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Fama and French model vs. CAPM: Procyclical Stocks

A case of the UK market

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Abstract

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Key words:	Procyclical, Countercyclical, Cross-Sectional Regression, Fama and French, Fama-MacBeth, CAPM, Industrial Production Index, Book-to-Market ratio, Market Capitalization.
Purpose:	To examine whether Fama and French multifactor model have indicative explanatory power over the CAPM to the excess returns of the 55 pro-cyclical, publicly owned companies from the UK and if so then to determine which risk factors from the model are significant in explaining the excess returns.
Method:	We collect the necessary data and form portfolios according to the stocks' excess returns sensitivity to the IPI after which a set of regressions are run in order to determine whether the variations in the portfolios can be explained by the Fama and French factors. We then run cross sectional regressions according to Fama-MacBeth.
Conclusions:	We find that the explanatory power of the market beta and of the HML factor are not strong enough. Furthermore we focus more on the GDP beta and on the size factor. Our results suggest that the SMB factor is significant and therefore serves as one of the main drivers of the procyclical companies in the UK.

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1. Introduction

The first chapter of our thesis provides a thorough explanation of our main area of interest along with the research objective. We will present the research problem which will offer the reader a more comprehensive perception of the underlying topic together with the purpose of this paper. Thereafter we focus on some limitations of the thesis followed by a disposal of the upcoming chapters.

1.1. Background

It has always been of great curiosity how a stock's price of a company behaves in different economic settings through time. The paper "Procyclical Stocks Earn Higher Returns" by Goetzmann et al. (2012) was one of primary inspirations to further research the underlying topic. In their paper they have found that US procyclical stocks, whose returns co-move with business cycles, earn higher average returns than countercyclical stocks.

Pro-cyclical stocks are stocks that co-move with the market index. When the market rises, the stock price of the company goes up too. These stocks obtain high returns in economic booms and low returns in economic downturns. Because of this property, we believe that this kind of stocks should be associated with a higher expected return than the counter-cyclical stocks, because they face a higher risk when the economy goes down. Thus the required return should be higher as a compensation of the risk undertaken. Pro-cyclical stocks perform well when the economy is recovering. In an

expansion salaries increase, new jobs are being created and customers have more disposable income in general. During this time they tend to purchase new automobiles, houses and more expensive every day goods. People buy their groceries in more expensive super markets, go to fancy restaurants and all in all spend more money. A typical pro-cyclical stock is usually from more luxurious and expensive brand such as Burberry. In a financial crisis the purchasing power of the average individual declines making her to do certain adjustments and trade-offs. Instead of buying clothing from Burberry she might opt for a less expensive brand like Marks & Spencer. The opposite applies when the economy recovers. The GDP per capita rises, making high-end brands "more affordable."

A counter-cyclical stock belongs to a company whose financial performance belongs to an industry or a segment of industries that is negatively correlated to the market index, or the general state of the economy. In an economic downturn this kind of stock performs well, resulting with returns higher than the market index. And vice-versa, in an economic expansion the return of the stock goes down, it decreases compared to the market. The most interesting distinction of these stocks is the "hedge" property. These stocks are natural hedges that investors use in order to protect their portfolio when the market slows down. Providing this protection against risk, it is a natural consequence that the returns provided by a counter-cyclical stock would be lower, hence the lower risk.

Finding a company that flourishes in a period when people are less wealthy is rather hard, therefore pro-cyclical companies are often more common in practice. Besides due-diligence, an important factor in finding contra-market stocks is to figure which companies might profit when people have less money. Stocks of companies with relatively stable profits, like huge fast-food chains (ex.: Harry Ramsden's – UK fast food chain) and various utility companies that are relatively steady sales-wise (ex.: E.ON Energy - UK's third largest natural gas supplier) tend to be counter-cyclical.

As the economy declines, contra-market firms perform well. However, these companies can suffer greatly during an economic boom and might end up going bankrupt, have they not have the vital balance sheets paramount to back up the company's existence. That's why investors attracted to this kind of stocks are faced with the problem of anticipating, or timing the market. Predicting when the bottom of the business cycle will occur is a grueling task that might result with disastrous results if not correctly anticipated. A great risk of investing heavily in counter-cyclical stocks comes from the entanglement of the market system alone. If it appears that the market is unmistakably headed for a big downturn, it might seem smart to invest in these companies; however there are numerous problems in this way of thinking. The growth of the market is almost never symmetrical to the growth of an individual stock. Therefore, while the whole market might be underperforming, certain firms may undergo surges, thus some countercyclical will not perform as expected.

Despite the potential risks, investing in counter-cyclical stocks is a smart way to diversify one's portfolio. By creating a portfolio where part of the investor's stocks are pro-cyclical, i.e. co-move with the market, and the rest counter-cyclical, i.e. negative correlation to the market index one achieves a well balanced portfolio. As long as careful research is done, along with intensive due-diligence, this method is a good defensive strategy.

The main purpose of this paper is to prove that the Fama and French 3-factor model is more fitting at explaining the excess returns of our chosen companies over the one-factor CAPM model. The follow up part of the purpose is to determine which Fama and French factors are significant in explaining the excess returns which represents the inferring part of our thesis.

Our economy of choice for this thesis was the United Kingdom. The economy of the United Kingdom being the sixth-largest national economy in the world measured by nominal GDP provided an exciting opportunity for further research. London is the biggest financial center besides New York that helped shape one of the most globalized economies. A further curiosity is that the UK endured a steep recession between 2008 and 2012, which was the longest and most severe in the last 50 years (The BBC Economy Tracker, 2013). This is an interesting fact that provokes to scrutinize how the public firms adjust to the cycles, what is the main implication to their returns and which factors provide

a significant explanation regarding the excess returns of the underlying companies.

1.2. Problem specification

The global financial crisis of 2007-2008 was one of the worst the world had experienced in the last century. A lot of the publicly traded companies in the UK have collapsed while quite a few managed to pull through and outperform the negative state of the market. This is of great curiosity to examine what model is better at explaining the returns of these procyclical securities. The Capital asset pricing model (CAPM) developed by Lintner (1965) and Sharpe (1964) states that the market beta is sufficient in explaining the security's return. The research of Fama and French (1992) was in contrast with Sharpe's and Lintner's idea, resulting with the conclusion that the theory supporting the market beta no longer holds. Fama and French (1992) offer a rather augmented model consisting of various risk factors believed to have a significant explanatory power.

The starting point of this paper is to examine, compare and determine the behavior of various pro-cyclical firms in different business cycles. After careful consideration we decided on choosing various companies from the UK. In our research we picked 55 publicly traded UK companies with the highest market capitalization (the market value of all outstanding shares). Using the London Stock Exchange (LSE) and Yahoo! Finance as our main sources of numerical

information we chose different entities from different sectors such as: Burberry Group (Luxury fashion brand), Big Yellow Group (self-storage space provider), Prezzo (Restaurant chain), Red24 (Security management group) and many others. Thus our portfolio consists of different publicly owned companies with pro-cyclical tendencies.

We chose to work with companies from the UK because of the complexity of the underlying market, the large amount of publicly available information and the fact that the economy of the UK is the sixth largest economy in the world. These are the primary reasons that motivated us to specifically choose the case of the UK. Also, the recent global economic crisis was of remarkable significance in our country of choice, providing us the opportunity to see its implications and consequences on some of the biggest publicly owned companies in the UK.

1.3. Problem statement

Does the Fama and French multifactor model have indicative explanatory power over the CAPM to the excess returns of the 55 pro-cyclical, publicly owned companies from the UK? If so, which risk factors from the model are significant in explaining the excess returns?

1.4. Purpose

Taking into account our assumption that pro-cyclical stocks outperform the counter-cyclical stocks because of the greater risk they face, we contemplate specifically on the 55 chosen publicly traded companies that have endured the recent global recession thus disclosing procyclical tendencies. The main objective is to determine whether the Fama and French model is superior over the CAPM model in explaining the excess returns of our chosen companies that have managed to overcome a very steep and remarkable economic downturn.

The Fama and French model being a multi-factor model provides us the opportunity to not only demonstrate that its explanatory power is superior to the one of the CAPM, but also determine what risk factors contribute the most to the excess returns of the underlying companies. It is our goal to examine the performance of various types of stocks in different economic conditions especially during a financial crisis.

1.4.1. Business Cycles

The term business cycle - as we know today, was analyzed and codified by Arthur Burns and Wesley Mitchell in their 1946 book Measuring Business Cycles (The Encyclopedia of New Zealand, 2013). One of the main objectives and revelations of their work was that many economic factors move together. During a crisis, the output of services and goods plummets, unemployment

increases, employment falls. Conversely, during an economic expansion besides the output, the employment also rises and unemployment declines. However, oftentimes the term "business cycle" might be perplexing. There are no regularity, duration and timing of rises and falls in economic activity. Rather, these 'switches' occur in irregular intervals, lasting from a small fraction of time up to many years. Inflationary booms can be induced by overspending in the private or public sector. Furthermore, monetary policy can as well be a possible cause of booms and recessions. The Bank of England strongly influences the size and growth rate of the monetary stock, and thus the level of interest rates in the economy. Consequently, interest rates strongly affect the degree of spending of customers.

1.4.2. Global Financial Crisis

One of the most inspiring factors of writing this thesis was the Financial Crisis of 2007-2008. A financial crisis is really hard to define and often they do not have a precise beginning or end. The world has faced one of the worst financial crises since the one in 1929-1933 when the global economy drastically slowed down and the confidence in the banking sector was at a staggering low rate. The most recent crisis had begun in the summer of 2007 when the ever exciting real estate market created turbulences on the secondary market of securities backed by housing loans. In times when the USA is faced with a economic crisis, no country is immune to the upcoming implications.

The crisis in the UK resulted in a large drop in retail sales. Quite a few well known brands went completely out of business. Thus our research will provide us with the answers which factors drive the excess returns of the companies that managed to outperform the market with their pro-cyclical properties.

