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THE FED MODEL: INTERNATIONAL ANALYSIS

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ABSTRACT

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The Fed model is a widely used market valuation model. It is often used only on market analysis of the S&P 500 index as a shorthand measure for the attractiveness of equity, and as a timing device for allocating funds between equity and bonds. The Fed model assumes a fixed relationship between bond yield and earnings yield. This relationship is often assumed to be true in market valuation.

In this paper we test the Fed model from historical perspective on the European markets. The markets of the United States are also included for comparison. The purpose of the tests is to determine if the Fed model and the underlying assumptions come true on different markets. The various tests are made on time-series data ranging from the year 1973 to the end of the year 2008. The statistical methods used are regressions analysis, cointegration analysis and Granger causality.

The empirical results do not give strong support for the Fed model. The underlying relationships assumed by the Fed model are statistically not valid in most of the markets examined and therefore the model is not valid in valuation purposes generally. The results vary between the different markets which gives reason to suspect the general use of the Fed model in different market conditions and in different markets.

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Fedin malli on yleisesti käytetty malli markkinoiden arvon määrityksessä. Mallia käytetään usein S&P500-indeksin analyysissä lyhyen aikavälin mittarina pääomamarkkinoiden houkuttelevuudesta ja lisäksi ajoitustyökaluna varojenjaossa osakemarkkinoiden ja velkakirjojen välillä. Fedin malli olettaa kiinteän yhteyden osakemarkkinoiden tuoton sekä velkakirjatuottojen välille. Tämä yhteys oletetaan yleensä päteväksi markkinoiden arvostustasoja arvioitaessa.

Tässä tutkimuksessa tarkastelemme Fedin mallia historiallisesta näkökulmasta Euroopan markkinoilla. Yhdysvaltojen markkinat ovat mukana vertailun vuoksi. Tutkimuksen tarkoitus on määrittää ovatko Fedin malli ja sen oletukset päteviä eri markkinoilla. Tilastolliset testit on suoritettu aikasarjoilla vuodesta 1973 vuoden 2008 loppuun. Käytetyt tilastolliset menetelmät ovat regressioanalyysi, kointegraatioanalyysi sekä Grangerin kausaliteetti.

Empiiriset tulokset eivät anna vahvaa tukea Fedin mallille. Mallin oletukset eivät ole tilastollisesti päteviä useimmilla tutkituista markkinoista ja siksi arvonmäärityksessä mallin käyttökelpoisuus ei ole yleistettävissä kaikille markkinoille. Tulokset vaihtelevat markkinoiden välillä ja siksi onkin syytä epäillä mallin yleistä käyttökelpoisuutta vaihtelevilla markkinoilla.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Background

We live in an era where scientists believe that practically everything can be forecasted as far as we know all the causalities and the starting values. Economics is a branch of science which tries to create models that can be used to forecast all sorts of different economic variables. One simple factor that makes forecasting hard is the human element. Investors make continuous decisions considering the values of market traded shares but these decisions are not always based on fundamental facts of the underlying corporations; instead a large portion of the stock movements is based on human emotions. Behavioral finance is a branch of economics that concentrates on these emotional factors and tries to understand the underlying causalities.

As economics has evolved and still failed to produce a valid model that incorporates the human factor, economists have concentrated on finding relations that have historically been valid. Some may say that the complex equations created by analysts and academics are closer to the truth than simple ones but the fact is that only the simple equations are used by masses. But what happens when masses use the same simple equation in the faith that it really works? Individuals start to act more and more like each other. For instance a security analysis discipline called technical analysis has evolved into a massive business which relies on the basic principle that security prices move in trends that can be identified with certain methods and tools. These tools are nowadays widely available in form of computer software in reasonably low prices which attracts many investors to use them without any doubt whether the underlying principles holds. Does the history really repeat itself in trends?

As long as stock markets have existed economists have tried to create a theory that would explain the movements of the stock markets. These models come in various forms which are based on very different factors ranging from weekday anomalies to a complex mathematical equations that sum dozens of factors to a single model. History has shown that only simple models have really moved masses. Some of the theories have really made their mark in economics and stood strong for over half a decade.

The underlying concept of economic theories is usually some kind of causality between different factors. Economists for example assume that the risk and the reward go hand in hand. This assumption brings us to the inevitable conclusion that also the different market instruments are correlated when the risk and rewards ratio is kept constant. The most fundamental assumption that has to be made is that humans act rationally. Otherwise we would end up in a situation where every factor that has human influence is just pure random walk.

The most famous economic model is the capital assets pricing model introduced in the beginning of 1960’s by William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966) independently. The model assumes a direct relationship between risk and return. The return is determined by taking into account the risk-free rate of return available in the market and the sensitivity of the security to non-diversifiable risk represented by the quantity of beta. The difficult part of the model to a human logic is the question of how to determine risk and how we experience risk as individuals.

A simple way to analyze stock markets is to look for correlations between different market instruments. By analyzing correlations we can “skip” the human aspect and rely on fundamental causalities that are assumed to exist between the instruments. We don’t have to actually understand what causes the relation, we can purely enjoy the fact that it does or does not exist. Maybe because of this simplicity, one model that has taken ground in past two decades is the so called Fed model.

1.2 Purpose of the study

The purpose of the study is to find out whether the Fed model has any historical validity when used in the European markets. The fact that the model is almost solely used to study the U.S. markets raises a question if the markets in the U.S. have some fundamental differences when compared to the other large stock markets in the world. The applicability of the Fed Model is tested in five different markets in Europe to find out its historical validity and predictability. The markets are selected to be largest markets in the Europe. For comparability the same tests are also made on the U.S markets.

Research questions are as follows:

Q_1 Is there a long-term relationship between stock market yields and government bond yields?

> H_1 There is a cointegration relationship between earnings, stock prices and government bond yield.

Q_2 Does the relationship between stock markets yields and bond yields differ between different markets?

> H_2 Relationship of the variables does not differ between different stock markets.

In order to study these questions the theoretical aspect of the Fed model is analyzed and different aspects presented by previous researches are taken into comparison. The topic has been in interest of several economists and therefore several studies considering the similar questions have been made. Previously made studies have used a wide variety of different methods and markets when analyzing the relationship between equity market yields and bond yields. The objective of this study is to use tested methods to create clear results that can be used to conclude the usability of the Fed model.

1.3 Structure and methodology

The study consists of theoretical and empirical sections. Theoretical part of the study goes through the different theoretical aspects of the Fed model and summarizes model's strengths and weaknesses from theoretical point of view in chapter 2. Theoretical part relies on the findings and opinions of the wide variety of previous studies and therefore also most fundamental research papers made on this field are reviewed in chapter 2. Chapter 3 is devoted to explain the used methodology in detail.

The empirical part of the study is based on historical market data analysis where the model itself is used and its performance is measured. The empirical part begins from chapter 4 where the data is described. The empirical part uses regression analysis and cointegration analysis to determine whether the model has had any historical strength in selected markets. A similar regression method has been used by Owain ap Gwilym et al. (2006). The results are described in chapter 5. The descriptive statistics of the data used can also be found in the same chapter. The length of the time-series varies largely between the different markets and therefore the validity of the results and conclusions differ significantly. This is noted when conclusions are made.

Chapter 6 of the study concludes the findings and compares results to previous studies. The final chapter also presents ideas for further study.

1.4 Limitations

The statistical analysis of the study relies on certain assumptions that have to be made considering the Fed model. Results may differ if the model itself is modified to correct certain theoretical weaknesses that are included in the model. The theoretical problems are described in chapter 2. The statistical strength of the analysis on smaller markets with shorted data-series creates problems with comparability of the results. The statistical validity of the used data is analyzed with statistical methods available while preserving the comparability of the results to a similar research.

2 THEORY

2.1 Equity valuation models

The equity valuation models are the fundamental tools used by analysts all around the world in almost any given day. The purpose of the analysis is to identify stocks that are mispriced relative to some measure of “true” value that can be derived from observable financial data. The problem is that there is that no model gives a reliable price that would exactly match the current market price. This is due to the fact that the market price is always a product of fundamental analysis and the behavioral analysis. The latter is the part that is practically impossible to model because the market participants do not share the same information and logics to which the price is at any given time based on. Nowadays the possibility to trade in different markets with the same product has given room to a class of investors who search arbitrage opportunities between different markets. They search for opportunities to buy an underpriced asset and simultaneously selling its overpriced equivalent to make a risk-free profit. Arbitrage opportunities are very rare because the markets are continuously watched by a range of automated computers which search for arbitrage opportunities day and night.

The fundamental analysis uses the data from financial statements and other observable market data to estimate the “fundamental” value of a corporation’s stock. The most commonly used financial figures are sales, P/E-ratio, P/B-ratio and profitability ratios. These figures are compared to the industry average to evaluate the possibility of pricing errors on a given stock. Although the balance sheet can give some useful information about the financial value of the company, the analyst must usually turn to expected future cash flows for a better estimate instead of analyzing the historic figures.

2.1.1 Intrinsic value and dividend discount model

The most common model to evaluate a fair price for a share is to focus on expected returns given by a particular stock. The expected returns consist of dividends and the expected rate of price appreciation. The investors also expect a compensation for the risk of carrying a certain stock and therefore the price should be adjusted for the risk. The intrinsic value for a holding-period of a one year can be calculated as follows:

$$V_0 = \frac{E(D_1) + \ E(P_1)}{1 + k} \tag{1}$$

where $E(D_1)$ is the expected holding period return, $E(P_1)$ is the expected price after the holding period and *k* is risk-adjusted expected rate of return When this logic is extended for a holding period of *H* years, the present value of dividends over the *H* years can be written:

$$V_0 = \frac{D_1}{1 + k} + \frac{D_2}{(1 + k)^2} + \frac{D_3}{(1 + k)^3} + \cdots \tag{2}$$

The equation states that the stock price should equal the present value of all expected future dividends into perpetuity. The model is called dividend discount model (DMM).

2.1.2 **The Gordon model**

Because the dividend discount model requires dividend forecasts for every year into the future it quickly becomes unpractical to use. To simplify the underlying assumptions of DMM we can assume that the dividends are growing on a constant rate to indefinite. The so called Gordon model or the traditional model can be therefore written like:

$$V_0 = \frac{D_0(1+g)}{k-g} = \frac{D_1}{k-g} \tag{3}$$

where *g* is the constant growth rate.

