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# Value Investing with F_SCORE
## -An OMX Stockholm application

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# Abstract


**Title:** Value Investing with F_SCORE – An OMX Stockholm application

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**Keywords:** F_SCORE, value investing, excess return, efficient market, EMH, Book-to-Market.

**Purpose:** The purpose of this thesis is to assess whether the value based investment strategy, F_SCORE, earns an above market return on OMX Stockholm between 1990 and 2007. In addition, the intent is to evaluate whether such an above market return can be explained by a beta-effect and size effect.

**Methodology:** The study implements a quantitative and deductive approach following Piotroski's (2002) study. Market-adjusted returns and Jensen's alpha are calculated in order to observe eventual abnormal returns. Statistical tests are used to examine the degree of significance obtained in the results.

**Theoretical perspectives:** The theoretical framework is built up around Efficient Market Theory and related theories and research concerning value investment strategies. This background will enable a deeper understanding of the F_SCORE strategy.

**Empirical foundation:** This thesis is based on the top quintile of value firms listed on OMX Stockholm each year between 1990 and 2007.

**Conclusions:** The analysed companies obtain, similarly to Piotroski's study, above market returns before being ranked by F_SCORE, confirming that value investing works on OMX Stockholm. Piotroski's model does not, however, create above market returns for firms obtaining a F_SCORE of 8 and 9. The majority of the results obtained are not statistically significant.

## Sammanfattning

| | |
|---|---|
| **Titel:** | Value Investing with F_SCORE – An OMX Stockholm Application |
| **Seminariedatum:** | 2009-06-04 |
| **Kurs:** | Examensarbete på Kandidatnivå i Corporate Financial Management, 15 ECTS |
| **Författare:** | Erik Dahl<br>Eric Roest<br>Eric Tetzlaff |
| **Handledare:** | Måns Kjellsson |
| **Nyckelord:** | F_SCORE, value investing, överavkastning, Book-to-Market, effektiva marknader, EMH. |
| **Syfte:** | Syftet med uppsatsen är att undersöka huruvida investeringsstrategin, F_SCORE, producerat överavkastning på OMX Stockholm mellan 1990 och 2007. Vidare avser vi att undersöka om en sådan överavkastning kan förklaras av en betaeffekt eller storlekseffekt. |
| **Metod:** | Studien utförs genom en kvantitativ och deduktiv ansats vid undersökningen av Piotroskis journal (2002). För att observera eventuella överavkastningar är marknadsjusterad avkastning och Jensens alfa beräknade. Statistiska test används för att undersöka om skillnader i avkastningar mellan portföljer är signifikanta. |
| **Teoretiska perspektiv:** | Den teoretiska referensramen är uppbyggd kring den effektiva marknadshypotesen och tidigare studier samt forskning rörande ”value investment” strategier. En återgivning av denna bakgrund och definitioner kommer att möjliggöra en förståelse av F_SCORE-strategin. |
| **Empiri:** | Uppsatsen är baserad på de 20 procent av samtliga bolag med högst årsvis ”book-to-market” ratio noterade på OMX Stockholm mellan 1990 och 2007. |
| **Resultat:** | I likhet med Piotroskis studie uppnår de analyserade företagen en överavkastning gentemot aktiemarknaden när dessa inte är uppdelade enligt Piotroskis F_SCORE modell. Piotroski’s modell ger dock ingen överavkastning för företagen med högst F_SCORE. Vidare är majoriteten av de resultat som uppnås inte statistiskt signifikanta. |

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# 1. Introduction

*This chapter will introduce the research topic in this thesis. First, a background will be presented. Second, the problem discussion and problem formulation surrounding the purpose of this thesis will be explained. Finally, delimitations, target audience and disposition is presented.*

This paper recognises that the business of picking stocks to buy, or recognising which stocks to sell is, a time consuming task, not forgetting to mention a serious gamble. As such, the strategies employed are as varied as the investors using them. Some swear by a method of technical analysis to pick stocks, whereas other mainstream investors prefer attempting to evaluate the opportunities for a firm within a specific sector before committing to an investment, and somewhat conventionally compile portfolios according to their preferences for risk and return. The rogue investor may, in turn, have a preference for a martingale betting system, like the one used by Jérôme Kerviel who lost 7 billion USD trading derivatives at Société Générale (Sage, 2007).

If there is one question that arguably preoccupies players on financial markets at one point or another, it is “How do you beat the market?” When trading securities, there is always the ambition to deal more cost-effectively and/or reap profits greater than current average market returns.

These objectives, however, are perhaps most apparent in the character of the conventional equity investor. In the same way, a portfolio strategy that consistently identifies winners and losers in the markets with minimum risk and earn returns superior to those averaged by the market index, is the investor’s equivalent of a dream come true. In actual effect, the existence of such strategy would challenge the efficient market hypothesis (EMH), one of the main pillars of financial market theory, which states “…that securities will be fairly priced, based on their future cash flows, given all information that is available to investors” (Berk, DeMarzo, 2007, p. 268). In other words, the EMH implies that the only way to attain higher returns is to increase the proportion of risk in one’s investments.

Consequently, a strategy that defies EMH and consistently beats the market would have to be one that that identifies under- and overvalued stock, or in the very least re-evaluates what information is important when considering what the potential value of a stock might be in the mid-term. For this reason also, the EMH requires the presence of competition among investors as a prerequisite, the degree of which determines its accuracy. The degree of competition, in turn, depends on the number of investors that have access to or indeed possess information that stands to affect the value of a firm (Berk, DeMarzo, 2007).

The kind of information that investors have access to will then ultimately determine the extent to which they are able to earn returns superior to those averaged by the market portfolio. This suggests that the type of information enabling such returns in an investment strategy is not easily understandable or interpretable to the investing public at large.

It is partially with the above in mind that this paper seeks to examine and evaluate the properties of one type of investment strategy that has yielded abnormal returns and received a fair amount of attention over the years in the related academic community. Value investment strategies, explored by Fama & French (1992), and more recently by Piotroski (2002), have demonstrated a tendency to yield these abnormal returns. Specifically, this paper considers the robustness of Piotroski's (2002) F_SCORE strategy, by applying it to the OMX Stockholm Stock exchange (OMXS).

Piotroski's (2002) paper on value investing, and the use of historical financial information to separate winners from losers asks whether a simple accounting-based fundamental strategy can be applied to a broad portfolio of high book to market firms, and in turn shift the distribution of returns earned by the investor. His study is interesting because it claims to generate an average annual return of some 23% between 1976 and 1996, using a strategy that buys expected winners and shorts expected losers on the US market.

From an academic standpoint, value investing (in light of Piotroski's paper) is an interesting subject to consider. The question is of course whether Piotroski's fundamental analysis and investment strategy would have equal success on foreign markets, and perhaps whether there are any existing financial market theories that could otherwise explain the abnormal profits that his strategy yields. As such, this paper asks whether Piotroski's strategy earns significant profits when applied to OMXS, and further considers whether there are any other underlying factors, like a beta effect or size effect (even momentum to a smaller degree) that could be attributed to the strategy's success.

### *1.1 Problem Discussion*

An American study performed in the US in 2002 by Joseph Piotroski, showed that historical financial information, including nine signals measuring a firm's profitability, financial leverage and liquidity and operating efficiency, could be used to form portfolios and create above market returns. By the creation of a portfolio of high book-to-market firms, investors could increase the return of a portfolio by at least 7.5% annually. The result from this study showed that the US stock market had not been entirely efficient between 1979 and 1996, which resulted in information asymmetry, creating possibilities to construct portfolios generating more than the market return.

An analysis of the OMXS with the nine criteria proposed by Piotroski, would evaluate whether such information asymmetry historically also has existed in Sweden. If the results in this study show that Swedish companies with the 20 percent highest book-to-market ratios each year also provides an above market return, then it can be concluded that the Piotroski model also has been applicable to a smaller market such as the OMXS.

### *1.2 Problem Formulation*

A number of relevant factors that can be derived from previous studies, in particular Piotroski's F_SCORE study, mainly performed on US stock markets, will constitute the majority of our hypotheses:

1) *The F_SCORE model has achieved above market returns for firms with an accumulated F_SCORE of 8 and 9 on the OMXS during the research period*
2) *Each year's 20% highest book-to-market firms have during the research period obtained an above market return*
3) *The above market return during the research period, achieved using Piotroski's F_SCORE model, can be explained by a beta-effect*

These three proposed hypotheses will constitute the foundation for our analysis in chapter 5.

### *1.3 Purpose*

The purpose is to empirically analyse, with existing theories, whether it has been possible to apply Piotroski's F_SCORE model on the OMXS between 1990 and 2007. The writers' intention is also to observe whether there has been information asymmetry on the OMXS and how these phenomena results in accounting based investment strategies providing the opportunity to achieve above market returns and if this can be explained by a beta effect or a size effect.

### *1.4 Delimitations*

We have decided to only focus on the OMXS in our thesis for a number of reasons. First, the US and Swedish stock market differ greatly in the number of listed companies, wherefore it would be interesting to see if Piotroski's (2002) model, based on accounting analysis and information asymmetry, also works in a market with less listed companies than in the US. Second, by focusing on the Swedish stock market, a positive result obtained by the F_SCORE model gives evidence towards that the signals selected by Piotroski (2002) are successful in separating "winning" from "losing" shares.

The time span for our observations is 1990-2007, a decision taken due to the large number of Swedish firms that Thomson Datastream (Datastream hereafter) did not provide the necessary figures needed to correctly conduct an analysis using the F_SCORE model prior to 1990. The study ends with annual accounts taken from 2007, due to this information being available first in May 2008, resulting in the last portfolio being available to hold for one year between May 2008 and May 2009.

Datastream, which has been the main database, does not supply the figures regarding small-, medium-, and large cap firms, wherefore this study will not classify analysed shares into these categories.

Piotroski (2002) used a method called Bootstrap, this test is of such advanced character that we are unable to perform these tests. It lies beyond the scope of this bachelor thesis to examine the Bootstrap test.

While firms do not always implement the calendar year as a fiscal year, this paper elects to use them synonymously.

### *1.5 Target Audience*

This study is mainly targeted to investors and organisations with a strong interest in the stock market. Even though the F_SCORE model may look easy to implement practically, it can be difficult to fully understand for individuals who do not possess knowledge within finance due to the nine signals used mainly being based on economic theory. To fully comprehend all information in this study, a basic understanding of statistics, accounting and stock trading is therefore recommended and presupposed.

### *1.6 Disposition*

In *Chapter 2*, the theoretical framework is introduced. In *Chapter 3*, the paper presents its chosen methodology, whilst *Chapter 4* will introduce the paper's empirical results. *Chapter 5* contains an analysis of obtained empirics, which leads to the analysis finding its conclusion in *Chapter 6*, which also gives suggestions to further research.

# 2. Theoretical Framework

*This paper looks to previous research concerning and related to book-to-market (or value) investment strategies, financial statement analysis, market anomalies, market efficiency and risk, to form the basis for discussion and interpretation of its own empirical results. This section includes segments that review each of the aforementioned topics.*

## *2.1Value Investment (and related) Strategies*

Piotroski's (2002) paper joins a wide range of financial research that investigates the gains yielded by a high book-to-market investment (or value investment) strategy. Most notably, research by Fama and French (1992) arguably deserves much of the credit for providing the foundation for Piotroski (2002). Lakonishok, Shleifer, and Vishny (1994) are also widely quoted in value investment strategy domain, and Banz (1981) also merits honourable mention.

Fama and French (1992) partially confine the extent of their study to investigating the properties of the size effect[1] and book-to-market, "…by considering portfolio performance based on stocks' market capitalisations" (Berk, DeMarzo, 2007, p.402). Essentially, they use size and book-to-market equity, in addition to a price/earnings ratio and leverage as proxies for different aspects of risk (beta), although Fama and French (1992) comment in their results that size and market-to-book factors essentially absorb the "apparent roles of leverage and E/P in average stock returns" (Fama and French, 1992, p.440). In turn, they observe strong cross-sectional relationships between average returns and size (and book-to-market), in addition to observing an unreliable relationship between average returns and beta.

With reference to the size and book-to-market effects in particular, their study was set up to measure excess returns within 10 portfolios formed each year, where the smallest 10% of stocks were placed in the first portfolio, the following 10% in the next portfolio, continuing up to the biggest 10% of stocks in the 10$^{th}$ portfolio. Monthly excess portfolio returns were then recorded for the duration of the following year and entire process was repeated for each of the years in their sample, between 1962 and 1989. Finally, Fama and French calculated

[1] The size effect refers to the observation that small stocks (or stocks with a high book-to-market ratio) have positive alphas (Berk, J and DeMarzo, P, (2007), *Corporate Finance,* p.403)

average excess returns for each of the portfolios in addition to calculating their beta values. One is able to observe from their results that, although portfolios with higher betas yielded higher returns, most portfolios perform above the security market line (Berk, DeMarzo, 2007).

Fama and French (1992) is arguably a subject of some debate in relevant financial and academic circles. Lakonishok, Shleifer, and Vishny (1994) certainly contribute to the debate in question. They reason that, while agreement certainly exists that value strategies can produce abnormal returns, their evidence suggests that value strategies do this because they "…exploit the suboptimal behaviour of the typical investor" (Lakonishok et al, 1994, p.1541), and not because the strategies in question are riskier.

Asgharian and Hansson (2000), who emulate the Fama & French (1992) study to a degree, comment that Fama & French (1992) results defy the Capital Asset Pricing Model (CAPM) where "factors besides market beta, 'idiosyncratic factors from a CAPM perspective, should have no power in explaining the cross section of returns" (Asgharian and Hansson, 2000, p.214).

Piotroski's (2002) F_SCORE strategy derives from observations related to the properties of the size and book-to-market effects that Fama & French (1992) observed. His interest in applying a high book-to-market strategy based on a set of 9 accounting-based fundamental performance signals,[2] stems from his observation that the ability of the Fama French strategy to yield abnormal returns depends on the strong financial performance of a few firms, while "…tolerating the poor performance of many deteriorating companies" (Piotroski, 2002, p.2). In effect, one of the conclusions made by Fama & French (1992) with regards to ability of book-to-market ratios to indicate the relative prospects of a firm, is that low book-to-market firms are strong consistent performers, whereas value (high book-to-market) firms are persistently weak. In light of this, Piotroski's (2002) sought to identify clear differences between winners and losers in the high book-to-market category, or what he dubs "out-of-favour" stock category.

[2] related to profitability, operating efficiency, leverage, liquidity and source of funds

Banz (1981) must be considered somewhat of a pioneer within the sphere of value investment strategy. He was the first to discover the size effect, the result of having concluded in his paper that the CAPM was miss-specified, due to the fact that smaller firms maintained significantly larger risk adjusted returns in comparison to larger firms over a 40 year period. His paper initially met with some criticism as researchers attributed the success of his data to the data-snooping bias.[3] However, financial economist later determined that we should expect to observe the size effect when the market portfolio is not efficient (Berk DeMarzo., 2007).

## *2.2 Financial statement analysis*

The opening comments made in the introduction of this paper relate to the role of firm value information and how the investor's ability to interpret the information correctly essentially determines the extent of his/her returns. Several published works show the benefits of trading on performance related variables. These strategies differ from conventional portfolio strategies to the extent that they do not trade off the basis of efficient market risk and return requirements, but seek instead "…to earn abnormal returns by focusing on the market's inability to fully process the implications of particular financial signals" (Piotroski, 2002, p.5).

Abarbanell and Bushee (1998) contribute to research related to the use of financial statement analysis to predict future earnings by demonstrating that various accounting based signals, such as capital expenditures, relative changes in inventory and effective tax rates are strong indicators of "one-year-ahead earnings information to which the market underreacts" (Abarbanell et al, 1998, p. 43). Moreover, they observe that returns to their fundamental analysis strategy are not significantly correlated to firm-size or book-to-market variables and furthermore, that "cumulative returns to the fundamental strategy level off after one year of the signals' disclosure" (Abarbanell et al, 1998, p. 43).

[3] The data snooping bias - the idea that given enough characteristics, it will always be possible to find some characteristic that by pure chance happens to be correlated with the estimation error of average returns. (Berk, J and DeMarzo, P, (2007), *Corporate Finance*, p. 404)

## *2.3 Market anomalies*

The documented effects of various anomalies are taken into account in want of being able to determine whether there are any underlying factors that can be attributed to the success of the F_SCORE strategy, and arguably many other strategies for that matter.

Asness (1997) considers the interaction of value and momentum strategies and finds that the two strategies, although effective, are negatively correlated. The implications of this are twofold. Firstly, pursing a value (or high book-to-market) strategy implies purchasing stock in firms with poor momentum. Secondly, investing in high momentum firms would tend to point to a low-value strategy.

Asness also makes an interesting point with regards to the different schools of thought that characterize the research related to value strategies. At the time of publication of his paper, he identifies three such schools, the first headed by Fama and French (1992) who claim that high book-to-market strategies function because “they represent some underlying risk that is higher for value stocks, for which compensation must be made” (Asness, 1997, p.36). The second school is occupied by Lakonishok, Schleifer and Vishny (1994), who reason that it is due to investor unwillingness to hold value stock or systematic forecasting errors by investors that lie at the root of value strategy success. Perhaps rather typically, the third school, headed by Black (1993) dismisses the success of a value strategy altogether and attributes apparent significance of presented empirical evidence in both of the aforementioned papers to the data snooping bias.

