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Inflation Illusion and Equity Return: a Fed Model Approach

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Abstract

Title:	Inflation Illusion and Equity Return: a Fed Model Approach
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Five key words:	Fed model, inflation illusion, inflation, earnings yield, bond yield.
Purpose:	Firstly, the purpose of the study is to investigate if inflation illusion is effecting investors' decisions in Sweden. Secondly, to examine whether the Fed model adjusted for debt capital gain error is successful in forecasting real stock return on industry level between 1984 and 2010.
Methodology:	Quantitative approach using regression analysis.
Theoretical Perspectives:	Theoretical perspective covers the theory underlying the Fed model and Inflation Illusion.
Empirical foundation:	The sample contains of time series on price earnings ratio of the Swedish index, the CPI-index, the Swedish 10-year governmental bond during 1982-2010. Supplementary data for the industrial-, banking- and consumer goods industry is the base for industry analysis
Conclusions:	We identified that investors in Sweden are affected by inflation illusion. Also they incorrectly account for debt capital gain for the levered companies. We can also conclude that the Fed model proved to be weak tool for forecasting future real returns and its modification only partially increase its quality. Finally we identified that earnings yield standalone is a much better measure for understanding the return dynamics

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1. Introduction

In this chapter we present the background to our research. We continue with the problem discussion which is followed by delimitations and the purpose. This chapter is concluded with the thesis outline.

1.1 Background

While global financial authorities still try to take effective steps in overcoming the financial crisis, professional investors and academicians try to understand what consequences will shape future market returns and overall investment strategies. From media coverage it is getting more and more obvious, that apart from other factors, global economy is likely to face a period of higher inflation than it had enjoyed the recent years (*The Economist* 2011; *Dagens Industry*, 2011).

Despite the seeming simplicity of the inflation phenomenon, prerequisites of its increase and effects that it can have are complex. As we will discuss in this master thesis inflation can be a source of market inefficiency and is therefore interesting as a research topic in the corporate finance field. In order to reach a balance between theoretical analysis and practical application, we will use the Fed model as a tool for understanding the effect of inflation on investment strategies.

In the Federal Reserve Humphrey-Hawkings report of July 22 1997 the Fed noticed that *"... the ratio of prices in the S&P 500 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* (..)"[1]. Dr Ed Yardeni, then an analyst at Deutsche Morgan Grenfell, formalized this relationship into what has now become the Fed model. From this model it follows that the stock market is fairly valued when the reciprocal of the price earnings ratio equals the yield on 10 year government bond. Consequently, deviations from this equality manifest an over- or undervaluation of the stock market relative to the bond market.

[1] Federal Reserve Board, Humphrew-Hawkins Report, 22 July 1997, Section 2: Economic and Financial Developments in 1997.

The Fed model is in practice used as a shorthand measure of the attractiveness of equity or bonds and concurrently used as a timing device for allocating funds between the two assets. Investors following the Fed model interpret higher earnings yield, the inverse of the price earnings ratio, than bond yield as their buy signal because the model calls for higher subsequent equity returns when this relation is fulfilled (Salomons, 2004).

Despite its simplicity the model has gained a large amount of attention from academics (Estrada 2009). Number of studies have been done on US data and aimed towards testing the model's predictive power over subsequent return over long time horizons and the results are mixed (Aubert and Giot 2007; Asness 2003; Salomons 2004). The other large part of empirical studies have focused on cross sectional analysis where the Fed model has been tested on a international level and found to be a failure in most cases (Estrada 2009; Giot and Durré 2004).

According to Asness (2003) the failure of the model can be attributed to its theoretical flaws foremost because it relates the real value earnings yield to the nominal bond yield. The author, who argues that a stronger candidate to forecast future return is to compare earnings yield with the current real interest rate, proposed an alternative approach to the model.

Further critique brought up in Asness (2003) is that the model fails to address that equity is a risky asset class while bonds are risk free. Salomons (2004) introduces a Fed model adjusted for risk and finds it to beat the unadjusted version in forecasting. Other proposed variations of the Fed model has been to compare earnings yield with bond yields of different maturities or to compare it with TIPS (Treasury Inflation-Protected Securities) but there are little support for these alternative models (Estrada, 2009).

1.2 Problem discussion

Previous researchers as Asness (2003) and Salomons (2004) refer to the inflation illusion phenomenon, introduced by Modigliani and Cohn (1979) as a way to understand how investors erroneously interpret the effect of inflation on returns. We believe that this criticism against the Fed model only moderately addresses the phenomenon introduced by Modigliani and Cohn in 1979. The original hypothesis of Modigliani and Cohn (1979) and ideas later developed by Ritter and Warr (2002) do not support the argument that earnings are real. Instead, one of the key inputs contributed by the inflation illusion theorists is that accounting earnings are only partially real, and the higher the leverage, the more significant is the impact of inflation. This is known as the debt capital gain error and is the focus in this thesis.

To enhance the comparability between stocks and bonds we will adjust the Fed model for inflation illusion effect. We believe that this approach to address the theoretical fallacies will enable us to evaluate the model from a more theoretical consistent point of view. It will also provide us with evidence regarding the question if investors are suffering from inflation illusion. As previously mentioned, the scope of this thesis is to investigate the effect of inflation on equity valuation, and therefore we do not intend to focus on the risk premium aspect brought up by Asness (2003).

The second contribution of this thesis is that we evaluate the model's prediction power, when adjusted for the debt capital gain error, on three different industries. Extending the analysis to the industry level enables us to discriminate between the industries according to their financial characteristics, especially the level of leverage. Additionally we argue that an industry level approach will provide us with an opportunity to better grasp the effect of the debt level, which will enable us to understand the results according to the inflation illusion theory. Furthermore, no study on the Fed model has been extended to the industry level and none have corrected it for the debt capital gain error. To start with, the thesis follows previous studies and evaluates the predictability of the model over 1 and 5 years for subsequent return in Sweden between the years of 1984 and 2010 using a quantitative approach. Sweden was chosen as the case country because of the specifics of the financial market where holdings of international investors are more significant than in US which is used the majority of previous research. For example, as of 2009, international investors holding Swedish stocks accounted for 35 percent of the owners[2] while the equivalent for US was about 12 percent[3].

Nevertheless, this thesis is focused on the theory underlining the Fed model and the critique against it. The forecasting period and the choice of Sweden, as case country, is foremost to

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[2] Sveriges Riksbank: " The Swedish Financial Market"
http://www.riksbank.com/upload/Dokument_riksbank/Kat_publicerat/Rapporter/2010/finansmarknaden_2010_eng.pdf [2011-05-20]

[3] Federal Reserve: "Flow of Funds Guide"
http://www.federalreserve.gov/apps/fof/DisplayTable.aspx?t=l.213 [2011-05-20]

explore our theoretical approach. As long as data is available our approach could be conducted on any country and respectively on any industry.

1.3 Purpose

Firstly, the purpose of the study is to investigate if inflation illusion is effecting investors' decisions in Sweden.

Secondly, to examine whether the Fed model adjusted for debt capital gain error is successful in forecasting real stock return on industry level between 1984 and 2010.

1.4 Delimitations

In addition to adjusting earnings for debt capital gain error Wilcox (2007) and Ritter and Warr (2002) include the effect of inflation on depreciation charges.

We argue that is valuable as long as US is the study object. US GAAP accounting standards for revaluation of fixed assets differs from the European IFRS. Unlike US GAAP that does not allow companies to account for revaluation of fixed assets (IAS Plus, 2007), IFRS does permit this for those who use fair value accounting policy. Considering the fact that fair value accounting is widely spread among European companies (Christensen and Nikolaev, 2008), we are therefore limiting the adjustments made to earnings to only account for the debt capital gain error.

1.5 Thesis outline

Chapter two reviews the covered theory interconnected with the Fed model. It provides a derivation of the formulas and relevant theoretical critique. The chapter also provides the reader with an introduction to Irving Fishers pioneering work regarding inflation and is followed with Modigliani and Cohn's discussion on inflation illusion. The literature review aims to present an overview on empirical research covering the Fed model. Chapter three consists of the methodological framework used in this thesis. We present calculations and the data collection process and conclude with a discussion aiming to defend the chosen quantitative approach. Empirical findings are to be found in chapter five where we graphically and numerically describe the collected data as well as the regression results. Chapter five consists of the analysis and a discussion regarding the results. The thesis is concluded in chapter six where the most interesting findings are brought forward in addition to further research proposals.

2. Literature review

In this chapter we start with providing the theory of inflation and inflation illusion. This part is followed by an introduction to the Fed model and the criticism it has received. The last part provides a review of the empirical evidence and summarizes the main academic contributions in the field.

2.1 Theoretical framework

2.1.1 Inflation and inflation illusion

Breakthrough in the understanding of inflation and its effect on the economy was made in the end of 19^{th} century by prominent American economist Irving Fisher. In 1896 in his book *Appreciation and Interest* Fisher defines nominal interest rate (R) as a linear function of real interest (r) rate plus expected inflation (p):

$$R = r + p + rp$$

Expected inflation according to the theory is equal to the percent change in the price of goods:

$$p = \frac{E(V)_{t+1} - V_t}{V_t}$$

Where:

$E(V)$ – Expected price of goods; V– Actual price of goods.

Despite the relative simplicity of Fisher's equation, effect of expected inflation on returns is a subject for century long discussions. Significant attention in this academic field is devoted to the understanding of inflation as a source of market inefficiency. This problem is primary related to the concept of *money illusion* introduced in Fisher (1930). According to the research money illusion occurs when increase in inflation results in nominal interest rate change with a certain time lag. This concept of money illusion is a way to understand possible deviation from Fisher's equation with a behavioral approach. Fisher describes how the process of interest adjustments is affected by the money illusion in the following way (ibid, p. 399-400):

"Most people are subject to what may be called "the money illusion," and think instinctively of money as constant and incapable of appreciation or depreciation. Yet it may be true that they do take account, to some extent at least, even if unconsciously, of a change in the buying power of money, under guise of a change in the level of prices in general. If the price level falls in such a way that they may expect for themselves a shrinking margin of profit, they will be cautious about borrowing unless interest falls, and this very unwillingness to borrow, lessening the demand in the money market, will tend to bring interest down. On the other hand, if inflation is going on, they will scent rising prices ahead and so rising money profits, and will be stimulated to borrow unless the rate of interest rises enough to discourage them, and their willingness to borrow will itself tend to raise interest."

Despite criticism from some prominent economists of such as James Tobin who thought that: "*An economic theorist can, of course, commit no greater crime than to assume money illusion*" (Tobin 1972 p.3), Fisher's ideas were further developed in the studies of Modigliani and Cohn (1979).The research of Modigliani and Cohn is more focused on the effect of inflation on a company's value and investors behavior.

While analyzing the complex effect of inflation on market equity value Modigliani and Cohn (1979) brought the money illusion phenomenon into the specific corporate finance case, by introducing the *inflation illusion* concept. According to their theory investors tend to make major errors in corporate equity valuation, because of an incorrect accounting of the inflation effect. The first source of inflation illusion is based on an incorrect reporting of accounting profits due to accruing nominal interest expense and not real. Thus, inflation adjusted profits should rise with growing inflation but accounting principles do not allow the reporting of inflation adjusted interest expenses. This error is referred to as debt capital gain error in Ritter and Warr (2002). The second source of inflation illusion according to the authors is the incorrect principle of equity capitalization. They claim that investors use nominal rates instead of real and, therefore, use the wrong discount factor in equity valuation. This is known as the capitalization rate error.