"…Falls in retail sales and rises in unemployment mean falling taxes revenues for governments worldwide. The UK was no exception. In the 4th quarter of 2008 UK Gross Domestic Product (GDP) fell by 1.5% and the country officially entered a period of recession…"* (Higher, 2013)

1.5. Limitations

The thesis main numerical source for the stocks' price is Yahoo! Finance. Our sample includes stock prices of various UK companies over the last 10 years (from 2002 to 2012). There are 55 publicly traded companies from the UK in this paper, for whom there's a publicly available info on the stock prices over our desired research period. Logically thus, we only considered publicly owned companies and not private, due to the lack of public information, limitations and restrictions they impose.

1.6. Target group

This paper is specifically written for students of economics and finance, researchers, teachers and all other having basic financial knowledge. Furthermore, this thesis could be of great interest for those familiar with the

Fama and French/CAPM model and for investors who are interested in investing in the UK stock market.

2.Method

This chapter will outline the procedure of obtaining the necessary financial data, the types of tests and theories utilized throughout the paper. It will describe the stages of estimating financial parameters as well as calculating the results.

2.1 Identification of Stocks

In order to select our stocks we first choose a country which in our case was the UK, and a time frame of ten years. Furthermore we select the companies with the highest market-cap (excluding the financial institutions) that have been listed on the London Stock Exchange (LSE) market since 2002 until present. We ignore the companies that have defaulted during this time period and only observe the companies that have survived which in total represent a number of 55 stocks.

Next we focus our method on the approach that Goetzmann et al. (2012) have utilized in their article and therefore employ such theories as Fama-MacBeth (1973) and Fama-French (1992).

2.1.1 Estimating the beta

Goetzmann et al. (2012) calculate the beta GDP for each asset; we however use the Industrial Production Index (IPI). The reason is that the IPI includes only specific sectors that contribute to the real GDP, these are: mining, manufacturing and utilities. Since our companies fit into these sectors we calculate the sensitivity of each asset to the IPI. The first step is to collect the

monthly prices for the specified time period. The assets' monthly excess returns which will serve as a dependent variable in the first-pass regression is then estimated using the historical prices.

We calculate the beta IPI using the following single factor regression:

$$R_{it} = \alpha_{it} + \widehat{\beta_{it}^{IPI}} \quad IPI_{tM} + \varepsilon_{it} \qquad (1)$$

Where:

R_{it} is the return of asset i at time t

α_{it} is the intercept of asset i at time t

$\widehat{\beta_{it}^{IPI}}$ is the estimated beta for each asset at time t i.e. the sensitivity of each asset to the IPI.

IPI_{tM} is the Industrial Production Index at time i

ε_{ti} is the error term at time t for asset i

After the regressions are run we are left with 109 monthly betas for each individual asset, starting from January 2004 and ending with January 2012.

2.1.2 Forming Procyclical Portfolios

In order to minimize the noise that may occur for each asset return, the assets are recommended to be grouped into portfolios (Chen, Roll & Ross, 1986). By doing so we account for the possible idiosyncratic risk therefore reducing the probability of the individual assets being affected by it. This has also been noted by Fama and French (1992) who point out that the use of portfolios

may generate more accurate estimates especially when it comes to the risk premium. In order to form the procyclical portfolios we group the assets by looking at their return's sensitivity to the IPI. Therefore we sort the stocks by utilizing the function percentile, i.e. we increase the percentile with 0.2 for every new portfolio. We are left with five portfolios each having 11 or 12 stocks.

Next we calculate the monthly returns for each portfolio as well the mean, variance and standard deviation. We present and talk about the summary statistics later on in the paper.

2.1.3 Fama French Regression

In order to proceed with the next step and calculate the risk premium we look at some variables used by Fama and French (1992) in their three-factor model. We collect the data from the Kenneth French's webpage. Since the data for the UK market is not available we therefore take the factor values for Europe instead. Fama and French (1992) argue that these variables can explain around 90% of the return variations within a portfolio and that it is important to consider them as risk factors.

The set of factors is therefore the following:

- Rm-Rf

This is the return on the market portfolio (Rm) minus the risk free rate (Rf) i.e. the market premium. To find Rm we subtract the value of the market

index at time *t-1*from the value of the index at time *t* and divide it by the value of the index at time *t-1*.

- SMB (Small minus Big)

Here we look at the market capitalization of each asset and sort them from the smallest value to the biggest. Furthermore we calculate an average of the monthly returns for the companies with a small market cap and another average for the companies with a big market cap. We then subtract the former from the latter and obtain the SMB.

The purpose of SML is to estimate the additional return that may be received from investing in firms with a low market capitalization. We can look at SML as a measure of the *size premium*. We choose this factor as it represents a *size risk* which should be examined when we talk about procyclical stock. The idea is that companies with a small market capitalization are more affected by changes on the market and by other risk factors.

- HML (High minus Low)

This is obtained by looking at the difference between the returns i.e. high returns minus low returns. It describes the *value premium* that is received when investing in firms with high B/M. It suggests that growth stocks yield lower returns than value stocks. By observing HML we can examine whether companies who previously had a low B/M ratio now exhibit a high B/M ratio which suggests that these companies have been affected by certain risk factors and their value is threatened by uncertain earnings in the future.

After collecting the necessary data we run the regressions between the three factors and the individual portfolios as well as an HML portfolio constructed by subtracting the portfolio with the lowest return from the portfolio with the highest return. We will call this variable HML_{pro}. The results are analyzed by looking at the goodness of fit, R^2, as it gives us information whether the Fama and French factors can explain the variations in the portfolio or not. We also analyze the factor betas and the intercept.

2.2 Fama-MacBeth Regressions

We further investigate the procyclical stock by using the Fama and MacBeth (1973) technique of estimating the cross-sectional regression parameters. The rationale behind the method that they have developed is determining the risk premium with respect to a risk factor (Kan & Zhang, 1999). In this paper we follow their two-pass methodology.

2.2.1 First-Pass Regression

The first step in their model is estimating the beta, of each individual asset for each factor. We decide to estimate the beta GDP and the market beta that will later be used in the cross-sectional regressions. For the market beta we collect the FTSE 100 data which comprises the top 100 companies listed on LSE. Next we run a simple CAPM regression where we choose to estimate the betas. According to Fama-MacBeth (1973) this step can be characterized as a first-pass time series regression.

Kan and Zhang (1999) specify that the existence of errors when estimating the betas may lead to being unable to identify a certain risk premium. In order to account for the error-in-variable problem we conducted a t-test. The hypothesis that was tested was whether beta is equal to zero and the selected confidence level was 90%. In case of more than 50% of insignificant betas we would have to change the model.

The first-pass stage can be summarized by the following algebraic model:

$$R_{it} - R_{ft} = \mu + \sum_{k=1}^{N} \hat{\beta}_{iMt} I_{Mt} + \varepsilon_{it} \qquad (2)$$

Where:

R_{it} is the return of asset *i* at time *t*

R_{ft} is the risk-free rate at time *t*

μ is the mean and

$$\mu = \gamma_0 1_N + \gamma_1 \beta \qquad (3)$$

$\hat{\beta}_{iMt}$ is a vector of the betas for *N* factors with respect to I_{Mt} and

$$\beta = \frac{cov\,[R_{it}, I_{Mt}]}{var\,[I_{Mt}]}$$

I_{Mt} is the value of the index *M* at time *t*

ε_{it} is the error term at time *t* for asset *i*

In equation (3) 1_N is an *N* vector of ones. This helps us test the hypothesis that β is equal to zero. As previously mentioned if this hypothesis cannot be rejected then we cannot observe beta which leads to incorrect or invalid results

and the cross-sectional regression of R_{it} on β cannot be run (Kan and Zhang, 1999)

2.2.2 Second-Pass Regressions

After estimating the betas we perform a set of cross-sectional regressions using the following variables: The excess return, the size, market to book ratio and the estimated betas. The time frame is from January 2004 until January 2013. The market capitalization data and book to market ratios are collected from Datastream.

The second-pass stage is algebraically represented by the following model:

$$R_{it} - R_{ft} = \gamma_{it} + \gamma_{tM}\hat{\beta}_{iM} + \partial_{it} \qquad (4)$$

Where:

R_{it} is the return of asset i at time t

R_{ft} is the risk-free rate at time t

γ_{it} is the zero-beta risk premium

γ_{tM} is the risk premium on the market factor

∂_{it} is the pricing error

$\hat{\beta}_{iM}$ the estimated beta for of the market factor of asset i from the first pass regression

Every cross-sectional regression will provide a certain estimate of the risk premium γ_{tM} linked with the exposure to the market factor for the corresponding month. The steps are repeated for each month in the sample.

We then conduct a t-test for significant differences from zero using the time-series averages.

The average risk premium $\bar{\gamma}_M$can be calculated using the formula:

$$\bar{\gamma}_M = \frac{1}{T}\hat{\gamma}_{tM} \tag{5}$$

The standard deviation of $\hat{\gamma}_M$ as:

$$\hat{\sigma}(\bar{\gamma}_M) = \sqrt{\frac{1}{(T-1)}\sum_{t=1}^{T}(\hat{\gamma}_{tM} - \bar{\gamma}_M)^2} \tag{6}$$

The appropriate t-statistic is simply the average risk premium divided by the standard deviation.

$$\hat{t}(\bar{\gamma}_M) = \frac{\bar{\gamma}_M}{\hat{\sigma}(\bar{\gamma}_M)/\sqrt{T}} \tag{7}$$

Next we present the results in a table and discuss the output in the Analysis section.

3.Theoretical Framework

This chapter will outline the main theories on which we base our paper. We will start with an overall presentation of the UK market during the past ten years as well as discuss scholars that have previously researched this topic. Furthermore the main idea behind Fama and French and Fama-Macbeth models will be presented.

