations assets.

Soon after this, appeared research concerning the same share market, but for the analysis a period of evaluated data was extended for 10 years. Gaunt (2004) presented that F-F model in the large degree explains the excess to returns than CAPM in Australian equities research. The only attention which underline Gaunt in his conclusions is fact that source of this majority is in a larger degree in the size factor. Therefore, it is an element to which it is necessary to pay particular attention.

3.8 Literature gaps and research questions

As I showed in previous subchapters, published literature doesn't contain explicit comparisons of CAPM and Fama-French models during specific time periods, and after recent financial crisis. There is also lack of robust evidence, how those models are able to explain returns form the equity markets during market declines and appreciations. Theory suggest that during those period of the explicit trend, models could lose they precision. It should be also emphasize, that precisely during those periods investors strategies are most likely to change. To implementation of those changes require many steps, such us: calculate required rate of return, conduct make valuation, assess the risk- all of them required to use asset pricing model with high precision. Thus, it is important to examine how popular asset pricing models behave during mentioned periods.

The first research question is whether CAPM and Fama-French models are able to explain all returns in tested portfolios in the chosen period from 1963to 2011. Second, whether or not FFM could explain grater part of the variance in returns than the CAPM model. Third whether tested models are able to explain

all returns in tested portfolios during selected periods of uptrends and downtrends.

This research questions will help to enrich current literature, and focus evaluation on usefulness and comprehensiveness of tested models and they explanatory power during periods of different statistical behaviour (uptrend/downtrend) as well as in the long run. Anny unexpected and significant behaviours will be analysed and discussed. As the tested portfolios, the S&P 500 index will be used, as well as twelve industries.

4. Methodology

All necessary data to conduct research directly are connected with modified capital asset pricing model, i.e. Fama French Model. Testing chosen model will concern the main USA index as well as period of conducted analysis regarding about 50 years from January 1963 to December 2011. Analyzing examples of long-term research described in chosen literature, the most often used data for such measurements are applied monthly data. However, some periods are too short to use monthly data. Moreover, necessary information needed to conduct reliable research will be resource of knowledge concerning company sizes as well as book-to-market value and information about market risk.

4.1 Resources

In order to conduct thorough analysis of the published until then research, concerning the effectiveness Fama French Model, it is necessary to provide access to key articles, which not always are available in the free version. Therefore wanting to build the appropriately high rank background of knowledge it is important to acquaint with the findings already studied theme. Moreover, the research problem appears in the close finance topics. Books containing such thematic and highly specialized are also essential to become acquaint with the theoretical knowledge.Moreover, the appropriate software enabling to conduct research is EViews7. “EViews 7 offers academic researchers, corporations,

government agencies, and students access to powerful statistical, forecasting, and modeling tools through an innovative, easy-to-use object-oriented interface" (eviews.com, 2012).

Summing up, the most important source for making researches, which are crucial for this work is to use the application, that gives possibility of building econometric models. Moreover, it is needed to have additional software, which allows to magazine large amount of data, which will be used, by Microsoft Excel. Its numerous functions will be needed to build graphs and assorting data, as well as to make comparisons easier.

The skillful using of this software is essential for making researches. In addition, the function of synchronization of this two applications decreases the risk of making mistake, during calculations. That is why having book guides of this applications is an extra asset.

The Chris Brooks's *Introductory Econometrics for Finance* guide book of Eviews application is particularly essential. It helps to use this applications in proper way.

4.2 Data collection

Data collection is the first stage of preparing researches. It is very significant part of researches, as it is the base of all future achievements and conclusions. The prices of main index in USA are downloaded from finance.yahoo.com.

This data concerns the daily price of liquidation of this index. The 12336 data sets from 1963-07-01 to 2012-06-29 were collected. The data about liquidation of S&P 500 are possible to download From Yahoo Finance in excel format, which additionally helps in data modifications and making further researches.

Below chart presents price level of the S&P 500 index.

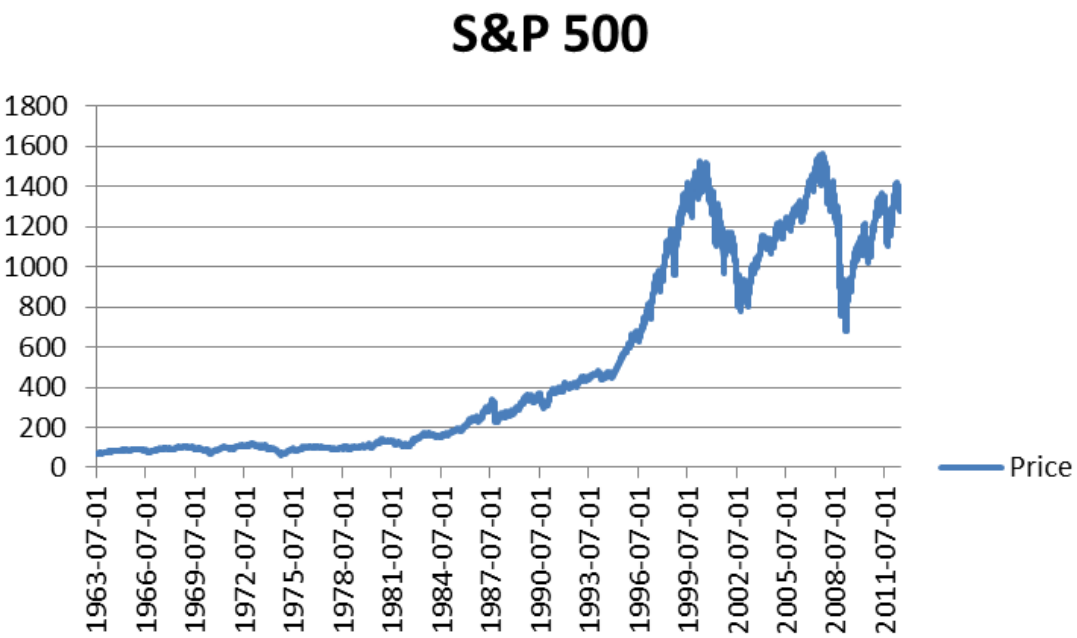


Figure 4 S&P 500 Price

The next stage, was to gather the data concerning the Fam –French's model. Such as SMB, HML and R_f . .Data for Fama-French factors has been downloaded from the Kenneth French Data Library. This data includes all factors concerning US market. What's more, 12 Industry Portfolios where downloaded from this source.

Table 8 contains characteristic of analyzed industry portfolios.

4.3 Analysed samples

The explanatory power of the evaluated models will be test on chosen samples (which could be also referred as an portfolios), which are S&P 500 index, as well as twelve industries with divide all US publicly traded companies into groups which contain companies with similar characteristics of underlying operations. The decision of sample choice is based on underlying financial theory. Different industries tends to have specific behaviour, which distinguish

them especially during period of higher volatility and price swings (Brooks, 2008). Defensive industries such us utility industry are more stable, and less volatile than the market. Due to risk-return trade-off, those low-volatile industries tend to have lower returns than the market as a whole. Aggressive industries such us: Business Equipment which includes high-tech companies, computers, software, and electronic equipment companies tends to be more volatile, thus have higher returns. There is no precise distinction between defensive and aggressive industries during long history of US equity market (Lynch, Rothschild 1989). In 80's that was telecommunication, in 90's technology, and in 2000's new aggressive bio-technology industry emerged. Usually aggressive industries owes they properties to the fast growing companies which they contain. Opposite to that, defensive industries tends to contain companies which are operating on highly saturated market with small opportunities to expansion and growth (Lynch, Rothschild 1989).