Even though Modigliani and Cohn mainly discuss the effect of debt capital gain error they also mention how inflation creates discrepancies in accounting value of inventory, fixed assets and its replacement costs. This results in erroneous depreciation charges that overstate accounting earnings. In further development of the hypothesis Modigliani and Cohn do not discuss this issue. While analyzing the effect of inflation illusion on taxes, they conclude that unlike untaxed debt capital gains, the company can not deduct the tax benefit that is the result from an increase in replacement cost of fixed assets (Modigliani and Cohn, 1979). The fact that replacement costs decrease with an increase in inflation, it should also result in a decrease in depreciation charges but if the company uses historical cost accounting the charge remains unchanged. This results in an overstatement of the depreciation expense and an overstatement of cost of taxes. However, the tax effect is partially eliminated by the fact that the magnitude of the inflation illusion effect is affected by leverage and does not appear in the tax accounting.

While analyzing the effect of leverage Modigliani and Cohn (1979) start with the fundamental principles of valuation:

$$S = V - D = \frac{X}{w} - D = \frac{X - rD}{w + d(w - r)}$$

Where:

S - Value of the equity, D - Outstanding amount of debt,

X - Operating income, w - discount rate, r - real interest rate,

$d = D/S$; $w + d(w\text{-}r)$ - capitalization rate.

If we introduce inflation (p), then according to Fisher's equation nominal interest rate (R) will be equal to $\mathrm{R} = \mathrm{r} + \mathrm{p}$, thereby adjusting the firm's profit E^* to:

$$\mathrm{E}^* = X - RD = X - (r + \mathrm{p})D = \mathrm{E} - \mathrm{p}D$$

Where: E - Non-adjusted effect of increased inflation on accounting profit.

Using Miller and Modigliani's proposition that the market value of the firm is independent of leverage (Miller and Modigliani, 1958), Modigliani and Cohn concludes from the formula above that despite inflation decreases the accounting profit, it does not affect the *real* profit. Therefore, because of the effect of increasing inflation, $\mathrm{p}D$ is a quantified benefit that accrues to the shareholders of the leveraged firm. This benefit is present when the accounting profit is incorrectly measured and used in corporate valuation. As previously stated Ritter and Warr

(2002) refer to this as debt capital gain error. Consequently, in order to correct the valuation error the following procedure is derived in Modigliani and Cohn (1979):

$$\frac{\mathrm{E} + \mathrm{p}D}{S} = \frac{X - rD}{S} = w + (w - r)d$$

Resulting in S:

$$S = \frac{\mathrm{E} + \mathrm{p}D}{w + (w - r)d} = \frac{\mathrm{E}^*}{w + (w - r)d}$$

Therefore:

$$\frac{\mathrm{E}}{S} = w + (w - r)d - \mathrm{p}d$$

Testing of this hypothesis resulted in unexpected results, in 1977 S&P 500 was considered to be 50 per cent undervalued compared to its intrinsic value. Modigliani and Cohn (1979) believe that this undervaluation is a result of a high inflation environment that US experienced at that time and an inability to correctly estimate the effect of inflation on the value of equity, previously defined as inflation illusion. The authors argue that either a decrease in inflation or a more correct understanding of valuation principles can solve the occurred undervaluation problem.

Furthermore, while discussing potential results regarding market identification on mispricing of equity, the authors state: "*The resulting switch from money-fixed securities to undervalued equities could rapidly generate the momentum needed to return the market to the reasonable level*". (ibid, p.36) This idea expressed in 1979 is highlighting the fact that despite the late crystallization of the Fed model as a tool for investment decision making, bonds and stock were considered to be competitive investment alternatives (Asness 2003). Next we will provide a description of the Fed model as a practical tool for investment decision making and main criticism against it in the light of inflation illusion theory.

2.1.2 The Fed Model

The Fed model rests on the equality between the long-term bond yield (BY) and the earnings yield on the stock market (EP), measured as the reciprocal of the price earnings ratio. These fundamentals harmonizes well with the reasoning of financial analysts, portfolio managers and financial commentators who assume a negative relationship between the stock markets price-earnings ratio and current interest rates, and the Fed model is the best-known formalization of this relationship (Estrada, 2009).

The origin of the model is not entirely known but the model was given its name by Edward Yardeni. While scrutinizing Federal Reserve Board's Monetary Policy Report to the Congress of July 1997 Yardeni derived the model from a paragraph explaining a graph depicting strong correlation between the 10-year Treasury bond yield and the S&P 500 earnings yield (Yardeni, 2003). In its simplest form, the model asserts the stock market to be fairly valued when earnings yield equals bond yield. The following indication of an over- or undervalued stock market can therefore be drawn:

$$\text{EP} > BY = \text{Stock market is undervalued}$$

$$\text{EP} < BY = \text{Stock market is overvalued}$$

Yardeni (2003) argues that the market will correct for the misevaluation, all though periods of disequilibria can last for a long while. However, by identifying the misevaluation the model will predict if the stock market earnings yield is likely to rise or fall as investors are expected to purchase the undervalued asset and sell the over valued one. In this basic form, high stock prices measured as a high price earnings ratio are reasonable when interest rates and inflation are low and vice versa (Aubert & Giot, 2007)

To justify the usefulness of the model three arguments must be brought up. The first argument is that bonds and equity are competing assets, that is, investors can only choose either one of them (Estrada 2009). If this holds, investors compare earnings yield and bond yield and choose the asset class with the highest yield. Consequently, this restricts the available investment products to only two.

The second argument refers to the fact that earnings yield can be expressed as a positive function of bond yield. The theoretical foundation of this argument is usually shown in relation to the widely known dividend discount model (ibid). The price, defined as the stock price (P), is a function of present and future dividends ($D(1 + \mathrm{G})$) discounted by the risk free rate (Rf) plus a risk premium (Rp) minus the long-term growth in dividends (G):

$$P = \frac{D(1 + \mathrm{G})}{Rf + Rp - G}$$

The first step is to divide each side with earnings (E) and assume that all earnings are paid out as dividends, therefore $D(1 + G) = E$.

$$\frac{P}{E} = \left[\frac{E}{Rf + Rp - G}\right] \div E$$

The second step is to assume that dividends are not expected to grow in the long term and therefore $G = 0$:

$$\frac{P}{E} = \left[\frac{E}{Rf + Rp}\right] \div E$$

Furthermore, investors require no more return from stocks than from bonds and thus $Rp = 0$.

$$\frac{P}{E} = \left[\frac{E}{Rf}\right] \div E \;\rightarrow \frac{P}{E} = \frac{1}{Rf}$$

The last step is the Fed model as traditionally expressed in Yardeni (1997). We will use the inverse of this relationship as put forward in Asness (2003).

The third argument, coined "Just look at the data" in Asness (2003), is an empirical argument that rests on the historical strong correlation between earnings yield and bond yield in the US. Except for a small decrease in earnings yield after 1985 the correlation of the two series is 0,81 (Asness, 2003).

2.1.3 Criticism against the Fed Model

The criticism against the Fed model has been substantial and researchers and practitioners focus on two theoretical fallacies. The first one being that comparison between stocks and bonds is theoretically flawed because bond yields are nominal and earnings are real. Investors making the fallacious comparison is said to be suffering from inflation illusion as was previously discussed. The Fed model can be augmented to correct for inflation illusion by subtracting inflation rate (p) from the bond yield. After adjusting for inflation the comparison is theoretically sounder because two real values are now comprised. This point is emphasized in Asness (2003) who argues that equities have been assessed as a good hedge against increasing inflation because nominal growth in earnings should offset an increase in inflation. Consistently with Asness (2003), the stock market is relatively better valued when:

$$\frac{E}{P} = BY - I$$

The second fallacy focuses on the fourth step of the derivation of the dividend discount model above and highlights that the assets different risk profiles make them unsuitable for comparisons. That is, the higher return on stocks can be explained by the higher risk. Therefore, the assumption that risk premium is equal to zero is a subject for extensive criticism as well (Estrada, 2009).

Wilcox (2007) shows that an earnings yield figure corrected for the effect of inflation will provide better forecasting power over real future return than the earnings yield. He argues that GAAP-based earnings reported by leveraged companies are not real; instead, they are affected by inflation in the way prescribed by Modigliani and Cohn (1979).

The author argues that two adjustments are necessary to adjust for this. The first one is addressing the fact that US companies use historical cost accounting when reporting their earnings. This relates to the depreciation expense "(..) *which fails to capture the cost of replacing fixed assets because it is based on the acquisition cost of those assets*" (Wilcox 2007, p55). For earnings to be considered real, the company should determine the depreciation cost by using current-cost accounting system. Therefore, an accounting adjustment (a) is necessary to adjust the reported earnings for changes in inflation that affect the value of the company's production inputs and assets.

The other adjustment relates to the debt capital gain error. The author argues, in line with Ritter and Warr (2002), that leveraged companies overstate the true cost of debt because accounting earnings do not account for the benefit that accrue to shareholders (pD). Correcting earnings yield for the accounting and the debt adjustments result in the following adjusted earnings yield (EP^{*})[4]:

$$EP^{*} = \frac{\mathrm{E} + \alpha + pD}{\mathrm{P}}$$

Empirical testing of the adjusted earnings yield was shown to be better in forecasting real returns in US compared to the unadjusted earnings yield. The highest forecasting power was found over a five year investment horizon.

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[4] As noted in delimitations most European companies use fair value accounting for fixed assets. The corrections made to earnings yield in this thesis exclude the accounting adjustment (a).

2.2 Empirical evidence

Yardeni (1997) was the first author to formalize the relationship between the price earnings ratio and the yield on long-term government bonds. Yardeni used the S&P 500 index comprised against US 10 year. The model was used to show that when the market was more than 15 percent overvalued the market dropped on average 8,7 percent in the following year. The usage of the Fed model as an investment strategy is based on this observation. Yardeni's measure for earnings is based on 12-month forward earnings, which he derives by weighting the consensus estimates compiled by Thomson Financials. Yardeni (2003) presents an updated variation of the Fed model to account for changing risk premium as the criticism has centered on this point.

Asness (2003) focuses on dissecting the high correlation between earnings yield and bond yield that Yardeni (1997) is based on. In essence, the article aims to explain why stocks earning yield have been higher than bond yields during the first half of 20th century and why the relationship have been the opposite the years afterwards. The author uses a dataset of historical returns on S&P 500 to evaluate the predictability of returns according to the Fed model and predictability of the earnings yield alone for comparison. Asness finds the Fed model to have no power in forecasting long-term future real returns except for the period between 1982 and 2005 and raises the theoretical flaws as the main factor. To explain why the model does not work Asness (2003) argues that investors are suffering from inflation illusion, referring to the ideas of Modigliani and Cohn (1979). The author shows that earnings yield, as a stand-alone measure, has better predictive power than the Fed model during all periods and suggests the reader to "fight the model". Finally, the author corrects the Fed model by adding historical volatility for the two asset classes and thus shows that conclusions in Yardeni (2003) is only viable to the period after 1980. Essentially, he argues, for the model to make any sense bond yield must be adjusted for inflation and a risk premium added to discriminate between the two asset classes. Conclusively, the Fed model only works on unadjusted basis during the period between 1982 and 2005 but this finding is contingent upon the investor's perception of risk.