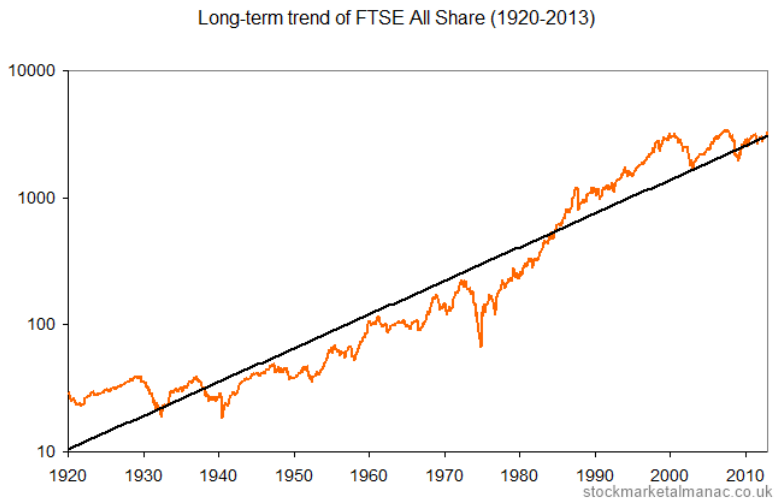
3.1 The UK Market between 2002 and 2012

The LSE is the most international of all stock exchanges with 2,500 companies from more than 68 countries (ADVFN, 2013), and it is the premier source of equity-market liquidity, benchmark prices and market data in Europe. The LSE is the most international of all exchanges.

The London Stock Exchange is mainly comprised of two different stock markets: the Main Market and the Alternative Investment Market (AIM). The Main Market is solely for established high-performance companies and has strict listing requirements. The Alternative Investment Market on the other hand trades in small-capitalization firms or new companies with high growth potential (ADFN, 2013).

Currently the London Exchange is the 4th biggest stock market in the world with almost 3000 companies listed and total market cap above $3,200 billion. The top 3 exchanges are NYSE (market cap $14.24 trillion), NASDAQ ($4.68 trillion) and the Tokyo Stock Exchange ($3.26 trillion) (RPlan, 2013).

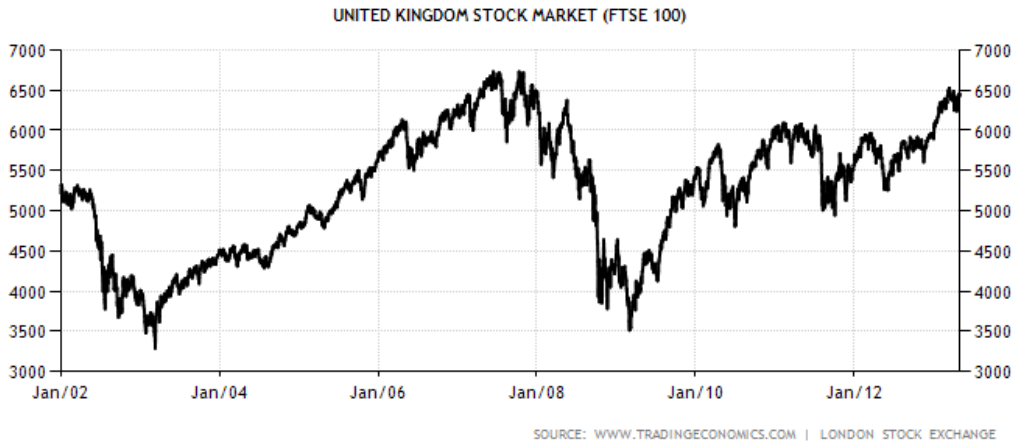
If we observe the long-term chart of the UK stock market, one could perceive that the line starts in the bottom left-hand corner and ends in the top right corner of the chart. Simply put, the trend over the decades has been up (along with a remarkable degree of volatility). However the UK has endured extraordinary crises in the last century, that had changed the landscape of the economy overall (Stock Market Almanac, 2013).



In our research we put an emphasis on the economic downturn which as a variation of the term business-cycle we find very interesting. The economy of the UK and thus the publicly owned firms, have been greatly affected by the recent global financial crisis. While not as deep as the slump of the early 1920s, the recession that began between the run on Northern Rock in September 2007 and the collapse of Lehman Brothers a year later has proved the most stubborn in Britain's modern history (Elliott, 2012).

The London Stock Exchange fell by more points in a day than ever before, as the deepening global financial crisis hit markets across the world, thus

suffering the worst fall in history. The FTSE in late 2008 lost almost a third of its value in the previous year of 2007.



As we can observe from the graph above there are two important recessions in the last decade: the Internet bubble and the recent financial crisis. In the late 90s, the Internet created a euphoric attitude towards business and inspired many investors of the aspirations of the online commerce. Solely for this reason, many online firms were launched, and investors were optimistic that if a company operated online it is going to be worth a lot of money. However, this overly enthusiastic expectations of the potential of the Internet resulted with the infamous "dot-com bubble" with severe global implications which impacted the UK as well (Smith, 2013). The current financial crisis on the other hand, is the worst the world has seen since the Great Depression of the 1930s.

In the new, globalized world of closely interdependent economies, the crisis affected almost every part of the world, receiving extensive coverage in the international media (Yale Global, 2013).

3.2 Procyclical stocks and their returns

In their paper, Goetzmann et al (2012) study the relationship between procyclical stocks and their return i.e. whether these stocks are compensated with a higher risk premium as they bear more risk. Procyclical stocks are defined as those stocks ”*whose returns commove with the business cycles*” (Goetzmann et al, 2012, p 3). They base their study on the US market, for a time period of 50 years. Their reasoning is that if the stocks should move with the market then their returns should be higher since the investor is more exposed to risk. Risks that are caused by recessions or distress, in other words, not related to the market movements, offer higher risk premia and as such the theory that their returns are independent no longer holds (Cochrane, 1999).
The connection between stock prices and the expected economic situation has been established a long time ago (Schwert, 1989). Recessions together with the failure of financial institutions increase stock volatility causing investors to be subject to high permanent losses (Bernanke, 1983).

Goetzmann et al (2012) focus on the expected real GDP growth rate and state that when the economy is expected to perform badly in the future, the expected returns increase and vice versa. In their paper they collect data from the Livingston Survey after which they obtain the two period ahead expected real GDP growth rate. In the next step they performed a regression where they tested whether the expected GDP can predict the future excess return of the

market. They use four extra variables such as the dividend yield, the default spread, the consumption wealth ratio and the term spread. Their results show that their expected GDP does have the ability to predict the future market excess returns and therefore they move on to the cross-sectional pricing models.

First they look at the Asset Pricing Model where they estimate the expected returns. Next they move on to the Fama-MacBeth regressions, for which they sort their stocks into 25 portfolios. At this stage they present the results of the regressions in a table which contains the variables they used amongst which there is the excess market return, the expected GDP and two of the Fama French factors, SMB and HML. Their findings show that the stocks that commove with the market exhibit signs of procyclicality premium.
They form the procyclical returns according to the stocks' sensitivity to the real GDP growth rate. They then estimate the procyclicality premium and find that it is robust when it comes to the adjustment for such factors as the size, value, the standard market and the momentum factor (Goetzmann et al, 2012). Their analysis also shows that stocks that commove with the market i.e. are procyclical, do have larger returns.

3.3 The CAPM

The Capital Asset Pricing Model (CAPM) was developed by Lintner (1965) and Sharpe (1964). The CAPM affirms that the right measure of risk is a

measure called the market beta, and the risk premium per unit is the same for all assets. This model proposes a linear relationship between the expected return on individual assets and the market beta, or the "systematic risk". Following this logic, the authors state that the expected returns vary between different stocks only because they have a different market beta. Scholes, Black and Jensen (1972) test the underlying model by investigating if the intercepts from the cross-sectional and time series regressions of excess return on the market beta are collectively zero. The CAPM model also predicts that all other variables add nothing to the model and only the market beta has an explanatory power regarding the returns. Thus the differences in expected returns across various companies are completely explained by the differences in the beta (Lam, 2005).

The CAPM model presents a couple of simplifying assumptions which most relate to the investor behavior and the presence of s single risk factor. The first assumption is that only the expected return and volatility is what matters most to investors. Following the rational behavior, they would want to maximize the expected return for any level of risk. A follow up conclusion is that all investors have homogenous beliefs about the risk/return trade-offs. The final assumption is the already mentioned, market beta, as the common risk (Borchert, Ensz, Knijn, Pope & Smith, 2003).

The CAPM is a static, ex-ante model. The main prediction is that a market portfolio of invested wealth is mean-variance efficient resulting in a linear cross-sectional relationship between mean excess returns and exposures to the

market factor (Fama and French 1992). In its simplest form the CAPM is defined by the following equation (Bhatnagar, 2008).

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

Quite a few anomalies from the CAPM model were brought to light between the '80s and '90s. These deviations are considered as challenges to the effectiveness of the CAPM by arguing that the marker beta is not sufficient in explaining the stock returns. Many findings from other researches such as Basu (1977), Banz (1981), Bhandari (1988), Fama and French (1992) show that the market beta, as a sole factor, doesn't have the sufficient explanatory power that Sharpe (1964) and Lintner (1965) once stated (Lam, 2005).

3.4 Fama and French

The correlation between expected returns and market conditions has been studied for a while now. Fama and French (1989) observe that there is dependence between the two events; more precisely they state that during good economic times, the expected returns are lower than when faced with a crisis. Later they deepen their research by looking at what variables in particular drive the variations in the stock returns. They establish that the market equity and the book to market ratio are one of the two components that capture these variations (Fama & French, 1992). They also find no evidence or if any then a weak one, of a positive relationship between the beta and the stock returns. Therefore they reject the findings of scholars such as

Black, Jensen and Scholes (1972) who conclude that such a positive relationship does in fact exist.