Fama and French (2008) consider the frequency of various return anomalies (accruals, asset growth, momentum, net stock issues and profitability) amongst microcaps, small stocks and big stocks, primarily by method of conducting cross-sectional regression tests. Their study suggests that the size effect is present to a significant degree in microcaps, and to a lesser degree in small and big stocks. Momentum, in turn, maintains stronger and similar correlations to average returns for small and stocks, while being significantly weaker for microcaps. A negative relationship is observed between average returns and asset growth, particularly among microcaps, while accruals, net stocks issues, profitability and the book-to-market ratio exhibit average relationships with average returns irrespective of size group. Interestingly, the paper concludes that over time, the anomalies all exhibit unique information about future earnings and that in one way or another, they are all rough proxies for expected cash flows. For example, firms that issue stock show a tendency that points towards lower net cash flows and the opposite is true of firms that repurchase stock. Some attention is also given to the common interpretation that average return anomalies are an indication of market inefficiency.

### *2.4 Market efficiency*

Chen and Zhang (1998) and Fama & French (1995) consider the risk and return of value stocks and show that depressed earnings are a common characteristic among companies exhibiting high book-to-market ratios.

Interestingly, Chen and Zhang (1998) note that there have been many historic measures of value stocks, related in part to a high book-to-market effect, but also to a cash flow effect, a size effect, a dividend effect, and a contrarian effect.[4] In particular, their study finds that value stocks display “riskier” characteristics, as a result of facing uncertainty with regards to the their future earnings, as well as having high financial leverages and dealing financial distress. Consequently, their empirical results show that value stocks offer “…reliably higher returns in the United States, Japan, Hong Kong, and Malaysia… but not in the high-growth markets of Taiwan and Thailand” (Chen and Zhang, 1998). Importantly, the results for the latter two markets stem from the risk-spread between high and low book-to-market stocks being too thin, whereas higher returns on the other markets are attributed to higher risk.

[4] Cash flow effect – high earnings or cash flow-to-market value. Dividend effect – high dividends relative to a low market price. Contrarian effect – low market price relative to the historical price (Chen and Zhang, 1998, p.502).

## *2.5 The Efficient Market Hypothesis*

Whether a market is efficient in pricing shares is the central question in stock picking theories such as the F_SCORE model, which can only work successfully if stock market inefficiency exist. The Efficient Market Hypothesis (EMH) partially owes its development to Eugene Fama in the 1960s, and expresses the notion that an efficient capital market fully reflects all available information (Fama, 1970). Security prices therefore reflect all available information in an efficient capital market, and no investor will be able to earn returns on a share that exceeds the risk associated with that share (Elton et al., 2007, p. 400)

The EMH became widely accepted in the financial arena and also resulted in the view that security markets were thought to be extremely efficient (Malkiel, 2003, p. 60). This also had implications for alternative valuation methods like technical analysis (in which investors study historical prices in order to predict future prices), which could seemingly no longer be used by investors to find undervalued stocks (Malkiel, 2003, p. 59). The same is true for a method of valuation by fundamental analysis, where one arrives at the value of a stock based on the analysis of information and forecasting payoffs from that information, in the hope of yielding returns superior to those of averaged by the market (Penman, 2003, p. 75). Even awareness of information when it is released has little effect according to the EMH, as this information, according to research, adjusts the price of securities before an investor has time to trade on it (Ross et al. 2002, p.342).

### 2.5.1 The Importance of Efficient Capital Markets

Before analysing and reviewing whether markets can be considered efficient, one must essentially consider why market efficiency is important. Firstly, investors must be able to trust the markets in order for them to buy stocks. If shares did not accurately represent the market value of company, then many investors would find alternative investments, as the risk aversion to and subsequent fear of a “bad” investment would be considerably higher than within efficient markets. This would result in companies being hindered to obtain external capital and would ultimately hinder development and growth (Arnold, 2002, p. 607). Secondly, a manager’s main objective when operating a firm is to maximise shareholder wealth. Whether the actions taken by a firm’s management are value enhancing is often observed through the stock price. If the market is not efficient, then the result of actions taken by a management will be seriously difficult, if not impossible, to observe. There is therefore a need, through a shareholder wealth-enhancing perspective, that markets are efficient (Berk et al., 2007, p. 271). Also, the risk associated with a firm, and the return investors demand, is signalled through the share price. Projects where the cost of capital is used could lead to poor investment choices due to the discount rate being either markedly high or low (Berk et al., 2007, p. 271). Lastly, the share price of a firm gives shareholders and investors a signal whether the company is being run successfully. A firm that is performing poorly, but where the market has not incorporated this fact into the share price, will lead to resources being inadequately allocated in a larger societal sense (Arnold, 2002, p. 607).

### 2.5.2 Weak-Form Efficiency

Fama classifies information, and the impact it has on security prices, into three different categories. If a market fully incorporates historical stock price information, then the market satisfies weak-form efficiency. This form of efficiency is the lowest type of efficiency as historical prices are hardly difficult to obtain. This type of efficiency coincides with the proposal of the "random walk", which purports the idea that price changes of stocks embody a random departure from preceding prices (Elton et al., 2007, p. 403). The logic behind this idea is that the price of a stock today is equivalent to the most recently observed price including the stock's expected return, as well as a random component occurring over the interval. The last component of the above equation is due to new information released regarding the value of the stock. By this logic, tomorrow's news will, due to the assumption of information being unimpeded and directly available, be instantly incorporated in tomorrow's price and independent of today's price changes (Malkiel, 2003, p. 59). Technical analysis, predicting future prices based on past prices, would be impossible therefore, as everyone would adapt this strategy if the only requirement to earn abnormal market returns is to recognize patterns in the movement of stock prices. Also, since news by definition is impossible to predict, price changes in the future must be random and unpredictable (Ross et al., 2002, p. 342).

There are several ways in which weak-form efficiency can be tested. Chartists analyse diagrams in order to find patterns that show whether one should invest, hold or sell stocks. A similar method is the filter method where small price adjustments are filtered out from charts so that the investor can focus on long-term movements. Although some studies show that the market sometimes overreact to bad news, creating opportunities to outperform the market, the general consensus of these methods is that they have not been proven to provide above market returns (Arnold, 2002, p. 612).

### 2.5.3 Semistrong-Form Efficiency

Semistrong-form efficiency tests of the EMH conclude that a market is efficient if prices reflect all publicly available information, such as published accounting statements as well as historical prices (Fama, 1970). The main difference between the weak and the semistrong-form of efficiency is that the latter not only demands that a market is effective in relation to information regarding historical prices, but also that all of the information that is available to the public is reflected in a stock's price (Fama, 1970, p. 409).

With the aforementioned in mind, the market form of efficiency that is of most interest when assessing the properties of the F_SCORE model, and is also likely to be the form related to the OMXS, is the semistrong-form. The reason for this is that it focuses on whether public information is meaningful to analyse in order to try to obtain above market returns. Analysts and researchers try to find models and ways to estimate the true value of firms and then compare these with their market values (Arnold, 2002, p. 615). Should this form hold true, investment models like the F_SCORE strategy will be unable to provide excess returns, since stock prices already accurately incorporate public information according to the semistrong model. Tests that tend to support that the market (U.S. stock market) is semistrong-form efficient, are event studies and the record of mutual funds (Ross et al., 2002, p.352). The event study test, performed in several studies, show that events considered to be both bad and good, tend to support that the market adjusts even before official news have been released, due to information leakage (Ross et al., 2002, p. 346). Also, mutual funds that use publicly available data when investing in stocks have been analysed, showing that these on an average, do not provide above market returns (Pastor et al., 2002, p.331). There are however, contrary to the above tests, analyses supporting the view that markets are not semistrong-form efficient.

### 2.5.4 Small Firms

Piotroski's (2002) study shows that the benefits to financial statement analysis, and the use of the F_SCORE model, are particularly concentrated in small firms. There is therefore a need to, in order to analyse the F_SCORE model's potential impact on market efficiency theory, explain the research regarding small firms' potential above market returns. Firms with small market capitalisation have been analysed and several studies have shown that these have outperformed larger firms over most of the 20th century (Ross et al., 2002, p. 354). These studies have been replicated during different times in different countries showing the same result in the western part of Europe (Arnold, 2002, p. 618).

The Three Factor Model was constructed to try to explain the small firm outperformance (Fama French, 1992). Fama and French argued that beta, whilst doing a regression, had almost no explanatory power when analysing small companies using the Capital Asset Pricing Model (CAPM). Fama and French therefore expanded the CAPM model to include size and value factors in addition to the market risk factor. The expected return in excess of the risk free rate is according to the model explained by three factors: 1) a broad market portfolio's excess return, 2) the difference in return between portfolios of small and large stocks, and 3) the difference between portfolios of high book-to-market firms and low book-to-market firms.

Explanations that have been presented for small firm outperformance have been that transaction costs are higher if one invests in small firms (Elton et al., 2007, p. 417)**.** Small firms are not as liquid as large firms, and trading them will result in higher transaction costs. The cost of owning a portfolio of small firms will also be higher with regards to monitoring stocks, as small firms generally have less easily accessible information with regards to monitoring value changing information. The risk associated with these small firms is higher than with large shares and this has also, together with the fact that the beta value perhaps is not as accurate for small firms as it is with large firms, been put forward for being a reason that small firms have outperformed large firms (Ross et al., 2002, p. 354).

Fama and French further analysed the difference between portfolios of high book-to-market firms and low book-to-market firms, and found that firms with high book-to-market equity had a tendency to be continually distressed. Also, firms with low book-to-market equity were associated with unceasing profitability. Therefore, holders of high book-to-market equity could be considered to receive compensation for holding uncertain stocks (Elton et al., 2007, p. 417).

### 2.5.5 Value Shares

Shares evaluated in the F_SCORE model are often referred to as 'value' shares. There are different ways, in which a stock can be considered to be a 'value' share but the following three definitions are regularly used to rate 'value' shares: 1) shares with a low price to earnings ratio (P/E ratios), 2) shares with high book-to-market ratios and 3) shares with low price in relation to its dividends (Penman, 2003, p. 70). Studies indicate that shares with low P/E ratios have exhibited returns superior to those averaged by the market. While the latter is generally accepted, the reason behind this market outperformance is still disputed. Some academics argue that the small market effect (as discussed in 3.4.1) lie at the root of above market returns, as small firms often have low price to earning ratios (Arnold, 2002, p.621). Several past works, such as Piotroski's F_SCORE study, also argue that shares with high book-to-market ratios outperform growth stocks that have low book-to-market ratios (Ross et al., 2002, p. 356). The outperformance of these shares can be interpreted as being evidence that the US market is not semistrong-form efficient. Finally, many studies conclude that shares offering a higher dividend yield have a tendency to outperform the market (Arnold, 2002, p. 622).

### 2.5.6 Seasonality and Cyclicality

Final tests that evaluate semistrong-form efficiency are the seasonal and cyclical differences typically identified with regards to stock returns. The weekend effect, where stock returns are highest on Fridays and lowest on Mondays, provides evidence contrary to market efficiency. Also, the January effect show that the average stock return is higher in January compared to all other months, for both small and large capitalisation companies (Ross et al., 2002, p. 354). Piotroski, however, does not incorporate a test in the F-Score study that assesses the effects of seasonality or cyclicality.

### 2.5.7 Strong-Form Efficiency

The last form of efficiency is strong-form efficiency which, in addition to incorporating the prerequisites for weak and semistrong form efficiency, also implies access to absolutely all information that is related to the value of the stock is incorporated in its price (Ross et al., 2002, p. 346). If today's price reflects all information, both public and private, the market is strong-form efficient. A strong-form efficient market would make it impossible to achieve above market returns using the F_SCORE strategy of buying winners and shorting losers. The relationship between the three forms of efficiency can be seen in the relationship graphic below.

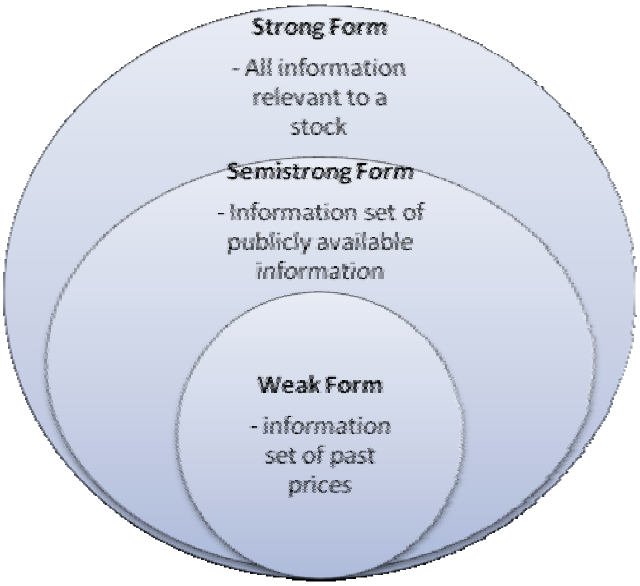



Figure 1. Strong-form efficiency incorporate both semistrong-form and weak form efficiency, whilst semistrong form efficiency incorporate weak form efficiency

## *2.6 Financial Performance Signals*

A common explanation regarding above market returns from high book-to-market firms is that they bear a higher risk due to a greater risk of falling into financial distress. Both Fama and French (1995) and Chen and Zhang (1998) have shown that high book-to-market equity companies continually present low earnings, uncertain earnings and high financial leverage. These firms also are more likely to decrease or even cut dividends completely compared to firms with lower book-to-market equity (Griffin et al., 2002, p. 1). In order to assess this distress, Piotroski "intuitively" selected nine criteria's that, according to Piotroski, should be useful to predict a firm's future performance (Piotroski, 2002, p. 6).

The aspiration of financial analysis is to calculate a firm's performance in the context of its known strategy and goals. In order to do this, two separate methods exist: ratio analysis and cash flow analysis. The first assess how a firm's service lines relate to each other, and the firm's past and present performance can through ratio analysis help to analyse a firm's future potential performance. The second method allows an investor or analyst to investigate the firm's liquidity (Palepu et al., 2007, p.196).

### 2.6.1 Profitability

One of the most difficult tasks for an analyst is how to measure a firm's profitability, and there is regrettably no unequivocal way in which one can know when a firm is profitable (Ross et al., 2002, p. 36). Company profit capabilities are, however, a key determinant when analysing a company's business. External capital tends to be more easily accessible to companies with strong earnings performance and these companies are therefore often valued higher than firms with weak earnings performances (Ganguin et al., 2005, p. 91). Piotroski argues that profitability signals supply information with regards to whether a firm internally can generate funds, and that a positive change compared to prior years gives information related to the underlying ability of a firm to generate future positive cash flows (Piotroski, 2002, p. 7). Piotroski uses four signals related to profitability when analysing companies: Return on assets (ROA), change in ROA, cash flow from operations (CFO) and accrual.

***Return on Assets (ROA)***

ROA is a frequently used ratio measuring managerial performance, and gives the ratio between income and average total assets (Ross et al., 2002, p.36). ROA therefore provides information regarding how much profit a company manages to generate for each amount of money invested (Palepu et al., 2007, p. 200). One of the most interesting aspects of ROA is that a firm can increase its ROA by taking two different actions. First, the firm can choose to increase its profit margins. Secondly, the firm can opt to increase its asset turnover. This is generally called the DuPont system of financial control (Ross et al., 2002, p. 37). Piotroski motivates the choice of selecting ROA as one of the nine variables, besides the fact that ROA shows that the firm has the ability to generate funds internally, because a substantial proportion of high book-to-market firms experience a loss in the prior two fiscal years (Piotroski, 2002, p. 7). ROA is also an easily implementable point of reference, as it does not rely on industry, time-specific or market-level comparisons (Piotroski, 2002, p. 7). The economic effect that is of interest is the fact that ROA is positive as long as the return on operating assets covers the firm's cost of borrowing (Palepu et al., 2007, p. 202).

***Change in ROA (∆_ROA)***

The second variable chosen by Piotroski is the change in ROA.  A firm that has not increased it compared to the previous year will be awarded positive signal, as a motive to reward the minority of companies of high book-to-market firms that have not experienced a loss in the two prior fiscal years (Piotroski, 2002, p. 7).

***Cash Flow from Operations (CFO)***

An analyst can get further insights into a company when reviewing a firm's operation through the breakdown of its cash flow statement. The cash flow statement provides information regarding a firm's operating, financing and investing activities. CFO discloses a firm's ability to generate cash from the sale of goods and services, after the cost of inputs and operations (Palepu et al., 2007, p. 217). Piotroski bases his choice of including CFO as the third variable due to studies showing that firms with profits outweighing cash flow from operations should be considered as a negative indication concerning future profitability and returns (Sloan, 1996, p. 314). Piotroski's reason for incorporating the CFO signal is that it rewards or penalises companies that use more or less cash than they generate. Companies that use more cash than they generate are, according to Piotroski, more likely to be in financial distress. Piotroski's model does not, however, take firms' growth strategies into account, and also shows disregard for industry specifics related to credit policies (Palepu et al., 2007, p.221).