Bekaert and Engstrom (2010) argue that stagflation in countries can explain the high correlation between bond yields and earnings yield that the Fed model was founded upon. In other words, they introduce the impact of macroeconomic changes and their effect on earnings yield and bond yield. Asness (2003) do confirm that the model explains how investors historically have required a higher (lower) stock market price-to-earnings when nominal interest rates have been lower (higher). Additionally, Thomas and Zhang (2009) find the model to be useful to provide information about investors' perception regarding required equity premiums and long-term growth forecasts.

Durré and Giot (2004) use a cointegrated[5] VAR model to analyze the relationship between earnings, stock prices and bond yields to test the usefulness of the Fed model. The sample consists of 13 countries and the results show that a long-run relationship between the variables exists except for the bond yield. However, bond yields are found to impact stock market returns on shorter time horizons. This leads the authors to stress the importance of absolute valuation ratios such as earnings yield for long-run stock returns. A cointegration framework is similarly the basis in Koivu et al (2005) where predictive power is examined, using a Vector Equilibrium Correction forecasting model, in US, UK and in Germany. The authors find the model to have most forecasting capability in US and also find it to better predict crashes than stock price rises. However, Jansen and Wang (2006) find the Fed model to improve their stock return forecasting model for longer horizons but reach opposite results for short horizons.

A variation of the Fed model is found in Aubert and Giot (2007) who follow the methodology outlined in Asness (2003) but repeats the tests with dividend yield instead of earnings yield. The research is extended to analyze the forecasting ability of various horizons in nine different countries including Sweden. They conclude that the Fed model is unsuited for forecasting real returns in all countries except US and find the earnings yield as a standalone measure to be more successful.

An international dimension is also the basis in Estrada (2009) who argues that the Fed model is flawed and questions the models empirical qualities by using a cross-sectional analysis. The author finds the yearnings yield ratio to outperform the Fed model in 18 of the 20 countries observed. He concludes however that the model should not be dismissed instantaneously because investors do seem to be willing to pay higher price-to-earnings ratio when interest rates and inflation are low.

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[5] Correlation between two variables can only be measured if the variables are stationary. If variables are non-stationary the correct approach is cointegration and several countries are found to have non-stationary earnings yield and bond yield figures (See Estrada 2009, p226).

Salomons (2004) uses the same dataset as Asness (2003) but chooses to use the Fed model to predict on several investment horizons. Predictability is examined for one month, three months, one-, five- and ten years. Support for the Fed model is only found in short return horizons and it comes with a modest statistical significance. The author corrects the model using perceived volatility as in Asness (2003) and the new improved model beats the Fed model for all periods. The findings are used to construct a tactical asset allocation (TAA) portfolio, which can gain additional short-term returns. Gwilym et al (2004) uses a similar approach and finds the Fed model to be valuable as a short-term TAA but fails in the long-term. TAA approach can also be found in Lander et al (1997) who find that deviations from the Fed model increases predictability on one-month return which is in agreement with Harris and Sanchéz-Valle (2000). Empirical support for the Fed model over both long and short time horizons is found in Maio (2008). Using an out-of-sample analysis based on US data he claims that an investment strategy based on the Fed model produces higher Sharpe ratios and thus outperforms a passive strategy.

3. Methodology

In this part we describe the chosen methodology and show that we conduct a quantitative study following the deductive approach. We follow the methodology outlined in Estrada (2009) to answer the research questions thereby correcting the time series for non-stationarity. Because the methodology plays a crucial role for the thesis validity a careful description of used calculations and data structuring technique are presented. The chapter is concluded with a methodological discussion where the chosen approach is defended.

3.1 Research approach

Based on theory developed by Modigliani and Cohen (1979) we are testing if a theoretical sounder version of the Fed model has better prediction power over the original model as put forward in Yardeni (1997). As shown in the literature overview, previous studies conclude that the original model is a failure in predicting future returns. The critique has circled around its theoretical flaws in regard to inflation and risk premium. We are focusing on the first of these fallacies and adjust the model to comprise of real variables and test it in a new context.

This reasoning follows the deductive process where the research question is derived from theory and is also the most common perception regarding the relationship between theory and practice (Bryman and Bell, 2002).

3.2 Data collection

As outlined in Asness (2003) the data required to test the Fed model forecasting ability is the CPI inflation rate, the price earnings ratio of a broad market index and the 10- year government bond yield. All data is secondary and collected using Thomson Financial Datastream (TFD) with monthly observations, otherwise stated.

The market index used in a great deal of previous papers has been the Morgan Stanley Composite Index (MSCI) (Estrada, 2009). MSCI publishes data on Sweden but a larger sample size was found using TFD total return index, which is also used in Durré and Giot (2004) for the cross sectional country study. Aubert and Giot (2007) use OMX as a benchmark index for Sweden in their international cross sectional study. We argue that TFD is better suited as a benchmark index because it takes into account more stocks and importantly, includes both dividends and capital gains, thus captures the aggregate stock market better. However, TFD does not report negative earnings and that might bias the result. We believe this will have minor impact because the correlation between OMX and TFD-and between TFD and MSCI index is 0,99 and 0,98 respectively. The time period studied on index level is 1984:1 until 2010:12.

To find appropriate industries we scrutinized TFD Swedish Industry for industries with: data ranging over a long time period, a representative amount of companies within each industry and figures on net debt. The last data series were needed to be able to discriminate between the financial characteristics of each industry. The industrial, consumer good-, and banking sector where found to fulfill the requirements. The corresponding companies within each industry are found in Appendix A. The industrial sector consists of 17 companies, the consumer goods and bank sector consist of six and four companies respectively as of 2010.

Yardeni (1997) uses the Institutional Brokers' Estimate System (IBES) as the measure for earnings in the earnings-to-price ratio. For Sweden, and most European countries, IBES data is available only from the mid nineties and onwards, and we are therefore using trailing earnings yield as in Estrada (2009).

From the TFD index we downloaded the price earnings ratio to retrieve a figure for earnings yield. In the second step, the earnings and stock index series were deflated using the CPI. The CPI index was also used to create year-on-year interest rate to deduct from the bond yield to create the real interest rate following the recommendations in Asness (2003).

The same data structuring process was performed for the industries as for the index. Additional data for net debt and was added to use in other versions of the Fed model, that are presented below. Net debt is an accounting figure and only available on annual basis. Therefore, the time series for net debt was adjusted into monthly observations by trailing it on yearly basis. Data on expected inflation in Sweden starts in 1990:1 and is on quarterly basis. Using expected inflation would decrease the time series considerably so we proxy expected inflation with year-on-year actual inflation rate.

The analyzed time period for the bank sector is limited because the time series of net debt could only be obtained from the beginning of 1990. The analyzed time period for banks is thus 1991:1

until 2010:4 because of the 12 month trailing earnings. Industrials and commercial products share the same time span as the index.

In a final step we arrange the independent variables used in the regression for the index and for the industries. We deduct the inflation component from the nominal bond yield in order to account for the real return. To adjust for the debt capital gain error we construct a separate earnings yield to account for the benefit that accrue to the shareholders due to inflation and leverage. Except for depreciation part we use the following formula for corrected yearnings yield as in Wilcox (2007):

$$EP^*{}_t = \frac{E_t + pD_t}{P_t}$$

Where:

EP^* - Earnings yield corrected for leverage

P – Price per share

E – Earnings per share

D – Debt per share

p – Annualized inflation rate

We also keep separately earnings yield and extended earnings yield because these are tested individually. Consequently, we end up with three series for the index (1-3) and six for each industry:

1) EP_t Earnings yield (EP)
2) $EP_t - BY_t$ Fed model (FM)
3) $EP_t - (BY - p)_t$ Adjusted Fed model (AFM)
4) $EP^*{}_t$ Earnings yield corrected for leverage (EPL)
5) $EP^*{}_t - BY$ Fed model corrected for leverage (FML)
6) $EP^*{}_t - (BY - p)_t$ Adjusted Fed model corrected for leverage (AFML)

The dependent variable in this paper is subsequent real return. To make the return measure comparable for the two different investment horizons we use annualized real returns as in Aubert and Giot (2007) and Estrada (2009). The return measure is calculated with the natural logarithm turning the measure into a compounded return figure (Brooks, 2002). Thus, we computed annualized returns using monthly observations with the following procedure:

$$RR_{r+t+i} = ln\left[\left(\frac{S_{t+i}}{S_t}\right)^{(12/i)}\right]$$

Where:

RR_{r+t+i} = Realized subsequent real return on stock index.

i = Investment horizon where i = months (12 and 60)

S_t = Stock index deflated by the CPI

3.3 Regressions

We are seeking to answer to how different versions of the Fed model can be used to forecast real subsequent returns. Letting y_t denote the dependent variable (real return), α the intercept and x_t the explanatory variable (for example EP – BY) and ε_t the error term, our regression is expressed followingly:

$$y_t = \alpha + \beta x_t + \varepsilon_t$$

Thus our regressions are bivariate and linear and the Ordinary Least Square (OLS) technique can be used (Brooks, 2002).

Brooks (2002) present strong arguments of why it is important to examine if a time series is stationary or not, and based on Estrada (2009) there are reasons to believe that the time series used are non-stationary. In essence, a stationary series is defined as one with constant mean, constant variance and constant auto covariance. Therefore, stationary series fulfill the OLS requirements. Financial data is though often non-stationary, this typically results in spurious regressions that produces significant coefficients that are valueless (Brooks, 2002).

The Augmented Dickey Fuller (ADF) test was performed on all variables, dependent and independent, to detect non-stationarity.[6] The results are presented below in Table 3.3 where a p-value higher than 5 percent indicates non-stationarity.

Table 3.3 Augmented Dickey-Fuller test for non-stationarity

Variable	Index	Industrials	Banks	Consumer goods
EP- BY	0,43	0,35	0,00	0,08
EP - (BY-p)	0,32	0,15	0,00	0,19
EP	0,10	0,06	0,00	0,08
EP* - (BY)		0,23	0,00	0,02
EP* - (BY-p)		0,15	0,00	0,10
EP*		0,09	0,00	0,07
RR12	0,02	0,00	0,02	0,00
RR60	0,40	0,07	0,72	0,23

The ADF test show that, except for the Bank industry, the majority of variables are non-stationary and needs to be adjusted before used in the OLS regression. To transform a non-stationary time series into stationary the series must be differenced according to its order of integration. As Estrada (2009) we concluded from the ADF tests that the series needed to be differenced once to induce stationarity. To be consistent we differenced the time series for the bank industry as well. Differencing was done according to Brooks (2002) for all series (z):[7]

$$z_t - z_{t-1} = \Delta z_t$$

The transformation of the series calls for a new usage of the Fed model. The original Fed model and our conducted theoretical adjustments are based on the static comparison between earnings yield and bond yield to forecast returns. The transformation results in a linear regression with change in future real returns as dependent variable and change in the independent variable. However, the economic interpretation of the regression results remains the same.

[6] The ADF test strictly tests if the series contains a unit root. A series containing a unit root is considered non-stationary (Brooks, 2002).
[7] To confirm the results we repeated the ADF tests on first level and all variables were found to be stationary.

Non-normal distribution of the error term can be dealt with in two different approaches according to Brooks (2002). The first one being to remove outliers by including dummy-variables. This technique has received critique because it is interpreted as an artificial improvement of the sample. The second approach is to stick with OLS if the sample size is sufficiently large and then the test statistics will follow the appropriate distributions even in the case of non-normality (ibid, p 182). We argue that our sample size is sufficiently large and we therefore rely on the second approach.