The Gordon model and dividend discount model are widely used in equity pricing and therefore there is also a wide variety of studies investigating the relationship between the stock prices and the price suggested by the dividend discount model or the Gordon model. Nassah and Strauss (2004) made an empirical based paper that used market data and the dividend discount model to analyze the stability of the relationship between dividends and stock prices over the period of 1979 to 1999. In their special interest was to find out whether the bubble in the stock prices in the late 1990's was due to a fundamental change in the discounting process during this period.

The authors found that in general there was a stable relationship between the stock prices and dividends until the middle of the 1990's when the stock prices started to rise rapidly. About half of the suggested 43 % overvaluation was due to expectations of extreme future dividend growth and half was due to a significant drop in the nominal discount rate. The authors concluded that based on this information the market break in the year 2000 should have been expected.

2.1.3 The Fed model

As most of the individuals are satisfied with a claim that the Fed model holds true, some are also skeptical about it. The strength of the model is the simplicity of it. When a graph is shown which compares the stock market earnings yield and the nominal interest rates, people usually see the relation between them (Figure 1).

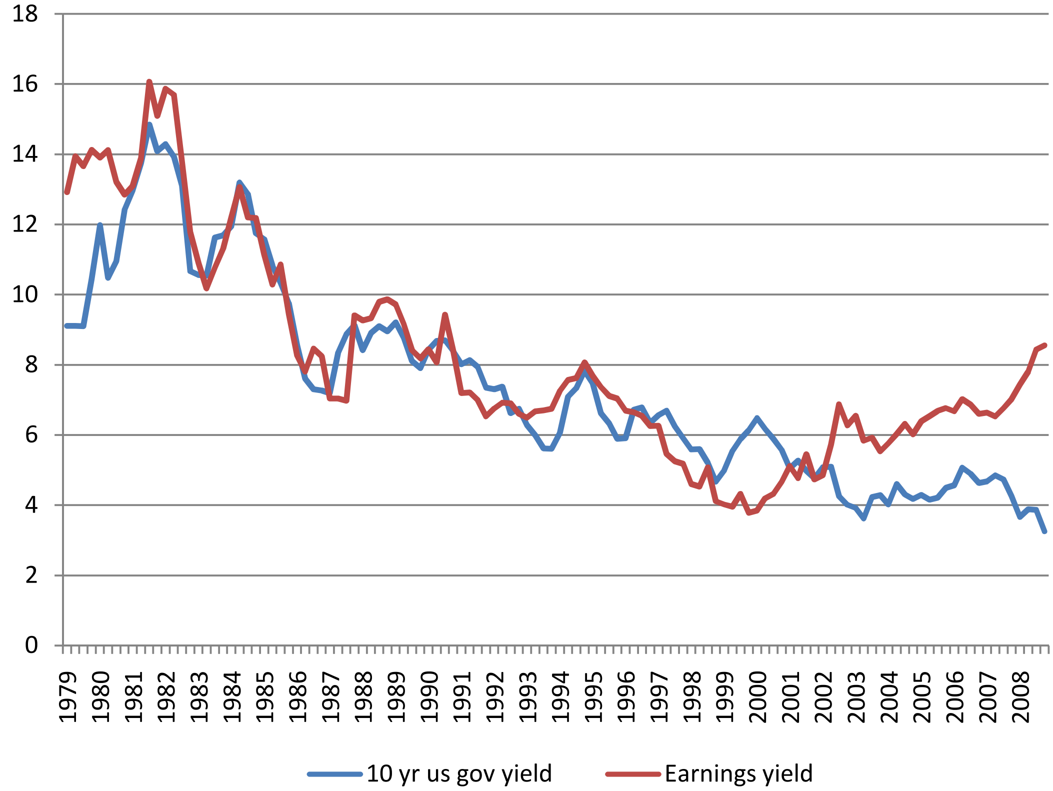

Figure 1. The Fed model historically in the U.S.

The model got publicity when the Federal Reserve Board of the United States used it in Humphrey-Hawkins[1] report of July 22, 1997. The speech was held by a chairman Alan Greenspan. Since then, the model has spread over to most of the financial institutions as a tool of an easy analysis of the stock markets in the United States. But why the model is so intensively used only when the markets of the United States are analyzed? Is there some reason why it would not work also for other markets?

Historically equities have dominated all other assets when total returns are compared (Figure 2). When looking at the total nominal return indexes we can notice that a one dollar investment in stock markets in 1801 has increased to 12.7 million dollars by the end of 2006 when assuming that all the returns are reinvested during those almost 200 years. The long-term performance of bonds is not as impressive. One invested dollar into bonds in 1802 would have increased to approximately 18.000 dollars by the end of 2006. (Siegel 2002)

The interest rate fluctuations were quite reasonable in the 19th century and in the beginning of the 20th century. In the 1970s the markets changed dramatically as inflation reached double-digit levels and the interest rates soared to unprecedented heights. The interest rates have always been closely tied to the level of inflation and therefore one must always take inflation into account when analyzing the returns of fixed-income assets.

[1] Humphrey-Hawkins: Representative Augustus Hawkins and Senator Hubert Humphrey created the full employment and balanced growth act in 1970's. The act was signed in October 14th 1978. The goals of the act are full employment, price stability, growth in production and balance of trade and budget. The act was based on numerical goals for certain years. The act is based on Keynesian economic theory and emphasizes the role of the Federal Reserve.

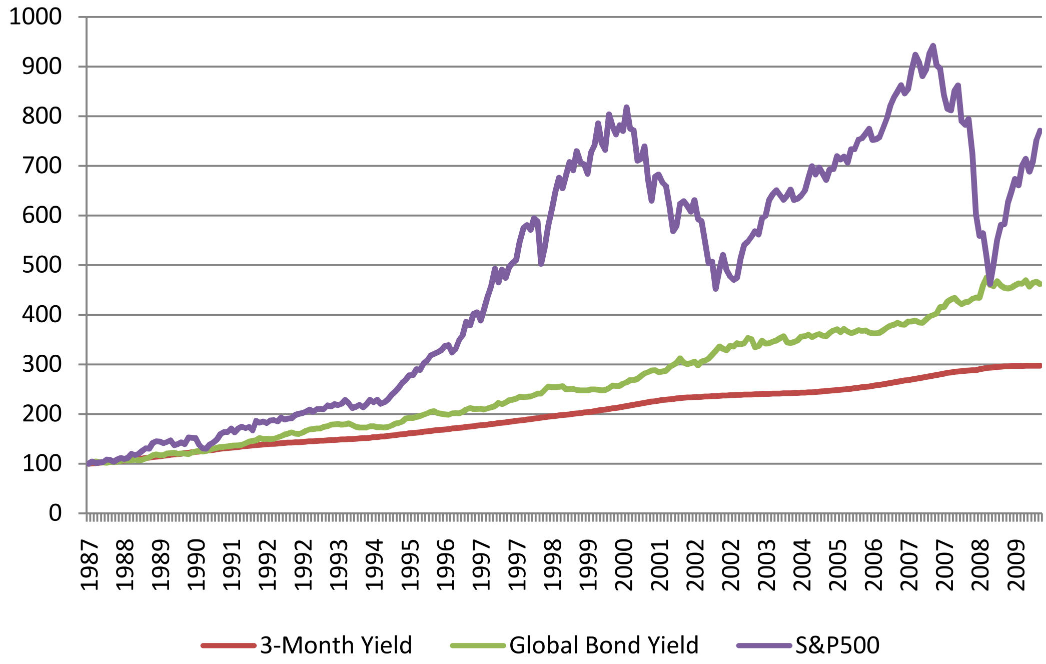

Figure 2. The comparative returns of different asset classes

The Fed model is based on an assumption that bonds and equities are comparable assets. This means that investors make a choice whether to invest on stock markets or on bonds. A rational investor compares the yields on these comparable assets and if earnings yield, E/P, exceeds bond yield, Y, stocks are yielding more than bonds and the rational investor buys stocks. This means that the stocks are relatively cheap. In contrast when E/P is lower than Y, stocks are relatively expensive. This logic creates the basic formula that describes the relation that the model itself is based on (Estrada: 2007).

$$\frac{E}{P} = Y \tag{4}$$

where E is market earnings based on consensus for the 12 months ahead, P is price and Y is 10-year government bond yield.

The model can be alternatively presented in a form that compares the forward P/E[2] ratio of stocks and bonds as follows:

$$\frac{P}{E} = \frac{1}{Y} \tag{5}$$

The model claims that only when this relation holds, both instruments are similarly attractive to investors. The inverse relationship between the stock market P/E-ratio and government bond yield has been used widely long before the Fed model got publicity in year 1997. For example I/B/E/S[3] has been publishing such a relationship between forward earnings, stock prices and treasury bonds since 1986.

In year 1997 the Fed noted: "…the ratio of prices in the S&P500 to consensus estimates of earnings over the coming 12 months has risen further from levels that were already unusually high. Changes in this ratio have often been inversely related to changes in long-term Treasury yields…". (Federal Reserve Board, 1997). The note was made with supporting graph similar to figure 1.

The notion might have gone unnoticed without Deutsche Morgan Grenfall analyst Ed Yardeni who published several reports (Yardeni 1997, 1999) where he used to evaluate stock market levels by using the model. He was also the first one to use the name Fed's Stock Valuation Model.

The main question is how to value stock markets. Traditional approach is based on cash flows, their timing and the risk associated. The assumption of constant dividend growth in the long-run is a common starting point.

[2] Forward P/E ratio is calculated with estimated earnings for the following twelve months instead of recent twelve months earnings per share which is used when calculating trailing P/E.
[3] I/B/E/S stands for The Institutional Brokers Estimate System. I/B/E/S offers information of the earnings estimates on companies of interest to institutional investors. The database contains international data since 1987 and US data back to 1976. The database covers over 18,000 companies in 60 countries.

If we assume that growth is constant, we have the Gordon model for valuing stocks:

$$P = \frac{D_0(1+g)}{k-g} \tag{6}$$

where k is the annual discount rate (expected rate of return) and p is the price of the index today.

The expected rate of return K can be easily derived from the equation and it is equal to the sum of the dividend yield and of the annual rate of dividends in perpetuity. This theory suggests that expected real[4] stock returns are a positive function of starting dividend yields. The method like this which relies on stock yields to predict real returns can be referred to as the traditional model. Traditional model assumes that growth varies only little over the long run and therefore movements in expected rate of return should mostly be reflected in movements of either dividend yield, D/P, or earnings yield, E/P. In comparison the Fed model assumes that changes in P/E can be expressed as an inverse function of Y.

