EKONOMIHÖGSKOLAN
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An Investment Strategy Based on P/E ratios

"How does one make abnormal returns by taking advantage of the price per earnings effect, and did such an effect exist on the Stockholm Stock Exchange during the period 2000-2009?"

Key words: P/E effect, Anomaly, Market Inefficiency, Investment Strategy, and Key Performance Indicators

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Abstract

Motivation

Well-known economists as well as investors have examined anomalies on the stock exchange around the world for decades. Investors' trying to beat the market in order to earn a quick buck or dollar is often what motivates them. With an investment strategy based merely on purchasing stocks with low price per earnings ratios it is said to be possible to beat the index. This so called price per earnings effect is such an anomaly, and is exactly what will be under scrutiny in this paper.

Purpose

The purpose of this study is to examine the price per earnings effect and whether or not it is in fact possible to generate abnormal profits on the Stockholm Stock Exchange by constructing a portfolio consisting merely of stocks with low P/E ratios.

The research question here is: "How does one make abnormal returns by taking advantage of the price per earnings effect, and did such an effect exist on the Stockholm Stock Exchange during 2000-2009?"

Methodology

The P/E ratios of every stock within the large, mid and small cap on the Stockholm Stock Exchange was computed annually from 1999-2008, and then sorted from lowest to highest. A portfolio consisting of 25 stocks with the lowest ratios at the beginning of every year was constructed. The portfolio's yearly return was calculated for 10 years, and then risk adjusted using the Jensen's index. To examine if there existed a P/E effect, the portfolios performance was compared to the return of two different indexes mainly, OMXAFGX and SIXRX, to see if there was a significant difference in return.

Conclusion:

After careful analysis of the results and the conducted T-test at a 1, 0% risk level, the low P/E portfolio's return proved to be statistically significant to both its comparison indices. This result answers the research question and verifies that a price earnings effect existed on the Stockholm Stock Exchange during the period 2000-2009 and that it was in fact possible to make abnormal returns.

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1.0 Introduction

1.1 Background

In the eighteen hundreds when the Stockholm Stock Exchange was founded, it was only accessible to renowned businessmen and large corporations. Now stock trading has become more and more common amongst ordinary people, and the current number of Swedish people investing in the stock market is estimated to be an astonishing two million! (UngaAktiesparare)

Over the last decade services such as investment consultants and fund managers selling their expertise have shown an exponential growth. These experts are supposed to beat the market index, but have lately faced harsh criticism when failing to do so. The other alternative to letting professionals place ones capital is to follow an investment strategy. Investors strive to find ways to increase their expected return while simultaneously maintaining the same levels of risk. Many believe the stock exchange is not as efficient as it theoretically ought to be, and different types of technical analysis are all working tools in obtaining abnormal returns. For many years researchers and professors have tried to unravel this mystery, however, the conclusion reached remains varied.

The relationship between stock prices and earnings per share is called a P/E ratio and is one of the most widely used key performance indicators by investors. Stocks that have low P/E ratios, also known as multiples, are considered to be cheap or undervalued and the opposite holds true for high ratios. Given that a stock is currently trading at a P/E ratio of twenty, an investor is said to be willing to pay $20 for every $1 of earnings. In other words, the lower the multiple, the less one pays for every dollar of earnings. The price-earning effect is based on the principle of investing in undervalued stocks. This investment strategy consists of constructing a portfolio merely on stocks with low multiples in the belief of obtaining abnormal returns.

1.2 Purpose

The purpose of this paper is to examine if it is possible to beat the market by investing in stocks with low P/E ratios. A portfolio consisting of 25 stocks with the lowest ratios on the Stockholm Stock Exchange's Large-, Medium and Small cap have been chosen, in order to assess whether such an anomaly existed during the time period 2000-2009. Research question:

"How does one make abnormal returns by taking advantage of the price per earnings effect, and did such an effect exist on the Stockholm Stock Exchange during 2000-2009?"