To answer our research questions we will in total run 42 bivariate regressions using Eviews 7.0. Following the procedure in Estrada (2009), each regression was performed using Newey-West heteroskedasticity/autocorrelation- consistent covariance matrix (HAC). Newey-West HAC produces standard errors that correct for both autocorrelation and heteroskedasticity that may be present (Brooks, 2002).

$$\Delta\, RR_{r+t+i} = \alpha + \beta_1 \Delta[EP - BY]_t + \varepsilon_t \qquad (1)$$

The first regression tests whether the traditional Fed model predicts real returns. In this basic form, a positive β implies that a positive change in spread between the earnings yield and the nominal bond yield can predict future returns. The Fed model has been disproved in Sweden (Estrada 2009; Aubert and Giot 2007) but if the model holds β_1 should be positive. The model has not been used previously on industries and if it holds then, analogously, β_1 should be positive. Based on previous studies we expect low forecasting power. The reason for using this regression is to be able to compere results with the theoretically improved models.

$$\Delta\, RR_{r+t+i} = \alpha + \beta_2 \Delta\big[\, EP - [BY - p]\big]_t + \varepsilon_t \qquad (2)$$

The second regression tests whether the adjusted Fed model can predict real returns as put forward by Asness (2003). Thus we adjust bond yield for inflation to make the comparison between earnings yield and real bond yield. For the model to hold the adjusted spread should predict future returns and β_2 should be positive. However, considering the fact that the earnings yield measure is not corrected for the debt capital gain error, we expect results from this regression to have less forecasting power compared to (5).

$$\Delta\, RR_{r+t+i} = \alpha + \beta_3 \Delta[\, EP]_t + \varepsilon_t \qquad (3)$$

The third regression tests whether earnings yield as a stand alone measure can predict future returns. As argued in Asness (2003); Estrada (2009); Aubert and Giot (2007) and Salomons (2004), the Fed model might be a noisy proxy for the earnings yield.

$$\Delta\, RR_{r+t+i} = \alpha + \beta_4 \Delta[\, EP^* - BY]_t + \varepsilon_t \qquad (4)$$

The fourth regression corrects the earnings measure by incorporating the effect of inflation on debt following the proposition put forward by Modigliani and Cohen (1979). This regression will solely be conducted on industry level where we can derive absolute figures for debt. As previously, if β_4 is positive then a change in spread can predict positive change in future real returns. The results from this regression will be compared to (1) to be able to understand the effect of debt capital gain error.

$$\Delta\, RR_{r+t+i} = \alpha + \beta_5 \Delta\big[\, EP^* - [BY - p]\big]_t + \varepsilon_t \qquad (5)$$

In the fifth regression we test how well the change in the adjusted Fed model corrected for leverage forecast change in real return. Theoretically, β_5 should be positive and high if investors are correctly adjusting earnings for inflation effect on debt and compares it to the real interest. We expect this model to have the greatest forecasting power.

$$\Delta\, RR_{r+t+i} = \alpha + \beta_6 \Delta[\, EP^*]_t + \varepsilon_t \qquad (6)$$

The last regression test whether extended earnings yield can predict future real returns as put forward by Wilcox (2007). This test will also exclusively be conducted on industries and will enable us to discriminate between the effect of the extended earnings yield used in two variants of the Fed model and extended earnings yield as a stand-alone measure. If change in earnings yield can predict change in future returns then β_6 should be positive. We expect relatively higher forecasting power of this model compared to (3).

3.4 Methodological discussion

To reach a comprehensive answer to the research questions a large number of regressions had to be performed in multiple contexts. We were therefore aiming for an econometric approach that is effective and robust. And arguable, because we adjust the time series for non-stationary variables the regression results is reliable (Estrada, 2009). An alternative approach for dealing with non-stationary variables in a regression is to analyze them within a cointegration framework. This approach has been conducted by Koivu et al (2005) and Giot and Durré (2004) and used in Estrada (2009) to evaluate the existence of a long term relationship between earnings yield and bond yield. A prerequisite is that the variables are cointegrated which can be evaluated with Engler-Granger test. We performed the Engler-Granger test, following the procedure outlined in Brooks (2002), on the time series used for index analysis and found them not to be integrated. The same test was not repeated on industries because we wanted to use a consistent regression technique for comparability. Estrada (2009) finds earnings yield and bond yield in Sweden to have different orders of integration, which confirms that a cointegration framework is not applicable.

3.4.1 Reliability

The main reason for the careful description of the used methodology is that we are striving for a high degree of reliability, that is, the results would be the same if the study was repeated (Bryman and Bell, 2002). The reliability is also high because the entire time series is used and there were no arbitrary removal of observations to artificially improve the data set. Furthermore, TFD is a reliable source of information used by previous researchers to collect data. Using TFD constructed index is also beneficial from the reliability perspective because of the availability.

Reliability is also high because we use the same data structuring technique as Robert Shiller used for US, which is publicly available[8]. The Shiller data set is the empirical part used in Asness (2003) and Wilcox (2007) for example. By using Shiller's data set as a construction benchmark our result on index will be comparable to previous research to a larger extent.

3.4.2 Validity

There are two main dimensions of validity that contribute to the overall academic quality of this study, namely internal- and external validity. Internal validity relates to whether statistical inference can be done accurately, more explicitly if there is a causal relationship between the dependent and the explanatory variables (Bryman and Bell, 2002). This measure is crucial in this thesis where we explore the possibility of explaining subsequent return on index as a function of

[8] Robert Shiller’s dataset is available at: http://www.econ.yale.edu/~shiller/data.htm

the spread between earnings yield and bond yield. Bryman and Bell (2002) highlight the importance of considering other variables to control for the result. This reasoning harmonizes well with researchers who call for an adjustment of the Fed model to incorporate the effect of risk. However, we are solely focusing on correcting the earnings measure and we expect theoretically improved versions to have better prediction power.

We base our conclusions on statistical inference that calls for the OLS technique to be applicable to minimize the chance of generating spurious regression results. We argue that the internal validity is high because the appropriate regression technique is used although it changes the model from static to dynamic. In addition, we perform the regressions using robust standard errors and we use a large sample size to minimize the effect of non-normality, which together minimizes the chance of fallacious interpretation of results.

External validity refers to the question if the results can be generalized beyond the specific research context (Bryman and Bell, 2002). As articulated in the introduction, Sweden was chosen as a case country because of its characteristics but this does not invalidate the external validity. In contrast to choosing Sweden as the case country, the industries were hand picked based on their profiles to confront the theoretical assumptions underlying the Fed model. We therefore believe that the results on industry level can be extended to industries that share the same financial characteristics in Sweden and in other countries.

4. Empirical findings

In this chapter we will present the descriptive statistics for the index and the industries and a comprehensive overview of the sample underlying the study. The reader is provided with both numerical descriptions and graphical illustrations focusing on the different spreads evaluated in this thesis. This will be followed by regression results of our empirical tests. For convenience we will use the abbreviations for the variables which are presented in the wordlist.

4.1 Descriptive statistics

The data is comprised of monthly observations ranging from 1984:1 until 2010:12 for consumer goods, industrial product and for the index. Due to data limitations, the time series for the banking industry begins in 1991. In total, 183 to 230 observations for banking sector are used and 268 to 315 observations make up the sample size for index and for the remaining industries. We will start with a brief overview of the development of the earnings yield with complementary statistics of bond yield and real return and then focus on the specific contexts.

4.1.1 Earnings yield, bond yield and real return

Appendix B plots earnings yield and bond yield from 1991 to 2010 in Sweden. The yield on the 10-year government bond was high during the early nineties, reaching over 14 percent in February 1990. However for almost two decades bond yield has had a clear decreasing trend, resulting in an average level of less than 3 percent. As provided in Appendix C the high interest rate environment in the nineties was accompanied by high inflation with spikes in 1989-1991, indicated by the large deviation between nominal and real interest rate. Thus, unlike nominal bond yield, the one adjusted for inflation never exceeds 10 percent during the observed period, and averaging at 5 percent. The corresponding average nominal bond yield is equal to 6 percent, thus only slightly higher.

The 12-month trailing earnings yields for all industries as well as for country index have two significant peaks. First during the Swedish banking crisis, in 1990-1992 reaching up to 96 percent for banks in 1992 and respectively 12 percent to 24 percent for industrial and consumer producers in 1990. The second set of high fluctuating values is observed during the recent financial crisis that was affecting Sweden directly between 2007 and 2010. This resulted in a 32 percent peak in earnings yield ratio for banks and a relatively modest peak of 15 percent for industrial products while consumer goods producers were are almost unaffected. The post-financial crisis period represents an earnings yield reaching 15 percent, which is historical maximum for the analyzed time period. This finding harmonizes with Shiller (2003) who argue that the unusual high price earnings ratio (low earnings yield) in US in the end of 1999, before the “dotcom-bubble”, can be explained by investors’ overly positive perception regarding high future earnings, driving the price of stocks up. Similarly, low earnings yield is observed before the recent financial crisis, which is followed by a substantial increase.

4.1.2 Index

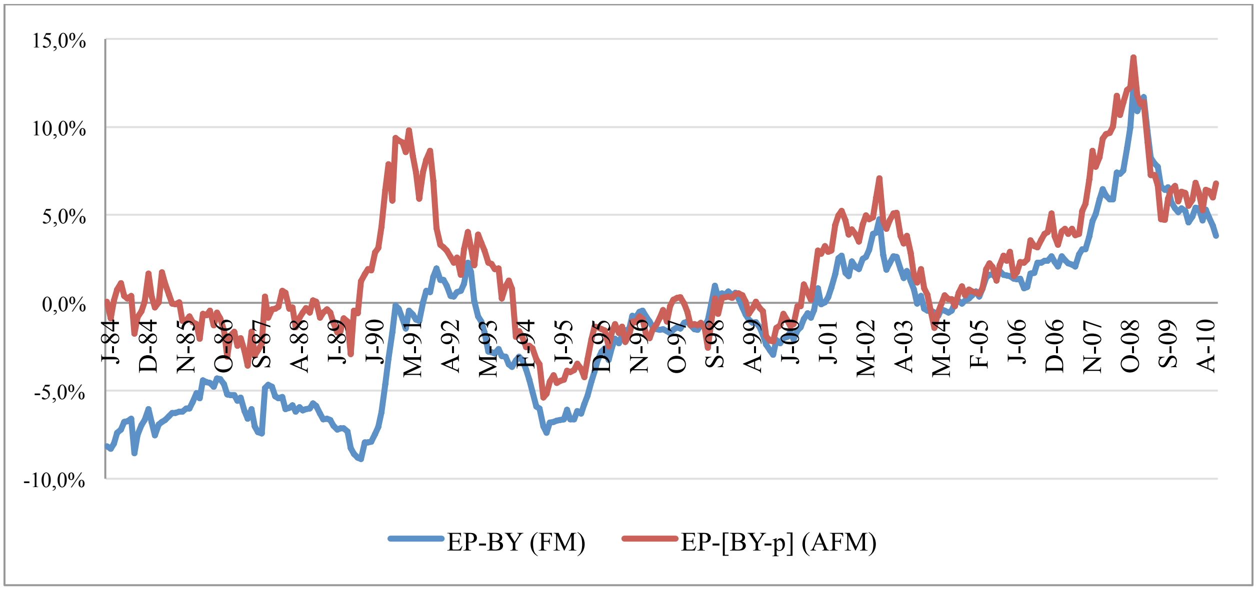
Subsequent return on the Swedish stock market has been volatile during the period for both 12 and 60 months investment horizons. Subsequent 12 month returns has a standard deviation in the range between 27- to 48 percent compared to 7- and 14 percent for the 60 months return measure. This can be explained by the less extreme maximum and minimum levels included in the 60 month return time series, compared to the 12 month horizon that include observations during the financial crisis. Appendix D provides an illustrative graph of real returns for the analyzed investment horizons.