***Accrual***

One essential attribute of corporate financial reports is that they are prepared using accrual rather than cash accounting. Accrual accounting distinguishes, unlike cash accounting, between the actual payment and receipt of cash with the recording of the costs and benefits associated with a firm's business activities (Palepu et al., 2007, p. 9).The accrual ratio receives a negative signal if the firm's profits are higher than the firm's cash flow from operations. The reason for defining this signal this way is that studies have shown that earnings driven by positive accrual alterations is a bad sign regarding future profits and earnings (Sloan, 1996).

### 2.6.2 Capital Structure

In the late 1950s, Modigliani and Miller developed the theory that a firm's capital structure did not impact the overall value of a firm. This theory was, however, based on the assumptions that firms had to operate in a perfect world of perfect knowledge, where companies and individuals could lend at the same rates and where taxation and cost of distress did not exist (Berk et al., 2007, p. 432). The prerequisites for perfect capital markets make it practically impossible for such markets to exist in reality. The financing of a business is therefore implemented more cost-effectively through loans than with the use of equity financing. The reason for this is that a lower rate of return is required by lenders, since they have prior claim to annual income and in matters regarding company liquidation. The use of debt does, however, also lead to higher risk of financial distress (Damodaran, 1994, p. 86). Piotroski therefore includes two ratios that evaluate firms' capital structure in order to analyse the risk of financial distress.

***Change in Leverage (∆_LEVER)***

The use of financial leverage allows a firm to obtain an asset base that is larger than the firm's equity. The change in leverage can be altered through external borrowing and actions such as the creation of provisions, trade payables and tax deferrals. A firm's return on equity increases with financial leverage as long as the return from investing is higher than the cost of the liabilities associated with leverage. (Palepu et al., 2007, p. 221) While a company through the use of leverage can increase shareholder wealth, it also increases the risk for the company's shareholders. The main difference between leverage and equity is that liabilities have predefined terms of repayment. If a firm fails to meet contractual obligations undertaken, the firm faces the risk of financial distress. Financially distressed firms risk difficulties obtaining external capital to undertake new, profitable, investments, and it can also create costs and conflicts between shareholders and the firm's debt holders (Palepu et al., 2007, p.480)

The use of leverage and the effect this has on stock prices and shareholder value has been considered in several studies. One study presents evidence that stock prices rise substantially on the date that an increase of leverage is presented, and conversely, that stock prices fall substantially when a decrease in leverage is announced (Shah, 1994). The conclusion of the above is therefore that the market interprets an increase in debt as a signal that the firm is managing well. This also coincides with the Pecking Order Theory. A divergence from the Pecking Order Theory, besides the argument regarding increase of risk, can however be motivated and be explained with recent studies showing that the Pecking Order Theory fails to work for small firms where information asymmetry is a presumably important problem (Frank et al., 2003, p. 241). The Piotroski definition of a change in leverage conforms to the latter and assumes that an increase in leverage is a bad signal with regards to financial risk.

***Change in Liquid (∆_LIQUID)***

Piotroski defines the change in liquidity as the historical change of the firm's current ratio, which is a firm's current assets divided by its current liabilities. If a firm finds itself having financial difficulties, it may be unable to pay its bills on time and the management might find itself having to extend the firm's bank credit. This may result in current liabilities rising faster than the firm's current assets, resulting in a fall in current ratio (Ross et al., 2002, p. 33). This may be a first sign of financial trouble. A negative aspect of this ratio is however that a firm can be in short-term financial distress, even when the current ratio exceeds one. This can occur when a firm's assets are difficult to liquidate. Also, firms in sectors with high turnover, such as food retailers, can afford to have ratios below one (Palepu et al., 2007, p. 212). Piotroski's (2002) definition incorporates the latter, so a firm with a ratio below one can still receive a score of one in the F_SCORE scale, if the firm's liquidity has improved compared to the previous year (Piotroski, 2002, p. 10).

***Change in Equity (EQ_OFFER)***

Whether a firm performs better or worse after having completed an equity issuance compared to firms who have not issued equity has been the subject of several studies. In order to maximise current shareholder value, a management should issue equity when they consider their stock to be overvalued, and vice versa. Empirical studies present the evidence that firms after a seasoned equity offer (SEO), on an average underperform non-issuing firms with 8 % per year during a five year period after the SEO (Loughran et al., 1995, p. 46). Firms with high book-to-market are considered to be priced low wherefore a management, subject to the above reasoning, should not issue new shares, as these will be issued at a too low price. Also, firms that repurchase shares have been found to produce abnormally high returns the two years subsequent to a share repurchase (Ikenberry et al., 1995, p. 206). Piotroski's method of rating firms using the change in equity, where non-issuing firms receive a positive signal, coincides with the result obtained in the above studies.

### 2.6.3 Operating Efficiency

Piotroski's two final signals measure the analysed companies' operation efficiency. These ratios are of importance due to the fact that they encompass the *Du Pont model.* First, operating efficiency, which is measured by profit margin, and secondly, asset use efficiency, which is measured by asset turnover ratio. A firm can therefore generate profitability by increasing its margins, and can lever the margins up by using operating liabilities and operating assets more effectively to generate sales (Penman, 2003, p. 360).

***Change in Gross Margin Ration (∆_MARGIN)***

The penultimate signal is an additional measurement of a company's management. A firm's current gross margin ratio gives evidence how a company's operating efficiency stands compared to other companies (Ganguin et al., 2005, p. 318). The gross margin is influenced by the price premium a firm's product or services commands in the marketplace, and the firm's efficiency regarding procurement and the production process (Palepu et al., 2007, p. 206). A high profit margin gives the management more flexibility in determining the firm's products or services. The use of operating margin as an analysis tool must, however, be used cautiously. An increase in new products and an increase in buyers will incur costs and will therefore lower a firm's operating margin. Therefore, a low operating margin may not reflect inefficiency, but the introduction of recent less high margin products or services (Ganguin et al., 2005, p. 318). Piotroski justifies the use of change in profit margin due to this ratio signalling improvement in factor costs, reduction in inventory costs or a rise in the price of firms' products. A positive change in profit margin adds measure of safety during tough economic times, which is especially relevant for financially distressed high book-to-market firms.

***Change in Asset Turnover Ratio (∆_TURN)***

Piotroski's final signal is the current year's asset turnover ratio. The asset turnover ratio uncovers the sales revenue per dollar of net operating assets put in place (Penman, 2003, p. 360). Since most companies invest a considerable amount of its resources in assets, this ratio enables an analyst to evaluate the effectiveness of firms' investment management (Palepu et al., 2007, p 208). Asset turnover and gross margin have a trade-off relationship. A firm can increase its asset turnover by reducing profit margins, and increased profit margins will generally reduce asset turnover. Piotroski argues that an increase in asset turnover ratio signifies greater productivity from the firm's asset base, which is something that can occur from an increase in sales or more efficient operations (Piotroski, 2002, p. 10).

## *2.7 Capital Asset Pricing Model and Beta*

As a further development of the F_SCORE model, this study will take into account beta and the Capital Asset Pricing Model (CAPM). The latter of these two prices the risk premiums that are part of the expecting return of an asset.

A major principle in investment finance state that an investor can decrease risk whilst investing in the stock market if the investor diversify his/her portfolio so that it contains more than one stock (Goetzmann et al., 2006). By doing this, an investor will reduce the standard deviation of return. However, the decline of the standard deviation when adding more shares into a portfolio becomes smaller as more shares are added into a portfolio. By diversifying, an investor will according with economic theory, only bear the risk that is non-diversifiable (Penman, p. 650, 2003).

CAPM acknowledges the fact that risk can be diversified and states that the only risk an investor has to bear is the risk of the market as a whole and by each investment's sensitivity to the market risk, which is the investment's beta. This risk factor can be considered to measure the covariance between a particular share's return and the return on the market as a whole. The latter is often measured by a market index. (Berk et al. 2007)

In the CAPM model, a single share's risk will be measured by its amount of risk (beta) that it adds to the market portfolio. As a result, shares that move a lot in relation to the movement of the market index will, according to CAPM, be considered to be more risky than a stock that moves little in relation to the market index (Damodaran, 1994).

The risk-return relationship can be graphically explained by the security market line (SML). Shares that are perfectly correlated with the market index will have a beta of 1, whilst more shares that are considered to be more risky will have a higher beta than 1. Conversely, shares with less risk than the market index will have a beta lower than 1, which also results in a smaller expected return (Arnold, p. 300, 2002). The difference between the stock's expected return and its required return according to SML is called the stock's alpha. The alpha value is zero, that is, all shares in the portfolio are on the SML, results in the market portfolio being efficient.

The CAPM model is however not a perfect model when analysing risk, as it bears several flaws. First, the method is based upon that investors have homogenous expectations, that investors can borrow and lend at a risk free rate, that all assets are marketable, that there are no restrictions on short sales, and finally, that there are no transaction costs. Second, the period of historical data over which beta should be calculated is not fully established. Third, Roll's (1977) critique of CAPM suggest that it is impossible to fully create a market portfolio, as a "true" market portfolio would include every investment in every market, including collectibles, commodities and basically everything with a marketable value. Finally, the CAPM model has been criticised for assuming that there is a single factor influencing the returns of shares. Several newer methods have been created, such as for example the Three-factor model created by Fama and French (1993).

Although the CAPM model has been criticised and that variants of the model have been developed where one or more of the assumptions put forward have been relaxed, financial economists still find the underlying qualitative intuition convincing, so it is still the most commonly used method of measuring risk (Berk et al. 2007). We are convinced that the original one-factor model will suffice in this study to show the relationship between the stocks generated in the F_SCORE model and their relationship to our market (OMX Sweden).

# 3. Methodology

*This chapter will explain the methodology used in this thesis. First, the section details the choice of shares, the data and sample selection, alongside size and the calculation of variables are presented. Second, each financial performance signal calculation, comprising the F_SCORE model, is stated. Third, the calculation of returns and how portfolios are formed is explained. The chapter ends with a presentation of the use of statistical methods.*

## *3.1 Choice of shares*

Piotroski's (2002) F_SCORE investment strategy is applied to the top 20% of value stocks on the entire US stock market every year from 1976 to 1996. Consequently, this paper considers the robustness of the aforementioned strategy by applying it to the top 20% of value stocks on, what is now the OMX Stockholm Stock Exchange (OMXS hereafter), every year between 1990 and 2007. Specifically, this time period is considered because data before 1990 related to several of Piotroski's (2002) signals is difficult to come by in Datastream, the main source of data for this paper.

The reasons for wanting to apply Piotroski's (2002) strategy to a portfolio of OMXS value stocks are twofold. Firstly, the F_SCORE strategy's applicability to value shares on the OMXS is interesting to consider because its market characteristics, related to size and activity, are drastically different to those of the entire US market. Should this paper observe tendencies on the OMXS similar to those in Piotroski's (2002) study despite these differences, then this would bolster the merits of the F_SCORE strategy and arguably provide interesting insight into the properties of value shares on the OMXS.

Secondly, it is with reference to the latter that this paper hopes to serve the Swedish investing public by attempting to provide greater market understanding.

## *3.2 Data Collection*

Our study uses secondary external data to form the basis for its analysis and conclusion, which implies that the data is collected and prepared by an external provider. Datastream provides the bulk of this data.

As previously mentioned, stocks included are or have been listed on OMXS from 1990 to 2007, on the Small, Medium and Large Cap lists. The overall number of firms obtained from Datastream and thereby listed on OMXS was 2518 initially. After allowing for the high book-to-market quintile cut-offs and manually clearing firms in spreadsheet software that have been de-listed (but that Datastream continues to list year after year), the study is left with 1041 1-year firm observations between 1990 and 2007.

Piotroski uses the market-to-book ratio to select companies, and this ratio is exported to Microsoft Excel (Excel hereafter) from DataStream in this study. The nine fundamental variables values, needed to calculate F_SCORE, have been obtained by performing a time-series request in Datastream. Beta values for each year, also needed in this analysis, were acquired using the static request function.

All data is processed and calculated in Excel and in order to avoid miscalculations, most data analysis stages and calculations are made automatically using Datastream or Excel functions. Steps that include calculations, which are not performed automatically by Datastream, Eviews or excel are described carefully throughout the data processing procedures. This is especially pertinent concerning the calculations made of each fundamental variable and the F_SCORE signals obtained from these calculations.

Obtaining a list of all listed companies on OMXS from 1990 to 2007 results in Datastream including companies that are not active. Such companies have i.e. been taken-over or gone into bankruptcy and have therefore been delisted. A company that has been delisted during 1990 to 2007 will display a constant BM ratio from its last date of activity until 2007. Due to F_SCORE model being based purely on active companies, it is necessary to erase the data that Datastream incorrectly has given shares after the date when they in reality have been delisted. Consequently, after the list has been erased from these non-active stocks, it will only consist of companies that have been active during the time period starting 1990 until a potential delisting. Datastream shows a company, which has been delisted and afterwards has re-entered the market, as two different stocks, removing any potential stock mix-ups caused by the delisting of firms.

### 3.3 Sample selection

Datastream does not provide the book-to-market ratio in its database. This ratio is therefore obtained by inverting the market-to-book ratio (MB)[5], which is a ratio provided by Datastream. The MB values are afterwards ranked and each year's highest BM quintile is singled out afterwards for the purpose of calculating F_SCORE of the firm for each year.

The nine fundamental signals used in the Piotroski (2002) model, described in section 2.6, are used by Piotroski to separate good companies from troubled firms. The data necessary to calculate these nine signals are once again derived from DataStream. Each of the nine signals are given a number of either 0 or 1 depending on how the data needed to calculate each signal has changed compared to the firms' previous financial statement or the prior fiscal year's value. The result of this is that firms aggregated F_SCORE will range from a maximum of 9, to a minimum of 0.

### 3.4 Size

Firm size is defined as a firm's market value of equity or market capitalisation (MV)[6]. Firms are grouped into thirds and categorized as small, medium and large firms based on their market value. Firms are grouped by size in order to examine whether there are any return differences amongst them, and if so, if a size effect is present concerning returns.

### 3.5 Calculations of variables

The next step in the process of obtaining an F_SCORE value is to calculate the nine fundamental criteria's on which the investment strategy is based. The data needed to compute these calculations are taken from Datastream. We use excel formulas to transform the data composing each signal into binary figures of either zero or one.

[5] Market-to-book (MTBV) is defined in Datastream as the market value of ordinary (common) equity divided by the balance sheet value of the ordinary (common) equity.

[6] Datastream defines MV as stock price multiplied by number of ordinary shares outstanding.

## *3.6 Financial performance signals*

### 3.6.1 Profitability

*ROA*

ROA values need no calculations as these are obtained directly from Datastream and the value is taken from each firm's last financial statement. Piotroski defines the signal so that a positive ROA value good signal rewarded a score of 1. Logically, a negative ROA value is rewarded a score of 0.

Δ_*ROA*

The calculation to acquire Δ_ROA is performed by dividing a firm's current year ROA by its prior year's ROA. Similarly to the definition of ROA, a positive change from prior year's ROA to current year's ROA is considered as a good signal, receiving a score of 1. A negative change of ROA is rewarded a score of 0.

*CFO*

Cash flow from operations, consisting of raw data, is obtained directly, needing no further calculations. Firms receive a score of 1 if cash flow from operations is positive, and otherwise a score of 0.

*ACCRUAL*

We calculate the accrual signal using a formula that calculates net income before extraordinary items less cash flow from operations divided by total assets. A result below zero is considered to be a good signal and is rewarded a score of 1. If accrual is positive, a score of 0 is rewarded.

### 3.6.2 Capital structure

Δ_*LEVER*

The Δ_LEVER signal is calculated using the following formula: current year's long-term debt scaled by average total assets (current year's assets plus last year's assets divided by two), less prior year's long-term debt scaled by average total assets. If the value obtained is negative, a score of 1 is rewarded, whilst a positive value is rewarded a 0.

Average total assets, used in the above formula, is calculated by adding the beginning and ending values for a year's average total assets. The result is thereafter divided by 2 as shown in the following calculation:

$$Average\ Total\ Assets = \frac{\textbf{Total Assets (t)} - \textbf{Total Assets(t} - \textbf{1)}}{\textbf{2}}$$

The beginning value for each year's total assets is computed by obtaining the prior year's total assets.

*Δ_LIQUID*

This signal is computed by current year's liquidity less the prior year's liquidity. If this ratio has positive (negative) change compared to the prior year's liquidity, it is considered to be a positive (negative) signal being rewarded a score of 1(0).

*EQ_OFFER*

Equity offer is estimated as the current fiscal year end's common shares less prior year end's common shares. This calculation is performed to see whether a firm has made an equity offer or has repurchased shares. Piotroski considers an equity offer is a "bad" signal and an increase in common shares receives a score of 0. A score of 1 is rewarded if no equity offer has been made.

### 3.6.3 Operating efficiency

*Δ_MARGIN*

This signal calculated by the taking current year net sales (t) less cost of goods sold (t) divided by net sales current year, less prior year's net sales (t-1) minus cost of goods sold (t-1) scaled by net sales prior year. A positive change in Δ_MARGIN reflects of a good signal and is rewarded a score of (1) and a negative change is rewarded a score of 0.

*Δ_TURN*

Change in turnover is derived from current year's net sales scaled by the current average total assets, less the prior year's net sales scaled by the prior year's average total assets. Average total assets are calculated as described under Δ_LEVER. A positive (negative) change is rewarded a 1 (0) score.