Furthermore Fama and French (1993) observe that portfolios that simulate the risk factors related to the market capitalization and the book to market ratio, can be explained in a greater proportion by the variations in the market portfolio. Focusing on these two factors they find that the size of a company is related with its returns i.e. smaller companies earn less while the opposite is true for companies with a large market capitalization. The BM ratio is also related to profitability, as a high BM ratio implies lower returns since typically these are companies in financial distress while high BM ratios are for growth companies (Fama & French, 1995). Therefore on the basis of this finding, Fama and French develop a three-factor model which they claim to explain around 90% of the variations in a portfolio. The steps of the model are explained throughout the paper where we talk in more detail about the factors.

3.5 Fama-MacBeth Model

The Fama-MacBeth (1973) model is a widely utilized method that describes what factors affect the stock's return. This model motivates how much return an investor would receive for a particular amount of beta exposure. The main idea is the use of a time-series regression to estimate betas, also called the first-pass regression as well as the use of cross-sectional regressions to test the

hypothesis derived from the asset pricing model, known as the second-pass regression (Sylvain, 2012).

Models such as the Capital Asset Pricing Model, Arbitrage Pricing Theory or the Intertemporal Capital Asset Pricing Model, take the following form:

$$R = \beta\gamma$$

Where R denotes the asset's excess return, β is a factor loadings vector, and γ is the excess returns vector (Hsu, 2012). The Fama-MacBeth (1973) model provides a thorough explanation in order to describe the returns.

In a scenario where we have *n* stocks or assets, we want to test whether the various factors included in the regression can explain the returns of the portfolio and the premia corresponding to every factor. To do so the Fama-MacBeth (1973) model can be divided into two parts. The first-pass regression consists of running the adequate regression in order to estimate beta. Followed by the second-pass regression where for each stock we estimate the risk premium and intercept by a cross sectional regression (Holden, 2008). The first pass is a time-series regression model:

$$R_{n,t} = \alpha_n + \beta_{n,F1}F_{1,T} + \beta_{n,F2}F_{2,T} + \cdots + \beta_{n,Fm}F_{m,t} + \epsilon_{n,t}$$

Where $R_{n,t}$ denotes the returns, F denotes the factors, β is the vector of factor loadings, α_n and $\varepsilon_{n,t}$ is the intercept and error terms, respectively.

This describes how the portfolio's returns are affected by each factor. The premium awarded to each factor exposure is not known yet but will be calculated in the second-pass regression. In order to calculate the factors' premia, we must run a cross-sectional regression for every return, in the following form:

$$R_{i,T} = \alpha_T + \gamma_{1,T}\hat{\beta}_{i,F1} + \gamma_{2,T}\hat{\beta}_{i,F2} + \cdots + \gamma_{m,T}\hat{\beta}_{i,Fm} + \epsilon_T$$

The $\gamma_{i,T}$ terms are regression coefficients, $\hat{\beta}$ is the empirically estimated factor loading, α and ε is the intercept and error terms, respectively (Fama & MacBeth, 1973).

The process of calculating a single risk premium for every factor consists of obtaining the average of all the estimated factor parameters, in the end having one γ_j. To find the standard errors one has to treat each observation as an independent one and calculate a t-statistic. The following hypothesis is being tested: $\gamma_j=0$ and it can be computed using the following formula:

$$\frac{\gamma_j}{\sigma_{\gamma j}/\sqrt{T}}$$

Where $\sigma_{\gamma j}$ denotes the standard deviation. If only one regression would have been run, instead of multiple cross-sectional regressions, then the expression would have looked identical to the one of the first equation:

$$R_i = a + \gamma_1\beta_{i,F1} + \gamma_{2,T}\beta_{i,F2} + \cdots + \gamma_m\beta_{i,Fm}$$

Some of the factors can definitely explain the stock's returns. First, we can regress each stock's return against the factors to determine the exposure to the factors. Second, we can calculate the premium for a unit exposure to each factor by regressing the returns against the exposures in each period. Averaging the coefficients over time gives us the premium for unit factor exposure.

The factors chosen in the Fama-MacBeth (1973) regression can either be macroeconomic (unemployment rate, economic conditions) or tradable factors (like the excess return). There are number of advantages of using the tradable factors.

1. If the alpha terms from the first set of regressions is significantly positive or negative, the main explanation might be that the model is poorly or miss-specified.

2. One can reduce or increase the exposure to a factor in a way that the investor can simply purchase or sell the tradable factor portfolio itself.

3. Financial (numerical) data is almost always observed with higher caution and precision.

4. Macroeconomic factors are unlikely to occur on a quarterly or even annual time intervals. Tradable factors on the other hand can be tracked minute by minute (Hsu, 2012).

4.Empirical Findings

This part will present the results obtained after running and grouping the stocks into portfolios and running the regressions. We start with presenting some key summary statistics after which we summarize the values of the betas, BM and size into a table. Furthermore the results of the Fama and French regressions as well as the cross-sectional regressions are presented. The implications of these findings and their meaning will be discussed in the next chapter.

4.1 Summary Statistics

Table 4.1 shows the summary statistics after the assets have been sorted into 5 portfolios according to their excess return's sensitivity to the IP Index. The table below shows that the portfolios have a mean return ranging from 0.009 to 0.01. More information can be found in Table 1 in the Appendix which shows the returns for each portfolio in each individual month from January 2004 until January 2013. If we look at the variance then portfolio 2 has the lowest value, 0.004 while portfolio 3 has the largest value, 0.01. The standard deviation exhibits the same pattern i.e. portfolio 2 with a value of 0.066 is the lowest amongst the rest of the portfolios while portfolio 3 with a value of 0.14 is the highest. We have also counted the number of assets that are included in the portfolios each month. On average there are 11 stocks with plus or minus one for some months. Since we have 55 stocks in total this is an indication that the number of stocks is evenly distributed across the portfolios.

Table 4.1: Summary statistics

	Mean	Variance	St. dev	Number of assets/month	
				min	**max**
Portfolio 1	0.010837	0.005674	0.075323	11	12
Portfolio 2	0.013231	0.004409	0.066399	11	12
Portfolio 3	0.021359	0.018363	0.135509	10	11
Portfolio 4	0.009379	0.005059	0.071124	11	11
Portfolio 5	0.021653	0.006655	0.081578	11	11

This table presents the mean, variance, standard deviation and number of assets per month for each portfolio. The portfolios were formed according to their sensitivity to the IPI beta.

4.2 Beta, BM and Market Capitalization

The results representing the average betas, BM and size values are represented in Table 4.2. The smallest beta belonging to the first portfolio has a value of -4.501 after which it grows up to 7.6 for the last portfolio.

It is also of interest for the analysis to calculate the average Market to book ratio and average size corresponding to each portfolio. Later in the paper we will discuss whether there is any connection between the stocks' excess return sensitivity to the IPI and the size or BM of a company. At this point we can say that the lowest BM value of 0.88 belongs to the third portfolio, while the first portfolio has the highest value, 1.98.

When it comes to the size, the difference between portfolio 2 which has the smallest market capitalization and portfolio 5 with the largest size as well as the highest beta, is equal to approximately 340 000.

Table 4.2: IPI betas and the average book to market ratios and market capitalization

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
Average IPI beta	-4.501	-0.497	1.025	2.651	7.590
Average BM	1.975	1.053	0.882	1.859	1.864
Average Size	642037.3	902404.8	874076.1	901811.6	558217.4

This table shows the average IPI beta, average BM and average Size for each portfolio. First an average for each month was calculated after which we computed the average for the time period January 2004-January 2013.

4.3 Fama-French Regressions output

Table 4.3 represents the output of the regression between the three Fama-French factors and the HMLpro portfolio which was calculated by subtracting portfolio with the lowest revenues from the portfolio with the highest revenues. The results suggest that the R^2 is low with a value of 0.04 therefore the variations in the portfolio are barely explained by the three factors.

Table 4.3: Regression output between the HML and the Fama-French 3 factors

	Coefficients	Standard Error	t Stat	P-value
Intercept	0,013779	0,008404	1,639597	0,104082
Rm-Rf	-0,00345	0,001757	-1,96474	0,052086
SMB	0,002379	0,004381	0,543001	0,58828
HML	0,004844	0,004903	0,987832	0,325506
R Square				0,0373

The output of the regression showing the coefficients, the standard error, the t-statistic and the p-value for the intercept and the three European Fama-French factors from K. French's webpage.

The intercept has a positive value of 0.01 which implies that the companies from this portfolio outperformed the benchmark value by 0.01 on a monthly basis. The second row shows the market loading which is negative and has a value of -0.003.

The SMB factor loading is equal to 0.0024 which is close to 0 and therefore implies that the companies have a rather large market capitalization, a number larger than 0.5 would have suggested the opposite.

The HML value in the fourth row is positive and it is 0.005. This tells us that the portfolio is a growth one since it is again close to 0 while a value greater than 0.3 would have suggested the existence of a value fund.

We performed several such regressions using different combinations of HML_{pro} portfolios. The results are similar to ones discussed and range from a R^2 of 0.03 to 0.08. However when we run the regression for each individual portfolio the goodness of fit increases up to approximately 50% for the fourth portfolio. These numbers are shown in Table 4.4.

Table 4.4: Regression output between portfolio 4 and the Fama-French 3 factors

	Coefficients	Standard Error	t Stat	P-value
Intercept	0,003687	0,004945	0,745631	0,457556
Rm-Rf	0,007377	0,001034	7,137111	1,28E-10
SMB	0,009148	0,002577	3,549143	0,00058
HML	0,001483	0,002885	0,513981	0,608346
R Square				0,495

Regression output between the Fama-French factors and the fourth portfolio. It presents the coefficients, standard error, t-statistic and p-value for the intercept and the three factors.

4.4 Cross-sectional Regressions

We present the results of the cross-sectional regressions in Figure 4.1 which has only the annual values. A table with the monthly values is presented in the Appendix in Table 3.