1.3 Limitations

The limitations have been carefully selected in this research paper. Although the limitations will somewhat affect the accuracy as well as the final result, some are crucial to the execution of this study.

The study has been limited to the Stockholm Stock Exchange's Large; Medium and Small cap totaling 164 stocks. The remaining stocks have purposely been excluded due to the lack of P/E ratios in the DataStream database. The selected stocks have been assessed over 10 years starting 1st January 2000 to 31st December 2009. In order to have a well-diversified portfolio 25 out of the total 164 stocks were selected. Due to "B stocks" being what most investors commonly purchase, all "A stocks" have been excluded. Furthermore the 25 selected stocks must have at least 48 months of historic data and a P/E ratio > 0.

For simplification purposes, transaction costs and taxes are excluded and the returns are assumed to be normally distributed.

1.4 Disposition

This research paper starts off with an introduction containing background information, a research question, and the purpose behind this particular study. After giving a rather swift insight to what the paper entails, an account of all the assumptions and limitations made is presented.

Subsequently, the next chapter starts by explaining the basic theory behind the research and ends with an extensive review of studies done earlier. After debating whether the market is inefficient and if a P/E effect really exists, the Capital Asset Pricing Model (CAPM) is introduced and thoroughly explained.

Under the chapter "Results" all the quantitative calculations are presented in the form of tables, graphs as well as written explanations. A final result is reached and thereafter methodically analyzed. The last chapter of this paper is the conclusion that acts as a summary and presents recommendations for further research or studies.

2.0 Efficient Markets

Maurice Kendall proposed the theory of an efficient market, also known as the efficient market hypothesis, when he examined the patterns of stock returns in 1953. After studying weekly changes on the British industrial stocks and spot prices for the New York cotton and Chicago wheat, he found that the random component of prices swamped any auto-correlations. (Random Walk Theory)

> *"The series looks like a wandering one, almost as if once a week the Demon of Chance drew a random number from a symmetrical population of fixed dispersion and added it to the current price to determine the next week's price." (Random Walk Theory)*

This is how the theory behind the efficient market hypothesis originated. The random walk theory explains how a stock price evolves according to a random walk and that it moves independently. If this is true, it is not possible to predict movements of any stock prices since the best prediction of tomorrows stock price equals today's price, which is also consistent with the efficient market hypothesis.

Often when someone refers to an efficient market, what they generally mean is that all available information is fully incorporated in the price of the security. According to Elton and Gruber this phenomenon can be explained by the assumption that acquiring information and the transaction costs of trading are equal to zero. This condition gives the investors the necessary incentive to trade until the security's price fully reflects all the accessible information (Gruber, and Elton 396-427).

However, this is quite a strong assumption, and not a very realistic one as the costs of obtaining information is not zero. In other words, a more satisfying definition is needed. Due to the fact that costs of acquiring information and trading is greater than zero, Gruber and Elton argued that the price will reflect the information to the point where the marginal costs of obtaining information equals the marginal benefit.

2.1 Three different types of markets

In a renowned study by Eugene Fama in 1988, he concluded that efficient markets can be subdivided into three different categories, each category decided by how much and what type of information is shown in the price. A weak-form tested if past prices could say anything about current or future prices, semi strong-form tested whether all public information was reflected in current prices and strong-form tested if private, non-public, information was incorporated in the prevailing prices.

Weak-form efficiency is when all historical data is impounded in current prices. This means that no technical analysis, or chartist analysis, can be used to predict future price movements. Thus any price change can only be influenced by new information that in itself is assumed to be random, and this leads us to the next category of market efficiency.

Semi strong-form efficiency can be defined when all public information and publications are reflected in current equity prices. This makes profiting from investing right after news releases impossible. Insiders who hold non-public information such as annual financial statements, dividend payments or ground breaking research results before the public do, are able to use this in their advantage in attaining abnormal return. However, because such advantages are considered unfair this is strictly illegal.

Strong-form efficiency holds that all available information, private as well as public information is fully reflected in the price. It would mean that the public capital market is infinitely wise, which is quite an outrages preposition. This is the strongest form of market efficiency and not even insiders will find their knowledge profitable.