The aggregated F_SCORE is the sum of the individual binary signals and each firm will, using the equation below, receive a score between 0 and 9.

F_SCORE = F_ROA+ F_ΔROA + F_CFO + F_ACCRUAL + F_ΔMARGIN
+ F_ΔTURN + F_ΔLEVER + F_ΔLIQUID + EQ_OFFER.

## *3.7 Calculation of returns*

We measure the returns as one-year buy-and-hold returns earned from the beginning of the fifth month after the firm's fiscal year-end. The decision to measure returns at the beginning of the fifth month has been taken because it is essential that investors have the ability to obtain important annual information prior to the creation of their portfolios. For compounding returns we obtain buy-and-hold data from Datastream. Unadjusted prices (UP) are used, which means that historical information has not been accustomed for rights issues and bonuses. $R_i$ (one-year return) is constructed using an annualised dividend yield, as follows:

Equation 1: $$R_i = \frac{(P_t - P_{t-1})}{P_{t-1}}$$

The one-year market-adjusted returns are calculated on the same principals as raw returns. Our market returns are obtained from Datastream, using monthly returns for each year. Thus, our market returns considers the market return of OMXS as a value-weighted index.

Equation 2: $$R_{it-mt} = \frac{(P_t - P_{t-1})}{P_{t-1}} - R_{mt}$$

Two-year raw returns and two-year buy-and-holds ($R_{2i}$) are calculate as the return of current year's unadjusted prices less the 2 year's prior prices (UP), scaled by the two-year's prior prices (UP), as described in the following equation:

Equation 3: $$R_{2i} = \frac{(P_t - P_{t-2})}{P_{t-2}}$$

For the two-year buy-and-hold ($R_{2it-2mt}$), we compute the market return of OMXS as the percentage change of current prices and the two-year historical prices. Thus, the market-adjusted return is two-year return of stock prices less two-year market return of OMXS, as described in the equation below:

Equation 4: $$R_{2it-2mt} = \frac{(P_t - P_{t-2})}{P_{t-2}} - R_{2mt}$$

The two-year buy-and-hold limits the time span of our study, due to investors are creating their portfolios based on e.g. 2008 annual report for 2009. Thus, a portfolio created in 2009 will be held until 2011. The last figures in our two-year buy-and-hold portfolios will therefore be based from annual reports from 2006.

The actual return of portfolios are calculated by each individual return multiplied by the number of firms in the portfolio and are subsequently summarised all together with the following equation:

Equation 5: $$R_{portfolio} = \frac{1}{n} * r_1 + \frac{1}{n} * r_2 + \ldots \frac{1}{n} * r_n$$

$r_n$ is in our observations defined as a firm's individual return. Consequently, *n* is the number of firms in each portfolio-formation.

Piotroski (2002) defines the market-adjusted return as the observed raw return of a security less the market return of a value weighted index. As an additional variable to Piotroski's (2002) study, this study includes CAPM calculations, as a means to observe a more correct stock returns, as each share is given an individual, specific beta value by using CAPM. This study will, however, analogous to Piotroski's study, also include raw returns and a value-weighted index (OMXS). We compute the alpha for the individual companies to observe if our value firms have excess return due to a beta effect. The expected alphas are calculated by holding the risk-free yield, SSVX 12 month period (Sweden's Central Bank, 2009-05-17). The yield begins at the same time as each the portfolio formation. Beta values are obtained using Datastream and our market return is the return of the OMXS. The expected return of the firm is computed through the risk-free yield after which the beta value is multiplied with the market risk-premium, following the equation below (Jensen, 1967):

Equation 6: $$E(r_i) = r_f + \beta_i^{Mkt}(E[R_{Mkt}] - r_f)$$

Further, the linear regression below will estimate an expected return where alpha is the observed return by the firm less the expected return calculated from CAPM:

Equation 7: $$\alpha = r_i - [r_f + \beta_i^{Mkt}(E[R_{Mkt}] - r_f)]$$

This return will below be referred to as a risk-adjusted return, due to the calculation of the beta effect for all firms, wherefore risk compensation is incorporated in the market return. This way of calculating excess returns will, hopefully, give extra explanation factors for the above market returns often obtained by holding value firms in a portfolio. Alpha will, in our analysis, examine the return performance of a firm relative to the security market line (SML). Thus, if the alpha-value is positive, we should observe a higher return than the SML, and consequently, an excess return compared to the market. The risk-adjusted return for two-year buy-and-hold portfolios are calculated as the average market returns of *t* and *(t-1)* and the average risk-free yield at time *t* and *(t-1) respectively* (Berk et al., 2007).

Equation 8: $$\alpha_{2y} = r_{i2Y} - [r_{f2Y} + \beta_i^{Mkt}(E[R_{Mkt2Y}] - r_{f2Y})]$$

## *3.8 Portfolio Formation*

After determining each year's F_SCORE firms, all observations during the time period from 1990 to 2007 are ranked jointly into a descending portfolio from 9 to 0. Piotroski's study examines if there is significant difference between high and low fundamental scores of individual firms. In preparation of such tests, we create single out high and low F_SCORE portfolios of 8 and 9, and 0 and 1 respectively, sorting these into individual columns.
The size effect is also taken into consideration wherefore all firms are divided into three equal portfolios based on the firms' market value of equity. Each of these portfolios will after this division contain 347 companies defined as large, medium or small firms.

Additionally we examine the yearly market- and risk-adjusted return for one-year buy-and-hold. This portfolio consists of strong F_SCORE firms (F_SCORE of 5 and higher) and weak F_SCORE firms (F_SCORE of 4 and lower). Furthermore, average return for all years is calculated and the average return difference between the yearly strong and weak returns. Hereby can a differentiation for years with high and low returns be made.

### *3.9 Statistical Tests*

One of the main purposes of this study is to test whether there differences between the returns of high F_SCORE firms and low F_SCORE firms. This purpose requires that such differences are statistically significant and therefore enabling a general investment strategy to be created. The intention is therefore to test how different portfolios may alter returns by size formations and categorisations into various F_SCORE configurations.

In order to examine the ordinal scale properly (as a part of this study's values), a Spearman correlation test is performed. The Spearman correlation test evaluates the dependency degree between the nine fundamental signals returns and the aggregated fundamental signal. This is important because it creates an opportunity to observe how the nine signals are correlated to each other (Körner, 2006).

Obtained results may have a broad/narrow standard deviation, wherefore the 10th, 25th, 75th, the 90th percentile return and median return are observed. The mean return is dependent of outliers wherefore such an outcome might not be representative of the data in general. The majority of the statistical tests in this study will therefore observe percentiles in order to present a correct picture of our data.

One of the complications with the risk-adjusted return and the capital asset pricing model in this study is the simplicity that risk, given by beta, is the only dependent factor for the security's return. The purpose with our multiple regression model is, however, to find some relation between the dependent variable and independent variables (Barreto et al 2006).

The regression model is well fitted if the underlying assumption about the central limit theorem is accurate. If a large number of data is available, it may take a standard normal distribution and as the dataset increases, it will apt towards a nearer normal distribution (Körner et al, p 112, 2006). This study will use the least-square (LS) for maximizing the estimated equation to our observed values. It means that the sum of all squares of the regression line is optimised.

After determining the estimated regression, Eviews will assist in testing the estimated equation with a hypothesis. This hypothesis determines if there is a statistical significance and if it is separated from null. When performing a hypothesis test, we rely on normal standard distribution of our sampling. The hypothesis test consists of one null- and a counter-hypothesis. The first one decides that there is no relation between the variables and the other the contrary result.

| | | |
|---|---|---|
| E.g. | Null hypothesis: | $H_0$: $\beta_1 = 0$ |
| | The alternative hypothesis: | $H_1$: $\beta_1 \neq 0$ |

Our hypothesis will be analysed through Eviews which will generate a t-test of the achieved significance level of the dataset. This significance level will either accept or reject the hypothesis at a 99, 95 and 90 percent confidence interval. Hence, if there is statistical significance, the null hypothesis is rejected if the p-value is lower than 0,01, 0,05 and 0,10. Since the heteroskedasticity can have significant impact on the least-square method a White Heteroskedasticity Consistent Standard Errors & Covariance is performed. (Barreto et al, 2006; Gujarati, 2003)

## *3.10 Evaluation of Sources*

If the research had no validity or reliability, science would not be trusted. In order to strive for valid results, which are also reliable, this thesis needs strong theoretical references and boundaries.

### 3.10.1 Validity

The validity can be stated as the correlation between the theoretical definition and the operational definition. The operational definition is the specification of how data should be collected and how it should be interpreted. The danger lies if a subjective element is incorporated into the analysis. Due to the whole study being based on quantitative data, results in a small space for subjective distortions. This results that our study should be considered to be of high validity.

### 3.10.2 Reliability

Furthermore, reliability is essentially about the quality being dependable. This means that the tests and measuring instruments ought to be replicable whether to determine the same results (inter-rater reliability) and regardless of how the tests are carried out (Halvorsen 1992). We are of the opinion that our thesis has a high amount of reliability. Data has been collected using Datastream and the Swedish Central Bank. Due to these sources being independent, enables researchers to replicate our study, which is important for a study to be considered to have a high amount of reliability (Bryman et al., 2005). We have, in order to increase reliability, also conducted spot tests of the data obtained from Datastream, where no data inaccuracies have appeared.

To achieve inter-rater reliability we will on a continually basis be self critical about our results, together with previous research in this field. We will in addition attempt to avoid as many manual-processing steps whilst measuring data, and have thoroughly reviewed all data several times, to minimize errors of human factor character and increase the reliability of our results.

# 4. Empirical Results

*This chapter presents our collected empirical results. The results are to a large extent, presented using tables alongside explanatory text. Finally, the results from completed statistical tests are presented and reviewed.*

## *4.1 Descriptive statistics*

Table 1 contains information related to the basic characteristics of the high book-to-market firm portfolio. Panel A exhibits the general values (mean, median, standard deviation and the positive proportion of each binary signal) of each of the individual financial signals attributed to 1041 1-year firm observations and incorporated in this study for the 1990-2007 timeframe.

**Table 1: Financial and return Characteristics of High Book-to-Market Firms**
***(1041 firm-year observations between 1990 and 2007)***

**Panel A: Financial Characteristics**

| **Variable** | **Mean** | **Median** | **Standard Deviation** | **Proportion with Positive signal** |
|---|---|---|---|---|
| **MVE**[1] | 3179 | 370 | 9768 | n/a |
| **BM** | 3,196 | 1,250 | 9,846 | n/a |
| **ROA** | 3,947 | 4,720 | 14,109 | 0,539 |
| **ΔROA** | 2,879 | 0,270 | 17,154 | 0,572 |
| **CFO**[2] | 227522 | 24229 | 8461352 | 0,572 |
| **ACCRUAL** | 0,129 | -0,006 | 4,520 | 0,451 |
| **ΔLEVER** | 0,018 | 0,000 | 0,163 | 0,405 |
| **ΔLIQUID** | 0,063 | 0,000 | 1,507 | 0,253 |
| **ΔMARGIN** | 0,042 | 0,000 | 5,499 | 0,447 |
| **ΔTURN** | 0,087 | 0,003 | 0,509 | 0,525 |

[1] MVE in Million SEK

[2] CFO in SEK

We note that the average and median firms in the highest book-to-market quintile of all firms displays a mean and median of 3,196 and 1,250 respectfully. Furthermore, the sizeable spread between mean (3179) and median (370) values for MVE indicates that there are some value firms in the sample with large market capitalisations that raise the mean. In contrast to the findings related to samples in studies by Piotroski (2002) and Fama and French (1995), we retain positive values for gross margin, with a mean of 0,042 and median of 0, and ROA with a mean (median) of 3,947 (4,720). Interestingly, however, while Piotroski (2002) retains a negative mean (median) value for ROA, 63.2% of his sample for this signal actually exhibits a positive value, in contrast to this paper's ROA signal, the positive proportion of which is only 53.9%. This makes sense as the median is superior to the mean for ROA in our study. We also see a slight increase in leverage 0,018 (0) and liquidity 0,063 (0) in comparison to Piotroski (2002).

**Panel B: Buy-and-Hold Returns from a High Book-to-Market Investment Strategy**

| Returns | Mean | 10th Percentile | 25th Percentile | Median | 75th Percentile | 90th Percentile | n | % Posi-tive |
|---|---|---|---|---|---|---|---|---|
| ***One-year returns*** | | | | | | | | |
| Raw | 0,379 | -0,492 | -0,230 | 0 | 0,350 | 0,843 | 1 041 | 0,4947 |
| Market-Adj. | 0,292 | -0,571 | -0,290 | -0,029 | 0,262 | 0,691 | 1 041 | 0,4859 |
| Risk-Adj. | 0,302 | -0,525 | -0,291 | -0,019 | 0,250 | 0,704 | 1 041 | 0,4688 |
| ***Two-year returns*** | | | | | | | | |
| Raw | 0,400 | -0,383 | -0,155 | 0 | 0,381 | 1,056 | 955 | 0,4723 |
| Market-Adj. | 0,168 | -0,865 | -0,513 | -0,075 | 0,346 | 0,749 | 955 | 0,4669 |
| Risk-Adj. | 0,189 | -0,317 | -0,036 | 0,171 | 0,467 | 0,670 | 955 | 0,6576 |

Panel B presents our raw, market-adjusted and risk-adjusted value portfolio returns for both a one-year and two-year buy-and-hold investment strategy. Furthermore, and in contrast to Piotroski (2002), we evaluate the risk-adjusted return of a one- and two-year buy-and-hold. All measures display positive returns. One-year raw returns exhibit a mean (median) of 0,379 (0) with a proportion of 49.47% earning a positive result. A two-year buy-and-hold with the raw returns sees an increase to 0,400 (0) in mean (median) and a drop in proportion of stock earning a positive result of 48.59%. Piotroski (2002) documents similar movement. Importantly, the two year buy-and-hold strategy earns returns between 1990 and 2006, and as such only 955 1-year firm observations exist because the investment strategy for 2006 begins with investing in the 5th month of 2007, with an investment span for the 5th month of 2009, the last month for which data was not available via Datastream when we began our study in April of 2009.

Overall, Table 1 portrays fairly extreme mean values for some signals and as such, the median results are likely to be more representative of the typical high book-to-market firm. One such 'misrepresentation' can be observed in the CFO signal, which exhibits a relatively high standard deviation. The standard deviation in combination with the difference between mean and median can is indicative of a wide spread in the distribution.

### *4.2 Relationship between variables*

Table 2 presents the correlation between all separate fundamental signals, the aggregate F_SCORE, and the market- and risk-adjusted buy-and-hold one- and two-year returns. The table shows that F_SCORE maintains positive correlation with both 1 and 2 year risk-adjusted returns, in addition to the one-year market-adjusted return. Notably, ΔMARGIN exhibits positive correlation with F_SCORE and negative correlations (-0,027) (-0,087) with market-adjusted returns.

**Table 2: Spearman Correlation Analysis between One- and Two-Year Market Adjusted Returns, the Nine Fundamental Signals, and the Composite Signal (F_SCORE) for high Book-to-Market Firms**

| | ROA | ΔROA | CFO | ACCRUAL | ΔLIQUID | ΔLEVER | EQ_OFFER | ΔMARGIN | ΔTURN | F_SCORE |
|---|---|---|---|---|---|---|---|---|---|---|
| **MAR_1** | -0,036 | 0,048 | 0,139 | 0,101 | -0,006 | -0,003 | 0,081 | -0,027 | 0,023 | 0,096 |
| **MAR_2** | -0,057 | -0,080 | 0,085 | 0,011 | -0,032 | -0,064 | 0,062 | -0,087 | -0,019 | -0,050 |
| **RAR_1** | -0,036 | 0,056 | 0,134 | 0,092 | -0,003 | 0,003 | 0,066 | -0,018 | 0,029 | 0,096 |
| **RAR_2** | -0,061 | 0,025 | -0,137 | 0,035 | 0,005 | 0,042 | 0,058 | 0,079 | 0,134 | 0,058 |
| **ROA** | 1,000 | 0,220 | 0,205 | -0,285 | 0,014 | 0,091 | -0,327 | 0,123 | 0,072 | 0,277 |
| **ΔROA** | - | 1,000 | 0,046 | -0,137 | 0,012 | 0,153 | -0,240 | 0,299 | 0,202 | 0,455 |
| **CFO** | - | - | 1,000 | 0,323 | -0,035 | -0,094 | -0,021 | 0,056 | 0,009 | 0,429 |
| **ACCRUAL** | - | - | - | 1,000 | 0,055 | -0,046 | 0,352 | 0,005 | 0,021 | 0,381 |
| **ΔLIQUID** | - | - | - | - | 1,000 | 0,067 | 0,053 | 0,079 | 0,015 | 0,371 |
| **ΔLEVER** | - | - | - | - | - | 1,000 | -0,142 | 0,160 | 0,022 | 0,353 |
| **EQ_OFFER** | - | - | - | - | - | - | 1,000 | -0,087 | -0,003 | 0,136 |
| **ΔMARGIN** | - | - | - | - | - | - | - | 1,000 | 0,124 | 0,521 |
| **ΔTURN** | - | - | - | - | - | - | - | - | 1,000 | 0,433 |

**Note:** Indicator variables are represented by the 9 individual binary signals in this table, and attribute a score of 0 or 1 depending on whether the underlying performance measure is bad or good with regards to future firm performance. MAR_1 and MAR_2 are the 1 and 2 year buy-and-hold market-adjusted returns beginning 5 months after fiscal year-end, held over the respective period, not forgetting to subtract the matching value-weighted market return. RAR_1 and RAR_2 signify the risk-adjusted returns for the 1and 2 year buy-and-hold.