We notice that the size risk premium or γ_{SMB} has the highest value, 0.0093, in 2006 and rapidly decreases in 2008 and reaches a value of -0.00432. The opposite is true for the equity premium or γ_{HML} which reaches a peak in 2008 after which in 2009 registers the lowest value. The relationship with the economical situation can be easily observed. We can see the equity risk premium rising faster from the middle of 2007 when the market became riskier and more uncertain. For this reason investor demand a higher compensation for taking on more risk. When it comes to γ_{SMB} this represents the premium that an investor would receive for taking on additional risk from investing in a company with a small market capitalization. If we look at the market premium than it moves in the same direction as the SMB premium does however its lowest value was in 2010 previously followed by a peak in 2009.

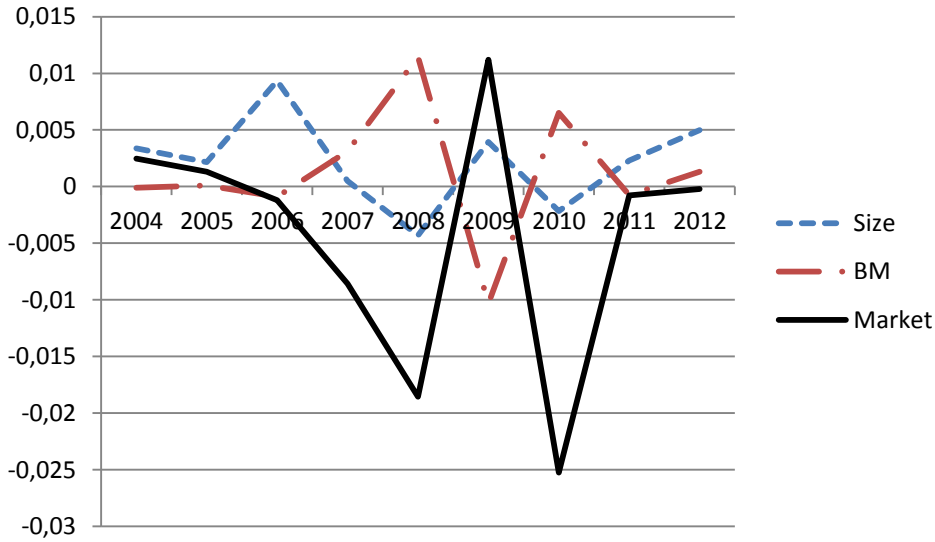


Figure 4.1: Average annual risk premia.

Figure representing the annual risk premia obtained after the cross-sectional regressions were run. γ_{SMB} and γ_{HML} are denoted by size and BM respectively in the legend while the last premium is the market premium.

5.Analysis

This section of the paper will deal with the analysis of the results obtained after testing our data and running the regressions. The empirical findings will be explained with the help of the models described so far, together with our own interpretation of the results.

Figure 5.1 is a graphical representation of the summary statistics that can be found in Table 4.1. As noted the third and fifth portfolios have the highest mean return and the same pattern when it comes to the variance and standard deviation. This relationship between the variance and the expected mean return has been previously analyzed by Markowitz (1952) which observes that yield and risk of a portfolio are codependent. As the rational investor wants to maximize his earnings, the reward that he receives for a portfolio with a higher risk, should be higher.

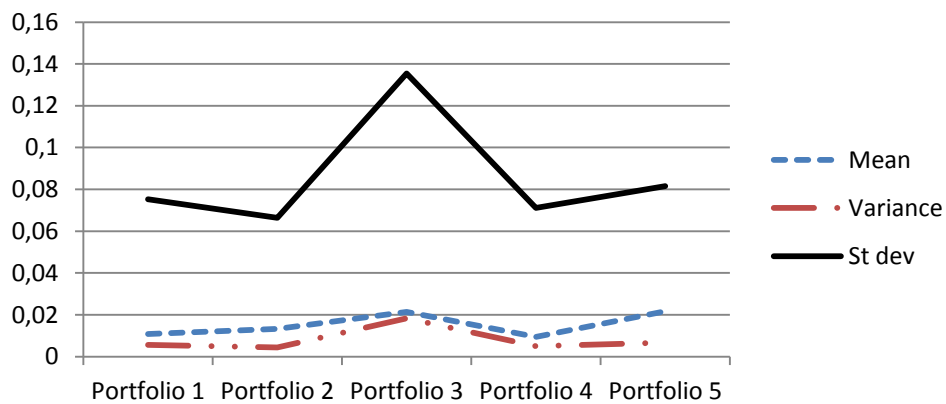


Figure 5.1: Summary Statistics
A representation of Table 4.1 showing the mean, variance and standard deviation for each portfolio

Table 2 from the Appendix comprises all the summary statistics for each month for all companies together.

Table 4.2 shows that the betas of the first two portfolios represent countercyclical stocks while the betas of the last three portfolios are procyclical. Our findings support the observations made by Goetzmann et al. (2012) which say that the book to market ratio does not exhibit any patterns when it comes to the increasing value of the beta while the size suggests that companies with a higher beta generally have a small market capitalization. This implies that procyclical stocks usually tend to be smaller in size and therefore have a lower market capitalization while the opposite is true for the countercyclical stocks. Jegadeesh and Titman (1993) have also studied this phenomenon and conclude that market capitalization is connected to a stock's beta.

Moving on to the Fama and French factors, Table 4.3 indicates that the three factors have a weak explanation power for the HML portfolio constructed by us. However we notice that the Fama and French factors explain a lot better the variations within the portfolio. For a more thorough analysis we focus on the cross-sectional regressions following Fama-MacBeth.

Before proceeding to the cross-sectional regression part of this paper it is important to take into account a possible drawback from the first stage time-series regression. The estimated betas that are carried through to the second

stage cross-sectional regression might contain the errors-in-variables problem. Kim (1995) notes that this errors-in-variables problem (EIV) results in an overestimation of the risk premia of the factors included and underestimation of the market risk premium (Mouselli, 2008).

Fama proposes two solutions to overcome this problem. First he suggests working with portfolios instead of using individual stocks, second he proposes calculating betas from long time series of monthly returns in order to decrease the standard deviation of the estimated betas. Following Fama's approach, we precisely did that: formed portfolios and estimated the monthly betas in the entire period of research. However, not even this method comes without flaws. The construction of portfolios doesn't mitigate the problem per se, but it introduces another one. The allocation of stocks into portfolios will emerge in loss of information; however, this loss can be decreased by forming portfolios on ranked values of betas (Mouselli, 2008).

Following the Fama-MacBeth cross-sectional regression procedure, after estimating the market beta (as the exposure to the market factor) we use the estimates in the cross-sectional regression. The estimated betas are used as explanatory variables, while the excess returns as the explained variables (equation (4)) (Mouselli, 2008).
We test for significance using a t-test and report the results in Table 5.1. By default, statistical programs report a t-stat with $\beta_0=0$ i.e. they test for significance of the corresponding regressor. We follow the same cross-sectional

procedure for the Fama-French risk factors (market beta, size, book-to-market). Using the following equation we estimate the portfolios' exposures to the market factor, HML and SMB by running the regressions of the excess returns against the mentioned variables over the whole period.

Each cross-sectional regression will give us an estimate of the risk premia γ_M, γ_{HML} and γ_{SMB} associated with the exposure (beta) to the market, HML and SMB. Finally the previous two steps are repeated for each month, providing each variable a time series of its corresponding risk premium γ_M, γ_{HML} and γ_{SMB}. The averages of these estimates are tested by a t-test for significant differences from zero.
Following the described steps we obtained the values from Table 5.1.

Table 5.1: T-stat results

	Intercept	**GDP beta**	**Market beta**	**Size (SMB)**	**B-to-M (HML)**
Average	-0,009	0,0016	-0,0044	0,00224	0,00115
Standard D	0,146	0,0104	0,0395	0,01294	0,01624
t-statistic	**-0,643**	**1,6395**	**-1,1565**	**1,79593**	**0,73818**
p-value	0,261	0,0520	0,1250	0,03766	0,23101

The second row consists of the average values of all the risk premia in the sampling period (22.01.2004 – 22.12.2012). The third row is the standard deviation of the risk premia, followed by the t-statistic. The t-stat is necessary for calculating the p-value which is the probability of obtaining a test stat that is at least as extreme as the one actually observed, assuming the null hypothesis

is true. The null hypothesis in this case is that the risk factor's beta is zero i.e. the loading factor does not have any explanatory power when it comes to the excess returns of the observed portfolios. We take our predetermined significance level to be 0.05.

Finally, we compare the p-values to the significance level to determine whether there is any significance in the risk factors. Only the size factor's p-value is less than 0.05 meaning there is some evidence against the null hypothesis in favor of the alternative. Therefore, the size (proxied by the Small-Minus-Big cap) is significant in explaining the excess returns in the UK. The GDP beta has some weak explanatory power as well, as the p-value is in the range of 0.05-0.10, although not as strong as the size factor. The market beta and the HML factor have p-values greater than 0.1 which means there is no evidence against the null hypothesis. This is an interesting revelation especially when it comes to the market beta. The capital asset pricing model introduced by Treynor, Sharpe, Lintner and Mossin as a single factor model utilizes the market beta as a sole component to explain the excess return of a stock/portfolio. Our results from this paper basically nullify to a certain extent this explanatory power of the market beta, and rather put an emphasis on other factors like the sensitivity to GDP and the size as main drivers of the returns to the 55 procyclical companies from the UK in the sample period from 2004 to 2012.

6. Conclusion

This chapter summarizes what has been discussed so far in this paper by reviewing the approach and methodology used to obtain the results as well as by presenting the findings that have been analyzed in the previous chapter.

This paper focuses on examining the returns of the stocks that commove with the market i.e. procyclical stocks. It discusses 55 stocks that have been listed on LSE over the past ten years. We use the methods and models developed by Fama and French (1992) and Fama-MacBeth (1973) in order to establish which risk factors have the power to explain the changes in the returns of the stocks that commove with the market. We examine parameters such as: beta GDP, beta IPI, book to market ratio, market capitalization etc. and utilize them both in time-series regressions as well as in cross-sectional regressions.