(Cunningham 8-9)

3.0 *Price per Earnings Ratios*

$$P/E = \frac{Market\ Value\ Per\ Share}{Earnings\ Per\ Share\ (EPS)}$$ (*Equation 1*)

Price per earnings ratio, P/E ratio, is one of the most commonly used key indicators on the stock market. It was made famous by investors Benjamin Graham and David Dodd in the 1930s (Kennon). However, it has undergone some modifications, and to this date there exists several different variants of P/E ratios. The general and most commonly known is simply the ratio between the market price and the equity's earnings per share. To make an example: given a fictional stock valued at $100 and its earnings per share came to $5 it will have a P/E ratio of 20. (Investopedia ULC)

Out of the many types of ratios the majority of investors are usually only interested in three, mainly trailing, current and forward. The difference between the three is not tremendous but it gives a different perspective depending on what the investors are after.

- o *Trailing:* is the most commonly used of the three since it is based on actual earnings and therefore the most accurate. A trailing P/E-ratio is calculated by dividing the stock's market value by the actual earnings per share from the previous four quarters. The ratio is used by investors to project or predict earnings for another four quarters ahead.

- o *Current:* is very much the same as the others. This ratio uses actual data from only two quarters compared to four back in order to predict another two quarters ahead. It is a more short-term estimate, hence the name "current".

- o *Forward:* is frequently used as a comparison with the trailing P/E ratio. A forward-looking P/E ratio uses an analyst's estimated EPS instead of actual historical data. Estimations are subject to human error and are therefore not as accurate.

(Investopedia ULC)

What can be said about the actual meaning of these ratios? Again, there are a few different ways of interpreting a P/E ratio. Given that a stock is currently trading at a P/E-ratio of twenty an investor is said to be willing to pay \$20 for every \$1 of earnings. Nonetheless, this is an oversimplified approach of analyzing as it does not take into account future growth prospects. Different industries have unrelated growth prospects and in order to get a valid judgment one only ought to compare stocks within the same industry.

Stocks with high P/E ratios are expected to have a large growth in future earnings compared to their counterparts with low ratios. The P/E ratio is a measure not only of last year's performance, but also a measure of the markets expected performance of the company. As stated earlier a share with a high multiple is expected to perform exceptionally well compared to the market index, and if the company fails to perform accordingly the stock will lose value, and abate in price, the contrary is true for stocks with low ratios. (Basu 663)

3.1 Elements of the P/E-ratio

The value of a stock can be calculated by summing up the present value of all future dividends accordingly:

$$P_0 = \frac{D_1}{(1+k)} + \frac{D_1(1+g)}{(1+k)^2} + \frac{D_1(1+g)^2}{(1+k)^3} + \ ... + \frac{D_1(1+g)^{N-1}}{(1+k)^N} \qquad (Equation\ 2)$$

This is a geometric progression series that can be simplified quite easily. Through multiplying the first term by (1 - (common ratio)^N) then dividing it by (1 - common ratio) we get the following equation:

$$P_0 = \frac{\frac{D_1}{(1+k)}\left[1 - \left(\frac{1+g}{1+k}\right)^N\right]}{1 - \frac{1+g}{1+k}} \qquad (Equation 3)$$

Due to the fact that we are summing up all future dividends, we know that N goes to infinity and simplifying the expression once more presents what is known as Gordon's formula.

$$P_0 = \frac{D_1}{k-g} \qquad (Equation\ 4)$$

The expression above is also known as the constant growth model or the single-period model. This is merely because it assumes the stock to only have one constant growth rate throughout its existence. There exists even a two and three-period model where one expects the growth to be exceptionally high/low the first couple of periods, then after the company becomes well established on the market it enters a constant, usually lower, growth rate.