## Table 3: Buy-and-hold Returns to a Value Investment Strategy Based on Fundamental Signals

The panels within Table 3 present the distribution of returns relative to the strategies of investing in the entire top quintile high book-to-market portfolio, the high and low F_SCORE portfolios, and the separate F_SCORE firms. F_SCORE is equal to the following:

F_SCORE = F_ROA+ F_ΔROA + F_CFO + F_ACCRUAL + F_ΔMARGIN
+ F_ΔTURN + F_ΔLEVER + F_ΔLIQUID + EQ_OFFER.

**Panel 3A** displays the aggregate high (low) F_SCORE portfolio. A 1-year firm observation that earns an F_SCORE of 0 (9) "… means the firm possesses the least (most) favourable set of financial signals" (Piotroski, 2002, p.16) Most of the 1-year firm observations accumulate an F_SCORE value of between 3 and 6, much like Piotroski (2002). F_SCORE 5 contains most if of these, with a total of 247 1-year firm observations between 1990 and 2007. The low score and high score portfolios contain 38 and 44 observations respectively. In proportion to the entire sample of value firms, these observations are noticeably different to those documented by Piotroski (2002). His high (low) F_SCORE portfolio represents 10,3% (2,8%) of his entire sample of 14043 firms, whereas this paper has a high (low) F_SCORE portfolio equal to 4,2 % (3,6%) of its entire sample.

### Panel 3A: One-Year Market-Adjusted Returns[1]

| Variable | Mean | $10^{th}$ | $25^{th}$ | Median | 75th | 90th | n |
|---|---|---|---|---|---|---|---|
| **All Firms** | 0,292 | -0,571 | -0,290 | -0,029 | 0,262 | 0,691 | 1041 |
| **F_SCORE** | | | | | | | |
| 0 | -0,018 | -0,213 | -0,213 | -0,106 | 0,264 | 0,264 | 3 |
| 1 | -0,099 | -0,680 | -0,345 | -0,080 | 0,153 | 0,434 | 35 |
| 2 | 0,461 | -0,571 | -0,352 | -0,077 | 0,303 | 0,956 | 79 |
| 3 | -0,046 | -0,591 | -0,358 | -0,092 | 0,195 | 0,461 | 165 |
| 4 | 0,570 | -0,549 | -0,268 | -0,034 | 0,232 | 0,645 | 226 |
| 5 | 0,216 | -0,585 | -0,288 | -0,004 | 0,250 | 0,679 | 247 |
| 6 | 0,279 | -0,571 | -0,277 | 0,016 | 0,326 | 0,799 | 169 |
| 7 | 0,629 | -0,551 | -0,264 | 0,022 | 0,478 | 1,307 | 73 |
| 8 | 0,106 | -0,609 | -0,162 | 0,042 | 0,376 | 0,762 | 41 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | -0,270 | -1,103 | -1,103 | 0,132 | 0,161 | 0,161 | 3 |
| | | | | | | | |
| **Low Score (0s, 1s)** | -0,093 | -0,654 | -0,327 | -0,082 | 0,156 | 0,357 | 38 |
| **High Score (8s, 9s)** | 0,081 | -0,670 | -0,181 | 0,052 | 0,372 | 0,753 | 44 |
| **High-All** | -0,211 | -0,100 | 0,109 | 0,081 | 0,110 | 0,061 | - |
| **P(T<=t) two-tail** | 0,105 | | | (0,000) | | | |
| **t Critical** | 1,970 | | | | | | |
| **High-Low** | 0,174 | -0,017 | 0,147 | 0,134 | 0,216 | 0,396 | - |
| **P(T<=t) two-tail** | 0,107 | | | (0,000) | | | |
| **t Critical** | 1,990 | | | | | | |

The results in Panel 3A shows that a value investment strategy based on the entire OMXS quintile of high book-to-market firms earns a 1-year market adjusted mean return of 0,292. In contrast, Piotroski's (2002) top quintile value portfolio earns a mean return 0,059. Subsequently a High-Low investment strategy, where one buys high score (winners) and shorts low score (losers) firms, earns a mean return of 0,174 in contrast to the mean return of the entire sample, which averages out to 0,302.

At a statistical significance level of 90%, this study can not differentiate between the returns yielded by a high F_SCORE strategy and other strategies in the table.

**Panel 3B** presents the risk-adjusted returns to a one-year buy-and-hold for the quintile portfolio, the nine fundamental signals, and the high and low portfolios. In comparison to Panel 3A, Panel 3B exhibits a higher mean return of 0,302 for the entire firm sample.

**Panel 3B: One-Year Risk-Adjusted Returns[2]**

| Variable | Mean | 10th | 25th | Median | 75th | 90th | N |
|---|---|---|---|---|---|---|---|
| **All Firms** | 0,302 | -0,525 | -0,291 | -0,019 | 0,250 | 0,704 | 1 041 |
| **F_SCORE** | | | | | | | |
| 0 | -0,016 | -0,293 | -0,293 | 0,008 | 0,238 | 0,238 | 3 |
| 1 | -0,100 | -0,699 | -0,412 | -0,090 | 0,180 | 0,373 | 35 |
| 2 | 0,471 | -0,536 | -0,314 | -0,076 | 0,309 | 1,033 | 79 |
| 3 | -0,024 | -0,550 | -0,320 | -0,064 | 0,168 | 0,511 | 165 |
| 4 | 0,592 | -0,472 | -0,226 | -0,019 | 0,225 | 0,635 | 226 |
| 5 | 0,212 | -0,522 | -0,306 | -0,015 | 0,240 | 0,668 | 247 |
| 6 | 0,295 | -0,525 | -0,231 | 0,011 | 0,339 | 0,828 | 169 |
| 7 | 0,628 | -0,496 | -0,302 | 0,036 | 0,424 | 1,425 | 73 |
| 8 | 0,091 | -0,555 | -0,203 | 0,035 | 0,308 | 0,714 | 41 |
| 9 | -0,182 | -0,789 | -0,789 | 0,108 | 0,137 | 0,137 | 3 |
| | | | | | | | |
| **Low Score (0s, 1s)** | -0,093 | -0,664 | -0,399 | -0,055 | 0,184 | 0,347 | 38 |
| **High Score (8s, 9s)** | 0,072 | -0,608 | -0,214 | 0,043 | 0,278 | 0,708 | 44 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **High-All** | -0,230 | -0,084 | 0,077 | 0,063 | 0,029 | 0,004 | - |
| **P(T<=t) two-tail** | 0,067 | | | (0,000) | | | |
| **t Critical two-tail** | 1,968 | | | | | | |
| **High-Low** | 0,165 | 0,056 | 0,185 | 0,099 | 0,095 | 0,361 | - |
| **P(T<=t) two-tail** | 0,112 | | | (0,000) | | | |
| **t Critical two-tail** | 1,990 | | | | | | |

The high (low) F_SCORE exhibits a mean 1-year risk adjusted return of 0,072 (-0,093). In addition, the median returns for the High-All and High-Low strategies are slightly lower in comparison to those exhibited in panel, 3A due to the beta of 0,728 attributed to the high F_SCORE firms, which reduces high F_SCORE returns.

**Panel 3C** shows raw returns to a 1-year buy-and-hold strategy. The quintile portfolio of high book-to-market firms exhibits a mean raw return of 0,379.

**Panel 3C: One-Year Raw Returns**[3]

| | Mean | 10% | 25% | Median | 75% | 90% | N |
|---|---|---|---|---|---|---|---|
| **All Firms** | 0,379 | -0,492 | -0,230 | 0,000 | 0,350 | 0,843 | 1041 |
| **Low Score** | 0,014 | -0,605 | -0,273 | -0,004 | 0,232 | 0,555 | 38 |
| **High Score** | 0,173 | -0,549 | -0,080 | 0,186 | 0,460 | 0,713 | 44 |
| **High- All** | -0,206 | -0,056 | 0,150 | 0,186 | 0,111 | -0,130 | - |
| **P(T<=t) two-tail** | 0,105 | | | | | | |
| **t Critical two-tail** | 1,969 | | | | | | |
| **High- Low** | 0,160 | 0,057 | 0,193 | 0,190 | 0,228 | 0,158 | - |
| **P(T<=t) two-tail** | 0,150 | | | | | | |
| **t Critical two-tail** | 1,990 | | | | | | |

**Panel 3D** displays the 2-year market-adjusted mean returns for the same strategies in 3A. These mean returns are lower than those retained from a 1-year buy-and-hold market-adjusted strategy. However, the 2-year buy-and-hold returns still exceed those averaged by the market.

**Panel 3D: Two-Year Buy-and-Hold Market-Adjusted Returns**[4]

| Variable | Mean | 10th | $25^{th}$ | Median | 75th | 90th | n |
|---|---|---|---|---|---|---|---|
| **All Firms** | 0,168 | -0,865 | -0,513 | -0,075 | 0,346 | 0,749 | 955 |
| **F_SCORE** | | | | | | | |
| 0 | 27,683 | -0,261 | -0,261 | 0,006 | 83,303 | 83,303 | 3 |
| 1 | 0,275 | -0,745 | -0,440 | 0,063 | 0,645 | 2,120 | 33 |
| 2 | 0,460 | -0,909 | -0,451 | 0,022 | 0,374 | 0,915 | 74 |
| 3 | 0,237 | -0,770 | -0,513 | -0,021 | 0,328 | 0,984 | 151 |
| 4 | 0,102 | -0,905 | -0,504 | -0,075 | 0,337 | 0,723 | 211 |
| 5 | -0,024 | -0,848 | -0,516 | -0,074 | 0,359 | 0,800 | 227 |
| 6 | -0,042 | -0,915 | -0,534 | -0,139 | 0,308 | 0,757 | 152 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | -0,092 | -0,911 | -0,693 | -0,037 | 0,402 | 0,736 | 64 |
| 8 | -0,129 | -0,844 | -0,566 | -0,194 | 0,336 | 0,469 | 37 |
| 9 | -0,007 | -0,194 | -0,194 | 0,074 | 0,098 | 0,098 | 3 |
| | | | | | | | |
| **Low Score** | 2,559 | -0,736 | -0,428 | 0,061 | 0,649 | 2,461 | 36 |
| **High Score** | -0,120 | -0,827 | -0,554 | -0,184 | 0,319 | 0,404 | 40 |
| **High- All** | -0,288 | 0,038 | -0,041 | -0,109 | -0,027 | -0,346 | - |
| **P(T<=t) two-tail** | 0,093 | | | (0,000) | | | |
| **t Critical two-tail** | 1,970 | | | | | | |
| **High- Low** | -2,679 | -0,091 | -0,126 | -0,245 | -0,330 | -2,058 | - |
| **P(T<=t) two-tail** | 0,255 | | | (0,000) | | | |
| **t Critical two-tail** | 2,030 | | | | | | |

**Panel 3E: Two-Year Buy-and-Hold Risk-Adjusted Returns[5]**

| Variable | Mean | 10th | 25th | Median | 75th | 90th | N |
|---|---|---|---|---|---|---|---|
| **All Firms** | 0,189 | -0,317 | -0,036 | 0,171 | 0,467 | 0,670 | 955 |
| **F_SCORE** | | | | | | | |
| 0 | -0,001 | -0,005 | -0,005 | -0,003 | 0,005 | 0,005 | 3 |
| 1 | 0,227 | -0,173 | 0,014 | 0,203 | 0,434 | 0,690 | 33 |
| 2 | 0,118 | -0,361 | -0,040 | 0,040 | 0,332 | 0,547 | 74 |
| 3 | 0,175 | -0,420 | -0,026 | 0,171 | 0,454 | 0,629 | 151 |
| 4 | 0,170 | -0,259 | -0,026 | 0,130 | 0,449 | 0,601 | 211 |
| 5 | 0,195 | -0,366 | -0,054 | 0,199 | 0,484 | 0,779 | 227 |
| 6 | 0,216 | -0,291 | -0,025 | 0,227 | 0,467 | 0,676 | 152 |
| 7 | 0,253 | -0,477 | -0,082 | 0,272 | 0,607 | 0,815 | 64 |
| 8 | 0,202 | -0,350 | -0,154 | 0,161 | 0,521 | 0,811 | 37 |
| 9 | 0,408 | 0,124 | 0,124 | 0,550 | 0,550 | 0,550 | 3 |
| | | | | | | | |
| **Low Score** | 0,208 | -0,130 | 0,006 | 0,142 | 0,416 | 0,645 | 36 |
| **High Score** | 0,217 | -0,332 | -0,150 | 0,179 | 0,543 | 0,788 | 40 |
| **High- All** | 0,028 | -0,015 | -0,114 | 0,007 | 0,076 | 0,118 | - |
| **P(T<=t) two-tail** | 0,686 | | | (0,000) | | | |
| **t Critical two-tail** | 2,018 | | | | | | |
| **High- Low** | 0,009 | -0,201 | -0,156 | 0,036 | 0,127 | 0,142 | - |
| **P(T<=t) two-tail** | 0,915 | | | (0,000) | | | |
| **t Critical two-tail** | 1,995 | | | | | | |

[1] One-year market-adjusted return is the security's 12 month return less the value-weighted index market return of OMXS over the same period, beginning at the 5th month after fiscal year-end.
[2] See Chapter 4.7 (Equation 7) for explanation.
[3] "One-year raw return is the 12-month buy-and-hold return of the firm, starting at the beginning of the fifth month after fiscal-year end" (Piotroski, 2002, p.17).
[4] The two-year market-adjusted return is calculated as the 2 year return less the value-weighted index market return of OMXS over the same period, beginning at the 5th month after fiscal year-end.
[5] See Chapter 4.8 (Equation 8) for explanation.

*T and P-values have been used to determine the significance of statistical tests. P--values show a significance level at 10%, 5%, 1% and are marked with *, **, *** separately.*

### *4.3 Returns conditional on firm size*

Previous studies have shown the firms with a small market capitalization retain excess returns to those averaged by the market. **Table 4A** and **4B** assess whether the returns in the paper's sample can be attributed to the size effect. The tables divide the top quintile of value firms into 3 equal groups labelled as small, medium, and large firms.

**Table 4A: One-Year Risk-Adjusted Buy-and-Hold Returns to a Value Investment Strategy Based on Fundamental Signals by Size Partition**

| | **Small Firms** | | | **Medium Firms** | | | **Large Firms** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Median** | **N** | **Mean** | **Median** | **n** | **Mean** | **Median** | **N** |
| **All** | 0,753 | -0,033 | 347 | 0,086 | -0,021 | 347 | 0,051 | -0,019 | 347 |
| **F_SCORE** | | | | | | | | | |
| 9 | - | - | - | - | - | - | -0,182 | 0,108 | 3 |
| 8 | -0,022 | -0,188 | 6 | 0,257 | -0,081 | 22 | 0,413 | 0,253 | 14 |
| 7 | 1,919 | 0,015 | 20 | 0,302 | 0,168 | 29 | 0,194 | -0,095 | 25 |
| 6 | 0,444 | 0,178 | 56 | 0,348 | 0,068 | 59 | 0,165 | -0,051 | 55 |
| 5 | 0,704 | -0,005 | 76 | 0,054 | -0,037 | 81 | 0,004 | -0,025 | 91 |
| 4 | 1,412 | -0,044 | 88 | 0,203 | 0,078 | 67 | -0,034 | -0,029 | 72 |
| 3 | 0,007 | -0,176 | 60 | -0,014 | -0,083 | 52 | -0,024 | -0,008 | 54 |
| 2 | 0,852 | -0,229 | 26 | 0,458 | -0,024 | 30 | 0,115 | -0,095 | 24 |
| 1 | -0,173 | -0,297 | 12 | 0,001 | -0,009 | 15 | -0,097 | -0,010 | 9 |
| 0 | -0,016 | 0,008 | 3 | - | - | - | - | - | - |
| **Low Score** | -0,141 | -0,217 | 15 | -0,070 | -0,044 | 14 | -0,097 | -0,010 | 9 |
| **High Score** | -0,022 | -0,188 | 6 | -0,112 | -0,094 | 21 | 0,308 | 0,230 | 17 |
| **High – All** | -0,775 | -0,155 | - | -0,198 | -0,073 | - | 0,257 | 0,250 | - |
| P(T<=t) two-tail | 0,051* | | | 0,062* | | | 0,063* | | |
| t Critical two-tail | 2,045* | | | 2,023* | | | 2,086* | | |
| **High – Low** | 0,119 | 0,029 | - | -0,041 | -0,049 | - | 0,405 | 0,241 | - |
| P(T<=t) two-tail | 0,672 | | | 0,737 | | | 0,038* | | |
| t Critical two-tail | 2,365* | | | 2,064* | | | 2,086* | | |

*T and P-values have been used to determine the significance of statistical tests. P--values show a significance level at 10%, 5%, 1% and are marked with *, **, *** separately.*

We observe high returns for nearly all 1-year firm observations in every category and surprisingly that the median is less than zero in nearly all categories. Notably in Table 4A, F_SCORE 4 exhibits 88 small firm 1-year observations with a mean (median) return of 1,412 (-0,044). F_SCORE 7 retains 20 small firm 1-year observations with a mean (median) return of 1,919 (0,015).