Historically we know that stocks have had superior returns when compared to bonds but have the returns between these two been really correlated? Siegel (2002) has divided the years between 1926 and 2006 in six different sub periods in order to study the correlation. The results show that from 1926 to 1997 the correlation has been positive but in recent years the relation has actually changed to negative. Siegel (2002) presents that this change is due to investors habit to move money to U.S. government bonds when equities and currencies get more volatile. This is especially safe nowadays because central banks have held firm against inflation when compared to high inflation conditions that have previously cast a shadow over treasury bonds in times of financial turmoil.

[4] The real return can be calculated by subtracting the inflation from corresponding nominal values. Inflation data is available in the OECD dataset.

Stocks are real assets whose price will rise with inflation but they also include the risk of uncertainty of earnings. Government bonds on the other hand are in practice certain income but bear the risk of inflation. Because nowadays the risk of inflation is on a much lower level than couple decades ago, the markets do not rate the risk on bonds and stocks as the same. The results can be seen as an inverse relation between stocks returns and bond returns. This fact hasn't affected the use of the Fed model as one of the basic tools of market valuation.

The Fed model can be also used as a tool of tactical asset allocation. Yardeni (2002) suggests a model which gives the proportion of stocks in a portfolio on the valuation levels retrieved from the Fed model (Table 1). This is one of the several tactical asset allocation models based on the Fed model. Generally these models seem to agree that the Fed model may have some value as a short-term allocation tool but little or no value as a long-term strategic asset allocation tool.

Table 1. Tactical asset allocation based on the Fed model

Stock Market	**Proportion of stocks (%)**
Over 30 % overvalued	30
20 – 30 % overvalued	50
10 – 20 % overvalued	60
10 % undervalued to 10 % overvalued	70
10 – 15 % undervalued	80
Over 15 % undervalued	90

2.2 Review of the earlier research

Since its public attention in late 1990's, the Fed model has been widely researched in the U.S. markets and also in the international framework. The model itself falls to a category of wide palette of different stock valuation models. One of the most significant valuation models is the Capital Asset Pricing Model mainly developed by William F. Sharpe (1964). It is used to determine expected rate of return for a certain asset by taking in consideration the asset's sensitivity to market risk (non-diversifiable risk). While this approach relies on the market data to determine the non-diversifiable risk, another model named Gordon's Model can be used to determine the value of a stock by forecasting dividends and discounting them to present values. Myron J. Gordon published this method originally in 1959.

Because of its recent publicity, most of the studies made on the Fed model are written on 21th century. Asness published a paper called Fight the Fed Model in fall of 2003 in the Journal of Portfolio Management. In the study, Asness studies whether the Fed model can predict future long-term stock returns in U.S. markets. The paper uses monthly U.S. CPI inflation data, monthly continuously compounded total real return of the S&P 500 and the ten-year U.S. Treasury bond from 1871 to 2001. The P/E-ratio is based on ten-year trailing earnings of the S&P 500. The earnings-to-price ratios based on last year's trailing earnings are multiplied by the S&P 500 price index to determine a monthly earning per share (EPS) estimate for the index.

Asness (2003) uses regressions to measure forecasting performance. The dependent variable used are either 20-, 10-, or 1-year real return on the S&P 500 and the independent variables are alternatively the E/P (traditional model) of the S&P 500 or the E/P minus the ten-year treasury bond yield (the Fed model) or both in a two-variable regression. The regressions are run over different time periods using different forecasting horizons. The results show that the traditional model has a strong forecasting power for the ten-year real stock market returns but the Fed model is rejected. The Fed model has some weak power but it is only because E/P is part of E/P – Y. The statistical weakness of the Fed model shines through when both the traditional model and the Fed model are tested in bivariate regressions. Asness found also significant differences between different time periods. In particular, over the 1926 – 2001 period, the power of E/P to forecast 20-year stock returns were found to be impressive (Adj. R^2 65.4 %). The R^2 is found to fall dramatically at shorter horizons. The only period that shows any support for the Fed model was found to be the recent 1982 – 2001 bull market although the t-statistic was very high.

Asness (2003) concluded that for forecasting long-term stock returns the Fed model is an empirical failure and the traditional model is a success story. Nevertheless, the Fed model seems to be a success at describing how investors set current market P/E-ratios. It seems that the investors set stock market P/E-ratios higher when the nominal interest rates are lower and vice versa. This relation is strong over the last 30 to 40 years.

Rolph and Shen (1999) examined the usefulness of the spreads between the E/P of the S&P 500 and the yields on 3-month and 10-year Treasury securities as indicators of future market conditions. The results showed that the spreads itself are not useful in a regression framework but the extreme values of the spreads do contain useful information on future overall equity market movements. They found that in particular for the time period of 1967 to 1997 the spreads managed to forecast market downturns in some degree. In general the short-term interest rates were found to perform marginally better in forecasting purposes than long-term interest rates which are more commonly used.

Stephen Foerster and Stephen Sapp (2005) studied the different valuation methods to determine which has been historically the most accurate when forecasting stock prices. They used single firm which has regularly paid dividend over a long period. The study provides evidence that discounted cash flow-based techniques are the most accurate ones. They found that dividends were highly correlated with changes in the market price and therefore the dividend discount model and the Gordon growth model both perform well at explaining the observed price. Earning-based models such as the Fed model do not perform as well although they found evidence that the earnings yield and the ten-year bond yield are correlated. They also noted that the difference between the earnings yield and the bond yield is consistent.

Berge and Ziemba (2003) researched the Fed model using data from the U.S., Germany, Canada, Japan and U.K. for the period from 1979 to 1999. The focus on the research was to find out whether the Fed model can be exploited to achieve a better performance than a buy-and-hold investment in the stock market. The results showed variation between different countries but in overall the results suggested that there is a relationship between the yield on long-term government bonds and the E/P of the stock market. The relationship was found to be exploitable to some extent to outperform the stock market.

The validity of the Fed model has been studied using a variety of the different methods. Because the regression model has some theoretical flaws, some have used cointegration analysis in their analysis. Matti Koivu, Teemu Pennanen and William T. Ziemba (2005) used cointegration analysis to test the Fed model in the United States, United Kingdom and Germany. Their approach was to build a Vector Equilibrium Correction model (VEC) which provides a quantitative dynamic version of the Fed model. Dataset consisted of quarterly observations from January 1980 to December 2003.

The results were that the Fed model is statistically significant in explaining variations in the logarithmic values of stock prices, earnings and bond yields. The results show that the Fed model is more successful in the U.S. than in the other markets. These results support the earlier findings of Ziemba and Schwartz (1991), Berge and Ziemba (2003), Ziemba (2003) and Campbell and Vuolteenaho (2004). They also found that during 1980–2003 the Fed model has had some predictive power in the U.S., the U.K. and German markets but the results do not validate the logic behind the Fed model.

Similar tests are also performed by Alain Durré and Pierre Giot (2007). They find a long-run relationship between earnings, stock prices and long-term government bond yields in Unites States and the United Kingdom although the long-term bond yield is mostly not statistically significant in this relationship. Alternating bond yields does impact contemporaneous stock market returns and therefore has an important short-term impact on the stock market.

Maio (2005) performed an out-of-sample analysis to determine the predictive role of a so called yield gap (the difference between the market earnings yield and the ten-year Treasury bond yield). The results showed that the yield gap forecasts positive excess market returns (short and long-term). The results showed also that the yield gap has ability to predict both stock market and long-term bond returns. Based on the results he claimed that an investments strategy based on the forecasting ability of the yield gap produces higher Sharpe ratios than passive strategies in both the market index and long-term bond. The test was performed solely on the S&P 500 index.

Asness (2000) found evidence that the difference between the stock yields and bond yields is driven by the long-run difference in volatility between stocks and bonds. The tests were performed on 1871 – 1998 data. The conclusion was that the stock market of 1998 had a very low yield for the reason that bond yields were low and stock volatility had been low as compared with bond volatility. These conditions lead investors to accept low yield on stocks.

Harris (2000) tested whether the gilt-equity yield ratio (GEYR) used mainly by financial analysts and fund managers in the U.K. has considerable explanatory power for stock returns in the U.K. and in the U.S. The GEYR is defined as the ratio of the long government bond yield to the equity dividend yield. The paper gives evidence that the GEYR has substantial explanatory power for U.K. and the U.S. equity returns and it can be successfully employed in a trading rule that earns excess returns over a simple buy-and-hold strategy in the equity market. The overall level of return predictability with the GEYR was found to be much better in the U.K.

Wong et al. (2003) used the methods of technical analysis to investigate whether the forecasts generated from the E/P ratio and bond yield can be used to beat the stock markets. The study was made on U.S, Germany and Singapore over a period of 20-years. The use of Standardized Yield Differential (SYD) which is a monthly indicator including E/P ratio and the bond yield or interest rate could enable investors to escape from most of the crashes and still benefit of the increasing market valuation. The performance of the SYD indicator was found to be significantly better than the performance of the buy-and-hold strategy. These results give support for the use of E/P and bond yields in valuation and forecasting models such as the Fed model.

Giot and Petitjean (2006a) investigated the predictability of stock returns in ten countries by using out-of-sample statistical tests and risk-adjusted metrics. The variables used to predict stock returns include both valuation ratios and interest rate variables. Variables used were: the dividend-yield, the price-earnings ratio, the short-term interest rate, the long-term interest rate and the term spread (the slope of the yield curve). The forecast horizons used were 1-month, 3-month and 1-year. The out-of-sample statistical analysis showed that the short-term interest yield and the long government bond yield are the most informative out-of-sample predictors of stock returns. These results support the ideology behind the Fed model. As a whole the analysis made by Giot and Petitjean does not find any common pattern of stock return predictability across the countries examined. They conclude that the ability of predictive regression models to predict international stock returns are found to be very limited.

Giot and Petitjean (2006b) also published a study investigating the usability of the Bond-Equity Yield Ratio (ratio of the bond market yield to the stock market yield). The study compared the short-term profitability of a strategy based on the extreme values of the BEYR to the short-term profitability of a more sophisticated strategy relying on a regime switches. The BEYR is derived from the Gilt-Equity Yield Ratio (GEYR). The Gilt-Equity Yield Ratio is defined as the ratio of the coupon yield on government bonds to the dividend yield on equities. The Fed model is based on the same rationale underlying the GEYR. The results show that active strategies outperform passive benchmark portfolios in the U.S. only. The active strategies are also found to be more successful when the market timing criterion is the BEYR instead of the equity yield. As a whole the BEYR is not found to be an effective tool to time the market.