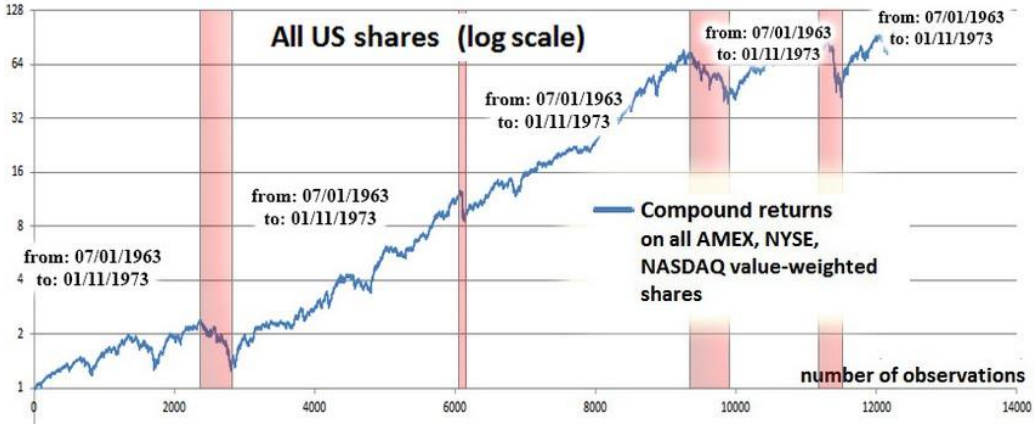
4.4 Determination of market phases length and frequency of used returns.

From the tested period, two phases could be recognized: falling phase and the growing phase. In order to maintain objectivity in determining the beginning and the end of each phase, extreme value of portfolio of all value-weighted shares from AMEX, NYSE, NASDAQ exchanges has been used as the determinant.

Usually falling phases are significantly shorter than the growing phases. For example the falling phase in the 1987 lasted only a few weeks. Such a short phases significantly reduce amount of observation, based on which the linear regression for CAPM and Fmama-french models could be estimated. For this reason daily data (instead of weekly or monthly data popular in finance) has been used.

In this case, falling phase has been designated form the last historical height (daily market closing price) to the lowest daily closing price (before next uptrend and the growing phase), and the growing phase from the mentioned lowest daily close price to the next historical height (also daily closing price).

For the clarity and presentation, mentioned phases has been presented on the figure X, below.



Graph 1All US shares

4.5 Formulas used in research

While making a research about models of Fama French and CAPM, it is essential to used all certain formulas and dependences. Undermentioned analyze of used models will precisely characterize taken steps, by using certain formulas, essential for interpretation and necessary for creating possibility of marking the explanation's power of F-F model and CSPM

4.5.1 Fama–French three-factor model

The target model of F-F ma has general form :

$$R_t = \alpha + \beta_{RM}\left(R_{Mt} - r_{ft}\right) + \beta_{SMB} SMB_t + \beta_{HML} HML_t$$

R_t- N-sized vector of surplus steps of return of created wallets in t-moment,

$\alpha, \beta_{RM}, \beta_{SMB}, \beta_{HML}$ - N-sized vectors of unknown parameters;

Alpha is not proceed from model, however it is presented in relation to whole market.

SMB "Small Minus Big" *- is the average return on the three small portfolios minus the average return on the three big portfolios"* (Fama; French, 2008).
HML "High Minus Low" *- is the average return on the two value portfolios minus the average return on the two growth portfolios*"(Fama; French, 2008).

By using gathered data the analyze of Fam-French's model will contain information, which are presented in the table below.

Dependent Variable: S_P500_LOG3
Method: Least Squares
Date: 09/07/12 Time: 09:55
Sample: 7/01/1963 6/29/2012
Included observations: 12336

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.016152	0.001047	-15.42563	0.0000
MKT_RF	1.011405	0.001110	911.1177	0.0000
SMB	-0.245991	0.002080	-118.2915	0.0000
HML	0.009658	0.002245	4.303098	0.0000

R-squared	0.987510	Mean dependent var	0.003829
Adjusted R-squared	0.987507	S.D. dependent var	1.038969
S.E. of regression	0.116129	Akaike info criterion	-1.467914
Sum squared resid	166.3073	Schwarz criterion	-1.465508
Log likelihood	9058.095	Hannan-Quinn criter.	-1.467108
F-statistic	325002.4	Durbin-Watson stat	2.220422
Prob(F-statistic)	0.000000		

Figure 5 Fama French model for 1963- 2012

4.5.2 Capital asset pricing model CAPM

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

Explanation of this model and marks were specifically characterized in the theory presented above. Generally, this model pictures the dependence between market marked as R_m and expected step of return. Its usage is very broad. It is used not only for assessing the effectiveness of investment from

corporate resource such as pension fund, but also for examination the level of effectiveness of exchange market.

The table below, contains the exemplary results of CAPM research during 1963-2012 period, on the base of downloaded data.

Primitive Capital Asset Pricing Model (CAPM) (single-factor) Fama and French Three-Factor Model is presented below with models. CAPM (equation 1) as well as Fama and French model (equation 2) are estimated for the six size-BM sorted portfolios:

$$RP(t) - RF(t) = a + b[RM(t) - RF(t)] + e(t), \quad (1)$$

$$RP(t) - RF(t) = a + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t). \quad (2)$$

SMB = the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks.

HML = the difference between the return on a portfolio of high book to market equity stocks and the return on a portfolio of low book to market equity stocks.

$RP(t)$ is the portfolio return at time t, RF is the risk-free rate which is the one-month Treasury bill rate, and RM is the market return calculated as the value weighted market return of all stocks in the six portfolios including negative book to market stocks, which were excluded from the sample while forming the size-BM portfolios. SMB is the difference between the returns on small minus big size firms (i.e. mimicking a portfolio long in small capitalisation stocks and short in big capitalisation stocks) and is calculated as the difference between the simple average return of the three small size portfolios (S/L, S/M, S/H) and the three big size portfolios (B/L, B/M, B/H). HML is the difference between the returns of high BM firms and low BM firms (i.e. mimicking a portfolio long in high BM stocks and short in low BM stocks) and is calculated as the difference between the simple average return of the two high BM portfolios (S/H, B/H) and the two low BM portfolios (S/L, B/L). This procedure for calculating SMB and

The table below, contains the exemplary results of CAPM research during 1963-2012 period, based on data from Kenneth French data library (French, 2012).