Table 4.1.2 Index

Variable	Average	Median	St.Deviation	Max	Min	Observations
RR12	10%	15%	30%	80%	-59%	315
RR60	7%	6%	8%	22%	-16%	268
EP	6%	5%	3%	15%	3%	315
EP-BY (FM)	-1%	-1%	4%	12%	-9%	315
EP-[BY-p] (AFM)	2%	0%	4%	14%	-5%	315

It is important to emphasize that unlike the spread for the adjusted Fed model, the mean and median spread of the traditional model is negative, indicating a long term historical overpricing of equity. Figure 5.1.2 provides historical development of the spread between earnings yield and bond yield adjusted and non-adjusted for inflation rate. It is also meaningful to highlight that while analyzing the Fed model in nominal terms, there are only short periods of equilibrium in 1992 and in the end of 1999 and in the middle of 2004.

Figure 4.1.2 Spread for FM and AFM



During the entire time series the Fed model indicates that mispricing of stocks and bonds occur frequently. Traditional Fed model showed that since 1984 and almost to 2001 stock market was overvalued with a trend towards equilibrium since 1997. Between 2001 and 2004 and respectively from 2005 and onwards, the Fed model shows relative undervaluation of stocks. However, it is important to mention that deviations from the equality should not refute the Fed model; rather it provides a fair value range with boundaries of ± 10 percent (Abbot, 2002 as quoted in Estrada 2009).

Different conclusions can be drawn from observing the same time period for the AFM. In this case, the period between 1984 and 1989 can be claimed as a relative equilibrium or slight stock overvaluation, the banking crisis of the early nineties is a period when stock undervaluation spiked driven by the sharp decrease in earnings. Furthermore, the period between 1994 and 2000 is represented by stock overvaluation and the latest period from 2000 and onwards demonstrates stock undervaluation (with a short equilibrium in 2004).

4.1.3 Consumer goods

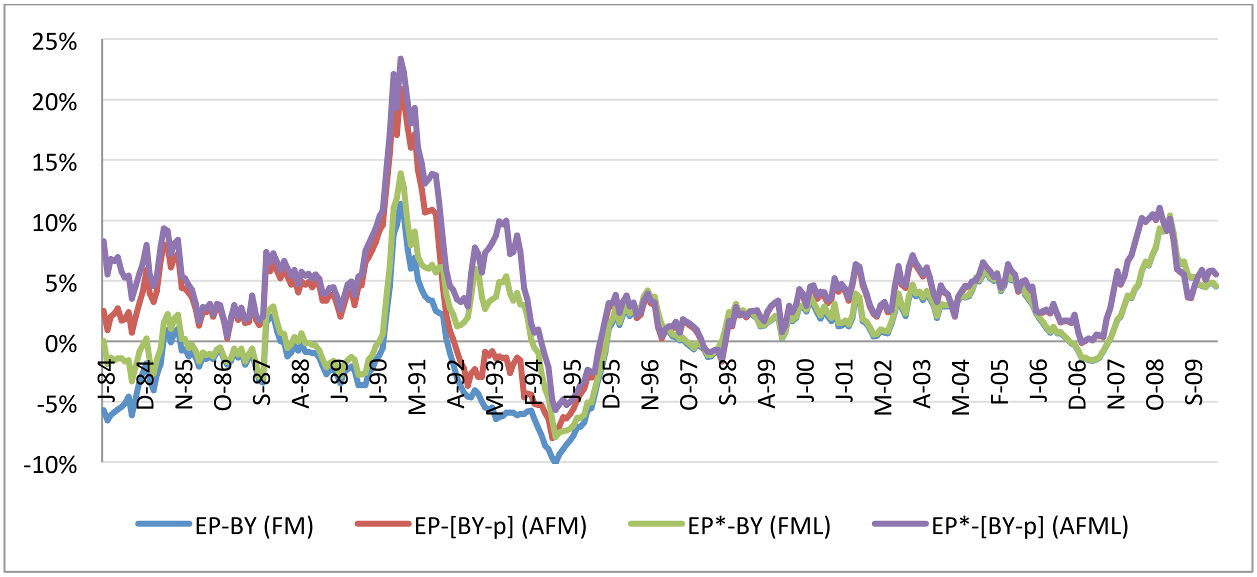
Consistently with index level data, standard deviation for different Fed model spreads are stable and equals 4 percent. The average and the median spread for FM is low, 0 to 1 percent respectively. This lead us to assume that historically the consumer goods equity and bonds have been in the state of equilibrium. However, the spreads turn higher when the model is adjusted and corrected for leverage, indicating that the effect of leverage is changing the conclusion in this context. Furthermore, the average 60 months return is 2 percent higher compared to the Swedish index.

Table 4.1.3 Consumer goods

Variable	Average	Median	St.Deviation	Max	Min	Observations
RR12	10%	11%	28%	75%	-71%	315
RR60	9%	10%	8%	31%	-12%	268
EP	8%	8%	4%	24%	1%	315
EP* (EPL)	9%	9%	4%	27%	2%	315
EP-BY (FM)	0%	1%	4%	11%	-10%	315
EP-[BY-p] (AFM)	3%	3%	4%	21%	-8%	315
EP*-BY (FML)	2%	2%	3%	14%	-8%	315
EP*-(BY-p) (AFML)	5%	4%	4%	23%	-6%	315

Figure 4.1.3 show that unlike the aggregated equity index, price of consumer goods manufacturing companies were not significantly overvalued in 1980s. We can conclude that with short exceptions between 1992 and 1995, equity of this sector was constantly underpriced relatively to bonds. As consumer goods manufacturing industry historically show low level of leverage, introduction of debt adjustment to earnings yield does not impact FM dynamics.

Figure 4.1.3 Consumer goods spreads



4.1.4 Industrial products

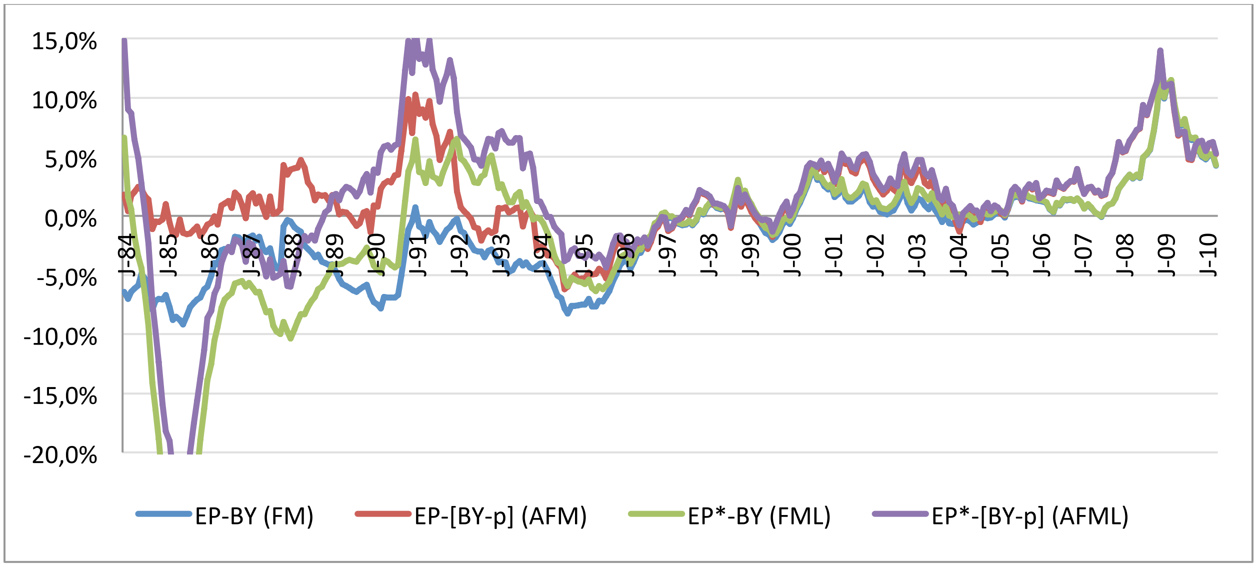
The leverage profile for the industrial products sector significantly differs from producers of consumer products. Therefore, we expected that both statistical data as well as regression results for these two industries in particular would be different and explainable by the debt levels. Table 4.1.4 summarizes the statistical indicators for industrial products.

Table 4.1.4 Industrial products

Variable	Average	Median	St.Deviation	Max	Min	Observations
RR12	11%	13%	27%	67%	-72%	315
RR60	11%	10%	7%	29%	-5%	268
EP	6%	6%	2%	15%	2%	315
EP* (EPL)	6%	6%	5%	19%	-22%	315
EP-BY (FM)	-1%	-1%	4%	12%	-9%	315
EP-[BY-p] (AFM)	2%	1%	3%	14%	-6%	315
EP*-BY (FML)	-2%	0%	7%	12%	-35%	315
EP*-(BY-p) (AFML)	1%	2%	6%	16%	-27%	315

Being more significantly affected by leverage, FML and AFML as well as EPL have been higher and show more diverse range of standard deviations. Specifically, the standard deviation for earnings yield increases from 2 percent to 5 percent, when corrected for leverage while the Fed model spread increases from 4 to 7 percent when accounted for leverage. Volatility is slightly less for the Fed model when adjusted for inflation and corrected for debt capital gain error at 3 and 6 percent respectively. The average return in the industry is the same for both investment horizons, though the median is slightly higher for the 12-month return.

Figure 4.1.4. Industrial products spread



As illustrated in Figure 4.1.4 the stocks of industrial products show relative overvaluation between 1984 and 1996. Similarly, a period of undervaluation is manifested between 1996 and 2010 if analyzed with FM. However, AFM shows that in the period between 1986 and 1992 stocks were relatively undervalued. Introduction of the leverage component in measuring the earnings yield ratio increases the magnitude of both under and overvaluation, because of higher debt dependence of industrial products manufacturing sector. Deviations between the ratios is narrowed in the end of the nineties and onwards. Conclusively, large deviations occur during the high inflation environment such as in 1990/1991 and in 2008 as inflation impacts earnings yields corrected for leverage.