Our results suggest that not all three factors are significant. We find that the SMB factor does have the potential to explain the variations in the procyclical portfolios while the other two factors do not show such significance and are therefore irrelevant. As concluded by Goetzmann et al. (2012), we also find evidence that companies with a small market capitalization tend to be procyclical, having a higher beta and implicitly a lot more risk. The smaller the size of a company the more affected it is by the fluctuations on the market. This can be well observed during the financial crisis in 2007.

Finally, for future research of this topic we suggest future scholars to choose a wider sample of stocks and also a bigger time frame such as half a century or a century. This will allow the formation of a larger number of portfolios that comprise more companies each. Thus it will enable the research to be more thorough and increase its reliability.

References

ADVFN (2013). London Stock Exchange. Retrieved on 28 April 2013, from http://uk.advfn.com/exchanges/LSE.

Basu, S. (1977). Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis, *Journal of finance, 32*, 663-682.

Banz, R.,W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics, 9*, 3-18.

Bernanke, B., S. (1983). Nonmonetary Effects of the financial crisis in the propagation of the Great Depression. *The Ametican Economic Review*, 257-276.

Bhandari, C., L. (1988). Debt/equity ratio and expected common stock returns: Empirical Evidence, *Journal of Finance, 43*, 507-528.

Bhatnagar C. S., (2008) The Capital Asset Pricing Model versus the three factor model: A United Kingdom Perspective. *The University of West Indies*

Borchert, A., Ensz, L., Knijn, J., Pope, G., & Smith, A. (2003) Understanding Risk and Return, the CAPM and the Fama-French Three-Factor Model. *Tuck School of Business at Dartmouth.*

Chen, N., Roll, R. & Ross, S.A. (1986). Economic forces and the stock market. *Journal of Business, 59*, 383–403.

Elliott, L. (2012). British Recessions – A Short History. Retrieved on 4 April 2013, from http://www.guardian.co.uk/business/2012/dec/07/britain-recessions-history-

Cochrane, J., H. (1999). New facts in finance. *National Bureau of Economic Research*.

Fama E., F. & French K., R. (1989). Business conditions and expected returns on stocks and bonds. *Journal of Financial Economics, 25*, 23-49.

Fama E., F. & French K., R. (1992).The Cross-Section of Expected Stock Returns. *Journal of Finance, 47*, (2), 427–465.

Fama E., F. & French K., R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*, 3-56.

Fama E., F. & French K., R. (1995). Size and Book-to-Market Factors in Earnings and Returns. *Journal of Finance, 50*(1), 131-155.

Fama, E., F. & MacBeth, J., D. (1973). Risk, Return and Equilibrium: Empirical Tests. *Journal of Political Economy, 81*, 607–36.

Goetzmann, W., Watanabe, A. & Watanabe, M. (2012). Procyclical Stocks Earn Higher Returns.

Higher, L. (2013). The financial crisis of 2007/2008 and its impact on the UK and other economies. *University of Liverpool*.

Holden, C.,W. (2008). *Excel modeling and estimation in investment*. Third Edition, Prentice Hall, New Jersey.

Investopedia (2013). London Stock Exchange LSE. Retrieved on 24 April 2013, from http://www.investopedia.com/terms/l/lse.asp.

Jegadeesh, N. & Titman, S. (2001). Profitability of momentum strategies: an evaluation of alternative explanations. *The journal of finance, 2*, 699-720.

Jensen, M.,C., Black, F., & Scholes, M.,S. (1972). *The capital asset pricing model: some empirical tests*. Praeger Publishers.

Kan, R. & Zhang, C. (1999). Two-Pass Tests of Asset Pricing Models with Useless Factors. *Journal of Finance, 54*, (1), p203–35.

Kim, D. (1995). The errors-in-variables problem in the cross-section of expected stock returns. *Journal of Finance, 50*(5).

Lam, K. (2005). Is the Fama-French three-factor model better than the CAPM? Simon Fraser University.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The Review of Economics and Science, 47*(1), 13-37.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance,7*(1), 77.

Mouselli S. (2008) Fama and French Factors, Their Definition in the UK, and Their Relationship with Macroeconomic Variables. *Manchester Business School.*

RPlan (2013). Brief History of The London Stock Exchange. Retrieved on 28 April 2013, from https://www.rplan.co.uk/post/1327/brief-history-of-the-london-stock-exchange.

Schwert, G.,W. (1989). Why does stock market volatility change over time?. *The Journal of Finance, 44*(5), 1115-1152.

Sharpe, W.,F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance, 19*(3), 452-442.

Smith, E. (2013). History of the Dot-Com Bubble Burst and How to Avoid Another. Retrieved on 27 April 2013, from http://www.moneycrashers.com/dot-com-bubble-burst/#ixzz2S9jDNHgi.

Stock Market Almanac (2013). Long Term Trend of The UK Market. Retrieved on 24 April 2013, from http://stockmarketalmanac.co.uk/category/market-2/.

The BBC (2013). Economy Tracker: GDP, Retrieved on 4 April 2013, from http://www.bbc.co.uk/news/10613201.

The Encyclopedia of New Zealand (2013). Business Cycles. Retrieved on 3 April 2013, from http://www.teara.govt.nz/en/business-cycles/page-1.

Yale Global (2013) Global Economic Crisis. Retrieved on 30 April 2013, from http://yaleglobal.yale.edu/content/global-economic-crisis.

Appendix

Table 1: Monthly returns for each portfolio

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5
1/1/2004	0.318848	0.025519	0.080091	0.0859	0.12741
2/2/2004	0.083346	0.019297	0.015269	0.0767	0.148564
3/1/2004	-0.03359	0.003299	-0.00648	-0.0398	-0.019434
4/1/2004	0.016455	-0.01002	-0.03664	0.0078	-0.005638
5/3/2004	-0.03952	0.022223	-0.03221	-0.1135	0.153627
6/1/2004	0.018032	0.032231	-0.02522	0.0337	-0.109313
7/1/2004	-0.05213	-0.05682	-0.05336	-0.0268	-0.008868
8/2/2004	0.023462	-0.03985	0.048646	-0.0106	0.062672
9/1/2004	-0.01456	-0.01612	0.017826	0.0517	0.025722
10/1/2004	-0.00507	0.034176	-0.01343	0.0348	-0.017565
11/1/2004	-0.05857	-0.00298	0.072265	0.016	0.14409
12/1/2004	-0.00065	0.00476	0.047666	0.0149	0.009202
1/3/2005	-0.02543	0.076249	0.049978	0.0118	0.033822
2/1/2005	0.030448	0.006342	0.0319	0.0539	0.066916
3/1/2005	-0.02898	-0.00831	-0.0224	-0.0024	-0.063837
4/1/2005	-0.08445	-0.02545	-0.03623	-0.0623	-0.053831
5/2/2005	-0.03778	0.007043	0.04658	-0.0223	0.021682
6/1/2005	0.115223	0.35303	0.007932	0.0635	-0.034576
7/1/2005	0.225006	0.044224	0.049251	0.0467	-0.026569
8/1/2005	0.002601	0.017218	-0.01402	0.0416	0.047459
9/1/2005	0.038465	0.021903	0.065113	0.046	0.070247
10/3/2005	-0.03448	-0.02219	0.0359	-0.0646	0.049195
11/1/2005	0.004411	0.127743	0.05162	0.0547	0.024566
12/1/2005	0.034188	0.042876	0.037776	-0.0062	0.097682
1/2/2006	0.124392	0.20388	0.057454	0.0175	0.1261
2/1/2006	0.08856	0.044618	0.118459	0.0104	-0.017843
3/1/2006	0.001531	-0.03005	0.020637	0.0286	0.117162
4/3/2006	0.055637	-0.03025	0.043001	0.043	-0.005744
5/1/2006	-0.02932	-0.09986	0.025854	-0.055	-0.001606
6/1/2006	-0.04728	-0.01266	-0.00644	0.0372	-0.038456
7/3/2006	0.041748	-0.00172	-0.00989	0.082	0.036157

8/1/2006	0.068924	0.019344	0.00705	0.0402	-0.024327
9/1/2006	-0.023	-0.00465	0.071863	0.0166	0.398336
10/2/2006	0.122397	0.041164	0.018953	0.0378	0.051437
11/1/2006	0.004815	-0.03599	0.056197	0.0792	-0.071246
12/1/2006	0.079418	0.029416	0.078464	0.1385	0.005056
1/1/2007	0.114111	0.102301	-0.03158	-0.0285	-0.005625
2/1/2007	-0.01454	0.095578	0.004084	0.0206	0.032933
3/1/2007	-0.05235	0.064851	0.0382	-0.0179	-0.004484
4/2/2007	0.088613	0.043573	0.07922	0.0015	-0.011826
5/1/2007	0.005795	0.003016	0.027279	-0.0131	-0.043
6/1/2007	-0.06783	-0.00827	0.050414	-0.0236	-0.007314
7/2/2007	0.058467	-0.00804	-0.06893	-0.0133	0.003398
8/1/2007	-0.04138	-0.03963	-0.0397	-0.0128	-0.072503
9/3/2007	-0.05941	-0.04981	-0.00564	0.0079	-0.057791
10/1/2007	-0.04996	0.054423	0.011202	0.2263	0.027442
11/1/2007	-0.02168	-0.02538	-0.06373	-0.0945	-0.118963
12/3/2007	0.004996	0.009608	0.005268	-0.1109	0.019561
1/1/2008	-0.00715	-0.1144	-0.05334	-0.0763	-0.037207
2/1/2008	-0.05199	0.01673	0.00171	0.0149	0.090878
3/3/2008	-0.11108	-0.05341	-0.0477	-0.0181	-0.117267
4/1/2008	0.041483	-0.00971	0.020067	0.045	0.076433
5/1/2008	0.082787	0.062959	-0.0158	0.0146	0.062151
6/2/2008	-0.05792	-0.06731	-0.10805	-0.1729	0.002138
7/1/2008	-0.07991	-0.04841	-0.00306	-0.1482	-0.029249
8/1/2008	-0.03004	0.000258	-0.01761	-0.0074	0.037686
9/1/2008	-0.19856	-0.09203	-0.17366	-0.2064	0.000622
10/1/2008	-0.15989	-0.10623	-0.18977	-0.1701	-0.124663
11/3/2008	-0.02434	-0.05205	-0.03259	-0.0418	-0.031268
12/1/2008	0.016781	0.004535	-0.11556	-0.0154	0.065382
1/1/2009	0.00093	-0.03919	-0.01503	0.0058	0.017632
2/2/2009	-0.01227	-0.01471	-0.01673	0.0056	-0.037807
3/2/2009	-0.0369	0.076804	0.104002	0.0832	0.160825
4/1/2009	0.228349	0.085661	0.074235	0.3446	0.257592
5/1/2009	0.017551	0.142487	0.00082	0.0182	0.150481
6/1/2009	0.071607	-0.01537	-0.02563	-0.0008	0.141209
7/1/2009	0.077192	0.025933	0.001205	0.1444	-0.041967