Owain ap Gwilym et al. (2006) tested the fed model with traditional technique in the same countries as Matti Koivu et al. (2005). In addition to U.S., U.K. and Germany they also included France, Switzerland and Japan. Instead of using cointegration analysis, they used traditional regression analysis. They found no evidence that the Fed model could explain long-term returns. When comparing to the cointegration based analysis, the results are in contrast. Owain ap Gwilym et al. found the Fed model to be in some degree useful as a tactical asset allocation tool because investors continue to repeat their past behavior by following the wrong model in constant fashion. When using the model as an allocation tool with one year horizon only, the model is the only rule to consistently outperform buy and hold.

Some of the academics have also tried to improve the Fed model in their studies. Roelof Salomons (2006) studied a Fed model that took into account the relative risk. The relative risk means that the model is corrected for inflation. The regressions were made on the U.S. markets with data ranging from 1881 to 2002. The results show that the Fed model has some success in forecasting equity returns on the 10-year forecast horizon. This is purely because the Fed model contains earnings yield. When the bond yield is added, the predictive power increases only marginally. The conclusion is that one should focus on the earning yield to predict equity returns. In one-year horizon, the model has some forecasting power although it is much lower than with the longer horizon.

Capstaff (2001) researched the earnings forecasts in the European markets. The forecasted earnings-per-share (EPS) is an important figure when the Fed model is approach is used. Capstaff (2001) concludes that analysts' forecasts generally outperform naive models but are typically optimistically biased. The results showed country specific differences in the quality of the earnings forecasts and he also found that the forecast accuracy considerable decreases when the forecast horizon increases.

Lamont (1998) studied whether earnings can be used to forecast expected returns. The results were that dividends and earnings help to predict short-term returns but these variables are unimportant for forecasting long-term returns. Lamont found that also dividend payout ratio helps to forecast returns. One interpretation is that dividends contain information about future returns because they help to measure the value of future dividends while earnings contain information because they are correlated with business conditions.

These results by Capstaff (2001) and Lamont (1998) should be taken in consideration when the Fed model is used as a predictive tool based on the analyst forecasts because the Fed model is based on earnings figures. Especially the forward earnings yield is affected by the quality of the analysis itself and this affects directly to the Fed model results when used as forecasting tool.

Asness (2000) found evidence that the difference between the stock yields and bond yields is driven by the long-run difference in volatility between stocks and bonds. The tests were performed on 1871 – 1998 data. The conclusion was that the stock market of 1998 had a very low yield for the reason that bond yields were low and stock volatility had been low as compared with bond volatility. These conditions lead investors to accept low yield on stocks.

Schwert (1989) researched the relation of stock volatility with real and nominal macroeconomic volatility, economic activity financial leverage and stock trading activity using monthly data from 1857 to 1987. Schwert concluded that recessions tend to increase the volatility of financial asset returns and he also found weak evidence that macroeconomic volatility can help to predict stock and bond volatility. Trading activity and stock volatility were found to have a relationship between them. The number of trading days in the month is positively related to stock volatility. The same relationship can be also found between trading volumes and stock volatility.

While most of the tests are based on a few countries or solely on the U.S, the Fed model has also been tested with wide pallet of world markets. Javier Estrada (2006) has analyzed the fed model in 20 different countries by analyzing the so called valuation gaps. The valuation gaps are based on a suggestion made by Abbott (2000) that the Fed model should be thought of as providing a “fair value range” with boundaries of ± 10 %.

Valuation gaps within this limit are considered as reasonable deviations that should not necessarily lead to short-term corrections in prices.

Estrada (2006) uses four different valuation gap measures in his paper. The first one of the expressions measures monthly gap between the earnings yield and the bond yield and the second expression measures the average monthly gap between the earning yield and the bond yield relative to the level of the bond yield. The latter two gaps measure the average absolute value and the average absolute value relative to the level of the bond yield.

The results indicate that departures from the Fed models proposed equilibrium are much larger than what can be expected from an accurate model. Estrada (2006) also accompanies these results with cointegration analysis. Cointegration analysis shows that earnings yields and bond yields do not move together over the long term. Only one of the 20 countries achieves to stay inside the restrictions imposed by the Fed model when based on forward earnings and no countries when based on trailing earnings. Estrada (2006) finds P/E-ratios outperforming the Fed model as a tool of forecasting real stock returns in 18 of the 20 countries considered when based on forward earnings. Finally, P/E-ratios outperform the Fed model in every country when the ratios are based on trailing earnings.

As a summary of the various studies we can conclude that there is a lot of evidence that in general the Fed model does not work. Some studies find the model working only in the long-run in the U.S. and U.K but some find the Fed model useful as a short-term tactical allocation tool. Maybe these somewhat mixing results are caused by different techniques of analysis. It is interesting that some studies find the U.S and U.K. stock and bond relationship different from other world markets. Is it purely learned behavior of the investors that differs these markets from others? Do especially the U.S. and the U.K. investors follow bond yields when valuating equities or is there some fundamental reason behind the relationship? None of the studies do explain the reason behind these differences.

2.3 Theoretical questions

2.3.1 Inflation illusion

Many critics argue that the rationale of the model is flawed from a theoretical point of view. The most popular argument is that the Fed model compares nominal values (bond yields) to real values (stock index yield) erroneously. In other words the Fed model assumes that the dividend or earnings yield on stocks should equal the yield on nominal treasury bonds or there should at least be a high correlation between these variables.

It can be easily said that both bonds and stocks do badly when inflation increases but is the relation really there? Feinman (2005) has an opposite view to the argument which claims that comparing nominal and real values alone makes the whole Fed model useless. He claims that although inflation affects bond yields, it should not affect earning yields. The reason for this is the fact that the stock prices are directly related to the rate of inflation through the expected growth of earnings. It is also obvious that stock prices are inversely related to the rate of inflation through risk free rate, R_f. These two opposite effects should offset each other and leave the earnings yields unchanged.

Modigliani and Cohn (1979) have argued that investors tend to make inflation-induced errors constantly when valuing stocks. The first mistake is to capitalize the real cash flows at nominal rates (capitalization error) and the second mistake is to fail to recognize the benefit of stocks when inflation erodes the real value of fixed income liabilities. Ritter and Warr (1979) have argued that the Fed model contains both of these errors and so do the behavior of investors.

Some of the academics have created variations of Fed model in order to account for these problems. Examples of corrections made are the use of trailing earnings yields and smoothed trailing earnings yields. One variation is to compare forward earnings yield of the stock market to TIPS (Treasury Inflation-Protected Securities) in order to account for inflation. These alternative models have little or no empirical evidence to support them. Despite of all the arguments, it can be said that low inflation figures make the Fed model unusable. Low inflation leads to low interest rates. Low inflation leads to low nominal earnings growth rate which affect the numerator (earnings and their growth rate) and denominator (discount factor) of the valuation model.

Boudoukh and Richardson (1993) performed empirical analysis on annual data on inflation, stock returns and short-term interest rates over the period of 1802 – 1990. The paper examined the relation between stock returns and inflation at long horizon in the U.S. and the U.K. The results showed strong support for a positive relation between nominal stock returns and inflation at long horizon in both countries examined. They also found that stocks are better inflation hedges over five-year periods than over one year periods. Based on these results the stocks are in some degree inflation protected.

The stocks are also favored by Siegel (2002) who noted that in the long run, history has shown that stocks are actually less risky investments than bonds. This is because historical evidence has indicated that we can be more certain of the purchasing power of a diversified portfolio of common stocks 30 years in the future than the principal on the 30-year U.S. government bond. If the investors demand for certain income with stable purchasing power Siegel (2002) recommends government-guaranteed inflation-indexed bonds which have been issued by the U.S. government starting from year 1997.

Bekaert and Engstrom (2010) examined the inflation and the stock markets from the perspective of the Fed model. The research objective was to find an explanation for the high correlation between the “real” equity yields and nominal bond yields in the U.S. They found that a large part of this covariation between the variables is due to the high incidence of stagflations in the U.S. data. They assume that in recessions economic uncertainty and risk aversion may increase leading to higher equity risk premiums which leads to increased yield on stocks. If expected inflation happens to also be high in recessions the bond yield increase through their expected inflation and potentially their inflation risk premium components. This results to correlations between the equity and bond yields and inflation. They also verified the results by a cross-country analysis that showed stagflation incidence to be the main purpose for the correlation between equity and bond yields.

The results achieved by Bekaert and Engstrom (2010) are supported by Thomas and Zhang (2007) who found the Fed model not working during the 1915 – 1960 period in which stagflations were rare. They also claim the market (U.S.) does not suffer from inflation illusion and the Fed model is can be useful tool mainly as it insights about the levels of risk premium and anticipated growth.

2.3.2 Competing assets

The Fed model relies on an argument that stocks and bonds are competing assets in the investment portfolio and therefore the yield should be the same. The portfolio distribution between stock and bonds is usually determined based on the investment horizon. Leibowitz and Krasker (1988) wrote a paper of stocks versus bonds over the long-term investment horizon. They used a model to determine how long investment horizon is enough to outperform fixed income portfolio with an equity portfolio.

The models were based on historical asset volatilities and risk premiums and showed that a stock portfolio has a 32 per cent change of underperforming a bond portfolio over a 10-year horizon and even after 30 years, there remains a substantial 21 per cent probability that stocks will fall short of bonds. Based on these statistics the long-term investors should also invest to bonds to adjust for the risks embedded in both asset classes.

Asness (2003) claims that the yield on the stock market (E/P) is not its expected return. The nominal expected return on stocks should move hand in hand with bond yields but this is accomplished by a change in expected earnings growth, not changes in E/P. This argument can be rationalized in a situation when long-term expected inflation and bond yields both suddenly fall. In these situations the Fed model implies that the stock market's expected nominal return falls more than bonds. This makes no sense if stocks and bonds are competing assets.

Maybe the most notable argument in favor of the Fed model is the historical data. When interest rates are low, the stock market's E/P is also on a low level and vice versa. Asness (2003) has studied historical relation between inflation and the median of S&P 500 P/E –ratios. The conclusion is that historically between the years 1965 and 2001 there has been a clear tendency for the S&P 500’s P/E to be high when inflation has been low, and vice versa. The Fed model assumes that when inflation falls then also the E/P must fall, and P/Es rise. Maybe the Fed model is only a tool that takes advantage of investors mistakenly making the same error continuously? Although the relation tends to look graphically convincing it does not mean that the Fed model is theoretically correct. This is a question of perspective. Do we approach the model from theoretical or practical point of view?