4.1.5 Banks

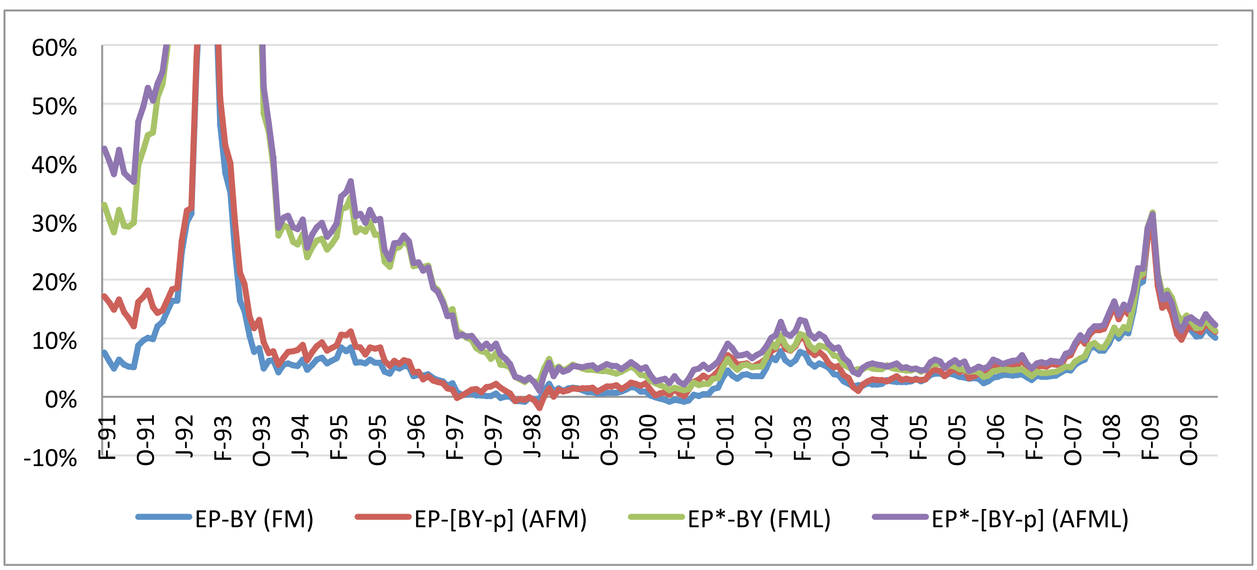
Statistics for the banking sector varies significantly in relation to the indicators of other industries as well in relation to the index. Table 4.1.5 shows that all variables of banking sector have double digits standard deviation. As average interest coverage ratio, defined as interest expense divided by EBIT, for the Swedish banking sector amounts to 0.7, impact of leverage for the sector is substantially higher than for any other analyzed series. See Appendix E for a comparison between the level of net debt per share in respective industry.

Table 4.1.5 Banking sector

Variable	Average	Median	St.Deviation	Max	Min	Observations
RR12	11%	17%	48%	206%	-149%	230
RR60	14%	12%	13%	57%	-9%	183
EP	13%	9%	13%	96%	4%	230
EP* (EPL)	34%	13%	64%	410%	6%	230
EP-BY (FM)	7%	4%	12%	85%	-1%	230
EP-[BY-p] (AFM)	9%	6%	12%	86%	-2%	230
EP*-BY (FML)	28%	8%	62%	399%	1%	230
EP*-(BY-p) (AFML)	30%	10%	63%	400%	1%	230

Average and median of Fed model spreads suggest that equity of banks is permanently undervalued by the market relatively to government bonds. This fact is explicitly observed in Figure 4.1.5 Interesting fact is that the 60 month real return on banking sector index is higher than the 12 month counterpart.

Figure 4.1.5 Banking sector spreads



The specific financial characteristic in the banking industry increases the magnitude of the spreads. Obviously, the banking crisis in 1992 had more severe impact on banks' valuation and financial performance than recent financial crisis. The magnitude of the crisis can be seen on all spreads and also on the return measure for 12 months that decreased substantially in the period between the beginnings of 1991 until the middle of 1992. Furthermore, the spread for FM reached 85 percent and AFML peaked to 400 percent. We noticed that statistics for banks has the most significant discrepancies between level of mean and median that can indicate skewness in the variables although more than 200 observations are used (Brooks, 2002).

4.2 Regression summary

For the different varieties of the Fed model, and the stand alone measures, to have forecasting power over subsequent real return some principal features are to look for in the regression results. First, forecasting power should translate into a high R^2 value. That is, a high R^2 value explains how variations in the return measure can be attributed to variations in the independent variable (Brooks, 2002). Secondly, the coefficient of the independent variable must be positive as a positive spread indicates that stocks are more attractive. Finally, the corresponding t-statistic must be sufficiently different from zero, indicated by a p-value less than 5 percent.

Regression results are provided in Table 4.2. Consistently with previous research that included the Swedish stock index (Estrada 2009; Aubert and Giot 2007), our analysis reveals statistically insignificant coefficient for the original Fed model, indicating that investors do not use simplified assumptions underlying the traditional Fed model to make investment decision on the index. In contrast to Estrada (2009) the coefficient sign for all the independent variables are positive and thus meet the second requirement. Additionally, as provided in Appendix F the coefficient for the intercept is in all regressions close or equal to zero and statistically insignificant.

Table 4.2 Regression results

Variable	Index		Consumer goods		Industrial products		Banks	
	12m	60m	12m	60m	12m	60m	12m	60m
(1) EP-BY (FM)	0.08	0.06	0.18	0.13	0.17	0.10	0.27	0.29
	(0.12)	(0.15)	(0.00)	(0.02)	(0.00)	(0.01)	(0.00)	(0.02)
(2) EP-[BY-p] (AFM)	0.03	0.03	0.13	0.10	0.08	0.06	0.25	0.27
	(0,03)	(0,05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(3) EP	0.28	0.41	0.36	0.32	0.28	0.26	0.29	0.31
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
(4) EP*-BY (FML)			0.35	0.30	0.03	0.03	0.28	0.33
			(0.00)	(0.00)	(0.11)	(0.12)	(0.00)	(0.00)
(5) EP*-[BY-p] (AFML)			0.22	0.19	0.02	0.02	0.28	0.32
			(0.00)	(0.00)	(0.14)	(0.10)	(0.00)	(0.00)
(6) EP* (EPL)			0.27	0.26	0.03	0.04	0.28	0.33
			(0.00)	(0.00)	(0.12)	(0.10)	(0.00)	(0.00)

Note: The table presents R-squared values for the regressions, the corresponding p-values are presented in paranthesis.

Even though adjusted model, that includes real bond yield instead of nominal, is statistically significant, it has very low R^2 value to consider it to be a significant improvement. Our results show that earnings yield is better in predicting real return on the index, resulting in R^2 value of 28 percent and 41 percent for 12 and 60 months forecast horizon respectively. Among all the regressions in the scope of our research the use of earnings yield as a forecasting tool for 60 month return on the Swedish stock index provides the highest explanatory power. This finding harmonizes well with that of Estrada (2009) and Aubert and Giot (2007) who both find EP to have more explanatory value than FM.

On industry level, almost all spreads are statistical significant and come with the correct sign of the coefficient. However, in the industry context, the results for banks show in average higher statistical significance for all types of independent variables with little change in R^2.

Regressions for consumer goods and industrial products showed similar results in the models unadjusted for the leverage component. We identified that unlike on index level FM shows statistical significance on industry level with relatively low R^2. Though for all industries adjustment of the model for inflation provides more modest results.

As well as for the index level, earnings yield as a stand alone measure fulfills the requirements to a larger extent then different kind of spreads. The R^2 value is ranging from 36 percent to 32 percent in the consumer goods industry for the 12- and 60 months return horizon. Industrial products show similarly 28- and 26 percent for respective investment horizons.

For consumer goods, correcting for leverage provides slightly better results than for FM and AFM. All the models corrected for leverage in industrial products sector appeared to be relatively worse in explaining real return. Specifically the statistical significance of the coefficients decreases substantially with the introduction of leverage.

In summary, our results partially confirm those provided by Estrada (2009) for Sweden. Again we should mention that the fact that no previous research has been made on industry level and that only provide us with the possibility to compare our findings to the index level.

We obtain similar R^2 for the 60-months returns measure as in Estrada (2009) when using the traditional Fed model. However, our regression results come with insignificant coefficients but they have the expected positive sign. Estrada (2009) reached opposite sign of the coefficient which distorted the ability to provide economic explanation for the regression results. Comparison of regression results provided in his paper for price-to-earnings ratio is consistent with our results for earnings yield, though we obtained higher statistical significance. We believe that this deviation in R^2 levels is explained by the longer time horizon used in Estrada (2009). Our results are similar to those showed in Aubert and Giot (2007) who also find EP to be a better forecasting tool than FM in the index level.

5. Analysis and discussion

In this part we analyze the empirical results provided in the previous chapter. The chapter is concluded with a discussion regarding the results.

As previous studies indicate we confirm that the Fed model is a weak tool for forecasting future real returns on the index level. Statistical insignificance of regression results showed that the spread between earnings yield and nominal governmental bonds yield provides low level of understanding regarding the market dynamics. This finding supports the criticism about the model as it points out that investors base their decisions on a more sophisticated analysis rather than the comparison between yields of two competing financial instruments. Following the reasoning in Asness (2003): If the Fed model has strong explanatory power, we would have been in the position to conclude that Swedish investors incorrectly benchmark partially real earnings yield with nominal bond yield.

Adjustment of bond yield for inflation, which is considered by Asness (2003) to be a better measure from a theoretical prospective, showed very modest improvement even though the coefficients are statistically significant. As R^2 for both 12 and 60 month forecast horizon do not exceed 3%, we do not consider it as a reliable tool for investment decision-making. The fact that the AFM corrects only for real bond yield and do not address leverage impacts forecasting power negatively.

Following our research objective to provide comprehensive analysis of the model, we aimed to understand if earnings yield standalone is a better variable to forecast returns and therefore, if bond yield is just a noise in the model. Our results show significantly using this approach and that partially confirms results of previous studies.

We expected the results obtained from the industry level to differ from the index analysis. As was described before, we believe that the analysis of aggregated data on companies with similar business profile, especially debt level, will help us to adjust for some obvious theoretical flaws in the Fed model. This idea is based on the assumption that the market is efficient and investors correctly understand the effect of leverage on shareholder wealth as suggested by Modigliani and Cohn (1979).

It is important to notice that for consumer goods industry introduction of the leverage and, therefore, correction for debt capital gain error, substantially increases the explanatory power of the model. FML provides more successful results than AFML, as well as FM is slightly better than AFM. This fact once again gives us an opportunity to question significance of bond yield as a part of the Fed model.

As well as on index level EP appeared to be the most credible model (outperforming FML, AFML and EPL). Consistent with our conclusions on index level we argue that the bond yield does not have significant importance for Swedish investors. The fact that EPL has slightly lower R^2 than EP is controversial based on the fact that FML and AFML are better predictors than FM and AFM. The opposite results that are provided when correcting for the debt capital gain error makes it more difficult for us to understand if Swedish investors address the issue in the way described in Modigliani and Cohn (1979). However our results in the industrial sector provide us with guidance on how to understand the mentioned problem. Because all models corrected for leverage (FML, AFML, EPL) are statistically insignificant, we believe that for both consumer goods and for industrial products correcting for debt capital gain error is not increasing predictability of real equity returns. Stating this we can confirm that investors do not account for the theoretically justified effect of debt capital gain in their investment decisions and that inflation illusion can be the reason.

The results from the banking sector are ambiguous and they do not provide us with a room for analysis. However, we can conclude is that neither adjustment for real bond yield nor correction for debt capital gain error increases the model's forecasting power. Nevertheless, it is interesting to mention, that average R^2 is relatively high and averages 28% and 31% for 12 and 60 month horizon forecast but we are not able to discriminate between the different corrections.

We also argue that our conclusions support the idea that banking sector has a direct impact on the Fed model ability to forecast returns, but as long as the model requires improvement, financial sector adjustments should be different from ones used for non-financial companies.

Adjustments to FM that we use in our regression analysis are aimed to account for inflation effect in relative equity valuation either through a correction of the earnings yield or through better benchmarking measures. We also want to put forward that number of studies have been conducted to understand how inflation effects earnings and returns from a point of the business model. Even though we did not account for this effect directly in the model, we believe that understanding of this phenomenon is essential for the interpretation of the results.