The relationship between dividend payments and expected earnings per share is not complex. When multiplying the dividend quote (*d*) with this year's earnings per share (*EPS_0*) adjusted by the expected growth in earnings (*1+g*), the product will give the expected dividend (*D_1*).

$$D_1 = d \times EPS_0(1 + g) \hspace{3cm} \textit{(Equation 5)}$$

Substitute this into Gordon's formula, equation 4. Given that last year's earnings per share is used, this is seen as a trailing P/E-ratio:

$$P_0 = \frac{d \times EPS_0 \, (1+g)}{k-g} \quad \rightarrow \quad \frac{P_0}{EPS_0} = \frac{d \times (1+g)}{k-g} \hspace{2cm} \textit{(Equation 6)}$$

(Gruber, and Elton Ch. 19)

3.2 Problems and limitations with P/E ratios

Even though the P/E ratio is one of the most commonly used key performance indicators, risks do exist, such as limitations and pitfalls. The market value per share is pretty much out of anyone's control, and therefore difficult to temper with, however, earnings per share is computed by the company's accounting department and can easily fall subject to manipulation.

First of all when comparing P/E ratios it is extremely important to acknowledge the fact that growth rates between industries vary greatly. Companies within the same industry share many of the same attributes, and therefore tend to bundle up around very similar relative P/E ranking. Commodities are usually on the list of the lowest ratios while for example technology usually averages higher (Mladjenovic 165). When comparing stocks merely on the basis of their multiples, it is difficult to decide which is the better pick. However, they can be compared to its own industry's average and if it is lower or higher one can deduce whether it is undervalued or overvalued, respectively. (Goodman, and Peavy 60-66)

Earnings per share are based on an *accounting measure* that can often be deceitful. Companies that have had an especially good year for instance, might want to set off some of the profits for colder days by transferring money to their tax allocation reserves. This money

will be seen as costs on their income statement and thus reducing earnings after taxes. These funds can also be resolved to have the opposite effect.

Another way of manipulating profits is by performing inventory write-downs/ups. Depending on what the company wants to achieve, cutting or adding costs to the income statement by writing up or down, respectively, is another way of influencing earnings after taxes.

Inflation is known to have quite an influential impact on stock prices. Knowing that a stock is valued at by totaling all future dividends, an inflation amendment would obviously affect the present value of the future stream of cash flows. If inflation was to rise it would mean tomorrows cash flow is worth less today, and if tomorrows cash flow is worth less then all future cash flows are worth less and consequently the stock price would depreciate. From this fact we can deduce that higher inflation means the future growth will be "worth less" as it is being eaten up by inflation. In other words, investors will not be willing to pay the same price for the given growth as it is eroded away by inflation. P/E-ratios are built upon the future growth of earnings and we will find that these ratios fall in high inflation markets; same is true for low inflation markets. (Mehmet, and Kocaman 4)

3.3 Review of Earlier Studies

The price-earning effect is an anomaly well known and well studied. Many regard Benjamin Graham and David Dodd, both professors at Columbia Business School, as the fathers of value investing. Co-authors of the ground breaking book "*Security analysis*" published in 1934; they discovered that abnormal returns could be made by using fundamental analysis. This book advocates for a cautious approach to investing, by picking stocks that generally trade at discounts for example low P/E and P/B ratios, dividend yields and book-value. In 1949 Graham alone published a second book in which he further developed the strategies presented in its predecessor in 1934. Graham, "*The Intelligent Investor*" presented a thorough comparison of four different stocks on the basis of their P/E ratio, dividend yield and P/B ratio. This book has received much acclaim and investors such as Warren Buffet describes it as "by far the best book ever written on investing" (Benjamin, and Zweig vii)

In the 1960s S.F Nicholson specifically studied stocks price-earnings ratios. In his study over a five-year period during 1939-1959 he considered mainly 100 industrial stocks on the New York Stock Exchange. Nicholson rebalanced the portfolio every five years and reached the result that the low P/E portfolio delivered 14.7 times the investor's initial investment. (Nicholson S.F 43-45) A few years later, in 1968, he extended his study done in 1960 by

including another 89 industrial stocks, totaling 189 stocks. Depending on the size of the P/E ratio he divided these 189 stocks into five different groups, and again, followed them over five-year periods from 1937-1962. He found that the portfolio with multiples below 10 averaged 131% return compared to the portfolio with multiples above 20 averaging only 71% over the first seven years. (Nicholson S.F 105-109)