**Table 4B: One-Year Market-Adjusted Buy-and-Hold Returns to a Value Investment Strategy Based on Fundamental Signals by Size Partition**

| | **Small Firms** | | | **Medium Firms** | | | **Large Firms** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Median** | **n** | **Mean** | **Median** | **N** | **Mean** | **Median** | **N** |
| **All** | 0,742 | -0,058 | 347 | 0,102 | -0,007 | 347 | 0,049 | -0,025 | 347 |
| **F_SCORE** | | | | | | | | | |
| 9 | - | - | - | - | - | - | -0,270 | 0,132 | 3 |
| 8 | 0,067 | -0,093 | 6 | 0,277 | 0,005 | 22 | 0,451 | 0,293 | 14 |
| 7 | 1,903 | 0,042 | 20 | 0,332 | 0,119 | 29 | 0,245 | -0,080 | 25 |
| 6 | 0,387 | 0,016 | 56 | 0,370 | 0,043 | 59 | 0,198 | -0,084 | 55 |
| 5 | 0,722 | -0,003 | 76 | 0,041 | -0,015 | 81 | -0,010 | 0,058 | 91 |
| 4 | 1,401 | -0,056 | 88 | 0,237 | 0,065 | 67 | -0,055 | -0,037 | 72 |
| 3 | -0,025 | -0,163 | 60 | -0,001 | -0,058 | 52 | -0,042 | -0,022 | 54 |
| 2 | 0,846 | -0,236 | 26 | 0,475 | -0,069 | 30 | 0,112 | -0,075 | 24 |
| 1 | -0,109 | -0,251 | 12 | 0,030 | -0,090 | 15 | -0,129 | -0,075 | 9 |
| 0 | -0,018 | -0,106 | 3 | - | - | - | - | - | - |
| **Low** | -0,091 | -0,213 | 15 | -0,039 | -0,096 | 14 | -0,129 | -0,075 | 9 |
| **High** | 0,067 | -0,093 | 6 | -0,091 | 0,000 | 21 | 0,323 | 0,290 | 17 |
| **High-All** | -0,675 | -0,034 | - | -0,193 | 0,007 | - | 0,275 | 0,315 | - |
| P(T<=t) two-tail | 0,092* | | | 0,090* | | | 0,070 | | |
| t Critical two-tail | 2,052 | | | 2,032 | | | 2,093 | | |
| **High-low** | 0,158 | 0,120 | - | -0,052 | 0,095 | - | 0,453 | 0,365 | - |
| P(T<=t) two-tail | 0,581 | | | 0,796 | | | 0,024 | | |
| t Critical two-tail | 2,365 | | | 2,048 | | | 2,074 | | |

*T and P-values have been used to determine the significance of statistical tests. P--values show a significance level at 10%, 5%, 1% and are marked with *, **, *** separately.*

**Table 5: One-Year Market-Adjusted Returns and Risk-Adjusted Returns to a hedge Portfolio Taking a Long Position in Strong F_SCORE Firms and a Short Position in Weak F_SCORE Firms**

| | **Market-Adjusted Returns** | | | | **Risk-Adjusted Returns** | | | |
|---|---|---|---|---|---|---|---|---|
| **Year** | **Strong F_SCORE Mkt-adj. Returns** | **Weak F_SCORE Mkt-adj. Returns** | **Strong-Weak Return Difference** | **Number of observations** | **Strong F_SCORE Risk-adj. Returns** | **Weak F_SCORE Risk-adj. Returns** | **Strong-Weak Return Difference** | **Number of observations** |
| 1990 | -0,127 | -0,220 | 0,092 | 36 | -0,169 | -0,254 | 0,084 | 36 |
| 1991 | 0,263 | 0,066 | 0,197 | 38 | 0,258 | 0,053 | 0,205 | 38 |
| 1992 | 0,638 | 0,599 | 0,040 | 36 | 0,689 | 0,695 | -0,006 | 36 |
| 1993 | -0,176 | -0,156 | -0,019 | 37 | -0,181 | -0,167 | -0,014 | 37 |
| 1994 | -0,107 | 0,414 | -0,521 | 38 | -0,061 | 0,478 | -0,539 | 38 |
| 1995 | -0,009 | 0,083 | -0,092 | 43 | 0,015 | 0,220 | -0,205 | 43 |
| 1996 | -0,299 | 0,049 | -0,348 | 47 | -0,197 | 0,136 | -0,333 | 47 |
| 1997 | -0,127 | -0,094 | -0,032 | 48 | -0,137 | -0,099 | -0,038 | 48 |
| 1998 | -0,519 | -0,645 | 0,126 | 58 | -0,302 | -0,367 | 0,065 | 58 |
| 1999 | 0,645 | 0,118 | 0,527 | 65 | 0,549 | 0,018 | 0,531 | 65 |
| 2000 | 0,417 | 0,333 | 0,084 | 70 | 0,353 | 0,286 | 0,066 | 70 |
| 2001 | 0,256 | 0,034 | 0,222 | 79 | 0,175 | -0,031 | 0,206 | 79 |
| 2002 | 0,386 | 1,040 | -0,653 | 72 | 0,417 | 1,131 | -0,714 | 72 |
| 2003 | 0,217 | -0,044 | 0,262 | 71 | 0,233 | -0,027 | 0,260 | 71 |
| 2004 | 0,085 | 0,447 | -0,362 | 69 | 0,148 | 0,565 | -0,417 | 69 |
| 2005 | 0,064 | -0,190 | 0,254 | 71 | 0,087 | -0,128 | 0,216 | 71 |
| 2006 | 1,501 | 2,584 | -1,083 | 77 | 1,429 | 2,522 | -1,093 | 77 |
| 2007 | 0,834 | -0,005 | 0,839 | 86 | 0,759 | -0,093 | 0,852 | 86 |
| Average | 0,219 | 0,245 | -0,026 | | 0,226 | 0,274 | -0,049 | |

Table 5 provides details of the calendar year market-adjusted and risk-adjusted returns retained between 1990 and 2007 for a value investment strategy that buys Strong and shorts Weak F_SCORE portfolios. The Weak portfolio contains firms that retain an F_SCORE between 0 and 4, and the Strong portfolio contains firms that retain an F_SCORE of between 5 and 9. The strategy earns a mean market-adjusted (risk-adjusted) return of -0,026 (-0,049). Strong (Weak) firms on the OMXS earn a market-adjusted return of 0,219 (0,245), in contrast to Piotroski (2002) who observes a Strong (Weak) portfolio market-adjusted return of 0,106 (0,009). This indicates an F_SCORE strategy that buys winners and shorts losers on the OMXS between 1990 and 2007 is unsuccessful.

### *4.4 Cross-sectional regression*

In order to further examine the relationship between the market-adjusted return and market value of equity, book-to-market, momentum, equity offer, F_SCORE and beta variables, this study makes use of a cross-sectional (pooled) regression. This will show the estimated equation for market-adjusted returns and explanations of how the variables are correlated and behave with each other. The study considers 4 dissimilar regressions with differing types and amounts of variables:

$$MA\_RET_i = \alpha + \beta_1 \log(MVE_i) + \beta_2 \log(BM_i) + \beta_3 MOMENTUM_i + \beta_4 ACCRUAL_i + \beta_5 EQ\_OFFER_i + \beta_6 F\_SCORE_i + \beta_7 (E(Rm) - rf)$$

MA_RET is the one-year market-adjusted return. Should Heteroskedasticity exist in the data sample, the cross-sectional regression is adjusted with a White- Heteroskedasticity Consistent Error Standard & Covariance test in Eviews. The paper calculates momentum as a firm’s market-adjusted return six months prior to the time of investment. EQ_OFFER is attributed a score of 1 if the firm issues “…seasoned equity in the preceding fiscal year, 0 otherwise” (Piotroski, 2002, p.23). Furthermore, the paper makes use of Piotroski’s (2002) method for ranking momentum and accrual, which implies that the variables are assigned into decile portfolios based on their prior annual distribution for all OMXS top quintile value firms. They are accordingly assigned a value between 1 and 10 for model estimation.

**Table 6: Cross-Sectional Regression**

| | Intercept | Log(MVE) | Log(BM) | Momentum | ACCRUAL | EQ_OFFER | F_SCORE | Beta |
|---|---|---|---|---|---|---|---|---|
| (1) | 1,4137 | -0,4290 | -0,7489 | - | - | - | 0,0317 | - |
| | (-2,0550)* | (-2,3637)* | (-1,8335) | - | - | - | (0,7925) | - |
| (2) | 1,6056 | -0,4158 | -0,7350 | -0,0052 | -0,0258 | 0,0087 | 0,0173 | - |
| | (2,3575)* | (-2,2365)* | (-1,7689) | (-0,2059) | (-0,5802) | (0,0371) | (0,4060) | - |
| (3) | 1,6220 | -0,4106 | -0,7284 | -0,0050 | -0,0257 | 0,0077 | 0,0177 | -0,0449 |
| | (2,3389)* | (-2,2676)* | (-1,8191) | (-0,1957) | (-0,5748) | (0,0327) | (0,4140) | (-0,1781) |
| (4) | 1,4318 | -0,4233 | -0,7419 | - | - | - | 0,0322 | -0,0482 |
| | (1,9789) | (-2,3734)* | (-1,8805) | - | - | - | (0,8169) | (-0,1959) |

*T and P-values have been used to determine the significance of statistical tests. P--values show a significance level at 10%, 5%, 1% and are marked with *, **, *** separately.*

# 5. Analysis

*This chapter begins with a general discussion related to the collected empirical results in chapter 4, with the help of the theoretical framework in chapter 2. Specifically, the analysis considers results related to the F_SCORE model, the nine fundamental signals and the returns of various portfolio strategies.*

The analysis of the empirical results presented in this paper is initially confined to the scope of the problem formulation. The robustness of the F_SCORE model across different markets (the OMXS in the case of this paper) thus depends on whether an investment strategy that buys winners and shorts losers, based on the analysis of fundamental accounting signals, can earn returns exceeding those averaged by the market index. Also, the analysis considers whether there are any underlying factors that can be attributed to irregularities in the results, with particular focus on the beta effect and the size effect.

## *5.1 Financial and return Characteristics of High Book-to-Market Firms*

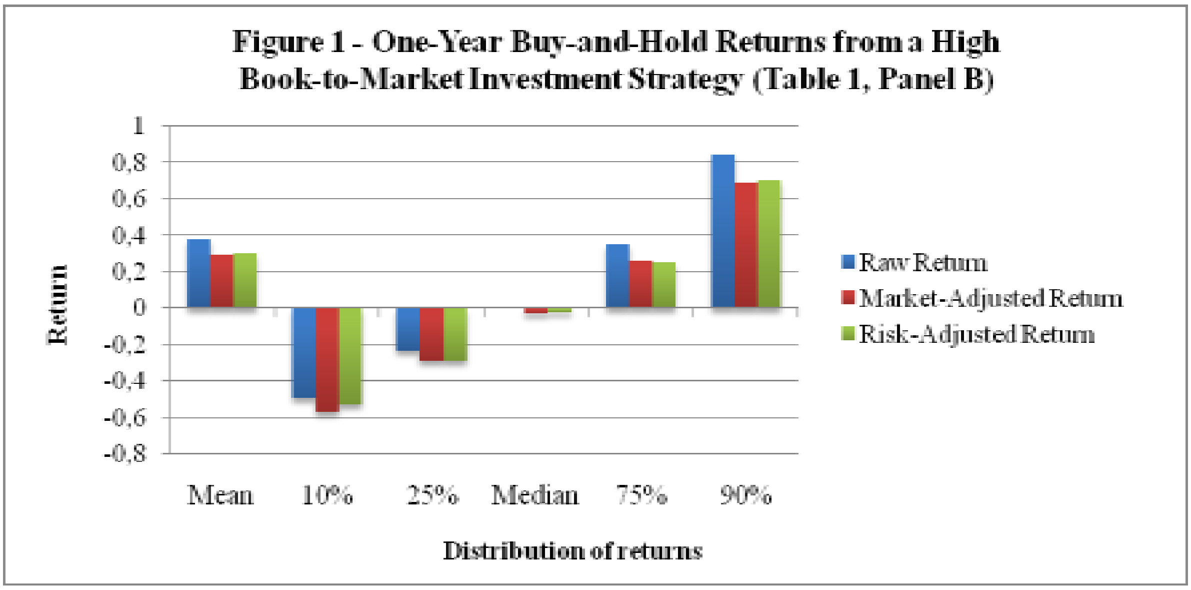
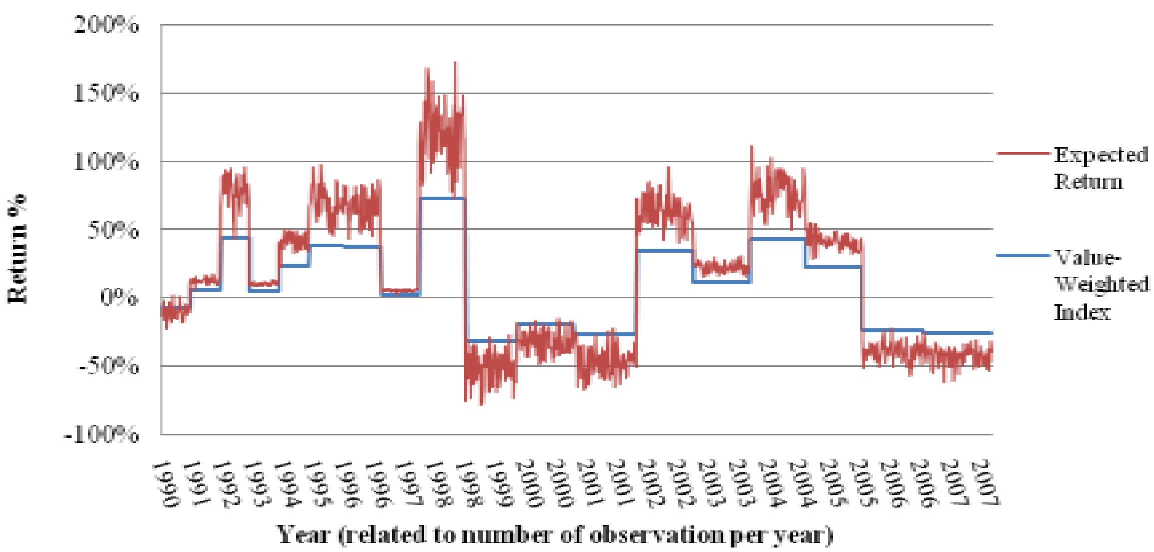



Figure 1 shows the one-year buy-and-hold returns exhibited in Table 1 Panel B. Firms in this paper's observation sample, in contrast to Piotroski (2002) and Fama & French (1995), exhibit a positive mean and median for the ROA signal, and a positive mean for ΔMARGIN (see Table 1, Panel A). At this stage, it is difficult to make inferences about the aforementioned signals, but it would appear that value firms on the OMXS between 1990 and 2007 do not display entirely equivalent characteristics to those on the US market.

The ROA value demonstrates that the mean and median of distressed firms on OMXS manage to cover their separate costs of borrowing to a better extent than their American counterparts, through the return of their operating assets (Palepu et al.,2007, p.202). Also, the fact that ΔROA is positive shows that these high book-to-market firms have improved their ROA, something that is also inconsistent with Piotroski's original result. One can therefore not draw the conclusion, like Piotroski does, that the portfolio consists of poor performing firms by singlehandedly analysing ROA.

Chen and Zhang (1998) note that value stocks generally offer higher returns in the United States and that this is linked in part to the US market growth rate. This paper's assessment is that it is likely that the Swedish market growth rate plays a central role in driving returns of its value stocks (see Figure 2). While over half (.539) of our 1-year firm observations retain a positive ROA, this signal on its own does not disclose whether firm stocks are likely to earn positive returns. The same is true of the CFO signal (which exhibits a .572 positive proportion), as it does not indicate what percentage of cash flow is reserved for expenses/short or mid-term debt (contrary to if one had used a Free Cash Flow signal). Fittingly, Piotroski (2002) makes no claim to using optimal financial signals.

**Figure 2 - Expected Return Related to OMXS**



With reference to the financial characteristics of the 1041-firm year OMXS observations (see Table 1, Panel A) exhibiting sometimes radically different properties to those of their US counterparts, it is initially difficult to make inferences about the success of a value strategy applied to the top quintile portfolio of value firms on the OMXS. Panel B in Table 1 offers some insight, and indicates that our results are consistent with Piotroski (2002), Fama & French (1992) and Lakonishok et al (1994). This implies that the OMXS top quintile value portfolios earn positive raw and market-adjusted mean returns for both a 1- and 2-year Buy-and- Hold strategy. Interestingly, and consistent with Piotroski's (2002) study, our observations indicate that these mean returns are always superior to their respective median. This result is attributed to the wide distribution of returns sizeable returns from firms located in the 90th percentile.