Understanding the ability of the company to exploit inflation in its operations is the key point in the analysis. The main problem that the company can face in the environment of raising inflation is hardship in transferring increasing costs to its customers. In other words, some companies have prices that are more sensitive to changes in inflation and any of the models used in the thesis account for this effect. Separating the industries from this angle might have been a more rigorous approach than using leverage adjustments alone. For example, there are reasons to believe that the return of noncyclical companies, like consumer goods manufacturers, is more sensitive to a change in inflation. Similarly, cyclical industries, including industrial products manufacturers, are experiencing lower sensitivity of returns to inflation. The non-cyclical industries can increase the prices when inflation rises while the non-cyclical companies do not have the possibility to do this quickly[9]. This can therefore provide a complementary understanding of the effect of inflation on accounting.

[9] For a discussion regarding price sensitivity see for example: Boudoukh et al (1994); Goedhart et al (2010) and Lu (2008).

6. Conclusions

In this chapter we present our conclusions and the most interesting results. This is followed by further research proposals.

We had two purposes with this thesis. The first purpose was to identify if inflation illusion is affecting investors decision-making in Sweden. The second one was to examine whether the Fed model adjusted for the debt capital gain error was successful in forecasting real stock return on industry level between 1984 and 2010.

As a result of our regression analysis we identified that investors in Sweden are affected by inflation illusion. Also they incorrectly account for debt capital gain for the levered companies. We can also conclude that the Fed model proved to be a weak tool for forecasting future real returns and its modification only partially increase its quality. Finally we identified that earnings yield standalone is a much better measure for understanding the return dynamics.

6.1 Further research

Because we find the inflation illusion phenomenon only to explain parts of the results we recommend future studies to address this issue by incorporating the effect of risk. In this way, the Fed model would satisfy the missing risk premium and take into account the inflation illusion. We believe that this approach would result in higher explanatory value. Similarly, we excluded the depreciation part when correcting accounting earnings because of fair value accounting measure used by the larger part of European countries. We would recommend a study on US industries to capture this part of debt capital gain error. We believe that in order to address effect of inflation in a more comprehensive way, further discrimination of industries on the basis of inflation sensitivity is required.

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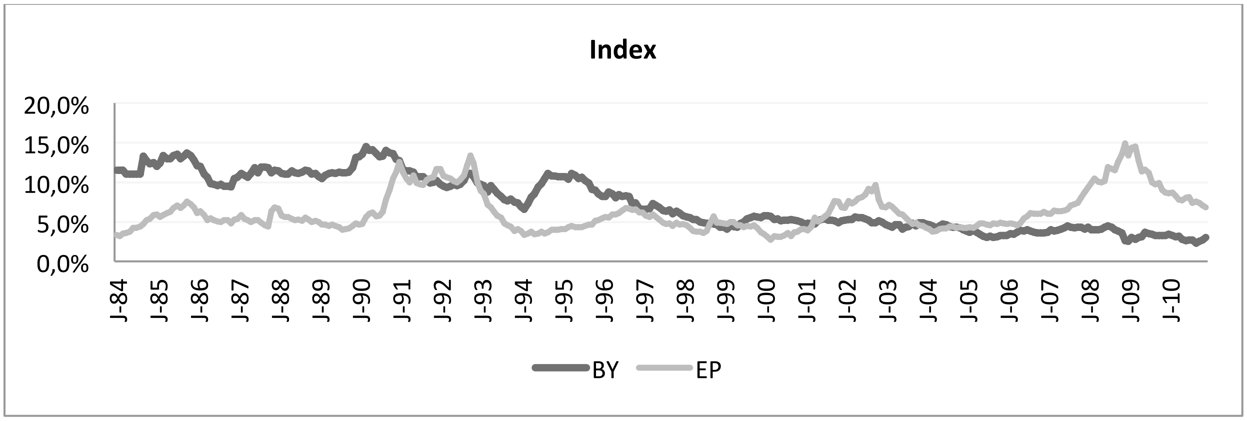
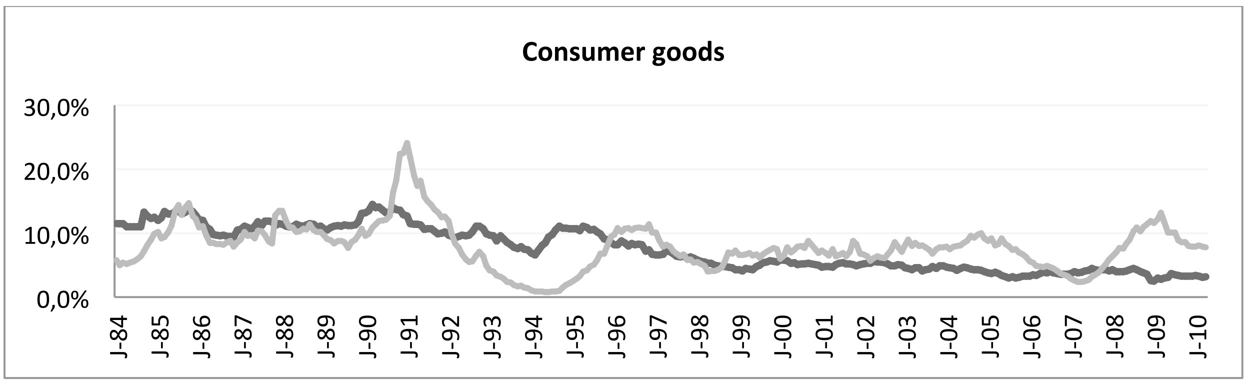
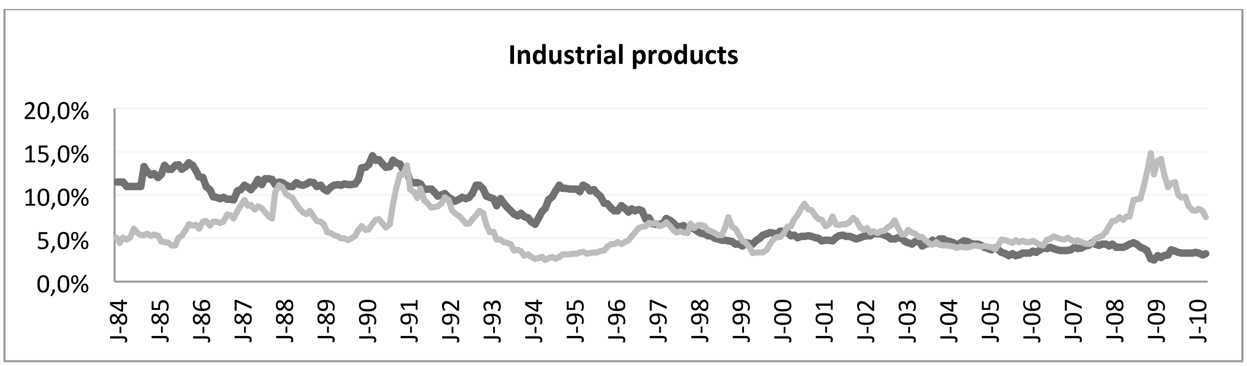
Appendix A. List of companies

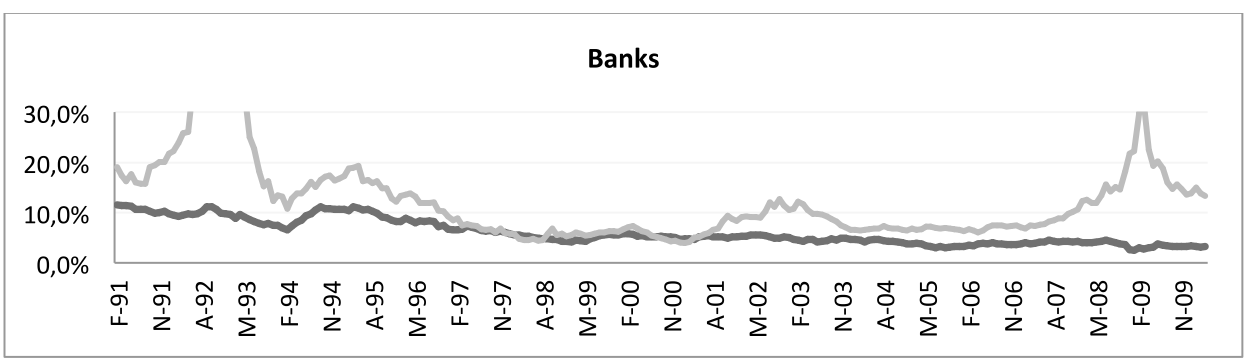
#	Industrial goods manufacturers	Consumer goods manufacturers	Banks
1	Alfa Laval	Electrolux	Nordea
2	Assa Abloy	Husqvarna	SEB
3	Atlas Copco	Mekonomen	Svenska Handelsbanken
4	Hexagon	Nobia	Swedbank
5	Indutrade	SCA	
6	NCC	Swedish Match	
7	Nibe Industrier		
8	Peab		
9	SAAB		
10	Sandvik		
11	Scania		
12	Seco tools		
13	Securitas		
14	Skanska		
15	SKF		
16	Trelleborg		
17	Volvo		