Not long after, in the late 1970s, an economist called Sanjoy Basu continued Nicholson's studies and discovered that stocks with low P/E ratios had a significantly higher return than their counterparts with high ratios (Siegel 149-150). Beginning 31st December 1956 to March 1971 Sanjoy Basu calculated the P/E ratio for every stock on the New York Stock Exchange. The total amount of companies trading during this time was about 1400; however, every sample stock selected out of the database of stocks had to fulfill his criteria. Firstly, the fiscal year-end of the company would have to be the end of December. Secondly, the firm was actually traded on the New York Stock Exchange, and thirdly relevant investment data and fiscal statements 60 months preceding the start of the portfolio were available. After ranking them from lowest to highest, he then proceeded to build 5 different portfolios out of the total 500 stocks that fulfilled the above criteria.

Most companies release their annual financial statements three months after the fiscal year ends, thus Basu decided not to purchase his portfolios until April 1st in order to avoid the market's reaction to these publications. This exact procedure was repeated annually for fourteen years, from April 1957 to March 1971. The portfolios were equally weighted and the monthly return of each portfolio was calculated over the following year (12 months) (Basu 663-682). The result from his research was the following:

> *"The low P/E portfolios, E and D, earned about 4,5% and 2% per*
> *annum respectively more than that implied by their levels of risk, while the*
> *high P/E portfolios earned 2,5-3% per annum less than that implied by*
> *their levels of risk. Furthermore, assuming normality, these differential*
> *returns are statistically significant at the 0.05 level or higher. …… As*
> *would be expected, all of the P/E portfolios are well diversified— the*
> *correlation coefficients for the return of the various portfolios and the*
> *market (Fisher Index) are all greater than 0.95. Consequently, the Sharpe*
> *measure (reward to-variability) also shows that the performance of the*
> *low P/E portfolios is superior to that of their high ratio counterparts."*
> *(Basu 668)*

Sanjoy Basu's result was remarkable as it conflicted with the efficient market hypothesis examined by Maurice Kendall and later Eugene Fama. In an efficient market one should not be able to make abnormal returns by basing an investment strategy merely on historical data, or any other technical analysis, the way Sanjoy Basu did. Evidently the market was not as efficient as it theoretically should have been.

Ball, in 1978, acknowledged the conclusions reached by Nicholson and Sanjoy Basu regarding the possible existence of a P/E effect. However, he argued that an investment strategy should not be based on the assumption that public information can be attained at little or no cost at all. He then proceeded to try and explain this effect by looking at various systematic errors, processing and transaction costs as well as a possible failure of CAPM.

Nine years later in 1986 Banz and Breen published a contentious paper criticizing all previous studies stating that the P/E effect was merely created by the biases existing in the COMPUSTAT database. Banz and Breen claimed that earlier studies suffered from two major biases, namely the survivorship bias and the look-ahead bias. The survivorship bias meant that businesses that merged, got delisted, or went bankrupt would not be presented in the COMPUSTAT database. The look-ahead bias meant that P/E ratios calculated at the end of the year was based on year-end-earnings that would not be available to investors until the following year when most annual reports are released. (Banz R.W, and Breen 779-93)

Banz and Breen continued by examining two different databases, one with and one without any biases. The COMPUSTAT database was to suffer from both survivorship and look-ahead bias while the second bias-free database was based on real-time collected data. When investigating the COMPUSTAT Database they discovered that the P/E effect was statistically significant. However, using the bias-free database they reached the conclusion that the price-per-earnings effect was no longer significant, and that this effect had been created solely by the biases existing in the database. (Jacobs, and Levy 165)