3 METHODOLOGY

3.1 Regression analysis

Regressions between bond yields, equity yields and market yield are performed by using OLS (Ordinary Least Squares).

The multiple linear regression model is concluded as follows:

$$Y_i = \hat{\alpha} + \hat{\beta}_1 X_{i1} + \hat{\beta}_2 X_{i2} + \ldots + \hat{\beta}_k X_{ik} + \hat{\varepsilon}_i \tag{7}$$

where *Y* is the dependent variable; *α* is the intercept, *X* is the independent variable and *ε* is the error term (residual)

Underlying assumptions of the analysis are:

1. $E(\varepsilon_t) = 0$
2. $Var(\varepsilon_t) = \sigma^2$
3. $Cov(\varepsilon_i, \varepsilon_j) = 0$
4. $Cov(\varepsilon_i, x_t) = 0$
5. $\varepsilon_t \sim N(0, \sigma^2)$
6. No perfect multicollinearity

Estimation of regression coefficients using ordinary least squares method can be done as follows:

$$\min_{\hat{\alpha}, \hat{\beta}_1 \ldots \hat{\beta}_k} \sum \hat{\varepsilon}_i^2 = \min_{\hat{\alpha}, \hat{\beta}_1 \ldots \hat{\beta}_k} \sum_{i=1}^{n} (Y_i - \hat{\alpha} - \hat{\beta}_1 X_{i1} - \ldots - \beta_k \hat{X}_{ik})^2 \tag{8}$$

This study concludes three different regression models in order to test the relationship between total market return, bond yields and equity yields.

The regression models used in this study are:

$$R_r = \alpha + \beta_1 EY + \varepsilon_t \tag{9}$$

$$R_r = \alpha + \beta_1 EY + \beta_2 LB + \varepsilon_t \tag{10}$$

$$R_r = \alpha + \beta_1 (EY - LB) + \varepsilon_t \tag{11}$$

where *R* is total market yield, EY is equity yield and *LB* is long-term bond yield.

These regression models are similar to models used by Salomons (2006).

3.2 Cointegration analysis

3.2.1 Stationarity and unit root testing

In order to test the data for stationarity of the data the augmented Dickey-Fuller test (ADF) is applied. Stationary process has the same parameters between different time and position. For example GDP time-series are not stationary because they exhibit time trends. Many of the nonstationary time-series can be converted to stationary processes. The process is called trend stationary if it is stationary after subtracting from it a function of time. A case when the first difference of the process is stationary is called difference stationary. There can be also determined several levels of stationarity as weak or wide-sense.

A stochastic process z_i (i = 1, 2 , …) is according to Fumio (2000) weakly stationary when:

E(z_i) does not depend on *i* and
Cov(z_i, z_{i-j}) exists, is finite and depends only on *j* but not on *I*

Stationarity of the data has implications for the properties of estimation methods used like the OLS and the cointegration analysis. If the variable is not stationary or is strongly dependent it must be transformed before OLS-regressions can be validly calculated. The first order integration is also crucial for the cointegration analysis.

The Dickey-Fuller test statistics are derived from the estimation of the first-order autoregressive model (Fumio, 2000):

$$y_t = \rho y_{t-1} + \varepsilon_{t,} \qquad (12)$$

where ε_t is independent white noise.

The stationarity of the variables also have on effect to correlation analysis. If the Fed model is expressed as *P/E = 1/Y* we can test for a unit root in *ln(P/E)* and *ln(1/Y)*. If the P/E ratios and the inverse bond yields are not stationary, the correlation analysis gives meaningless results. This is the reason why it is important to test for stationarity before making any conclusions of correlations.

3.2.2 Cointegration

In order to adjust for nonstationary variables, the cointegration analysis is performed between analyzed variables instead of the regression analysis. From an econometric point of view, an ordinary least-squares regression analysis fails to combine the long-term and the short-term dynamics if these are present in the analysis. When analyzing the Fed model, it must be taken into consideration that bond yields might have long-term impact on stock prices in the long run or in the short run. Therefore the cointegration analysis should be used to get valid test results in both cases.

The cointegration methodology is originally developed by Engle and Granger (1987). The methodology can be demonstrated by using the variables of the Fed model. The variables are earnings index, stock index and government bond yield. If the cointegration relationship among these three variables exists, the cointegration model can be written as:

$$\Delta e_t = \gamma_e + \alpha_e\big(e_{t-1} + \beta_p p_{t-1} + \beta_r r_{t-1}\big) + Dynamics_{S-R}\ for\ e + \epsilon_{e,t\,,} \quad (13)$$

$$\Delta p_t = \gamma_p + \alpha_p\big(e_{t-1} + \beta_p p_{t-1} + \beta_r r_{t-1}\big) + Dynamics_{S-R}\ for\ p + \epsilon_{p,t,} \quad (14)$$

$$\Delta r_t = \gamma_r + \alpha_r\big(e_{t-1} + \beta_p p_{t-1} + \beta_r r_{t-1}\big) + Dynamics_{S-R}\ for\ r + \epsilon_{r,t,} \quad (15)$$

where $e_t = \ln(E_t)$; $p_t = \ln(P_t)$; $r_t = \ln(R_t)$

This is the same specification as used by Durre and Giot (2007).

The relationship in the parenthesis represents the long-run relationship. The change in stock price (Δp_t) is a combination of the long-run relationship and the short-run dynamics. The change in stock prices (Δp_t) is driven by both past disequilibrium in the long-run relationship $e_{t-1} + \beta_p p_{t-1} + \beta_r r_{t-1}$ and the short-run dynamics for $p + \epsilon_{p,t,}$.

With given notions we can write the Fed model in following form (Durre and Giot 2007):

$$\frac{E_{t-1}}{P_{t-1}} = R_{t-1} \quad (16)$$

The logarithm of the equation can be written as follows:

$$e_{t-1} - p_{t-1} = -r_{t-1} \quad (17)$$

If the Fed model is valid then β_p = -1 and β_r = -1 (equations 10 to 12).

If the long-term government bond yields do not have an effect in the relation and the adjustment comes from earnings and stock prices, then β_p should be significantly negative and β_r should not be significant.

Durre and Giot (2007) discuss the sign α_p which is suggested to be positive in economic good sense if β_p is negative. For example if the stock prices increase more than warranted by the increase in earnings, there is a negative disequilibrium in the cointegration vector which means that $e_{t-1} + \beta_p p_{t-1} + \beta_r r_{t-1}$ is negative. In this case the system should correct by having stock prices decrease requiring α_p to be positive.

If the economic assumptions in which the Fed model is based on are correct, the coefficients of the long-run relationship are expected to be negative. The adjustment speed coefficients α_p, α_e and α_r determine how each variable is affected by the disequilibrium in the lagged long-run relationship.

3.3 Granger causality

A time series is said to Granger cause another series if it has incremental predictive power when forecasting it. The Granger causality can simply assessed in a following direct way where each value is regressed on lagged values of itself and the other value: (Freeman 1983)

$$Y_t = \beta_0 + \sum_{j=1}^{J} \beta_j Y_{t-j} + \sum_{k=1}^{K} \gamma k X_{t-k} + u_t \tag{18}$$

The method was developed by Clive Granger in the 1960's (Granger 1969).

4 DATA

The main focus of the study is to determine whether the Fed model has behaved differently in the main European markets than in the United States. The selected markets are:

- United Kingdom
- Germany
- France
- Denmark
- Italy
- (United States)

These markets represent a major part of the European economy and therefore act as a good comparison for the markets of the United States. The primary source for the equity variables is the Thomson Financial Datastream. The Datastream offers harmonized data between different countries which increases the comparability of the results. The Datastream also offers global indexes which include all the stocks of the given country. These indexes are more relevant than standard stock indexes like the FTSE 100 which include only a part of the markets. The global indexes are highly correlated with the standard indexes. It should be also noted that the global indexes do not include losses or negative earnings but only positive earnings.

The global indexes are available for the major part of the selected markets starting from year 1973. Hence the analyzed period is between the years 1973 and 2009 giving 144 observations in total. All the time-series are quarterly data which with given period provides enough data also for valid use of cointegration method.

In order to analyze also inflation adjusted data, the data is deflated with data provided by the harmonized OECD dataset[5]. The according inflation levels are calculated from the Consumer Price Index (CPI). The amount of deflation data differs between different markets due to varying levels of inflation between different currencies (Figure 3).

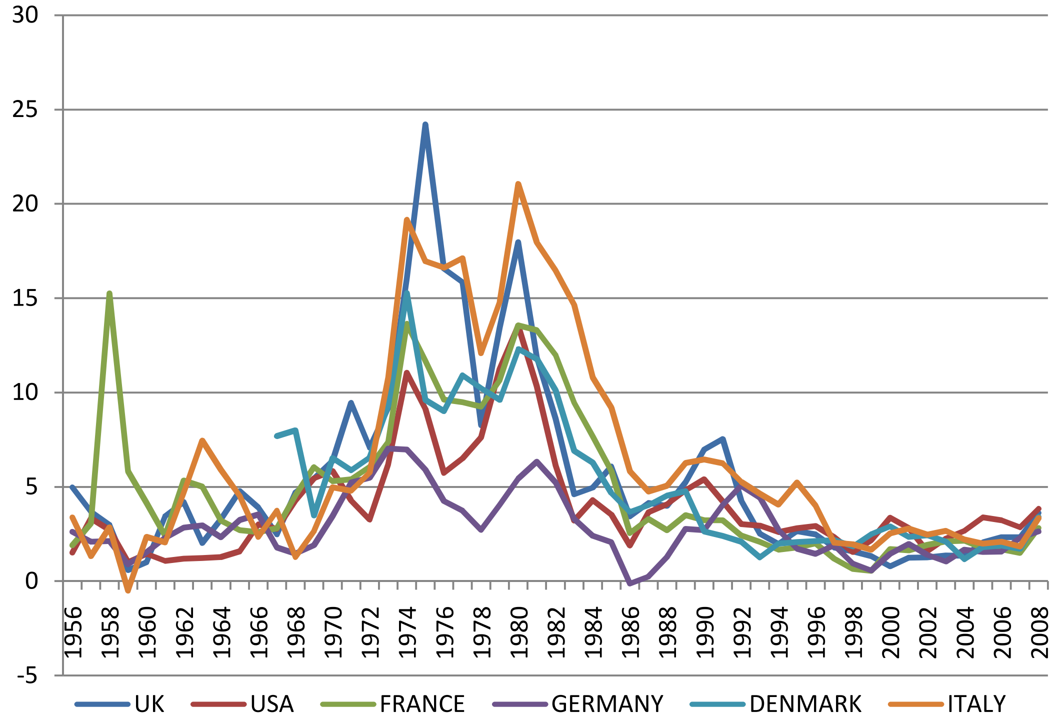

Figure 3. Yearly inflation figures

In contrast to the traditional Fed model, current earnings are used instead of expected earnings. The reason for this is that expected earnings (I/B/E/S database) have been calculated for a much shorter time than the period analyzed. The use of current earnings has previously been utilized by Koivu, Pennanen and Ziemba (2005) with similar data. So called earnings yields for equity indices are calculated from the reported P/E-ratios.