Dependent Variable: S_P500_LOG3
Method: Least Squares
Date: 09/06/12 Time: 23:42
Sample: 7/01/1963 6/29/2012
Included observations: 12336

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.018090	0.001535	-11.78681	0.0000
MKT_RF	1.028009	0.001539	667.9110	0.0000

R-squared	0.973096	Mean dependent var	0.003829
Adjusted R-squared	0.973093	S.D. dependent var	1.038969
S.E. of regression	0.170424	Akaike info criterion	-0.700890
Sum squared resid	358.2337	Schwarz criterion	-0.699687
Log likelihood	4325.092	Hannan-Quinn criter.	-0.700487
F-statistic	446105.1	Durbin-Watson stat	2.148913
Prob(F-statistic)	0.000000		

Figure 6 CAPM for 1963- 2012

4.5.3 The determination factor R^2

To analyze the model's effectiveness, the factor of verity will be used. His character is to examine in what level, variables are described by model. Precisely speaking, it defines the level of reflection of variable explained by model, which is analyzing the dependency between explained and explaining in model. The factor may reach a maximum value of 1, which proves the ideal matching of model to explained variable.

As an example of extreme value, the minimum value which can be reached is 0 -which means that the model does not explains the relation between explained variable and explaining variable. The closer the value of R-Squared to one, the bigger is part of volatility explained by the estimated regression. R-Squared is expressed by formula:

$$R^2 = \frac{\sum_{t=1}^{n} (\hat{y}_t - \overline{y})^2}{\sum_{t=1}^{n} (y_t - \overline{y})^2}$$

Where:

y_t- the actual value of Y variable in t- moment

$\hat{y}_t$- the theoretical value of explained variable (on the base of model)

$\overline{y}$- the arithmetic mean of empiric values of explained variable.

4.6 The experimental procedure

The first stage of experimental procedure is gathering whole essential data. This stage was already precisely described above. Having all data gathered, the next step is segregation and arrangement of particular data in homogenous files, to enable full synchronization of two programs used for mathematical calculations.

To storage the data, Microsoft Office Excel was used.

The next step was optimal marking of growth and underdevelopment decline trends for S&P 500.

In addition, the logarithmic regression was made, in way of smoothing the large fluctuations, proportionally to their size. Furthermore, this technique is used not to change any value, but to gain more precise and clear data.

The table below contains five growth trends and four decline trends.

Table 1Different market phases

NO.	Growth trend	Decline trend
I	From 07/01/1963 to 01/11/1973	From 01/12/1973 to 09/03/1974
II	From 09/04/1974 to 10/05/1987	From 10/06/1987 to 10/26/1987
III	From 10/27/1987 to 03/24/2000	From 03/25/2000 to 10/09/2002
IV	From 10/10/2002 to 10/09/2007	From 10/10/2007 to 03/09/2009
V	From 03/10/2009 to 12/30/2011	

The following table contains sample results for the CAPM.

Table 2Sample results for the CAPM

		CAPM-GROWTH				
07/01/1963 01/11/1973	**TERM I**	Variable	Coefficient	Std. Error	t-Statistic	Prob.
		C	-0.015004	0.002408	-6.230466	0.0000
		MKT_RF	0.977917	0.003861	253.3096	0.0000
		R-squared	0.964322			
09/04/1974	**TERM**	Variable	Coefficient	Std.	t-Statistic	Prob.

10/05/1987	**II**			Error		
		C	-0.025616	0.002385	-10.73859	0.0000
		MKT_RF	1.065789	0.002898	367.8000	0.0000
		R-squared	0.976144			
10/27/1987 03/24/2000	**TERM III**	Variable	Coefficient	Std. Error	t-Statistic	Prob.
		C	-0.017211	0.003039	-5.663302	0.0000
		MKT_RF	1.086121	0.003557	305.3370	0.0000
		R-squared	0.967468			
10/10/2002 10/09/2007	**TERM IV**	Variable	Coefficient	Std. Error	t-Statistic	Prob.
		C	-0.019219	0.003134	-6.131945	0.0000
		MKT_RF	1.008546	0.003717	271.3684	0.0000
		R-squared	0.983230			
03/10/2009 12/30/2011	**TERM V**	Variable	Coefficient	Std. Error	t-Statistic	Prob.
		C	-0.017331	0.004334	-3.998569	0.0001
		MKT_RF	0.955896	0.003026	315.8507	0.0000
		R-squared	0.992943			

For each of these periods, the examination of Fam-French's model effectiveness has been made, as well as examination of CAPM's effectiveness. Then, selection of data due to probability in order to evaluate the explaining power by specific models in determined trends has been made.

The same actions were made for 12 portfolios, consisted of 12 main industrials of United States. Identical to S&P 500 range of growth and decline trend as has been used. Selection of obtained data was made in the same way, by analyzing the probability factor.

For each of these periods, studies efficiency Fama-French model and in the same manner CAPM efficiency was examined.

The table shows a sample Growth trend for financial sector.

Table 3 Sample results for growth trends

				MONEY		
07/01/1963 01/11/1973	TERM I	Variable	coefficient	Std. Error	t-StatistiAlpha	Prob.
		Alpha	0.019791	0.006819	2.902385	0.0037
		MKT_RF	0.961527	0.010931	87.96334	0.0000
		R-squared	0.765219			
09/04/1974 10/05/1987		Alpha	0.042268	0.005110	8.272168	0.0000
		MKT_RF	0.884574	0.006207	142.5067	0.0000
		R-squared	0.859999			
10/27/1987 03/24/2000		Alpha	0.020297	0.009117	2.226420	0.0261
		MKT_RF	1.039694	0.010670	97.43704	0.0000
		R-squared	0.751761			
10/10/2002 10/09/2007		Alpha	0.002447	0.010069	0.243013	0.8080
		MKT_RF	1.037821	0.011940	86.92101	0.0000
		R-squared	0.857455			
03/10/2009 12/30/2011		Alpha	-0.034375	0.034029	-1.010165	0.3128
		MKT_RF	1.416964	0.023761	59.63324	0.0000
		R-squared	0.833768			

5. Empirical results and conclusions

This chapter is designed to report explanatory power of CAPM and Fama-French factors from US market on chosen international indexes. Models will be tested for the whole researched period, as well, as for different market phases. The statistical properties of those results, will be briefly explained. This chapter will be divided for two parts:

1. Explanatory power of commonly used asset pricing models during whole researched period.

H1A - CAPM have a sufficient explanatory power

H1B – Fama-French have a sufficient explanatory power

2. Explanatory power of commonly used asset pricing models during different market phases.

H2A1 - CAPM have a insufficient explanatory power for growth trends

H2A2 - CAPM have not a insufficient explanatory power for decline trends

H2B1 – Fama-French have a sufficient explanatory power for growth trends

H2B1 – Fama-French have a sufficient explanatory power for decline trends

5.1 CAPM and Fama-French during whole research period

Table 4CAPM during whole research period

Sample: 7/01/1963 6/29/2012
Included observations: 12336

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.018090	0.001535	-11.78681	0.0000
MKT_RF	1.028009	0.001539	667.9110	0.0000

R-squared	0.973096	Mean dependent var	0.003829
Adjusted R-squared	0.973093	S.D. dependent var	1.038969
S.E. of regression	0.170424	Akaike info criterion	-0.700890
Sum squared resid	358.2337	Schwarz criterion	-0.699687
Log likelihood	4325.092	Hannan-Quinn criter.	-0.700487
F-statistic	446105.1	Durbin-Watson stat	2.148913
Prob(F-statistic)	0.000000		

Analyzing the explanatory power of CAPM model from the following results can be concluded that it is significant . This model throughout the period considered is very well matched to the explanatory variable. Beta factor has a 1.028 and indicates that fluctuations hardly deviate from market fluctuations. Addition Beta does not have specific defensive or extensywnej. Propability is zero so it can be concluded that in the long run has a the CAPM model, significant explanatory power.