Fuller, Huberts and Levinson, in 1993, refuted Ball's argument made in 1978, and decided to include numerous possible explanatory factors provoking the low P/E portfolio's remarkable performance. Using a complex multi-factor to correct for systematic risk, 55 different industry classifications to correct for the industry effect and 13 different factors to allow for risk, the very same conclusion was reached. This meant that the superior performance of the low P/E

stocks did not depend on the included variables, and thus contradicted Ball's earlier stated argument. (Fuller R.J, Huberts L.C, and Levinson M.J 13-24)

In 1994 Lakonishok, Schleifer and Vishny carried out an extensive study on value and glamour stocks. Value stocks were defined as stocks that were considered low/under priced compared to a key indicator such as book-value or cash-flow. Companies were divided into two respective groups, value and glamour stocks and were assessed over the time period 1963 to 1990. Value strategies with low growth as well as low P/E ratios proved to perform better than glamour strategies by up to 10-11% per annum. The explanation reached by Lakonishok, Schleifer and Vishny was that value strategies utilize investors' sub-optimal behavior. (Lakonishok J, Schleifer A, and Vishny R 1541-78)

3.4 Capital Asset Pricing Model (CAPM)

When comparing P/E ratios it is essential to adjust for the different risks. In this study the capital asset pricing model will be used to adjust for risk, as this allows for a comparison between the actual return of the portfolio and the expected return computed by CAPM. This risk and return model has been in use the longest, and it is still to this very day used in most real-world analyses. (Aswath 69)

The general idea behind the Capital Asset Market Pricing model is that investors are compensated for risk and time-value of money accordingly:

$$\bar{R}_i = r_f + \beta_i[\bar{R}_m - r_f] \hspace{4cm} (\textit{Equation 7})$$

The formula above represents the expected return of a security according to CAPM. The first component of the formula consists of r_f (risk free rate) which is the compensation to investors for placing their money in any risk free assets, in other words the time-value of money. The second component of the formula illustrates the risk premium investors get for adding further risk to their portfolio.

The measure of risk, β, compares the asset's return to that of the market over a longer period of time, usually 48 months. The market portfolio has a beta value of one. Securities with higher and lower beta values should accordingly have higher and lower expected returns respectively. Another important part of CAPM is that rational investors in efficient markets have well diversified portfolios, nonsystematic risk tends to be close to zero, and the only relevant risk is the systematic risk measured by beta. (Investopedia ULC)

Assumptions

1. Investors are expected to make decisions solely based on terms of expected values and standard deviations of the returns on their portfolios.

2. Unlimited short sales are allowed

3. Unlimited lending and borrowing at the risk less rate. The investor can lend or borrow any amount of funds desired at a rate of interest equal to the rate for risk free securities.

4. All investors are assumed to define the relevant period in exactly the same manner and they are all assumed to have identical expectations.

<div align="right">(Gruber, and Elton 281)</div>

4.0 Methodology

4.1 Selection of stocks (formulation of database)

The number of stocks existing on the Stockholm Stock Exchange has augmented to about 300 companies compared to in 1778 when merely the exchange of goods and services took place (Stockholmsbörsens Historia). Out of the total 300 companies, 164 are represented in three major listings. Large Cap consists of stocks with values above one billion Euros, Mid Cap above 150 million but less than one billion Euros and Small Cap less than 150 million Euros.

Due to the fact that the other 130 companies are very small, often volatile growth companies establishing themselves in the market and the introduction as well as the delisting rate is higher amongst these companies I have selected to exclude them. Another reason is that many of these companies have very low or even negative earnings and consequently have either negative or extraordinarily high P/E ratios.

Certain companies such as Ericsson, Volvo and Investor have what is called "A" and "B" stocks. This is very much a unique system usually found only in the Nordic countries. "A" stocks are known to have a greater influential vote, usually by more than a factor of one to ten votes. The reason why "B" stocks exist is that companies can attain additional capital without diluting their own influence. When it comes to dividend payments however, they are both treated equally. It is usually these stocks that are traded by investors on the stock exchange, and is the reason why I have chosen not to include any "A"stocks. This limited my database by approximately 15 to 20 stocks per year.