8/3/2009	0.067305	0.058539	0.01847	0.0992	0.107415
9/1/2009	0.030069	0.033429	0.073718	0.0679	0.117678
10/1/2009	0.006117	-0.0156	0.053813	-0.0184	-0.102353
11/2/2009	-0.02396	0.075733	0.026297	0.0064	-0.035761
12/1/2009	0.035627	0.024497	-0.03686	-0.0121	-0.05227
1/1/2010	0.029008	0.004777	1.315592	0.0228	0.113199
2/1/2010	-0.02492	0.047582	-0.01999	-0.009	0.00592
3/1/2010	0.030112	0.173375	0.140232	0.062	0.198763
4/1/2010	0.001299	0.035112	0.080967	-0.0188	0.027039
5/3/2010	-0.00747	-0.08003	-0.04879	-0.1238	0.011876
6/1/2010	0.032564	-0.04282	0.01722	0.0638	-0.057242
7/1/2010	-0.00141	-0.00683	0.005883	0.012	-7.06E-05
8/2/2010	-0.01687	-0.01908	0.013274	0.0295	0.017827
9/1/2010	0.116659	0.024559	0.036314	0.1112	0.081539
10/1/2010	-0.01372	-0.06745	0.087245	-0.0015	-0.01872
11/1/2010	-0.0673	0.034351	0.007422	-0.0052	-0.060457
12/1/2010	0.171891	0.060591	0.032563	0.0196	0.063176
1/4/2011	0.03543	0.126361	0.015395	0.0308	0.039763
2/1/2011	0.027003	-0.00266	-0.0153	0.0228	0.030142
3/1/2011	-0.03744	0.039148	0.026449	-0.001	-0.010365
4/1/2011	-0.01868	0.002791	0.02145	0.0394	-0.02928
5/3/2011	-0.01827	-0.0554	0.004603	-0.0464	0.02778
6/1/2011	0.025929	0.053459	-0.03207	0.0361	-0.098269
7/1/2011	-0.10251	0.011079	-0.0292	0.0068	-0.069461
8/1/2011	-0.09906	-0.08137	-0.0582	-0.0727	-0.020857
9/1/2011	-0.00679	-0.05436	-0.01455	-0.06	-0.009292
10/3/2011	0.016595	0.030033	0.02074	0.0068	0.069986
11/1/2011	0.085067	-0.01959	0.000672	0.028	0.037371
12/1/2011	0.002543	0.00771	-0.02096	-0.0514	-0.095434
1/2/2012	0.11946	0.035321	0.106725	0.0549	0.192762
2/1/2012	0.068982	0.090587	0.066652	0.0265	0.074455
3/1/2012	-0.04065	0.015423	-0.04619	-0.0094	-0.028094
4/2/2012	0.027542	-0.04151	0.006508	-0.0148	0.012995
5/1/2012	-0.06814	-0.12228	-0.01896	-0.0399	-0.035208
6/1/2012	-0.05503	-0.02537	0.013085	-0.0212	-0.03105
7/2/2012	0.020632	0.008988	0.007667	-0.0325	-0.002342

8/1/2012	0.091911	-0.01822	0.030022	0.0457	0.095696
9/3/2012	-0.09624	0.032514	-0.01743	0.0493	-0.026105
10/1/2012	-0.0499	0.020116	0.030683	0.0212	0.050729
11/1/2012	-0.0061	0.05963	0.039023	0.0051	-0.032074
12/3/2012	0.029159	0.009379	0.064524	0.0979	-0.015385
1/1/2013	0.150261	0.155229	0.030342	0.0668	0.090442

Table 2: Monthly summary statistics for all the stocks

	Mean	**Variance**	**St Dev**
1/1/2004	0.13	0.2018	0.4533
2/2/2004	0.07	0.0338	0.1857
3/1/2004	-0.02	0.0117	0.1089
4/1/2004	-0.01	0.0116	0.1078
5/3/2004	0.00	0.0760	0.2781
6/1/2004	-0.01	0.0171	0.1315
7/1/2004	-0.04	0.0088	0.0938
8/2/2004	0.02	0.0101	0.1016
9/1/2004	0.01	0.0173	0.1316
10/1/2004	0.01	0.0116	0.1080
11/1/2004	0.03	0.0361	0.1916
12/1/2004	0.01	0.0112	0.1069
1/3/2005	0.03	0.0137	0.1179
2/1/2005	0.04	0.0115	0.1064
3/1/2005	-0.02	0.0119	0.1101
4/1/2005	-0.05	0.0136	0.1177
5/2/2005	0.00	0.0251	0.1596
6/1/2005	0.10	0.2690	0.5235
7/1/2005	0.07	0.0400	0.2018
8/1/2005	0.02	0.0146	0.1218
9/1/2005	0.05	0.0189	0.1383
10/3/2005	-0.01	0.0146	0.1211
11/1/2005	0.05	0.0165	0.1295
12/1/2005	0.04	0.0383	0.1975
1/2/2006	0.11	0.0618	0.2507
2/1/2006	0.05	0.0700	0.2671

3/1/2006	0.03	0.0278	0.1679
4/3/2006	0.02	0.0102	0.1018
5/1/2006	-0.03	0.0304	0.1754
6/1/2006	-0.01	0.0068	0.0834
7/3/2006	0.03	0.0237	0.1548
8/1/2006	0.02	0.0186	0.1376
9/1/2006	0.09	0.2948	0.5476
10/2/2006	0.05	0.0238	0.1556
11/1/2006	0.01	0.0428	0.2089
12/1/2006	0.07	0.0227	0.1521
1/1/2007	0.03	0.0280	0.1684
2/1/2007	0.03	0.0195	0.1408
3/1/2007	0.01	0.0140	0.1187
4/2/2007	0.04	0.0240	0.1562
5/1/2007	0.00	0.0121	0.1103
6/1/2007	-0.01	0.0135	0.1173
7/2/2007	-0.01	0.0309	0.1770
8/1/2007	-0.04	0.0084	0.0921
9/3/2007	-0.03	0.0185	0.1357
10/1/2007	0.05	0.0847	0.2937
11/1/2007	-0.06	0.0457	0.2157
12/3/2007	-0.01	0.0253	0.1603
1/1/2008	-0.06	0.0158	0.1254
2/1/2008	0.01	0.0152	0.1245
3/3/2008	-0.07	0.0096	0.0985
4/1/2008	0.03	0.0117	0.1085
5/1/2008	0.04	0.0312	0.1782
6/2/2008	-0.08	0.0359	0.1909
7/1/2008	-0.06	0.0201	0.1432
8/1/2008	0.00	0.0164	0.1273
9/1/2008	-0.13	0.0492	0.2199
10/1/2008	-0.15	0.0300	0.1716
11/3/2008	-0.04	0.0294	0.1726
12/1/2008	-0.01	0.0453	0.2106
1/1/2009	-0.01	0.0449	0.2134
2/2/2009	-0.02	0.0266	0.1613

3/2/2009	0.08	0.1003	0.3147
4/1/2009	0.20	0.0842	0.2925
5/1/2009	0.07	0.0465	0.2174
6/1/2009	0.03	0.0541	0.2346
7/1/2009	0.04	0.0227	0.1499
8/3/2009	0.07	0.0366	0.1930
9/1/2009	0.06	0.0165	0.1295
10/1/2009	-0.02	0.0458	0.2159
11/2/2009	0.01	0.0234	0.1517
12/1/2009	-0.01	0.0153	0.1247
1/1/2010	0.27	2.5383	1.6074
2/1/2010	0.00	0.0100	0.1007
3/1/2010	0.12	0.0324	0.1814
4/1/2010	0.02	0.0181	0.1344
5/3/2010	-0.05	0.0336	0.1851
6/1/2010	0.00	0.0272	0.1655
7/1/2010	0.00	0.0125	0.1111
8/2/2010	0.00	0.0182	0.1362
9/1/2010	0.08	0.0507	0.2267
10/1/2010	0.00	0.0335	0.1849
11/1/2010	-0.02	0.0134	0.1161
12/1/2010	0.07	0.0251	0.1595
1/4/2011	0.05	0.0384	0.1970
2/1/2011	0.01	0.0100	0.1011
3/1/2011	0.00	0.0141	0.1199
4/1/2011	0.00	0.0096	0.0986
5/3/2011	-0.02	0.0116	0.1085
6/1/2011	0.00	0.0123	0.1121
7/1/2011	-0.04	0.0164	0.1292
8/1/2011	-0.07	0.0144	0.1203
9/1/2011	-0.03	0.0155	0.1224
10/3/2011	0.03	0.0180	0.1311
11/1/2011	0.03	0.0304	0.1760
12/1/2011	-0.03	0.0125	0.1130
1/2/2012	0.10	0.0423	0.2076
2/1/2012	0.07	0.0143	0.1205