Table 5FFM during whole research period

Sample: 7/01/1963 6/29/2012
Included observations: 12336

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.016152	0.001047	-15.42563	0.0000
MKT_RF	1.011405	0.001110	911.1177	0.0000
SMB	-0.245991	0.002080	-118.2915	0.0000
HML	0.009658	0.002245	4.303098	0.0000

R-squared	0.987510	Mean dependent var	0.003829
Adjusted R-squared	0.987507	S.D. dependent var	1.038969
S.E. of regression	0.116129	Akaike info criterion	-1.467914
Sum squared resid	166.3073	Schwarz criterion	-1.465508
Log likelihood	9058.095	Hannan-Quinn criter.	-1.467108
F-statistic	325002.4	Durbin-Watson stat	2.220422
Prob(F-statistic)	0.000000		

The above graph shows the results of testing the effectiveness of Fama French model for the whole period considered. It includes daily data from 7/1/1963 to 06/29/2012. Analyzing the probability that is equal to zero, we can conclude that this model throughout the period considered has explanation power. Moreover each of the examined factors has a significant impact.

5.2 CAPM and Fama-French during different market phases

Because there is significant evidence that coefficients estimates for both models can change during periods of high market swings, they has been calculated for different market phases for both CAPM and Fama-French models.

Figure 1, contain plot of cumulative compound returns on value-weighted portfolio of all US shares, traded on AMEX, NASDAQ, NYSE. Plot has been divided for growing and declining (red colour) phases.

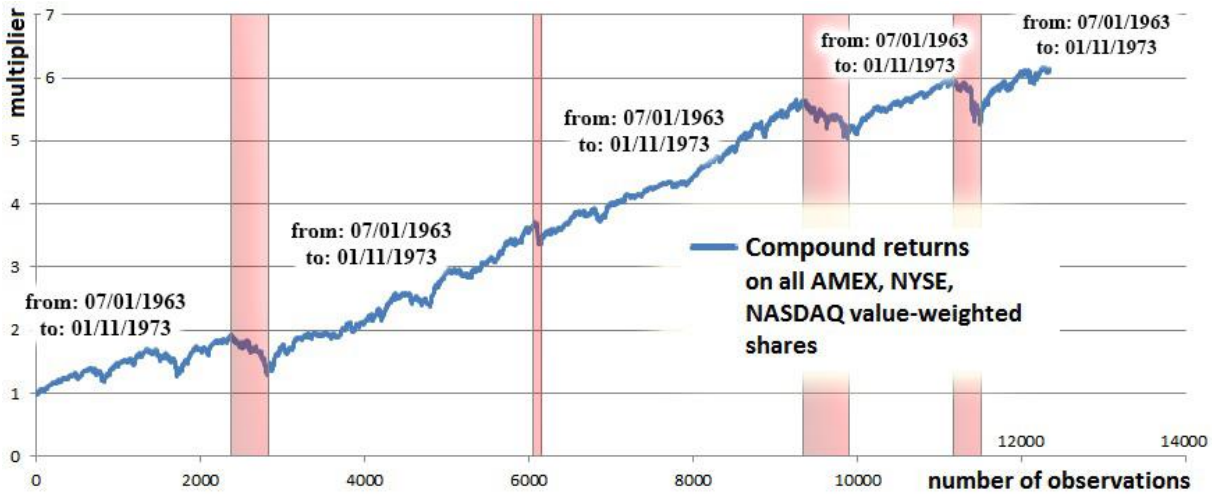


Figure 7Compound return on all US stocks (NYSE, NASDAQ, AMEX) between 1963 and 2011

In the first part estimates of classical linear regression for CAPM and Fama-French models will be presented. For estimation purpose the Ordinary Least Squares (OLS) method available in eViews statistical package, has been used. Regression has been estimated based on 12211 daily observations between 1 July 1963 and 30 December 2011 for S&P 500 index, as well as for twelve different industries separately.

I will evaluate estimates of coefficients of CAPM model for S&P 500 index during different market phases. First coefficients during market appreciation will be examine (Table 1)

Table 6CAPM and Fama-French estimates for S&P 500; Appreciation periods

Growth period	**07/01/1963 01/11/1973**	**09/04/1974 10/05/1987**	**10/27/1987 03/24/2000**	**10/10/2002 10/09/2007**	**03/10/2009 12/30/2011**
CAPM					
Alpha	-0.015004	-0.025616	-0.017211	-0.019219	-0.017331
β wrt (Rp-Rf)	0.977917	1.065789	1.086121	1.008546	0.955896
R-squared	0.964322	0.976144	0.967468	0.983230	0.992943
Fama–French three-factor model					
Alpha	-0.013309	-0.017818	-0.014833	-0.015985	-0.017340
β wrt (Rp-Rf)	1.002079	0.993941	1.009031	1.024141	0.989690

β wrt SMB	-0.158539	-0.280878	-0.293390	-0.176462	-0.118977
β wrt HML	0.007833	-0.006304	0.001119	-0.091827	-0.033339
R-squared	0.970339	0.991155	0.990669	0.992859	0.995043

For all growth periods S&P 500 does not disclose any unexpected properties. Both: CAPM and Fama-French models, show beta which does not differ significantly from 1, which is expected due to underlying financial theory. In this periods Fama-French model disclosed that S&P 500 have a negative exposure to small companies and inconclusive exposure to high book-to-market stocks. Interestingly in 2002-2007 boom market, S&P tends to have more exposure to high book-to-market companies which are related to P/B premium (Fama, French, 1992), but produced significant and negative alpha of -0.016% for daily observations, which suggest approximately 4.1% underperformance compare to "broad market" (all value-weighted AMEX, NYSE, NASDAQ) shares.

Table 7CAPM and Fama-French estimates for S&P 500; Depreciation periods

Decline period	**01/12/1973 09/03/1974**	**10/06/1987 10/26/1987**	**03/25/2000 10/09/2002**	**10/10/2007 03/09/2009**
CAPM				
Alpha	0.002150	0.427270	-0.014960	-0.034367
β wrt (Rp-Rf)	1.034065	1.252530	0.959161	1.007588
R-squared	0.987662	0.954649	0.969330	0.990826
Fama–French three-factor model				
Alpha	-0.010412	-0.246384	-0.016156	-0.035535
β wrt (Rp-Rf)	0.996983	1.283118	0.986231	0.989957
β wrt SMB	-0.204567	-0.211251	-0.242080	-0.119964
β wrt HML	-0.039430	0.983577	0.051971	0.046696
R-squared	0.994934	0.997570	0.987173	0.992814

In the calculations for the different industries, following categories has been used (CRSP SIC industrial codes are in Appendix 1):