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[5] The OECD dataset is available at http://stats.oecd.org/

The long-term interest rates used in the analysis are equivalent to the yield-to-maturity of long-term government bonds. The source for the interest rates is the IMF International Financial Statistics (IFS). As per definition by IFS, the long-term government bond yield refers to one or more series representing yield to maturity of government bonds or other bonds with longer-term rates than other available interest rates.

As the basic principle of the Fed model is to compare bond yields and equity yields, earnings yield of the equity markets has to be also calculated. The earnings yields were calculated from corresponding total market indices by dividing the index value by the P/E to get the actual earnings. After that the actual earnings were divided by the equity index and multiplied by 100 to gain percentage values of the equity earnings.

5 RESULTS

5.1 Descriptive statistics

This part discusses the descriptive statistics of the different variables used in the empirical analyses. For each variable the minimum, maximum, mean, standard deviation, kurtosis, skewness and Jarque-Bera values are reported. All statistics are logarithmic quarterly data.

5.1.1 Market indices

Table 2. Descriptive statistics - Market Indices

	Min.	Max.	Mean	Std. Dev.	Kurtosis	Skewness	Jarque-bera
USA	4.080	7.224	5.707	1.039	1.504	0.032	13.460
UK	4.453	8.463	7.042	1.115	1.913	-0.494	12.954
Germany	4.254	6.866	5.543	0.793	1.642	0.019	11.069
France	4.155	7.937	6.227	1.155	1.684	-0.226	11.616
Italy	6.562	8.136	7.354	0.458	1.555	0.146	8.327
Denmark	4.514	8.617	6.574	1.252	1.740	-0.129	9.933

This table contains descriptive statistics (logarithmic values) of the analyzed market indices for the analyzed period 01:1974 - 04:2008 (144 observations) except Italy for which the dataset starts from 01:1986 (92 observations).

The market indices (Table 2) are the price indices calculated from the global indices provided by the Thomson Financial DataStream. The logarithmic index mean values are ranging from the minimum of 5.707 to the maximum 7.354. The standard deviation which implies the volatility of the market shows that Germany and Italy have had exceptionally low volatility when compared to the other markets. It should be noted that the analyzed period of the Italian market is different from the rest of the markets which leads to smaller standard deviation of the index. Skewness of all the variables differs from zero. Skewness of the dataset shows close to zero values for all the samples. Negative skewness means that the sample has a longer left tail and vice versa. Kurtosis values are below three which means that the all the samples are platykurtic (kurtosis of normal distribution is 3).

The normality of the variables was examined using the Jarque-Bera test. The null hypothesis was that the variable is normally distributed. The reported value probability is the probability that the Jarque-Bera statistic exceeds the observed value under the null hypothesis. Results of the normality test indicate that all the variables are not normally distributed. The test statistics have high values which indicate that the samples are distributed unevenly. This is natural for such a time-series.

5.1.2 Earnings yield

Table 3. Descriptive statistics – Earnings Yield

	Min.	**Max.**	**Mean**	**Std. Dev.**	**Kurtosis**	**Skewness**	**Jarque-bera**
USA	1.168	2.631	1.889	0.386	2.019	0.148	6.296
UK	1.366	3.411	2.082	0.379	3.116	0.533	6.905
Germany	1.452	2.430	1.912	0.234	2.287	0.049	3.105
France	1.287	2.718	2.077	0.319	2.505	-0.030	1.486
Italy	1.106	2.797	1.739	0.278	4.632	0.310	11.699
Denmark	0.574	2.900	1.879	0.460	3.277	-0.018	0.470

This table contains descriptive statistics (logarithmic values) of the analyzed earnings yields for the analyzed period 01:1974 - 04:2008 (144 observations) except Italy for which the dataset starts from 01:1986 (92 observations).

The earnings yields (Table 3) represent the returns that equity markets have had to offer. Standard deviations show that earnings yields between different markets have differed very little during the analyzed period. The highest mean earnings yield has been in the U.K. The kurtosis of the samples differs quite much between platykurtic and leptokurtic. Skewness of the variables also differs between both sides of the normal distribution. The Jarque-Bera test statistic show high and low values. Especially Denmark and France have an exceptionally low Jarque-Bera values which means that the variables are quite close to the normally distributed values.

5.1.3 Government bond yield

Table 4. Descriptive statistics – Government Bond Yield

	Min.	**Max.**	**Mean**	**Std. Dev.**	**Kurtosis**	**Skewness**	**Jarque -bera**
USA	1.179	2.697	1.952	0.346	2.386	0.034	2.286
UK	1.387	2.805	2.135	0.415	1.711	-0.317	12.387
Germany	1.152	2.368	1.833	0.305	2.117	-0.313	7.019
France	1.173	2.824	2.014	0.427	1.971	-0.183	7.153
Italy	1.221	2.638	1.983	0.479	1.330	0.018	10.693
Denmark	1.151	3.055	2.151	0.512	1.824	-0.175	9.034

This table contains descriptive statistics (logarithmic values) of the analyzed government bond yields for the analyzed period 01:1974 - 04:2008 (144 observations) except Italy for which the dataset starts from 01:1986 (92 observations).

The government bond yields (Table 4) represent the risk-free return provided in particular the country. We can notice that the UK has had a higher bond yield than earnings yield in the analyzed period. The standard deviations differ between 0.305 and 0.512. Most of the variables are highly not normally distributed with the exception of the USA which shows more normally distributed values than the other markets.

5.1.4 5-year real returns

The 5-year real returns (Table 5) are calculated from the market indexes by inflating the returns with 5-year inflation figures calculated from the CPI (Consumer Price Index)

Table 5. Descriptive statistics – 5-year Real Returns

	Min.	Max.	Mean	Std. Dev.	Kurtosis	Skewness	Jarque-bera
USA	-9.905	26.62	8.413	8.516	2.317	0.023	2.418
UK	-8.301	29.41	10.00	7.447	2.900	-0.311	2.054
Germany	-9.887	25.08	7.111	8.564	2.282	0.155	3.163
France	-12.06	34.74	10.56	9.757	2.712	0.311	2.430
Italy	-22,57	29.75	8.782	13.78	2.156	-0.544	7.272
Denmark	-16.27	30.57	9.869	9.163	3.077	-0.378	2.989

This table contains descriptive statistics of the real returns for the analyzed period 01:1978 - 04:2008 (124 observations) except Italy for which the dataset starts from 01:1986 (92 observations).

The mean returns deviate between 7.1 % and 10.56 % in the markets analyzed. The Jarque-Bera statistics show that the variables are not normally distributed.

5.1.5 Augmented Dickey-Fuller unit root test

To test the stationarity of the variables the augmented Dickey-Fuller statistics are calculated. The stationarity of the variables is analyzed in order to know the suitability of the data to regression analysis. The null hypothesis is that the series is non-stationary which means that it has a unit root. The ADF tests are made to both as level tests. The results for the level tests are shown in table 6.

Table 6. Augmented Dickey-Fuller results – Level

	***e* = ln (E)**		***e* = ln (P)**		***e* = ln (R)**	
Country	***c***	***c + t***	***c***	***c + t***	***c***	***c + t***
United States	0.55	0.47	0.85	0.80	0.89	0.80
United Kingdom	0.47	0.64	0.63	0.96	0.94	0.00**
Germany	0.07	0.21	0.81	0.39	0.60	0.07
France	0.08	0.09	0.75	0.81	0.83	0.08
Italy	0.40	0.70	0.41	0.41	0.78	0.26
Denmark	0.03*	0.04*	0.66	0.38	0.88	0.04*

This table contains P-values (MacKinnon one-sided p-values) for the AFD unit root tests for the earnings index, stock index and government bond yield (nominal data). The time period is 1973:01 – 2008:04 (quarterly data) for all countries. P-values of column c include a constant in the unit root test and p-values of column c+t include both constant and a time trend. **1 % level *5 % level

The reported one-sided p-values show that most of the data series have a unit root and therefore are non-stationary series. The results of the ADF tests in the table 6 are very similar across the markets and their first differences are stationary. The tests were also made with first differenced variables and the results showed that every variable is stationary when first differenced.

Non-stationary series can be analyzed with cointegration analysis but in contrast it is well known that in the presence of nonstationary variables, correlations are a misleading indicator of the strength of the relationship between them. The unit root results are similar to results reported by Koivu, Pennanen and Ziemba (2005).

5.2 Regression analysis

5.2.1 Regression analysis results

The main question behind all this analysis is whether the Fed model is capable to forecast returns. One way to approach this question is to use the regression analysis to analyze historical data. The left-hand side of the regression (dependent variable) is the real return of the market index over the 5-year horizon and the right hand side is alternatively earnings yield (traditional model), earnings yield and government bond yield or earnings yield minus the ten-year government bond yield (the Fed model).

The real market returns are calculated by deflating the market returns (total indices including dividends) with the corresponding inflation figures provided by the OECD dataset. The five-year time horizon is selected because of the relatively short time period of the dataset. This test setup is the same as Salomons (2006) has performed, though inspired by several earlier papers such as Asness (2003). Asness found a correlation between earning yield and bond yield in the U.S. over 1965–2001. Salomons (2006) reports this correlation true also in the other markets which means that the test results should be examined with caution.

If the Fed Model has forecasting power, it should be seen in the bivariate regression results of E/P – Y. Likewise if traditional model holds true it should be seen in the regressions on earning yield. By running a univariate regression of the earnings yield and government yield we can determine whether the statistical power comes only from the earnings yield or from the bond yield.