Papers that have analysed above market returns for high book-to-market firms have reasoned that such returns have occurred due to biases in commercial databases or because of differences in risk (Kothari et al., 1995). We have been unable verify to a full extent that Datastream includes every single share that has been listed on OMXS during the timeframe for our paper. Therefore, we cannot draw the conclusion that our results are not tainted due to missing financial data in Datastream. We have, however, investigated the argument that market returns superior to those averaged by the market index occurs due to risk. Our findings show that both our one- and two-year risk adjusted portfolios present an above market return of 0,302 and 0,189 respectively (see Table 1, Panel B). Our findings therefore point to that a value investment strategy would function; however, these figures do not give any insight into the success of the F_SCORE strategy on their own. Correlation analysis does offer a way to do this on the other hand.

### *5.2 Correlation Analysis*

The results of the spearman correlation analysis offer some interesting insights into the ability of the Piotroski fundamental signals to show indication of winning and losing firms. The key indicators of this are the relationships between F_SCORE and market-adjusted returns for a 1 (MAR_1) and 2 (MAR_2) years (see Table 2). Where Piotroski's (2002) study exhibits reasonable correlation for one (two) year market-adjusted returns with F_SCORE of 0,121

(0,130), this paper finds weaker correlation between MAR_1 and F_SCORE equal to 0,096, and negative correlation between MAR_2 and F_SCORE equal to -0,050. The latter suggests that for a two-year investment horizon, a '1-year old' F_SCORE would not earn positive market-adjusted returns to a reliable degree. Abarbanell and Bushee (1998) conclude that fundamental signals provide strong indicators of market-adjusted returns over a 1-year investment horizon, and that there is generally fallout from results in relation to the signals after this period, i.e. information asymmetry exists and the signal is no longer valid. Other signals that display interesting relationship with F_SCORE are 1 and 2 risk-adjusted returns, with which both exhibit positive returns. The details of these relationships are examined more closely later in the analysis (see section 6.3). Notably, CFO demonstrates the highest positive correlation with both MAR_1 and MAR_2 and F_SCORE (as it also does in Piotroski's 2002 study), suggesting that it might be a reasonable proxy for superior returns.

To some extent, it is logical to think that in some form or other, all of Piotroski's signals are either proxies for risk or return. In an effort to assess what some of Piotroski's signals say about value firms on the OMXS, and how they are relevant for a strategy that is supposed to buy winners and short losers on the OMXS, it is plausible to consider whether there are other characteristics that are more successful at identifying winners and losers among value firms. Abarbanell and Bushee (1998) comment that the fundamental signals that provide the strongest indicators of 1-year market adjusted returns, are those related to changes in inventory, effective tax rates and capital expenditures.

The pecking order hypothesis suggested by Myers (1984), offers additional insight related ΔLEVER and EQ_OFFER, and provides a solid foundation with which to assess Piotroski's (2002) interpretation of the aforementioned signals. Myers (1984) points out that managers have a preference for financing investments with retained earnings first, then loans (i.e. an increase in ΔLEVER), and when no other alternatives exist, by issuing new equity. In addition, the paper Famously put forward by Modigliani-Miller's (195X) propositions related to perfect capital markets suggest that the amount of leverage a firm has (or the way in which its capital structure is organised) should not influence its value in the eye's of investors.

One can question whether the same order applies for high book-to-market firms and whether Piotroski accurately penalises firms for increases in changes in leverage and equity offer. As described in section 2.6.2 above, research has shown that news presented by companies of an increase in leverage has resulted in substantial stock price increase (Shah, 1994). It is therefore of interest that the correlation between ΔLEVER and MAR1 and MAR2 in our study is negative, converse to the positive signals that Piotroski obtains. One can therefore, with our obtained results in mind, question if Piotroski has made a correct decision to consider an increase in leverage as a negative signal for future positive market-adjusted earnings.

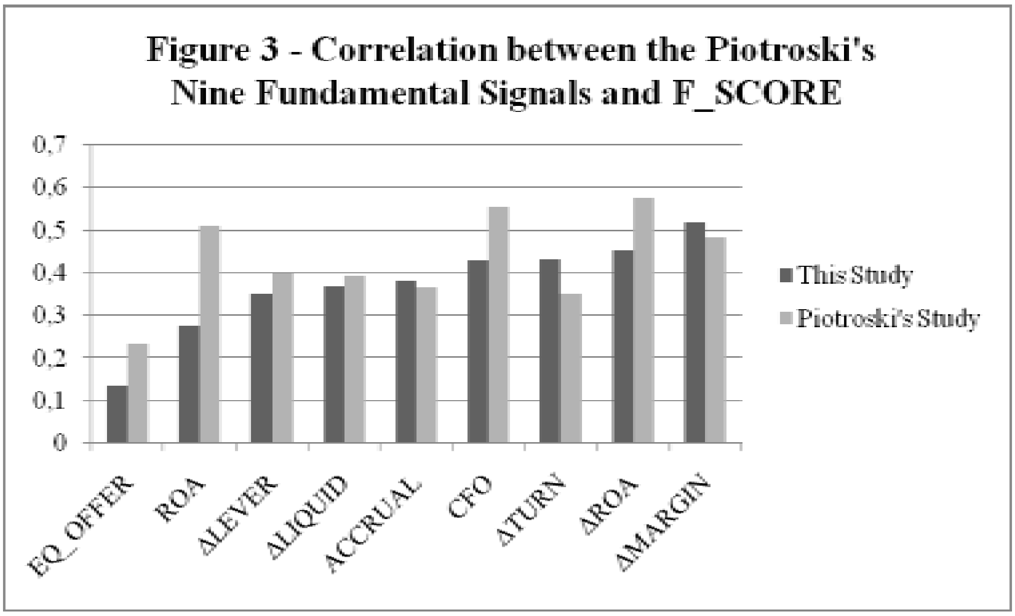



Figure 3 illustrate the correlation between the nine signals selected by Piotroski and the total F_SCORE. An analysis between this study and Piotroski's show that the only sizeable difference in correlation between the signals and F_SCORE in these papers are EQ_OFFER and ROA. The difference in the correlation between F_SCORE and ROA could be one explanation to our study presenting a positive ROA and ΔROA observed in table 1a.

### *5.3 Different Buy-and-Hold Returns to a Value Investment Strategy based on Fundamental Signals*

The tables exhibiting one-year raw buy-and-hold return, and one- and two-year market-adjusted and risk-adjusted buy-and-hold returns to an OMXS-based value investment strategy, make interesting conclusions related to F_SCORE.

Table 2 revealed a weak positive (negative) relationship between F_SCORE and 1-year (2-year) market-adjusted return. While these relationships are not statistically significant, we can not reject the potential relationship between these. Table 3A (3B) takes a closer look at the 1-year market-adjusted (risk-adjusted) returns to the entire distribution of F_SCORE ranked firms. Briefly, the High-Low and High-All investment strategies in 3A and 3B show a string of returns, all of which are not statistically significant at the 90% level, with the exception of the High-all strategy for one-year risk adjusted returns, which exhibits a return of -.230.

Ultimately, the distribution of F_SCORE firms is interesting to consider. The majority of firms within the distribution in Tables 3A and 3B obtain an F_SCORE of between 3 and 6, a score which is an indication of conflicting signals according to Piotroski (2002). Despite these conflicting signals, the majority of these categories exhibit relatively strong mean returns. Logically, considering the relative ability the entire OMXS top quintile value portfolio to earn positive market-adjusted and risk-adjusted means, it is not surprising that the 3 to 6 F_SCORE category firms earn average positive MAR1 and RAR1 returns, as they contain the bulk of firms within the observation sample.

With reference to Panel 3B in particular, a mean RAR1 return of 0,302 for all firms is observed which is superior to the corresponding mean MAR1. According to the CAPM model, the risk-adjusted return takes the beta effect into consideration. The assessment made in this paper is that our securities maintain lower beta values on average than the one attributed to the OMXS value-weighted market index, where beta is equal to 1. In turn when stocks exhibit lower beta values to in comparison to the index, the risk-adjusted returns will be superior to market-adjusted returns. As such, the excess risk-adjusted returns presented in this paper can be attributed to a beta security value of 0,728. Our portfolio has, due to its beta of 0,728, moved less in relation to the market portfolio. The F_SCORE portfolio will be considered to be less risky than holding the market index (Damodaran, 1994).

We obtain a lower return on our high score portfolio in relation to the market portfolio. According to the theory of CAPM, the only way possible to obtain an above market return is to bear more risk (Damodaran, 1994). Due to the assumption that the market index has a beta of 1, and our portfolios beta is 0.728, the conclusion can be drawn that our findings are in line with the CAPM reasoning.

As a consequence of calculating the risk-adjusted returns we observe that the high F_SCORE gets affected by beta and therefore gets a lower expected return because the beta is less than 1. The median results for High-All and High-Low exhibit slightly lower returns than the market-adjusted return because the beta attributed to high F_SCORE firms is 0,728, which pulls down the high F_SCORE returns. Due to Piotroski's beta assumption of 1 for his entire firm sample, he would almost certainly get different risk-adjusted returns. Consequently, to observe excess returns on the stock market, an adjustment for risk, beta, has to be made.

While panel 3C display information about the distribution of raw returns to a 1-year buy-and-hold strategy, the panel merely serves as a comparative tool for use with MAR1 and RAR1 for the benefit of the reader.

With reference to Tables 3D and 3E, theory about efficient capital markets, as described in section 2.5.1, provides reasonable explanation for the drop in mean returns exhibited in the 2-year market- and risk-adjusted buy-and-hold portfolios. Due to the theory that even awareness of information when it is made public is of little benefit to the investor, and that markets quickly adjust share prices when gaining information relevant to the value of the share (Ross et al. p. 342 2002), it is conceivable that a two year buy-and-hold strategy, that relies on signal information which is already old once it has been compiled into an F_SCORE, will not earn returns superior to it's 1-year buy-and-hold counterpart. An above market return two years after a financial statement has been released to the public, could indicate a substantial breach against the efficient-market theory. Here, our result points to the contrary due to these findings not being statistically significant. Conclusions can not be drawn therefore, implying that the market has not incorporated the financial statement information resulting in a positive market adjusted return.

The CAPM model awards a higher expected return if beta increases. Appendix 7.XXX displays that beta increases with F_SCORE. An assumption can therefore be made that beta provides a better correlation with risk-adjusted returns compared to market adjusted returns.

It is not 100 percent clear which factors affect the correlation between the risk-adjusted returns and F_SCORE, and how this differs from the correlation between the market-adjusted return and F_SCORE. The intricacies of CAPM suggest that the risk-free rate and the beta value for the actual company remains in the risk-adjusted return, as both risk- and market-adjusted returns incorporate the market return. This would tend to enable F_SCORE to better correlate with risk-adjusted returns (see Table 2 and Appendix 7.3). A lower F_SCORE has a lower beta value. An analysis is therefore made to test high F_SCORE firms (with high betas) versus low F_SCORE firms with low betas. This analysis shows that the risk-adjusted return is a better proxy to study above market returns. The two-year investment horizon also confirms the CAPM model that the beta effect will give us a higher alpha of returns.

There is no statistical significance between any variable in panel 3D or panel 3E. If we use a heuristic-based strategy, information asymmetry is incorporated into stock prices of the two-year market- and risk-adjusted portfolios. Therefore our F_SCORE is computed for the time (*t*), then a portfolio formation occurs at time $t_{(4/12)}$. Thus we can then calculate the return for this investment strategy for one-year at time $t_{(1+4/12)}$ and for two-year buy-and-hold portfolios at the time $t_{(2+4/12)}$. We see, using one- and two-year returns, that the nine fundamental signals have a higher impact on firm returns in directly connection to the fiscal year ends.

### *5.4 Analysis of Returns conditional on firm size*

Table 4A and 4B consider whether the underlying factor of a size effect has links to the returns offered by a value strategy. Consistent with Banz (1981), Fama and French (1992) and Lakonishok et al. (1994), this paper's observation sample must be said to observe the same size effect tendencies. As such, small firms tend to exhibit greater excess returns than large firms in our sample. Principally, the mean return attributed to small firms stands at 0,753 where the highest return in that category comes from F_SCORE of 4 and 7. It is with a statistical significance level of 90% that all firms in the small firms classification are separated from the low returns of high F_SCORE firms in the same category.  We observe high returns for all firms in every category even though we examine the median to be less than zero in all categories.

One major difference between this study and Piotroski's original study is the difference in returns obtained in these studies with regards to value partitions.  Piotroski obtains the highest return for small and medium firms (High-All), whilst our study shows a negative High-All return for both small and medium firms. Also contrary to Piotroski's results are our findings that the Large Firms partition performs best out of the three partitions, producing a 25% excess return of compared to all large firms. A potential drawback between this comparison is however that Piotroski does not provide information regarding the size/value of the firms in his value-partition. Due to this lack of data, it is impossible to draw any conclusion regarding small firms' poor performance on the OMXS versus their strong performance in the US. Relatively, however, out of the quintile of the highest book-to-market firms in both markets, our findings show that a value partition does not find that a small firm effect analogous to the one Piotroski (2002) discovers.

### *5.5 Weak and Strong Portfolios*

Table 5 provides the calendar-year market-adjusted returns for a one-year Buy-and-hold strategy that buys winners (strong firms) and shorts losers (weak firms). Calendar-years that were particularly significant in terms of global/national activity that affect the OMXS are in the late 90's (when global markets fell victim to the IT Bubble). In particular, the 1998 F_SCORE is practically the perfect hedge where the strong market-adjusted F_SCORE had a negative return of -0,519 and weak F_SCORE had a return -0,645. This is as result of the IT-"Crash" in Sweden in the late 1990s and both strong and weak F_SCORE firms had strong negative result.

The F_SCORE model cannot be considered to be successfully separating weak and strong firms on the OMXS. This conclusion can be drawn due to strong portfolios, only earning superior market- and risk-adjusted returns, 55% and 50% of the time respectively, in comparison to weak firms during the 1990 – 2007 timeframe. Also, the average return difference between the strong and weak portfolio for the market- and risk adjusted returns are -2.6% and -4,9% respectively. Our results therefore differ greatly to the results obtained by Piotroski, who, through taking long positions in strong firms, whilst taking short position in weak firms, obtains a market adjusted return of +9,7%. Chen and Zhang (1998) comment that value stocks do not always earns returns superior to those of the market because the spread of risk between high and low book-to-market firms can be too small. It is entirely possible that this is the case for the top quintile of OMXS value firms.

### *5.6 Cross-sectional Regression Analysis*

A momentum effect should not be present on the analysed firms with high book-to-market ratios (Asness, 1997). Performing the cross-sectional regression, no statistical significance evidence of momentum is presented (See table 6). A momentum effect would, however, have little effect, according to Asness (1997) due to the F_SCORE portfolio consisting of value firms. The findings in this thesis are not in line with the findings in Piotroski's study, as he finds a statistical significance between momentum and market adjusted return.

This paper find a statistically significant relationship between market value of equity (log(MVE)) and market adjusted return. As described in chapter 3, small market capitalised firms have in research proven to obtain higher returns than market indexes. The regression analysis in this study confirms, with a statistical significance, that the return decreases if market value of equity increases.

Studies related to value investing strategies such as high book-to-market investments have a possibility to earn above-market returns (Chen et al, 1998). The findings from the cross-sectional regression analysis performed in table 6 shows that book-to-market actually has a negative effect on market-adjusted returns in this study. These findings are, however, not statistically significant, wherefore we cannot conclude that high book-to-market has a negative impact on market-adjusted returns.

A remarkable observation can be made regarding the intercept obtained in this regression analysis. The statistically significant intercepts range from 1.4137 to 1,6220, which is considerably higher than Piotroski's intercepts that have values of -0,077 and -0,057.

Due to the large amount of non-statistically significant values that are obtained, the conclusion can be made that the coefficients used in Piotroski's study, cannot explain the returns correctly on OMXS.

# 6. Conclusions

*This chapter contains a short summary of the study's analysis and results. Each of the hypotheses, presented in chapter 1, are discussed. Finally, limitations of the results are presented alongside suggested further research of Piotroski's F_SCORE model.*

The purpose of this thesis has been to analyse the F_SCORE model, a value investment strategy invented by Joseph Piotroski, on the OMXS between 1990 and 2007. Furthermore, the intention has been to analyse the relationship between this investment strategy and underlying factors contributing to its success, such as size and beta factors. The top quintile of all listed value firms companies were assessed during the given timeframe, and resulted in a total of 1041 one-year firm observations divided into 18 yearly portfolios.

The results obtained from our different analyses vary to a great extent, both with regards to returns obtained and to their statistical significance.

Firstly, the F_SCORE model was analysed, using raw-, market-, and risk adjusted returns. The only occasion the high F_SCORE portfolios obtained above market returns, and beat the quintile of the highest book-to-market firms, was surveyed in the tests for two-year risk-adjusted returns. The result was, however, not statistically significant, wherefore this result can be dismissed as evidence that supports efficiency of the F_SCORE on OMXS. The paper therefore rejects its first hypotheses.