3/1/2012	-0.02	0.0164	0.1287
4/2/2012	0.00	0.0150	0.1230
5/1/2012	-0.06	0.0104	0.1010
6/1/2012	-0.02	0.0110	0.1049
7/2/2012	0.00	0.0178	0.1345
8/1/2012	0.05	0.0306	0.1761
9/3/2012	-0.01	0.0352	0.1894
10/1/2012	0.01	0.0163	0.1288
11/1/2012	0.01	0.0069	0.0837
12/3/2012	0.04	0.0177	0.1341
1/1/2013	0.10	0.0743	0.2752

Table 3: CSR results

	Intercept	**GDP_beta**	**Market beta**	**Size**	**BM**
2004-01-22	0,51888	0,00850	-0,02535	-0,03642	-0,00063
2004-02-22	-0,00551	0,01100	0,04630	0,00377	0,00044
2004-03-22	-0,08374	-0,00019	-0,00089	0,00614	-0,00034
2004-04-22	-0,14098	-0,00470	-0,00675	0,01401	0,00002
2004-05-22	-0,15773	0,04404	-0,01877	0,01238	-0,00013
2004-06-22	-0,13342	-0,02216	-0,00019	0,01375	-0,00015
2004-07-22	-0,05879	0,00022	-0,00413	0,00161	-0,00002
2004-08-22	-0,01429	0,00609	0,01449	0,00154	-0,00004
2004-09-22	-0,13215	0,00042	0,02709	0,01246	-0,00021
2004-10-22	-0,06688	-0,00024	0,02445	0,00671	-0,00030
2004-11-22	0,10251	0,01319	-0,01081	-0,00732	-0,00004
2004-12-22	-0,10500	0,00277	-0,01596	0,01181	0,00012
2005-01-22	0,03050	0,00081	0,00309	-0,00022	0,00011
2005-02-22	0,03683	0,00243	0,00134	-0,00016	-0,00106
2005-03-22	-0,14944	-0,00144	-0,00638	0,01218	0,00018
2005-04-22	-0,14199	0,00820	0,00907	0,00810	-0,00333
2005-05-22	-0,01991	-0,00203	-0,00336	0,00089	0,00379
2005-06-22	-0,04131	-0,01638	0,04871	0,01334	-0,00051
2005-07-22	0,06087	-0,01552	-0,01528	0,00351	-0,00608

2005-08-22	0,09031	-0,00283	-0,01667	-0,00612	0,00113
2005-09-22	0,05890	0,00098	-0,00473	-0,00258	0,00582
2005-10-22	0,10179	0,00567	-0,00577	-0,00925	-0,00087
2005-11-22	-0,04376	0,00028	0,01976	0,00807	-0,00145
2005-12-22	0,06775	0,01586	-0,01414	-0,00179	0,00333
2006-01-22	0,24696	-0,00192	0,01372	-0,01200	-0,01114
2006-02-22	-0,18857	-0,02221	-0,03505	0,02718	-0,00039
2006-03-22	-0,01797	0,00794	0,01544	0,00097	0,00493
2006-04-22	-0,11792	-0,00291	-0,01228	0,01538	-0,00442
2006-05-22	0,04066	0,00943	-0,02330	-0,00406	-0,00364
2006-06-22	-0,06049	0,00071	-0,00040	0,00426	0,00066
2006-07-22	0,02072	-0,00789	0,02509	-0,00202	0,00293
2006-08-22	-0,06709	-0,00836	-0,00865	0,00919	0,00015
2006-09-22	-0,56604	0,01244	0,02726	0,05911	-0,00427
2006-10-22	0,13923	-0,00145	-0,00758	-0,00660	-0,00131
2006-11-22	-0,10129	-0,01092	0,01032	0,00752	0,00562
2006-12-22	-0,05553	-0,00182	-0,01889	0,01330	0,00005
2007-01-22	0,14619	-0,00303	-0,01715	-0,01058	0,00766
2007-02-22	0,06314	0,00425	0,00112	-0,00282	-0,00125
2007-03-22	-0,15120	-0,00114	-0,00026	0,01355	0,00264
2007-04-22	0,04936	-0,00321	-0,00603	-0,00366	0,00912
2007-05-22	-0,06574	-0,00188	-0,01390	0,00615	0,00133
2007-06-22	-0,01928	0,00397	0,01533	-0,00134	0,00310
2007-07-22	0,07620	-0,00016	-0,01423	-0,00669	0,00029
2007-08-22	-0,09725	0,00137	-0,01490	0,00614	0,00053
2007-09-22	-0,19787	0,00143	0,02643	0,01246	0,00189
2007-10-22	0,14293	0,01328	-0,05241	-0,00445	-0,00208
2007-11-22	0,01664	-0,00458	-0,02212	-0,00799	0,00820
2007-12-22	-0,08202	-0,00161	-0,00473	0,00515	0,00618
2008-01-22	0,04055	-0,00614	0,01437	-0,01149	0,00012
2008-02-22	-0,03617	0,00978	-0,01605	0,00729	-0,00609
2008-03-22	-0,15992	0,00067	-0,00511	0,00721	0,01242
2008-04-22	0,07949	0,00142	0,04622	-0,01067	0,01152
2008-05-22	0,07656	-0,00656	0,04065	-0,00902	0,01929

2008-06-22	0,02429	0,01177	-0,03523	-0,01199	0,01892
2008-07-22	-0,14544	0,00300	-0,02955	0,01328	-0,01804
2008-08-22	-0,11277	0,00097	0,02679	0,00682	0,01082
2008-09-22	0,09541	0,01912	-0,11831	-0,01772	0,01942
2008-10-22	-0,02263	0,00443	-0,03495	-0,01296	0,02929
2008-11-22	0,07427	-0,00112	0,04759	-0,01966	0,04759
2008-12-22	0,03166	0,02220	-0,15910	0,00709	-0,00768
2009-01-22	0,07533	0,00163	0,07616	-0,01782	0,02986
2009-02-22	0,08810	0,00062	-0,03567	-0,00933	0,01450
2009-03-22	0,01482	0,03281	-0,10143	0,01151	-0,02353
2009-04-22	-0,02875	0,00613	0,02929	0,02090	-0,02342
2009-05-22	0,04870	-0,00374	0,03587	0,00589	-0,05958
2009-06-22	0,08494	-0,00212	0,04594	-0,00934	0,00925
2009-07-22	0,00103	-0,01244	0,01525	0,01069	-0,04454
2009-08-22	-0,02432	-0,00405	0,12160	-0,00475	0,03781
2009-09-22	0,07378	0,00786	0,01973	-0,00523	0,00406
2009-10-22	-0,11959	-0,02647	0,00042	0,02622	-0,07724
2009-11-22	0,00040	-0,00289	-0,01210	0,00126	0,00867
2009-12-22	-0,11813	-0,00513	-0,06073	0,01731	0,00028
2010-01-22	0,73847	0,04249	-0,19044	-0,04456	0,06873
2010-02-22	-0,09951	-0,00229	-0,02741	0,01521	-0,02534
2010-03-22	0,15035	0,00106	-0,01125	-0,00057	-0,01582
2010-04-22	0,21084	0,00277	0,01412	-0,02082	0,01698
2010-05-22	-0,02057	-0,00442	-0,03081	0,00062	0,00602
2010-06-22	0,13794	-0,00233	0,00197	-0,01229	0,00618
2010-07-22	-0,18255	0,00236	0,02904	0,01189	0,01625
2010-08-22	-0,07075	0,00341	-0,01000	0,00484	0,01470
2010-09-22	0,26124	-0,00414	-0,02849	-0,01360	-0,00333
2010-10-22	-0,18430	-0,00351	-0,03332	0,01977	-0,00059
2010-11-22	0,03481	-0,00041	0,00641	-0,00647	0,00771
2010-12-22	-0,10555	-0,00803	-0,02278	0,02019	-0,01346
2011-01-22	0,11227	0,00115	0,00608	-0,00635	0,00089
2011-02-22	-0,09481	0,00383	0,01955	0,00908	-0,00099
2011-03-22	-0,10891	0,00246	0,01186	0,00819	0,00453

2011-04-22	-0,20284	0,00355	0,01213	0,01808	-0,00056
2011-05-22	-0,05556	0,00460	0,00827	0,00354	-0,00158
2011-06-22	0,00317	-0,00364	-0,00467	0,00036	-0,00050
2011-07-22	-0,03818	-0,00102	-0,00178	0,00066	-0,00130
2011-08-22	-0,02086	0,00582	0,01558	-0,00550	-0,00125
2011-09-22	0,07144	-0,00329	-0,01172	-0,00731	-0,00165
2011-10-22	-0,05089	0,00191	0,01043	0,00653	-0,00143
2011-11-22	0,04513	-0,00835	-0,03721	0,00113	0,00190
2011-12-22	0,02973	-0,00767	-0,03773	-0,00073	-0,00721
2012-01-22	0,17446	0,01106	0,06919	-0,01094	-0,00288
2012-02-22	0,12819	-0,00261	0,04699	-0,00881	0,00214
2012-03-22	-0,10509	-0,00095	0,01401	0,00705	-0,00023
2012-04-22	-0,06299	-0,00069	-0,04587	0,00741	0,00212
2012-05-22	-0,15814	0,00388	-0,02097	0,01102	-0,00056
2012-06-22	-0,18064	0,00369	0,01078	0,01394	0,00199
2012-07-22	-0,11907	0,00100	-0,06793	0,01577	-0,00433
2012-08-22	0,04329	0,00814	-0,00485	-0,00468	0,02294
2012-09-22	-0,12491	0,01380	-0,00293	0,01155	0,00008
2012-10-22	-0,12175	0,02709	-0,00278	0,01384	-0,00110
2012-11-22	0,01362	-0,00587	0,00070	0,00005	-0,00083
2012-12-22	0,01079	0,00332	0,00101	0,00356	-0,00378