One might believe that stocks with negative P/E ratios would be regarded as low ratios, but in fact it is the complete opposite. A negative value can only be produced when earnings per share are less than zero given that a stocks market price is always positive. Companies with low P/E ratios yet greater than zero usually reveal high earnings per share contrary to negative earnings. Due to this fact many disregard negative P/E ratios completely and replace them with either zero or not applicable instead. The companies with negative multiples for any given year in the database have therefore been excluded.

4.2 Constructing a portfolio

After deciding the number of stocks to include in the database the next decision was to select the number of stocks the low P/E portfolio would be composed of. In order to minimize the

risk exposure to one single industry, a well-diversified portfolio was required. The question remained as to how many stocks were necessary to balance the portfolios exposure to different industries risks? Going through previous papers written by economists such as Sanjoy Basu and Benjamin Graham, a portfolio consisting of somewhere between 10-30 stocks seemed fairly reasonable. However, this is quite a large interval, and discussions with my supervisor led to a figure of 25 stocks being agreed upon.

Selecting the 25 stocks to include in the portfolio was rather an easy process. After calculating the P/E ratio of all stocks included in the database for each respective year, they were simply ranked rising from lowest to highest. This meant that any stock having a positive P/E ratio for that year would be taken into account. The 25 stocks topping the list of lowest P/E ratios each respective year were selected. The lowest ratio averaged to just over 2 while the highest averaged to about 13.

Monthly data for each stock was gathered, from the earliest of January to the last day of December. The dates might have varied a little depending on whether the dates fell subject to weekends or bank holidays when the stock exchange is closed. In order to adjust the portfolio for risk a beta value for each stock is needed. Calculating this required at least 48 months of historic data. Not every company that qualified to enter the portfolio had such historic data as they might have been listed earlier than 48 months prior to the year in question. Such companies had to be replaced, as calculating a beta value would prove impossible. On average about 5 stocks had to be replaced every year. The importance of beta will be addressed in more detail later in this chapter.

The stocks were selected strictly on the basis of their P/E ratios. This might have caused a bias in the portfolio to invest in several stocks belonging to the same industry as certain industries tend to have lower P/E ratios. Disregarding this effect was intentional. The main scope of this study is to see if a P/E effect existed and not an industry effect. Secondly, it also proved extremely difficult to define the boundaries of certain industries and companies, as they often switched between industries over the period of time examined. For these two reasons normalizing P/E ratios to any type of industry was considered irrelevant.

4.3 Restructuring of portfolio

Sanjoy Basu chose to restructure his portfolio annually and the decision was made to follow in his footsteps. Companies generally have dividend payments only once a year, either during autumn or the fall. In order to attain this payment it made sense to hold the stock for the

whole year so that the specific time of the dividend payment would not affect the portfolios performance.

This in total led to 10 observations, nine when restructuring over the period 2000-2009 plus one when including the final sale of the whole portfolio at the end of 2009. The portfolio was sold at the end of each year to the latest accessible stock price in December. At the same date the P/E ratios were calculated, and the stocks with the 25 lowest ratios were purchased the first available date in January of the following year.

4.4 Dividend payments, bankruptcies and mergers

During the year events such as dividend payments, stock splits, initial public offerings, bankruptcies and/or mergers might have occurred. Since these all directly affect the return of a stock it was crucial to this study to find out if any of the following events had taken place during the investment period.

Dividend payments occur at different times during the year. Most dividends as stated earlier, are usually paid out to shareholders during spring although it might occur during summer or autumn as well. By having dividend-paying stocks in the portfolio meant that a certain amount of money would be distributed before the year ends. Due to the complications of reinvesting the money back in stocks I decided to invest them in a risk-free asset earning a risk-free interest rate. With help from companies' annual fiscal statements it was possible to find the exact size and month of the dividends. This enabled me to place the dividends in a risk-free asset for the remaining months before the portfolio was sold at the end of the year. Although the rate earned might have been minimal it provides for a more accurate calculation.