Table 7. Regresssion analysis results

	Intercept	EY	LB	EY-LB	Adj. R^2
USA	17,79* (9,94)	-1,35* (-5,67)			20,8 %
	6,77* (10,67)			-3,09* (-8,62)	37,8 %
	12,93* (7,90)	-3,47* (-9,89)	2,62* (7,35)		45,3 %
UK	13,75* (6,87)	-0,47* (-1,98)			3,1 %
	9,03* (15,08)			-1,70* (-6,47)	25,5 %
	10,88* (6,00)	-1,89* (-6,08)	1,65* (6,15)		26,2 %
Germany	26,89* (10,29)	-2,90* (-7,81)			33,3 %
	7,84* (10,50)			-1,28*	12,0 %
	27,78* (8,52)	-2,89* (-7,68)	-0,16 (-0,46)		33,4 %
France	22,53* (7,95)	-1,44* (-4,41)			13,8 %
	11,14* (13,36)			-1,54* (-4,21)	12,7 %
	24,43* (9,39)	-3,30* (-7,07)	1,72* (5,17)		29,3 %
Italy	15,98* (3,98)	-1,34* (-2,08)			4,6 %
	7,66* (5,58)			-0,16	0,3 %
	16,86* (3,56)	-1,34 (-2,05)	-0,11 (-0,35)		4,7 %
Denmark	16,35* (8,98)	-0,87* (-3,94)			11,3 %
	9,68* (10,67)			-0,10 (-0,49)	0,2 %
	16,38* (8,51)	-0,85* (-3,03)	-0,11 (-0,54)		11,3 %

This table contains regressions for analyzed time period starting from 01:1973 and ending up to 04:2008 (except Italy for which the dataset starts from 01:1986). T-statistics are shown in parentheses. *p < 0,05

The results on regression analysis (Table 7) show remarkably different results for different markets. Three largest markets (U.S., U.K., and Germany) show significantly higher correlations between earnings yield and real returns than the smaller markets. In the U.S and Germany earnings yield has considerable ability to explain real returns on itself. The LB in the bivariate equation adds little to the explanatory power in the case of Germany but increases the power in case the of the U.S. Interestingly the U.K. shows very modest relationship between earnings yield and real returns but gains explanatory power largely from the bond yield. All three smaller markets show lower relationships between the variables but still EY maintains to be statistically significant in all markets. The statistical significance on 5 % confidence level is not achieved in the U.K., Denmark and Italy. It should be noted that Italy suffers of a shorter data period.

The Fed model (EY-LB) has best results in the U.S. and the U.K. In other markets earnings yield performs better. The results seem to follow the market-size because in all aspects the smaller markets have less significant explanatory powers than the larger markets. It seems that the Fed model has some success in forecasting equity returns in the U.S., U.K., Germany and France. The explanatory power is largest in the U.S.

In the bivariate regressions there are three statistically significant results for the LB. The U.K., the U.S. and France are the markets showing dramatic increase in significance when compared to EY alone. Other markets gain a little or not at all from the inclusion of LB to the regression. The relationship between past returns and current earnings yield is negative in each country. This is natural because typically in the bull markets the P/E-ratios are increasing which means that inversely earnings yield are decreasing. This means that relationship is inversely connected between returns and earnings yields.

The unusually high explanatory power in the largest markets gives a reason to suspect that the data is not statistically entirely valid for the purpose of regression analysis. This was no surprise because in section 5.1.5 the variables where found to be non-stationary.

5.2.2 Regression analysis conclusions

The results on the regression analysis show little evidence on the Fed model (Table 8) when compared to the results supporting the traditional model. The only market showing some support for the Fed model is the United Kingdom where bond yield explains a clear majority of the regression between the variables. In contrast the results on Germany, Italy and Denmark show significant results supporting the traditional model. The results on the United States show support for both the traditional model and the Fed model. France is the only country where the introduction of the LB adds to the explanatory power of the regression but the EY-LB regression lacks explanatory power when compared to EY.

Table 8. Support for the Fed model – Regression analysis

	Fed model	**Mixed results**	**Traditional model**
USA		X	
UK		X	
Germany			X
France		X	
Italy			X
Denmark			X

The findings in general show that the earnings yield has considerable ability to explain real returns while the Fed model clearly fails in most cases. It should be noted that Asness (2003) reports a correlation between EY and LB in the U.S. over 1965–2001 and this is most likely to be true also on the other markets. This weakens the statistical validity of these results.

5.3 Cointegration analysis

5.3.1 Results of cointegration analysis

The cointegration analysis focuses on the short- and long-term relationship between the variables. The stationary linear combination is called the cointegrating equation and the presence of a cointegrating relation forms the basis of the VEC specification which may be interpreted as a long-run equilibrium relationship among the variables. The following tests are VAR-based (Vector Auto Regression) cointegration tests using the methodology developed by Johansen (1991, 1995a). It combines the Vector Auto Regression modeling with cointegration.

Three cointegration test specifications used are:

Model 1: No Trend in CE[6] and no intercept in VAR[7]
Model 2: Unrestricted constant and no trend in CE
Model 3: Unrestricted constant and restricted trend

Durré and Giot (2007) have studied the Fed model in a similar cointegration framework that asses the cointegration methodology for both long- and short-term dynamics. More information considering their paper can be found from section 2.2. Koivu et al. (2005) have also made cointegration tests on the Fed model but with a focus on long-term relationships.

[6] CE stands for co-integrating equation
[7] VAR stands for Vector Auto Regression

Due to the quarterly data, the lag length is selected to be 4 as is suggested by Johansen (1992). The results are for the model that has unrestricted constant and restricted trend. This has been found to be the most valid when analyzing the Fed model in the cointegration framework because it allows for linear deterministic trend in the data to be included. The null hypothesis of the Johansen's test is that the variables are not cointegrated. The test statistic results are indicated at the level of 5 %.

Table 9. Cointegration results for the USA

	Null hypothesis	Trace Statistics	5% Critical Value	Max Eigen Value	5% Critical Value
No trend in CE and no intercept in VAR	r = 0	22.510	24.275	12.753	17.797
	r1	9.758	12.320	7.132	11.224
	r ≤ 2	2.626	4.129	2.262	4.129
Unrestricted constant and no trend in CE	r = 0	25.645	29.797	19.560	21.131
	r1	6.085	15.494	5.717	14.264
	r ≤ 2	0.367	3.841	0.367	3.841
Unrestricted constant and restricted trend	r = 0	40.228	42.915	23.617	25.823
	r1	16.611	25.872	12.425	19.387
	r ≤ 2	4.186	12.517	4.186	12.517

The cointegration tests were made for each country for the system of log price, log earnings yield and log government earnings yield. Lags interval is 1 to 4.
*** signifies the rejection of null hypothesis**

The cointegration results for the USA (Table 9) in system of log earnings, log price index and log government bond yield show no statistically significant cointegration relationships on any model tested. This is an opposite results when compared to the results of regression analysis which showed statistically significant correlation relationships between real return and earnings yield. This is also an opposite results when compared to the results achieved by Durre and Giot (2007) on their cointegration test setup. Durre and Giot found the variables in the case the U.S to have a cointegration relationship although the level of cointegration was low.

Table 10. Cointegration results for the UK

	Null hypothesis	Trace Statistics	5% Critical Value	Max Eigen Value	5% Critical Value
No trend in CE and no intercept in VAR	r = 0	24.824*	24.275	16.012	17.797
	r1	8.812	12.320	7.861	11.224
	r ≤ 2	0.951	4.129	0.951	4.129
Unrestricted constant and no trend in CE	r = 0	29.270	29.797	21.443*	21.131
	r1	7.826	15.494	6.281	14.264
	r ≤ 2	1.544	3.841	1.544	3.841
Unrestricted constant and restricted trend	r = 0	45.061*	42.915	22.031	25.823
	r1	23.029	25.872	18.501	19.386
	r ≤ 2	4.528	12.517	4.528	12.517

The cointegration tests were made for each country for the system of log price, log earnings yield and log government earnings yield. Lags interval is 1 to 4.

The results on the UK (Table 10) show one cointegration relationship in models one and three. The results on model two is also very close to significant results on 5 % level. When compared to the results of the regression analysis, the results are in the same direction. The regression analysis showed statistically significant correlation between the real variables in all the cases tested. It is interesting to notice that two fairly similar markets as the U.S and the U.K have such a different results. In cointegration tests made by Durre and Giot (2007), the UK was also found to have cointegration relationships between a similar system of variables.

Table 11. Cointegration results for the Germany

	Null hypothesis	Trace Statistics	5% Critical Value	Max Eigen Value	5% Critical Value
No trend in CE and no intercept in VAR	r = 0	13.736	24.275	6.204	17.797
	r1	7.532	12.320	4.591	11.224
	r ≤ 2	2.940	4.129	2.940	4.129
Unrestricted constant and no trend in CE	r = 0	28.802	29.797	23.219	21.131
	r1	5.583	15.494	5.329	14.264
	r ≤ 2	0.253	3.841	0.253	3.841
Unrestricted constant and restricted trend	r = 0	39.047	42.915	23.682	25.823
	r1	15.364	25.872	10.092	19.387
	r ≤ 2	5.272	12.517	5.272	12.517

The cointegration tests were made for each country for the system of log price, log earnings yield and log government earnings yield. Lags interval is 1 to 4.
*** signifies the rejection of null hypothesis**

Among the group of variables in Germany (Table 11), no cointegration relationships are found. Again this is in contrast to the results of regression analysis which showed significant relationship between real return and bond yield. The results are the same as in similar test performed by Durre and Giot (2007).

Table 12. Cointegration results for the France

	Null hypothesis	Trace Statistics	5% Critical Value	Max Eigen Value	5% Critical Value
No trend in CE and no intercept in VAR	r = 0	21.176	24.275	11.246	17.797
	r1	9.929	12.320	9.929	11.224
	r ≤ 2	9.95E-06	4.129	9.53E-06	4.129
Unrestricted constant and no trend in CE	r = 0	34.774*	29.797	25.487*	21.131
	r1	9.287	15.494	9.100	14.264
	r ≤ 2	0.187	3.841	0.187	3.841
Unrestricted constant and restricted trend	r = 0	48.327*	42.915	25.503	25.823
	r1	22.283	25.872	15.892	19.387
	r ≤ 2	6.931	12.517	6.931	12.517

The cointegration tests were made for each country for the system of log price, log earnings yield and log government earnings yield. Lags interval is 1 to 4.
*** signifies the rejection of null hypothesis**

The results on France (Table 12) show one cointegrating relationship on both models two and three. The null hypothesis of no cointegration is very strongly rejected in both cases although max eigen value is statistically significant on 5 % level only in the model two. Regression analysis showed a strong correlation relationship between real return and real earnings yield. Durre and Giot (2007) also found cointegration in the case of France.