Table 8 Industries list

No	Abbreviation:	Industry name:	Product representations:
1	**NoDur**	Consumer NonDurables	Food, Tobacco, Textiles, Apparel, Leather, Toys
2	**Durbl**	Consumer Durables	Cars, TV's, Furniture, Household Appliances
3	**Manuf**	Manufacturing	Machinery, Trucks, Planes, Off Furn, Paper, Com Printing
4	**Enrgy**	Energy	Oil, Gas, and Coal Extraction and Products
5	**Chems**	Chemicals	Chemicals and Allied Products
6	**BusEq**	Business Equipment	Computers, Software, and Electronic Equipment
7	**Telcm**	Telecommunication	Telephone and Television Transmission
8	**Utils**	Utilities	Electricity, Gas,
9	**Shops**	Sale	Wholesale, Retail, and Some Services (Laundries, Repair Shops)
10	**Hlth**	Health	Healthcare, Medical Equipment, and Drugs
11	**Money**	Finance	Banks, Funds, Brokerage firms
12	**Other**	Others	Mines, Constr, BldMt, Transportation, Hotels, Bus Serv, Entertainment

Source: Self-made, based on Keneth Kenneth R. French Data Library (2012).

Table 9, presents estimates of coefficients of CAPM model for different industries during whole researched period. More detailed estimate output has been attached.

Table 9CAPM estimates- whole researched period

From: 07/01/1963 to: 12/30/2011	CAPM			
Industry	**MONEY**	**UTILS**	**BUSEQ**	**CHEMS**
Alpha	0.020606	0.026810	0.018877	0.025297
β wrt (Rp-Rf)	1.089622	0.591247	1.264477	0.877525
R-squared	0.767755	0.497781	0.747235	0.707378
Industry	**DURBL**	**HLTH**	**MANUF**	**NODUR**
Alpha	0.014238	0.030617	0.023602	0.035176
β wrt (Rp-Rf)	1.116654	0.879974	1.050463	0.735644
R-squared	0.707058	0.657814	0.894386	0.701708
Industry	**OTHER**	**SHOPS**	**TELCM**	**ENERGY**
Alpha	0.015473	0.027519	0.021591	0.033307
β wrt (Rp-Rf)	1.028478	0.933791	0.888916	0.947657
R-squared	0.854112	0.753200	0.634091	0.529762

What is more, variability of the response variables of 12 examined sectors of American market is in a higher degree explained by the model. However, the model does not explain in a detailed way shaping the response variables for the energy sector, telecommunication and Utilities sector receiving the proper value R-squared 0.497781. Those values have been evaluated on the basis of the whole examined period **from: 07/01/1963 to: 12/30/2011**. Additionally, it can be noticed that the probability for Alpha is significant, which means it oscillates below 1 per cent which is why despite the risk analysed by CAPM, the model can account for oscillation for the given sectors in the given period of time. A suggestive explanation for that situation is the length of analysed period in relation to the number of analysed risk factors.

To simplify significance level description, colour diagram has been used for this and following tables. Colours could be translated as stated in the table below.

Table 10Legend of significance levels

Estimates shows that there are significant differences between exposures of different sectors to the market risk premiums. Lowest exposure has been given by Utilities, than by Consumer Non-Durables, Chemicals, Health, Shops and Energy. These properties show that that sector tends to be defensive in comparison with portfolio containing all shares.

non	Non-significant, probability >10%	10%	Significant at 10% level, probability <10% and >5%	5%	Significant at 5% level, probability <5% and >1%	1%	Significant at 1% level, probability < 1%

Table 11Fama–French three-factor model From 07.01.1963 to 12.30.2011

Fama–French three-factor model

From: 07/01/1963 to: 12/30/2011

Sector:	MONEY	UTILS	BUSEQ	CHEMS
Alpha	0.006287	0.018605	0.034769	0.024882
β wrt (Rp-Rf)	1.187234	0.644336	1.158337	0.876543
β wrt SMB	0.067252	-0.130871	0.055857	-0.224445
β wrt HML	0.652486	0.444066	-0.778196	0.112625
R-squared	0.827991	0.569761	0.811000	0.722869
Sector:	**DURBL**	**HLTH**	**MANUF**	**NODUR**
Alpha	0.004789	0.039405	0.019401	0.036615
β wrt (Rp-Rf)	1.180582	0.816934	1.080360	0.722851
β wrt SMB	0.015862	-0.227620	0.094792	-0.184223
β wrt HML	0.442338	-0.323288	0.160330	0.007922
R-squared	0.731405	0.685873	0.900296	0.713097
Sector:	**OTHER**	**SHOPS**	**TELCM**	**ENERGY**
Alpha	0.010624	0.029026	0.019693	0.027111
β wrt (Rp-Rf)	1.066128	0.923535	0.897712	0.985079
β wrt SMB	0.295982	-0.005996	-0.237473	-0.257595
β wrt HML	0.107835	-0.069122	0.188513	0.401087
R-squared	0.873161	0.754103	0.653617	0.563505

As it can be observed matching the models to particular response variables by Fama-French model for the whole examined period is shaped in a similar way

as for the CAPM model. Mainly for the three sectors this matching is slight, oscillates about 65%. What is more, for the Consumer Durables and financial sector model F-F analysing three risk factors is not capable of accounting for those oscillations.

Table data summary mentioned below contains CAMP analysis during the determined uptrends. Analysing the first period starting from 07/01/1963, lasting about 10 years we notice equivocal explanatory power of that model for all of the examined sectors. Eight sectors behave in a defensive manner as BETA takes values lower than 1. Additionally, it signifies relations of a lesser risk rate to lesser rate of profit. In the following examined stage CAPM does not explain market oscillations at all. However, it should be underlined that in the examined period a substantial market revival occurred. Monthly, weekly and even daily increases were significant. What is more, in that period only 4 sectors behave in a defensive manner. The third period, just like the previous one, lasted 13 years but CAMP has not greater potential of explaining the oscillation. The number of defensive sectors during all of the examined periods is variable. What is more, there are two sectors which in every period behave in a defensive manner, namely: Customer Nondurables and Utilities sector. In the following shorter 5 and 2 year periods the results of CAMP model has significantly worsened. Almost all of the APLHA had the probability value more than 10%.