Secondly, our analysis showed that a high book-to-market investment strategy results in raw, market- and risk-adjusted returns obtaining above market returns, both for one- and two-year portfolios. This confirms the paper's second hypotheses, that the highest book-to-market quintile achieves an above market return between 1990 and 2007, a result which is paralleled in studies performed by Fama French (1992) and Lakonishok et al., (1994). The returns obtained by the whole portfolio of value firms have, however, not been tested statistically. The results between one- and two-year returns differ in the way that mean one-year returns are higher than the mean two-year returns. One explanation for this difference may be the time aspect of the potential benefits of fundamental accounting based strategies, suggesting that information regarding a firms' economic status is more beneficial in close association to its release. The lower return on two-year buy-and-hold portfolios could therefore suggest that any beneficial information becomes incorporated into the share price prior to the disposal of the two-year buy-and-hold portfolios. Due to the return achieved of these firms, one could, based the aforementioned market return findings, question if OMXS truly is an efficient capital market according as dictated by the EMH.

Thirdly, an analysis has been performed in order to explain a potential above market return by F_SCORE firms. When implementing the CAPM model, results show that the returns are higher in comparison to the market-adjusted returns for the same time period. This result is obtained due to the firms analysed, having a lower beta than the market. This results in these companies bearing lower risks, and consequently, lowering the expected return of these shares. This paper concludes that Piotroski’s 2002 study would most certainly have obtained different results, if an element of risk had been included in his model. It is fairly surprising that risk has not been included in Piotroski’s study, as this unquestionably has been subject to some intense debate during previous studies, regarding the analysis of above market returns achieved using value strategies.

## *6.1 Proposal for further research*

It would, in future research, be particularly interesting to apply the F_SCORE investment strategy to additional equity markets. A similar study to this one, should not take any considerable amount extra time to perform on a larger market. A study performed on markets would provide further insights into the applicability and the robustness of the F_SCORE strategy.

Similar studies could also be performed on smaller national markets, like Aktietorget and the Nordic Growth Market. Firms listed on these stock exchanges would provide an interesting comparison for the value stocks listed on the OMXS.

Finally, Piotroski performed his 2002 study using the COMPUSTAT database. It would therefore be of interest to perform a replica of this study, however, using the COMPUSTAT database. In the light of this, it would be interesting to repeat this study with COMPUSTAT as the providing source of external data.

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# 8. Appendix

## *8.1 Thomson Datastream Definition of Variables*

**MVE** Market value on Datastream is the share price multiplied by the number of ordinary shares in issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change.
§ For companies with more than one class of equity capital, the market value is expressed according to the individual issue.
§ Market value is displayed in millions of units of local currency.

**Assets** Average total assets are calculated in much the same way as you calculate the normal average. To calculate the average total assets for a year, first add the beginning and ending values for average total assets for that year and then divide the resultant value by 2. The beginning value for the year can be taken as the last year's ending total asset. Average of the aggregate assets during a two year period. Formula: Total assets (current year) + Total assets (previous year) / 2.

**ROA** Return on Assets is a profitability ratio and as such gauges the return on investment of a company. Specifically, ROA measures a company's operating efficiency regardless of its financial structure (in particular, without regard to the degree of leverage a company uses) and is calculated by dividing a company's net income prior to financing costs by total assets. IBES provides both expected and actual ROA data (where available).

**Δ ROA** Is calculated based on the prior information of ROA. Delta RAO is defined as the fiscal year ends ROA scaled by the prior year (t – 1) ROA.

**CFO** CASH FLOW FROM OPERATIONS – GAAP represents the sum of net income and all non-cash charges or credits of a non-U.S. company adjusted to conform to U.S. Generally Accepted Accounting Principles. DS_CODE WC06915

**ACCRUAL** TOTAL ASSETS represent the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets.
Other financial companies: TOTAL ASSETS represent the sum of cash & equivalents, receivables, securities inventory, custody securities, total investments, net loans, net property, plant and equipment, investments in unconsolidated subsidiaries and other assets. (Total assets WC02999)

Net income before extraordinary items/preferred dividends represents income before extraordinary items and preferred and common dividends, but after operating and non-operating income and expense, reserves, income taxes, minority interest and equity in earnings. (WC01551)

**DEBT** LONG TERM DEBT represents all interest bearing financial obligations, excluding amounts due within one year. It is shown net of premium or discount. WC03251

**ΔLIQUID** Liquidity Ratio, Annual Item, = Current Assets-Total / Current Liabilities-Total, WC08106

**ISSUED COMMON EQUITY** COMMON EQUITY represents common shareholders' investment in a company, WC03501

**ΔMargin** WC01001 NET SALES OR REVENUES represent gross sales and other operating revenue less discounts, returns and allowances.

**ΔTURN** Net Sales or Revenues/Total Assets WC08401

**UNADJUSTED PRICES** This is the closing price which has not been historically adjusted for bonus and rights issues. This figure therefore represents actual or 'raw' prices as recorded on the day. One year buy and hold: =(H5-G5)/G5 Two year buy and hold: =(I5-G5)/G5

**BETA** The beta factor of a stock relates movements in its price to movements in the market as a whole. Over a period it expresses the relative movement of the price against the market, showing the likely relative change for a given market movement and whether the stock is prone to under- or over-react.

In order to display beta calculations, at least 2½ years of data are required. Data is not held historically.

There are many ways of calculating beta factors. The method adopted by Datastream is described here. The beta factor is derived by performing a least squares regression between adjusted prices of the stock and the corresponding Datastream market index. The historic beta so derived is then adjusted using Bayesian techniques to predict the probable behaviour of the stock price on the basis that any extreme behaviour in the past is likely to average out in the future. This adjusted value, or "forecast" beta, is represented by the BETA data type.

The Datastream beta factor is calculated using stock prices and market indices as the only variables.

## 8.2 Equations variables and definitions:

$R_i$ = Raw return in percentage change

$R_{2i}$ = Two-year raw returns in percentage change

$R_{it-mt}$ = Market-adjusted return one year

$R_{2it-2mt}$ = Market-Adjusted return two year

$P_t$ = Current stock price at fiscal year-end, unadjusted prices

$P_{t-1}$ = Prior year-end stock price, unadjusted prices

$P_{t-2}$ = Historical two-year prices, unadjusted prices

$R_{mt}$ = OMXS value weighted index, market index one year

$R_{2mt}$ = OMXS value weighted index, market index two year

$\alpha$ = Jensen's alpha

$\alpha_{2y}$ = Jensen's alpha two-year buy-and-hold

$r_f$ = risk-free of return, SSVX 12M

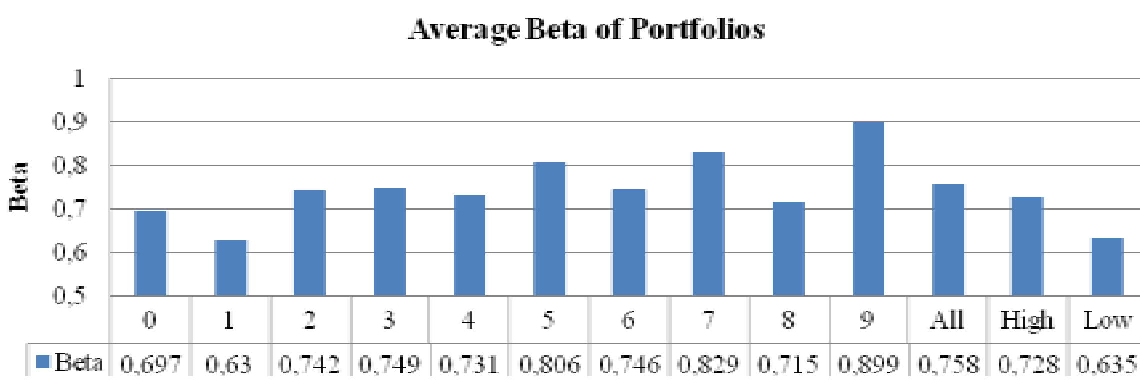
$r_{f2Y}$ = risk-free of return, two-year average of SSVX 12M

$E[R_{Mkt}]$ = OMXS value weighted index

$E[R_{Mkt2Y}]$ = OMXS value weighted index, two-year

$\beta$ = the Beta coefficient, a measure of systematic risk.

## 8.3 Average Beta of portfolios



## *8.4 Table: Determinations of fundamental signals*

| | |
|---|---|
| 1. F_ROA | =OM(ROA>0;1;0) |
| 2. F_ΔROA | =OM(ΔROA>0;1;0) |
| 3. F_CFO | =OM(CFO>0;1;0) |
| 4. F_ACCRUAL | =OM(ACCRUAL<0;1;0) |
| 5. F_LEVER | =OM(LEVER>0;1;0) |
| 6. F_ΔLIQUID | =OM(ΔLIQUID>0;1;0) |
| 7. F_EQ_OFFER | =OM(EQ_OFFER<0;1;0) |
| 8. F_ΔMARGIN | =OM(ΔMARGIN>0;1;0) |
| 9. F_ΔTURN | =OM(ΔTURN>0;1;0) |
| 10. F_SCORE | ∑(F_ROA: F_ΔTURN) |

## *8.5 A Panel A: Coefficients from a pooled Regression*

Dependent Variable: **Market-Adjusted Returns One-Year Buy-and-Hold**
Method: Least Squares
Date: 05/20/09 Time: 17:06
Sample: 1 1041
Included observations: 1041
White Heteroskedasticity-Consistent Standard Errors & Covariance

| | **Coefficient** | Std. Error | **t-Statistic** | Prob. |
|---|---|---|---|---|
| **Intercept** | 1.413719 | 0.687939 | 2.055008 | 0.0401 |
| **Log(MVE)** | -0.429025 | 0.181508 | -2.363670 | 0.0183 |
| **Log(BM)** | -0.748916 | 0.408461 | -1.833504 | 0.0670 |
| **F_SCORE** | 0.031720 | 0.040026 | 0.792503 | 0.4282 |

| | | | |
|---|---|---|---|
| **R-squared** | 0.012197 | Mean dependent vary | 0.292206 |
| Adjusted R-squared | 0.009339 | S.D. dependent var | 3.248623 |
| S.E. of regression | 3.233417 | Akaike info criterion | 5.188791 |
| Sum squared resid | 10841.82 | Schwarz criterion | 5.207804 |
| Log likelihood | -2696.766 | Hannan-Quinn criter. | 5.196003 |
| F-statistic | 4.268151 | Durbin-Watson stat | 1.970934 |
| Prob(F-statistic) | 0.005253 | | |

## *8.5B Panel 2A: Coefficients from a pooled Regression*

Dependent Variable: **Market-Adjusted Returns One-Year Buy-and-Hold**
Method: Least Squares
Date: 05/20/09 Time: 17:12
Sample: 1 1041
Included observations: 1041
White Heteroskedasticity-Consistent Standard Errors & Covariance

| | **Coefficient** | Std. Error | **t-Statistic** | Prob. |
|---|---|---|---|---|
| **Intercept** | 1.605634 | 0.681089 | 2.357451 | 0.0186 |
| **Log(MVE)** | -0.415814 | 0.185920 | -2.236519 | 0.0255 |
| **Log(BM)** | -0.734959 | 0.415489 | -1.768901 | 0.0772 |
| **Momentum** | -0.005228 | 0.025396 | -0.205862 | 0.8369 |
| **ACCRUAL** | -0.025796 | 0.044459 | -0.580219 | 0.5619 |
| **EQ_OFFER** | 0.008697 | 0.234679 | 0.037059 | 0.9704 |
| **F_SCORE** | 0.017321 | 0.042663 | 0.405997 | 0.6848 |

| | | | |
|---|---|---|---|
| **R-squared** | 0.012659 | Mean dependent var | 0.292206 |
| Adjusted R-squared | 0.006929 | S.D. dependent var | 3.248623 |
| S.E. of regression | 3.237348 | Akaike info criterion | 5.194088 |
| Sum squared resid | 10836.76 | Schwarz criterion | 5.227359 |
| Log likelihood | -2696.523 | Hannan-Quinn criter. | 5.206708 |

| | | | |
|---|---|---|---|
| F-statistic | 2.209470 | Durbin-Watson stat | 1.971791 |
| Prob(F-statistic) | 0.039997 | | |

## *8.5C Panel 3A: Coefficients from a pooled Regression*

### With additional beta variable

Dependent Variable: **Market-Adjusted Returns One-Year Buy-and-Hold**
Method: Least Squares
Date: 05/20/09 Time: 17:14
Sample: 1 1041
Included observations: 1041
White Heteroskedasticity-Consistent Standard Errors & Covariance

| | **Coefficient** | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| **Intercept** | 1.621969 | 0.693465 | 2.338936 | 0.0195 |
| **Log(MVE)** | -0.410550 | 0.181050 | -2.267607 | 0.0236 |
| **Log(BM)** | -0.728421 | 0.400423 | -1.819132 | 0.0692 |
| **Momentum** | -0.005039 | 0.025755 | -0.195652 | 0.8449 |
| **ACCRUAL** | -0.025720 | 0.044748 | -0.574770 | 0.5656 |
| **EQ_OFFER** | 0.007735 | 0.236318 | 0.032730 | 0.9739 |
| **F_SCORE** | 0.017711 | 0.042779 | 0.414004 | 0.6790 |
| **Beta** | -0.044902 | 0.252155 | -0.178074 | 0.8587 |

| | | | |
|---|---|---|---|
| R-squared | 0.012678 | Mean dependent var | 0.292206 |
| Adjusted R-squared | 0.005988 | S.D. dependent var | 3.248623 |
| S.E. of regression | 3.238883 | Akaike info criterion | 5.195989 |
| Sum squared resid | 10836.54 | Schwarz criterion | 5.234014 |
| Log likelihood | -2696.512 | Hannan-Quinn criter. | 5.210413 |
| F-statistic | 1.894943 | Durbin-Watson stat | 1.972341 |
| Prob(F-statistic) | 0.067108 | | |

## *8.5D Panel 4A: Coefficients from a pooled Regression*

**With additional beta variable**

Dependent Variable: **Market-Adjusted Returns One-Year Buy-and-Hold**
Method: Least Squares
Date: 05/20/09 Time: 17:18
Sample: 1 1041
Included observations: 1041
White Heteroskedasticity-Consistent Standard Errors & Covariance

| | **Coefficient** | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| **Intercept** | 1.431831 | 0.723538 | 1.978930 | 0.0481 |
| **Log(MVE)** | -0.423337 | 0.178367 | -2.373399 | 0.0178 |
| **Log(BM)** | -0.741868 | 0.394511 | -1.880474 | 0.0603 |
| **F_SCORE** | 0.032157 | 0.039364 | 0.816915 | 0.4142 |
| **Beta** | -0.048160 | 0.245782 | -0.195945 | 0.8447 |

| | | | |
|---|---|---|---|
| **R-squared** | 0.012219 | Mean dependent var | 0.292206 |
| Adjusted R-squared | 0.008406 | S.D. dependent var | 3.248623 |
| S.E. of regression | 3.234941 | Akaike info criterion | 5.190690 |
| Sum squared resid | 10841.58 | Schwarz criterion | 5.214455 |
| Log likelihood | -2696.754 | Hannan-Quinn criter. | 5.199705 |
| F-statistic | 3.203975 | Durbin-Watson stat | 1.971514 |
| Prob(F-statistic) | 0.012567 | | |

## *8.5E Descriptive Statistic of Cross-Sectional regression Variables*

| | **LOG_BM_** | **F_SCORE** | **BETA** | **LOG_MVE_** | **EQ_OFFER** | **Mark.- Adj. Return** | **Risk-Adjusted Return** | **ACCRUAL** | **MOM** |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 0,193087 | 4,521614 | 0,753714 | 2,611352 | 0,747358 | 0,292206 | 0,302134 | 5,495677 | 5,495677 |
| Median | 0,096910 | 5,000000 | 0,709000 | 2,568073 | 1,000000 | -0,028636 | -0,019070 | 5,000000 | 5,000000 |
| Maximum | 2,000000 | 9,000000 | 1,818000 | 5,197349 | 1,000000 | 74,23132 | 74,08008 | 10,00000 | 10,00000 |
| Minimum | -0,187521 | 0,000000 | 0,000000 | -0,494850 | 0,000000 | -1,427145 | -1,255812 | 1,000000 | 1,000000 |
| Std, Dev, | 0,356113 | 1,661719 | 0,334069 | 0,944366 | 0,434736 | 3,248623 | 3,240112 | 2,875666 | 2,875666 |
| Skewness | 2,460560 | -0,001383 | 0,028789 | -0,078158 | -1,138517 | 16,26931 | 16,28927 | 0,000825 | 0,000825 |
| Kurtosis | 10,28199 | 2,715854 | 2,546333 | 2,920269 | 2,296221 | 316,7252 | 317,1567 | 1,774875 | 1,774875 |
| Jarque-Bera | 3350,495 | 3,502379 | 9,070985 | 1,335599 | 246,3782 | 4315043, | 4326907, | 65,10298 | 65,10298 |
| Probability | 0,000000 | 0,173567 | 0,010722 | 0,512836 | 0,000000 | 0,000000 | 0,000000 | 0,000000 | 0,000000 |
| Sum | 201,0039 | 4707,000 | 784,6160 | 2718,418 | 778,0000 | 304,1866 | 314,5213 | 5721,000 | 5721,000 |
| Sum Sq, Dev, | 131,8891 | 2871,764 | 116,0665 | 927,5009 | 196,5552 | 10975,69 | 10918,26 | 8600,231 | 8600,231 |
| Observations | 1041 | 1041 | 1041 | 1041 | 1041 | 1041 | 1041 | 1041 | 1041 |

## 8.6 Data Collected from Datastream (1990-2007)

We have reduced the number of decimals in our observations for a better overview of our data

[illegible]