Table 13. Cointegration results for the Denmark

	Null hypothesis	Trace Statistics	5% Critical Value	Max Eigen Value	5% Critical Value
No trend in CE and no intercept in VAR	r = 0	24.974*	24.275	14.653	17.797
	r1	10.321	12.320	9.389	11.224
	r ≤ 2	0.932	4.129	0.932	4.129
Unrestricted constant and no trend in CE	r = 0	34.311*	29.797	24.807*	21.131
	r1	9.503	15.494	8.927	14.264
	r ≤ 2	0.576	3.841	0.576	3.841
Unrestricted constant and restricted trend	r = 0	50.317*	42.915	28.664*	25.823
	r1	21.653	25.872	12.895	19.387
	r ≤ 2	8.757	12.517	8.757	12.517

The cointegration tests were made for each country for the system of log price, log earnings yield and log government earnings yield. Lags interval is 1 to 4.
*** signifies the rejection of null hypothesis**

The test results on Denmark (Table 13) show statistically significant cointegration relationships on all three models. The results are especially strong in models two and three, where also the max eigen values are statistically significant. All the results show one cointegration relationship. Durre and Giot (2007) also have found similar results on their cointegration setup in the case of Denmark.

Table 14. Cointegration results for the Italy

	Null hypothesis	Trace Statistics	5% Critical Value	Max Eigen Value	5% Critical Value
No trend in CE and no intercept in VAR	r = 0	16.771	24.275	9.130	17.797
	r1	7.641	12.320	5.932	11.224
	r ≤ 2	1.708	4.129	1.708	4.129
Unrestricted constant and no trend in CE	r = 0	25.494	29.797	18.317	21.131
	r1	7.177	15.494	6.946	14.264
	r ≤ 2	0.231	3.841	0.231	3.841
Unrestricted constant and restricted trend	r = 0	30.571	42.915	18.352	25.823
	r1	12.218	25.872	7.001	19.387
	r ≤ 2	5.216	12.517	5.216	12.517

The cointegration tests were made for each country for the system of log price, log earnings yield and log government earnings yield. Lags interval is 1 to 2.

The quarterly data on Italy starts from 1986 which makes the analyzed period significantly shorter when compared to other countries tested. This can also be seen from the results (Table 14) of regression analysis which shows a weak correlation between the real variables tested although the correlations are statistically significant. The cointegration results show no cointegration relationships on any of the models tested. The results are the same as in a similar test performed by Durre and Giot (2007).

5.3.1 Cointegration analysis conclusions

The results on the cointegration analysis (Table 15) show both support and no support for the model. On half of the countries examined the analysis found no cointegration in the system analyzed. The countries showing one cointegration vector are the U.K., France and Denmark. The test model producing the cointegration differs between the countries. In the regression analysis the U.K. and France showed mixed results between the traditional model and the Fed model which somewhat supports the Fed model.

Table 15. Support for the Fed model – Cointegration analysis

	No cointegration	**Cointegration**	**Co.int model***
USA	X		
UK		X	Model 3
Germany	X		
France		X	Model 2
Italy	X		
Denmark		X	Model 2 and 3

*Statistically significant trace statistic and max eigen value.

5.4 Granger causality analysis

5.4.1 Granger causality

The purpose of the Granger causality test is to clarify the relationship between the variables found to have cointegration between them (UK, France and Denmark). The Granger causality test implies whether one time series can be used to forecast another. The test is based on the analysis of the lagged values of the variables. If the lagged values provide statistically significant information about the future values of the other time-series, the time-series is said to Granger-cause the other. In other words the analysis tells us whether the current value of one variable has correlation between the past values of the other variable. This specifies the type of cointegration that the variables are exhibiting in the short-term.

The null hypothesis is that the variable A does not affect the variable B. If the P-value is under 0.05, the statistical significance is above 95 % which means that the null hypothesis is rejected and therefore variable A has an impact on variable B in the short-term. It should also be noted that the causality is not necessarily positive which means that the variables can also have an inverse relationship. The single test results always indicate one-way causality between the variables. If the variables Granger cause each other, the both cross-tests have to be statistically significant. All the tests are made with the logarithmic values of the original data (the same data as in the cointegration analysis).

Table 16. Granger causality results: UK

Null Hypothesis	F-Statistic	P-value
GOV does not Granger Cause EARNINGS	1.06	0.346
EARNINGS does not Granger Cause GOV	6.53	<0.01
PRICE does not Granger Cause EARNINGS	6.24	<0.01
EARNINGS does not Granger cause PRICE	244.07	<0.01
PRICE does not Granger Cause GOV	4.95	<0.01
GOV does not Granger Cause PRICE	2.14	0.12

The results on the U.K. (Table 16) show that the null hypothesis is rejected in four cases. The results show that earnings yield does Granger cause government bond yield and price index. The two other causalities show that price index granger causes earnings yield and government bond yield. Especially the causality between earnings yield and price index is statistically very significant (F-value is 244.07). Earnings yield does inversely Granger cause price index changes. This supports the underlying assumptions of the Fed Model. The three other causalities are also well inside the 95 % statistical significance with p-values under 0.01.

Table 17. Granger causality results: France

Null Hypothesis	F-Statistic	P-value
GOV does not Granger Cause EARNINGS	2.56	0.08
EARNINGS does not Granger Cause GOV	1.99	0.13
PRICE does not Granger Cause EARNINGS	4.16	0.01
EARNINGS does not Granger cause PRICE	104.21	<0.01
PRICE does not Granger Cause GOV	3.27	0.04
GOV does not Granger Cause PRICE	3.93	0.02

The test results on France (Table 17) show four separate statistically significant causalities between the examined variables. The most significant causality is found between earnings yield and price yield. There variables showed a remarkably strong inverse Granger causality also in the previous test country U.K. The results here are very much similar. The other three statistically significant (on 95 % level) causalities are found between price index and earnings, price index and government bond yield and government bond yield and price index. The results show that the price index and government bond yields are Granger causing each other.

Table 18. Granger causality results: Denmark

Null Hypothesis	F-Statistic	P-value
GOV does not Granger Cause EARNINGS	3.14	0.04
EARNINGS does not Granger Cause GOV	9.55	<0.01
PRICE does not Granger Cause EARNINGS	3.15	0.03
EARNINGS does not Granger cause PRICE	26.00	<0.01
PRICE does not Granger Cause GOV	5.77	<0.01
GOV does not Granger Cause PRICE	0.48	0.61

The null hypothesis gets rejected five times out of six tests in the case of Denmark (Table 18). As with the other countries, the most significant Granger causality is found between earnings yield and price index. Opposite to other countries analyzed the test shows also statistically significant Granger causality between government bond yield and earnings yield. The only pair of variables that do not exhibit the Granger causality is government bond yield and price index.

The Granger causality tests performed on the U.K., France and Denmark show quite similar results on each country. The Granger causality between variables is strongest between earnings yield and price index in all three countries examined. The causality is also found in the opposite way: in all the three countries price index does granger cause earnings yield. The only country that shows Granger causality between government bond yield and stock price index is France. Denmark on the other hand shows statistically significant Granger causality between government bond yield and earnings yield but gives very little statistical significance between government bond yield and stock price index.

The test as a whole shows very high p-values on almost all the causalities. This gives a reason to suspect the statistical validity of the test.

5.4.2 Granger causality conclusions

The Granger causality tests performed on the U.K, France and Denmark show evidence on the relationship between earnings yield and price index. On all three countries the test found earnings yield to Granger cause the price index. The Granger causality was found to be statistically very high between earnings yield and the price index when compared to other statistically valid Granger causalities which showed significantly lower f-statistics.

According to these results the forward earnings yield can be used to forecast stock prices. The results on Denmark and the U.K. also give support to the Fed model because the price index is found to Granger cause government bond yield. When these two causalities are combined we can conclude that the earnings yield Granger causes government bond yield. The results are supported by Berge and Ziemba (2003) who also found that there is a relationship between the yield on long-term government bonds and the E/P of the stock market.

6 CONCLUSIONS

The tests confirm that the Fed model is not a tool that can be reliably used to value the stock markets because the variables were found not be cointegrated in most of the countries examined. These results also give an answer to the research question of whether there is a long-term relationship between stock market yield and government bond yields. These results support the findings of Asness (2003) and Durré and Giot (2007) who also found that the government bond yield does not have a significant role in the relationships in the long-term. In most cases the earnings yield is the best estimator of the real returns. The results are supported by the regression analysis results but the Granger causality shows also evidence that there is a relationship between the earnings yield and the government bond yield in Denmark and the U.K. Overall the results show variations between the countries examined and therefore the Fed model seems to be a theory that works in some markets for a chosen period but in general it does not work for longer periods because the market conditions change over time. The results of Thomas and Zhang (2007) also support the view that the market conditions affect greatly on the Fed model results on the long-run (see chapter 2.3.1 Inflation Illusion).

From methodological point of view, the cointegration approach used in this paper provides statistically more valid results than the regression analysis. The cointegration analysis concentrates on the long-term relationships between the variables and is also suitable for the non-stationary time series used in this study.

The results of the study show interesting evidence on how differently the Fed Model behaves in different market conditions. As pointed by Asness (2000, 2003), the Fed model has been quite successful as an empirical description of stock prices. Despite the empirical success of the Fed model, there is serious difficulty to show that the model is applicable in different markets directly. Does this make the Fed model obsolete? Are the differences in the market behavior the reason why the Fed model is so rarely used outside the U.S? These are hard questions to answer. The underlying reasons that make the model work or not on specific markets are not known. Several studies before this have shown that the model might work on some market but does not work on others. Despite these results, no studies have found any single reasons that might cause the Fed model or the underlying causality to work or not.

The objectives of this study were to find out if there is a long-term relationship between earnings, stock prices and government bond yield as stated by the Fed model and also to find out whether this relationship is similar across the markets researched. It should be noted that the selected markets are all European markets except for the U.S which acted as reference market.

As stated before in this study, the simplicity of the Fed model is appealing for the average investors in the markets. The investors tend to like simple causalities and therefore the Fed model is widely used in market research and publications as an easy point of entry in the world of market analysis.

Part of the research questions was the question of whether the relationships differ between the markets. It is confirmed that the results show very different relationships between the markets examined. It should be noted that the shorter time-span of the data on Italy has somewhat impacted the results but the underlying reason of different relationships on different markets remain unknown. These reasons could be studied in further studies. It would be interesting to know the fundamental differences between the markets which cause different behavior of the variables such as bond yield and equity yields and especially the reasons for different relationship between the variables. Are the differences caused by different investors with different preferences or are the market conditions simply different? These are the questions that are left unanswered.

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