Table 12 CAPM Growth for sectors

CAPM growth			Sector:										
No.	Period length	Coefficient:	MONEY	UTILS	BUSEQ	CHEMS	DURBL	HLTH	MANUF	NODUR	OTHER	SHOPS	TELCM	ENERGY
I	From: 07/01/1963 to: 01/11/1973	**Alpha**	0.019791	0.007572	0.024853	0.018997	0.014368	0.043089	0.020649	0.026466	0.014234	0.034355	0.004204	0.020345
		β wrt MKT_RF	0.961527	0.482236	1.436745	0.933194	1.156613	0.977794	1.115231	0.800765	1.313165	0.910518	0.711988	0.943328
		R-squared	0.765219	0.510107	0.723707	0.756269	0.673671	0.722625	0.910222	0.806884	0.838428	0.688837	0.327739	0.683459
II	From: 09/04/1974 to: 10/05/1987	**Alpha**	0.042268	0.047030	0.018542	0.023656	0.033420	0.024315	0.026123	0.053347	0.039144	0.038106	0.048851	0.035098
		β wrt MKT_RF	0.884574	0.600566	1.235033	1.071379	1.131285	1.088949	1.019843	0.878948	1.004789	1.016416	0.698578	1.103740
		R-squared	0.859999	0.634307	0.773493	0.861155	0.742003	0.797412	0.924964	0.837298	0.881898	0.824497	0.481329	0.625246
III	From: 10/27/1987 to: 03/24/2000	**Alpha**	0.020297	0.019586	0.031478	0.011191	0.000439	0.022017	0.017760	0.013495	0.005767	0.014733	0.028739	0.020069
		β wrt MKT_RF	1.039694	0.447868	1.367155	0.910485	1.009719	1.113416	0.978405	0.910805	0.919982	1.095215	0.965091	0.728925
		R-squared	0.751761	0.362795	0.703418	0.600392	0.553707	0.653899	0.834707	0.702697	0.800920	0.785397	0.641658	0.323231
IV	From: 10/10/2002 to: 10/09/2007	**Alpha**	0.002447	0.047786	0.001384	0.011429	-0.010399	-0.010493	0.025474	0.009035	0.012805	-0.009106	0.001635	0.053332
		β wrt MKT_RF	1.037821	0.765225	1.315193	0.814799	1.188773	0.794425	1.116454	0.644907	1.050379	1.003338	1.045622	0.942091
		R-squared	0.857455	0.490620	0.781736	0.702915	0.736075	0.642700	0.876392	0.622465	0.894745	0.753745	0.701944	0.372238
V	From: 03/10/2009 to: 12/30/2011	**Alpha**	-0.034375	0.026819	0.012481	0.019745	0.030970	0.006229	0.012781	0.039554	-0.006299	0.024000	0.025251	-0.025610
		β wrt MKT_RF	1.416964	0.662814	0.950907	0.849034	1.420706	0.648484	1.215933	0.609588	1.137938	0.778497	0.873228	1.116127
		R-squared	0.833768	0.728836	0.886643	0.876486	0.856128	0.730085	0.944146	0.801574	0.948955	0.847433	0.859241	0.845559

Table 13CAPM decline for sectors

CAPM decline			Sector:											
No.	Periodlength	Coefficient	MONEY	UTILS	BUSEQ	CHEMS	DURBL	HLTH	MANUF	NODUR	OTHER	SHOPS	TELCM	ENERGY
	From 01/12/1973 to 09/03/1974	**Alpha**	-0.023284	-0.045504	0.054626	0.096001	0.013246	0.053289	0.061996	-0.006385	0.005354	-0.014198	0.045842	0.081874
		β wrt MKT_RF	0.970084	0.519525	1.213928	1.154542	1.103304	1.079301	1.129977	0.894980	1.035976	1.060972	0.620374	1.001186
I		**R-squared**	0.890153	0.591691	0.747266	0.885616	0.798619	0.785173	0.945591	0.903656	0.910708	0.845261	0.503469	0.724549
	From 10/06/1987 to 10/26/1987	**Alpha**	0.013594	1.064404	-0.498390	-0.064296	-0.153020	0.053612	-0.272273	0.283281	-0.683719	-0.487908	1.054067	0.878854
		β wrt MKT_RF	0.859691	0.777118	1.099802	1.117179	1.063990	1.062531	1.111699	1.023670	1.000700	1.012175	1.020543	1.150038
II		**R-squared**	0.981591	0.963049	0.985060	0.995144	0.950841	0.993885	0.992355	0.980243	0.899782	0.979937	0.893432	0.938497
	From 03/25/2000 to 10/09/2002	**Alpha**	0.088613	0.022229	-0.022788	0.065601	0.034384	0.051236	0.057599	0.077039	0.021508	0.053263	-0.071549	0.048815
		β wrt MKT_RF	0.886209	0.359239	1.824049	0.439479	0.800637	0.588386	0.883141	0.320857	1.016604	0.773344	1.005011	0.434764
III		**R-squared**	0.677037	0.129496	0.796981	0.239450	0.490678	0.340850	0.792527	0.227059	0.752501	0.500038	0.622724	0.151204
	From 10/10/2007 to 03/09/2009	**Alpha**	-0.025704	0.034351	0.018484	0.022952	-0.117540	0.035589	-0.031287	0.029044	-0.054252	0.046312	0.013657	0.144565
		β wrt MKT_RF	1.447578	0.812913	0.955748	0.836316	1.181765	0.661065	1.067812	0.667401	0.957227	0.807426	0.997802	1.226548
IV		**R-squared**	0.797813	0.750853	0.904412	0.889956	0.860430	0.812493	0.944633	0.842411	0.909275	0.813558	0.866250	0.742968

Analysing the effectiveness of CAMP during the risk-off trends on the basis of 12 sectors of American market the results are not better than in comparison with the analysis of this model during the uptrends. Each of the examined periods is shorter as it oscillates to 3 years more in the third examined period. Preserving the excess rate of return in particular sectors surpasses in the third and the longest period. But better matching of the model to the response variable (R-squared) was recorded in the second examined period.

Examining the Fama-French model's potential for explaining during the downward quotations and crisis we obtained almost identical results. In the initial period in majority of sectors has got BETA SMB negative which means that the sectors possess the majority of minor partnerships. Additionally, it can be inferred from the following HML sector that the proportion of companies with higher book-to-market value is the same as companies with greater market value to book value. In most cases companies which specialize in service sector or invest in high-technology and development possess more intangible assets which is why for example APPLE company should have negative HML value as the intellectual value of employees, managers is not being added to the book value. In the following period the potential for explaining F-FM is slightly biggest, however, the R-squared value for each of the sectors which oscillates about 0.99 is impressive. Moreover, the proportion of defensive and non-defensive behaviour in the sectors is divided evenly. In the third examined period, the majority of sectors constitute of big companies as the BETA SMB value is negative and the sectors consist of companies with high book-to-market value. In the last period the efficiency of the examined model is very small. In almost every sector probability reaches value of more than 10%. This examined period is the longest as it lasts about 2 years. Model matching is insignificant, far worse than in the following period. Nevertheless most of the sectors behave in a defensive manner in all of the examined periods. Additionally, the potential for explaining of the F-F model in comparison to CAPM does achieve significantly worse results in the periods of decrease.