Appendix B. Earnings yield and bond yield

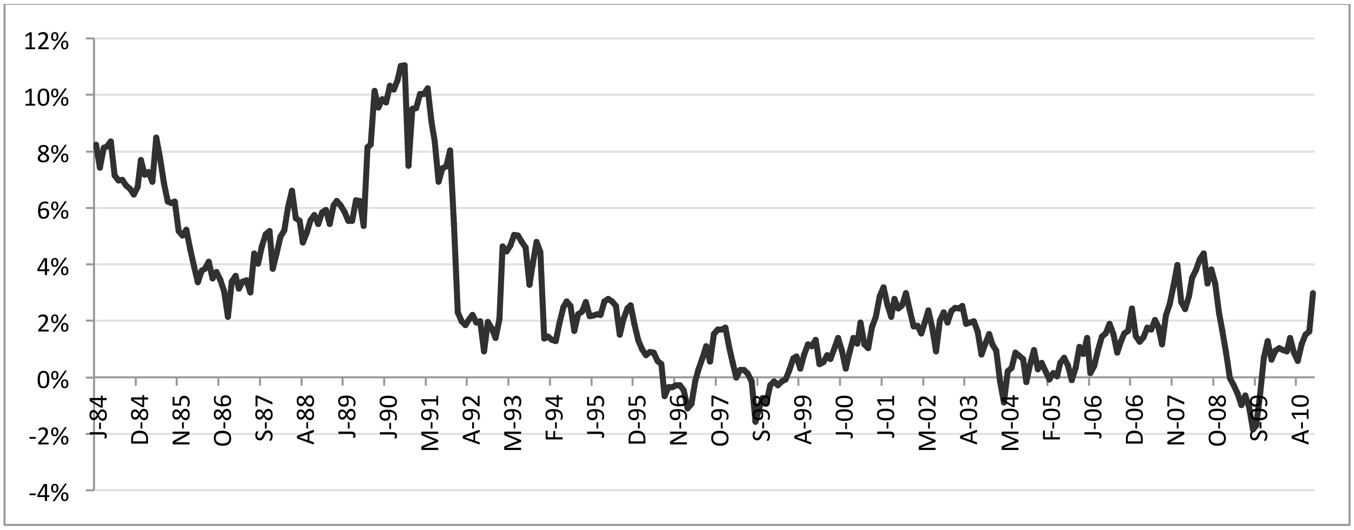




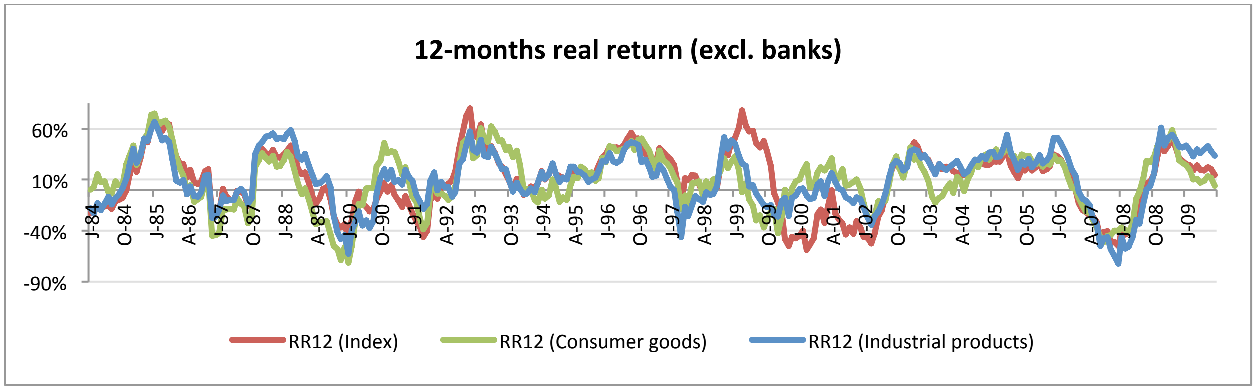


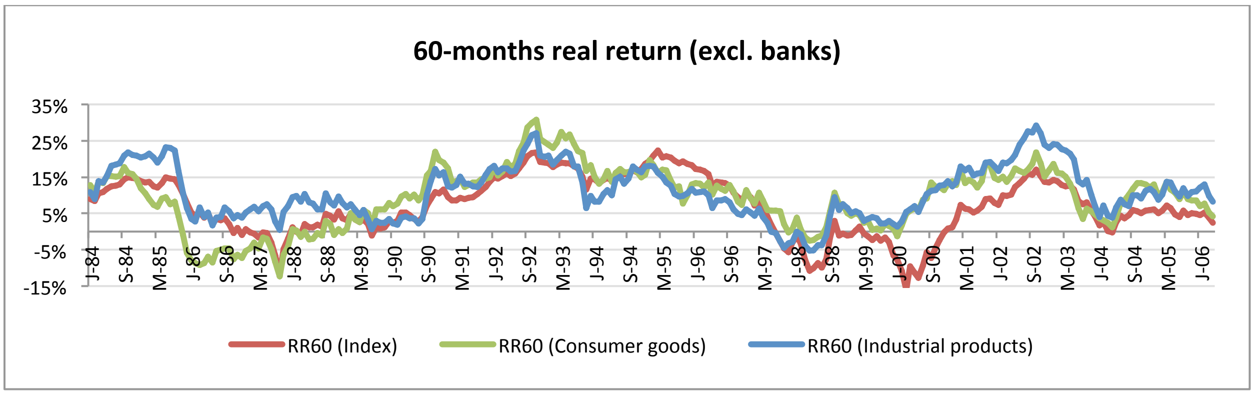


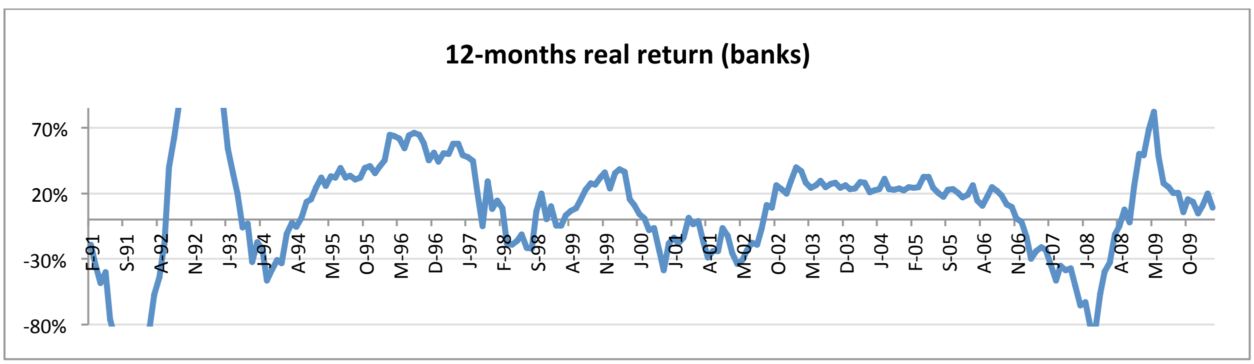
Appendix C. Inflation rate in Sweden, % change year-on-year

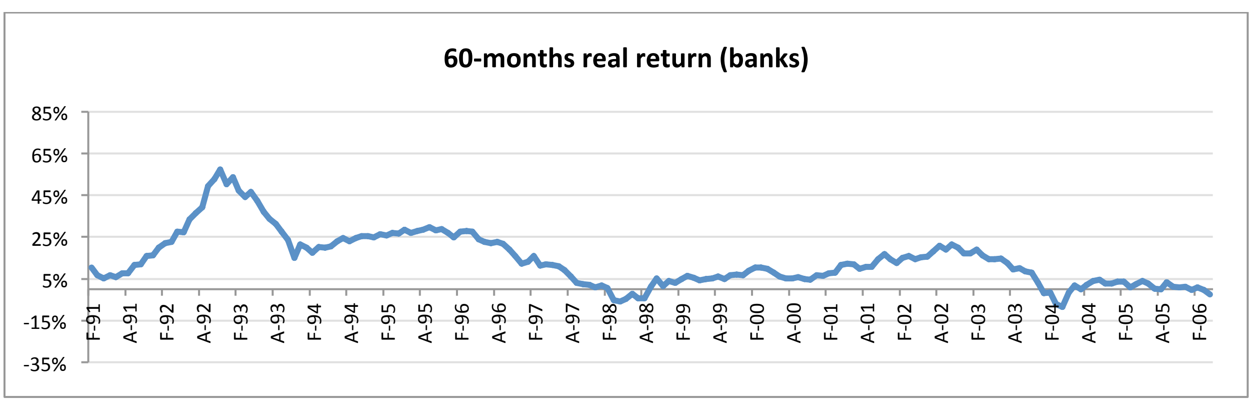


Appendix D. Real return

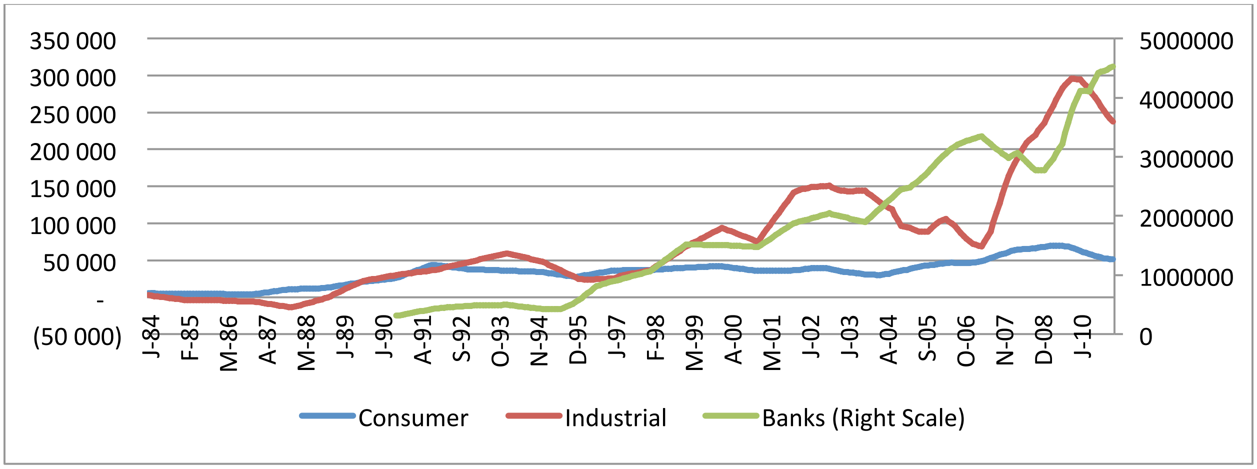








Appendix E. Book value of net debt per share



Appendix F. Regressions summary (p-value presented in parenthesis)

INDEX

	Intercept	EP-BY	EP-[BY-p]	EP	R^2,%
12-month	- 0.00	1.19			0.08
	(0,81)	(0,12)			
	- 0.00		0.65		0.03
	(0,85)		(0,03)		
	- 0.00			3.64	0.28
	(0,64)			(0,00)	
60-month					
	- 0.00	0.56			0.06
	(0,81)	(0,15)			
	- 0.00		0.33		0.03
	(0,84)		(0,05)		
	- 0.00			2.66	0.41
	(0,65)			(0,00)	

CONSUMER GOODS

	Intercept	EP-BY	EP-[BY-p]	EP	EP*-BY	EP*-[BY-p]	EP*	R^2,%
12-month	0.00	4.49						0.18
	(0,95)	(0.00)						
	0.00		3.35					0.13
	(0,87)		(0.00)					
	0,00			8.14				0.36
	(0,95)		-	(0.00)				
	0,00				7.10			0.35
	(0,87)				(0.00)			
	0.00					4.44		0.22
	(0,95)					(0.00)		
	0,00						5.13	0.27
	(0,84)						(0,00)	
60-month								
	-0,00	0.71						0.13
	(0,88)	(0.02)						
	-0,00		0.54					0.10
	(0,93)		(0.00)					
	-0,00			1.44				0.32
	(0,85)			(0.00)				
	-0,00				1.23			0.30
	(0,77)				(0.00)			
	-0,00					0.77		0.19
	(0,88)					(0.00)		
	- 0.00						0.92	0.26

BANKS

	Intercept	EP-BY	EP-[BY-p]	EP	EP*-BY	EP*-[BY-p]	EP*	R^2,%
12-month	-0,00 (0,88)	2.04 (0.00)						0.27
	-0,00 (0,94)		1.94 (0.00)					0.25
	-0,00 (0,94)			2.08 (0.00)				0.29
	0,00 (0,94)				0.51 (0.00)			0.28
	0,00 (0,94)					0.51 (0.00)		0.28
	0,00 (0,94)						0.51 (0,00)	0.28
60-month								
	0,00 (0,60)	0.36 (0.00)						0.29
	0,00 (0,67)		0.35 (0.00)					0.27
	0,00 (0,66)			0.37 (0.00)				0.31
	-0,00 (0,73)				0.09 (0.00)			0.33
	0,00 (0,75)					0.09 (0.00)		0.32
	-0,00 (0,75)						0.09 (0,00)	0.33

INDUSTRIAL PRODUCTS

	Intercept	EP-BY	EP-[BY-p]	EP	EP*-BY	EP*-[BY-p]	EP*	R^2,%
12-month	0,00 (0,90)	5.65 (0,00)						0.17
	0,00 (0,78)		3.03 (0,00)					0.08
	-0,00 (0,95)			8.19 (0,00)				0.28
	0,00 (0,83)				1.73 (0,11)			0.03
	0,00 (0,80)					1.05 (0,14)		0.02
	0,00 (0,83)						1.24 (0,12)	0.03
60-month								
	0,00 (0,96)	0.92 (0,01)						0.10
	0,00 (0,98)		0.53 (0,002)					0.06
	0,00 (0,80)			1.70 (0,00)				0.26
	-0,00 (0,96)				0.32 (0,12)			0.03
	0,00 (0,99)					0.24 (0,10)		0.02
	-0,00 (0,94)						0.27 (0,10)	0.04