Table 14 Fama French Model decline for sectors

FFM decline			Sector:											
No.	Periodlength	Coefficient	MONEY	UTILS	BUSEQ	CHEMS	DURBL	HLTH	MANUF	NODUR	OTHER	SHOPS	TELCM	ENERGY
I	From 01/12/1973 to 09/03/1974	Alpha	-0.012140	0.025714	0.050912	0.096238	-0.001622	0.080982	0.065843	0.014786	0.032633	0.019926	0.005858	0.036868
		β wrt MKT_RF	1.026448	0.864484	0.964201	1.111342	1.119552	0.882670	1.093689	0.911618	1.093242	1.009223	0.739282	1.094095
		β wrt SMB	0.233479	-0.334013	-0.589600	-0.093430	-0.108852	-0.165952	-0.042937	0.243138	0.392682	0.217780	-0.126031	-0.232579
		β wrt HML	0.101887	-0.388814	-0.692368	-0.124412	0.124783	-0.706722	-0.123759	-0.064285	0.019309	-0.327607	0.549992	0.502375
		R-squared	0.900901	0.791785	0.807404	0.887839	0.800833	0.823312	0.947036	0.915762	0.934474	0.858451	0.544158	0.747713
II	From 10/06/1987 to 10/26/1987	Alpha	0.225635	0.742557	-0.535013	-0.165036	-0.547347	0.051935	-0.259069	0.021243	0.115988	-0.177437	0.319946	0.264180
		β wrt MKT_RF	1.047302	0.798773	1.126903	1.067563	0.720327	0.995446	1.270911	0.839652	1.156078	0.872437	0.719805	1.023110
		β wrt SMB	0.350736	-0.090781	0.025174	-0.109684	-0.644715	-0.097312	0.234446	-0.364508	0.527025	-0.083702	-0.711646	-0.415892
		β wrt HML	0.580463	0.501692	0.168261	-0.097449	-1.055862	-0.300620	0.701883	-0.501496	-0.302610	-1.020273	-0.435662	0.198749
		R-squared	0.999070	0.988605	0.985266	0.996839	0.988621	0.994366	0.994904	0.996259	0.997983	0.994753	0.984310	0.984623
III	From 03/25/2000 to 10/09/2002	Alpha	0.067944	-0.046640	0.048665	0.029688	-0.015875	0.040703	0.036040	0.053809	-0.002626	0.025395	-0.085558	-0.001188
		β wrt MKT_RF	1.071797	0.893928	1.266912	0.737536	1.192226	0.687325	1.047199	0.516617	1.198847	0.999782	1.121638	0.823014
		β wrt SMB	-0.349574	-0.027779	0.061315	-0.275878	-0.039132	-0.237477	0.036409	-0.218762	0.059918	-0.148128	-0.112466	-0.020650
		β wrt HML	0.390080	1.149083	-1.196494	0.633833	0.841068	0.206637	0.353732	0.415327	0.393442	0.483116	0.247898	0.834365
		R-squared	0.754843	0.416098	0.873349	0.413743	0.610650	0.373166	0.816798	0.375569	0.773133	0.558519	0.636279	0.271742
IV	From 10/10/2007 to 03/09/2009	Alpha	-0.008068	0.025714	0.016566	0.019034	-0.105762	0.032839	-0.031495	0.026666	-0.048401	0.051032	0.010212	0.126427
		β wrt MKT_RF	1.155917	0.864484	1.025444	0.883470	1.185197	0.695585	1.122982	0.712910	0.940398	0.836555	0.981944	1.326141
		β wrt SMB	0.115427	-0.334013	0.102913	-0.079260	0.679708	-0.051344	0.155900	0.003205	0.281299	0.356772	-0.243956	-0.727900
		β wrt HML	1.545818	-0.388814	-0.321341	-0.272233	0.232612	-0.196837	-0.226954	-0.233387	0.190328	-0.018757	-0.008099	-0.781384
		R-squared	0.928749	0.791785	0.920092	0.904566	0.900597	0.823493	0.953009	0.857113	0.924337	0.832996	0.872601	0.819743

Examining the F-F model efficiency in the first stage of uptrends produced almost the same results and in the following stage. The potential for explaining of the F-F model in those periods is medium enough to become models for the risk analysis. Most of the companies in sectors behave in a defensive manner. In almost the same sectors big companies prevail with the exception of Health sector in the first period when BETA SMB value is 0.092769. BETA HML factor is divided evenly and proportionaly in both periods. There is a similar number of sectors which have got greater number of book-to-market value. The following periods show worse results of F-F model usage. In the third period the response data to a relative degree match the model. Slight oscillations occur with the exception of the energy sector. Great majority of companies from this sector possess high book value in comparison to the market value. What is more, the number of sectors with defensive companies is the same. The next two and the last examined periods are quite short periods in comarision with the rest. Their range oscillates between 5 to 3 years. The potential for explaining of the Fama French model is insignificant as in most cases it is greater than 10%. Model matching to the explanatory data is very small espacially for the final period. In the final period, shorter than the following, we can notice a greater number of companies with higher market value in comparison to book value (HML). As it can be observed on the basis of data included in the table, shorter periods of dynamic economic growth are not favourable to the potential for explaining of the F-F model. Long-time intervals charaterised by minor dymanics increases the potential of explaining of the F-F model. This thre-component model takes into account sufficiant number of risk sources with the short time research.

Table 15Fama French Model growth for sectors

FFM Growth			Sector:											
No.	Periodlength	Coefficient	MONEY	UTILS	BUSEQ	CHEMS	DURBL	HLTH	MANUF	NODUR	OTHER	SHOPS	TELCM	ENERGY
I	From 07/01/1963 to 01/11/1973	Alpha	0.016012	0.004800	0.036627	0.020051	0.016110	0.045277	0.017043	0.021882	0.007060	0.033606	0.003216	0.020927
		β wrt MKT_	0.928649	0.516433	1.309470	0.936235	1.218095	0.918850	1.118242	0.776133	1.271659	0.881401	0.875597	1.005780
		β wrt SMB	0.284108	0.016041	-0.127435	-0.059029	-0.283799	0.092769	0.157708	0.294379	0.470453	0.130883	-0.493899	-0.233114
		β wrt HML	0.031553	0.159508	-0.635464	-0.023136	0.093769	-0.200600	0.110528	0.073968	0.108842	-0.046583	0.410849	0.129303
		R-squared	0.780458	0.523597	0.757887	0.757003	0.685202	0.732675	0.915738	0.832005	0.863120	0.692971	0.401038	0.698054
II	From 09/04/1974 to 10/05/1987	Alpha	0.030413	0.028481	0.046905	0.026180	0.038951	0.035863	0.021282	0.046553	0.029400	0.034035	0.041843	0.040711
		β wrt MKT_	0.987320	0.755505	0.993663	1.048361	1.078639	0.992585	1.063691	0.938056	1.098385	1.054686	0.747068	1.047270
		β wrt SMB	0.212448	0.139948	-0.361194	-0.083210	-0.254839	-0.083872	0.149193	0.129370	0.477126	0.171684	-0.279581	-0.359383
		β wrt HML	0.188646	0.455758	-0.574071	-0.008450	0.041925	-0.286463	0.024943	0.101737	-0.097384	-0.017597	0.449632	0.126649
		R-squared	0.875744	0.692933	0.810286	0.862304	0.750644	0.806181	0.929362	0.842645	0.928138	0.829806	0.530421	0.641682
III	From 10/27/1987 to 03/24/2000	Alpha	0.013414	0.013437	0.042302	0.008628	-0.011465	0.033444	0.013377	0.016557	0.012534	0.014259	0.029662	0.013813
		β wrt MKT_	1.230979	0.611178	1.071904	0.973128	1.342369	0.782802	1.100660	0.813480	1.048949	1.108984	0.929998	0.896542
		β wrt SMB	0.018055	-0.182026	0.116346	-0.217078	0.078520	-0.370774	0.022677	-0.327255	0.015510	0.016571	-0.248643	-0.147069
		β wrt HML	0.540688	0.612754	-0.944959	0.347769	0.904201	-0.674577	0.337042	-0.031617	0.007461	0.027231	0.088607	0.598482
		R-squared	0.785704	0.539983	0.771477	0.637574	0.624075	0.693138	0.850690	0.730856	0.894807	0.785482	0.659564	0.375881
IV	From 10/10/2002 to 10/09/2007	Alpha	0.002836	0.027691	0.017273	0.012683	-0.014702	0.003400	0.020292	0.012006	0.012534	-0.001173	0.001835	0.021022
		β wrt MKT_	1.068395	0.872692	1.213543	0.820864	1.185669	0.756432	1.106497	0.657126	1.048949	0.964197	1.106290	1.068743
		β wrt SMB	-0.194942	-0.140589	0.212120	-0.068548	0.127987	-0.122567	0.191777	-0.149362	0.015510	0.035619	-0.372305	0.053246
		β wrt HML	0.037465	0.916085	-0.752526	-0.035595	0.152021	-0.571973	0.172559	-0.087941	0.007461	-0.356100	0.095258	1.394942
		R-squared	0.867194	0.592569	0.824757	0.704506	0.739815	0.687700	0.886036	0.633372	0.894807	0.766883	0.731182	0.477855
V	From 03/10/2009 to 12/30/2011	Alpha	-0.023854	0.026702	0.007782	0.018116	0.031450	0.002129	0.011715	0.037281	-0.005609	0.021276	0.025559	-0.026290
		β wrt MKT_	1.157679	0.708696	1.055171	0.916430	1.256646	0.779073	1.180795	0.700738	1.069503	0.817270	0.898924	1.195534
		β wrt SMB	-0.125264	-0.151148	0.096948	-0.077315	0.534500	-0.056044	0.230673	-0.097555	0.174300	0.133150	-0.121782	-0.214180
		β wrt HML	1.037642	-0.053090	-0.452334	-0.186963	0.194315	-0.432885	-0.045893	-0.258140	0.117702	-0.241341	-0.001764	-0.127581
		R-squared	0.903209	0.734066	0.920036	0.882451	0.872896	0.774981	0.949739	0.821519	0.952590	0.865973	0.861645	0.850362

6. Conclusions and recomendations.

6.1 Conclusions

Many research has been conducted about efficiency of the the CAPM model and Fama–French three-factor model. Researches on the asset pricing models are motivated by the need to use of those models in financial practice. Historical price swings, stock bubbles and highly-volatile periods, were the most difficult challenge during tested periods.

The major objective of this dissertation was to evaluate efficiency and explanatory power of the the CAPM model and Fama–French three-factor model during different time periods, which characterize distinct market phases. Moreover the additional advantage of conducted studies was wide range of the portfolios, on which returns the models has been tested. Those extensive research include twelve portfolios which represent twelve major US industries, as well as the S&P 500 index, which is on of the most commonly use benchmark for studies on US market, and to measuring relative performance of the alternative investments.

Conducted research shows that CAPM model have enough explanatory power to explain statistical behaviour of S&P 500 index for the whole researched period, and its beta coefficient is highly significant and amounted 1.028 which means that S&P 500 index is slightly more risky than the broad market. However the alpha was significant. Similar behaviour for S&P 500 index during the same period has been described by Fama-French model, which gave beta with respect to the market risk premium of 1.0114, but negative and significant alpha of -0.0162 after adjustments for the size and book-to-market effects.

Analysed alpha are based on daily observations, and has been stated in percentage points. Both CAPM and Fama-French allows for conclusive inferences during this long period, due to high R-squared, which was above 98%. Research for this period confirmed hypothesis 1A and 1B, thus both CAPM and Fama-French models have sufficient explanatory power.

In the second part of research, CAPM and Fama-French models has been evaluated during different market phases. Empirical results for S&P 500 index, shows that

during all growing phases both model has significant explanatory power. Hover during first three phases beta for HML was insignificant, thus any inferences about exposure of portfolios to book-to-market factor is inconclusive. Research leads to rejection of Hypothesis 2A1 which assumes that CAPM model have insufficient explanatory power.

In comparison with CAPM, Fama-French model could be perceived as the better alternative, because its provides higher explanatory power, however probability of its coefficient estimates for the two researched periods was oscillating between 1 and 10%, which show insignificance for the more restrictive significance level requirements. Reassuming, hypothesis 2A2 has been approved for the first three declining periods, due to insignificant alpha.

In the second approach, instead of S&P index, different portfolios representing twelve industries has been used.

For the all twelve industries during the whole researched periods CAPM estimates showed that this model is able to explain large part of variance in the returns, thus could be use to explain asset pricing over long period of time. However does findings could slightly differs between sectors. Interestingly smaller portion of sectors shown defensive character which could be concluded based on beta with respect to market risk premium coefficient. However in each case Alpha is significant and positive. It could suggest that CAPM failed to explain all returns of sectors, and that other factors (such as size, and value) should be include. Similar conclusions could be drawn for Fama-French model, but FFM was able to explained larger part of variance in the returns. Excluding mentioned troubles explanatory power of Fama-French and CAPM model for the whole research period is strong.

In case of research on the selected growing and falling periods, there was no clear pattern in explanatory power and comprehensiveness of description of the statistical behaviour in returns, for both asset pricing models. Different inferences could be

drawn from the different periods of research. During few market phases alpha for both CAPM and Fama-French models was significant, which shows inability of model to explain some parts of returns after adjusting for risk represented by used factors. However for the declining period alpha was insignificant, which shows small chance that it will occur in reality, thus it could be conclude that models were better explained returns during this period. Also shorter length of this period, and smaller amount of the observations affected R-Squared, which were lower during declining (shorter) period.

In case of Fama-French robust conclusions could not be made for the all periods. Model quite good, explained returns during falling periods, and produced alpha was insignificant, hover during some of the growing period produced significant and positive alpha. This could be seen particularly in 80’s and 90’s where alpha was reasonably large, positive and significant. Some might argue, that market boom in the 80’s and 90’s was due to pension investments of babe boomers generations, thus both model have to deal with unexpected upswings (Lynch, Rothschild, 1989).

All conducted research was based on frequent and extensive data, and inferences were based on twelve industrial portfolios as well, as on S&P 500 index. Research shows that over long run both of tested asset pricing models have a good explanatory power. However during explicit trend CAPM model could fail to explain all returns on securities which is consistent with theory of Fama and French (1992). After inclusion size and value (book-to-market) factors, explanatory power significantly increase, which could be observed during whole period as well as researched falling and growing market phases. Evidence of research in some period shows, that even after controlling of risk from size and value effects some part of returns are not explained by Fama-French model, during shorter period. This finding is robust especially for some sectors, such us financial sector. Arguably sophisticated financial companies, could be exposed to other type of risk, than average publicly traded company in US, and proxy for those kind of risk, has not been introduced yet in the financial literature.

5.2 Recommendations

Conducted research significantly enriched available literature on the Fama-French and CAPM asset pricing models. However, some research questions still remain unanswered.

Research about additional factors such us: momentum, and liquidity factors could be conducted in the future. This will help to develop new answers about pricing assets during periods of directional market moves.

Also research which are based not only on periods of trends but also periods distinguished by changes in market volatility could be made.

List of tables and figures

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