Bankruptcies among companies in Large, Medium and Small Cap are very rare. Companies of this scale are usually bought by others in the same industry in an attempt to increase their own market share. If bankruptcy were to happen it would have to be counted as the entire initial investment having been lost, in other words a return of negative 100 percent.

Mergers occur when two or more companies decide to unite and join forces. This is quite a frequent occurrence, and it is often a result of companies wanting to reduce competition and increase market share as well as saving costs. Knowing that there exists a survivorship-bias in the DataStream database, such mergers are difficult to incorporate. DataStream stores no historic data for companies that do not currently exist. For this reason only companies that currently existed as from 2010 have been included in this study. In the prevalence of a

company name change the stock's previous name will simply be swapped for the new company name.

Stock splits can take place when the company needs cash to invest or wants to bring the stock price down to a more feasible level. The opposite of a stock split is called a reverse stock split. A company can issue a reverse stock split in order to reduce the voting power of shareholders or to increase the price when in danger of being de-listed. Also initial public offering (IPO), might have taken place during the ten year period. However, such events are already integrated in the DataStream database, and are therefore in the low P/E portfolio.

4.5 Comparison Index

In order to evaluate if the low P/E portfolio has actually beaten index, it has been compared to two different indices on the Stockholm Stock Exchange. In this study I have chosen to compare the portfolio of two different indices mainly Affärsvärldens General Index (OMXAFGX) and SIX Return Index (SIXRX).

Affärsvärldens generalindex (OMXAFGX):

"The index measures the average stock performance on the Stockholm Stock Exchange and is therefore a suitable benchmark for the progress of Swedish stock portfolios. Many Swedish fund consultants choose to use just this index as comparison. The OMXAFGX index is capital-weighed which means every stocks weight is in proportion to its market capitalization." (Åsberg)

Even though dividend payments are excluded in this particular index, the OMXAFGX has been chosen based on the frequent utilization of it by the market. However, in the low P/E portfolio dividends are included, and thus a dividend adjusted index will provide a more exact comparison. For this reason the portfolio is also being compared to a second index.

SIX Return Index (SIXRX):

"SIXRX has been constructed on the basis of mirroring the company's performance on the Stockholm Stock Exchange. This index reflects the return attained considering dividend payments received during the year." (SIX Telekurs Nordic AB)

4.6 Beta value (β)

The beta value used in this analysis of the P/E effect has been calculated on the basis of 48 months historic data. In order to calculate beta one also needs historic data of the market which was found using OMX Stockholm (OMXS) – price index.

The following formula was used:

$$\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)}$$
 (*Equation 8*)

Stocks which did not have such historic data had to be excluded. Comparing companies which beta value has been calculated under different circumstances (projected and actual) would influence the legitimacy of the study. Referring back to the study done by Sanjoy Basu to support my reasoning, he required companies to have no less than 60 months of historic data. The reason for this is that it otherwise proves difficult to calculate the expected returns for the portfolio.

4.7 Risk-Free Interest Rate

When placing the dividend payments into a risk-free asset as well as when calculating the expected return, the risk-free interest was set equal to the average of a 12 months treasury bill. The interest rate was found on Riksbanken's[1] homepage for each year, and gives a fairly good representation of the risk-free rate during each period.

4.8 Expected Return (CAPM)

The portfolios expected return has been calculated through using the Capital Asset Pricing Model or CAPM. This model is very popular, and to this very day is still seen by many financial institutions as the better choice, and is thus the reason why it has also been used in this study.

By calculating the expected return it is possible to assess whether the portfolio performed well or worse than expected. Another reason for its importance is that it accounts for different risk levels in respect to the calculated return. The following equation was used to calculate the expected return:

$$\bar{R}_i = r_f + \beta_i[\bar{R}_m - r_f]$$
 (*Equation 9*)

---

[1] Central Bank of Sweden

The risk free rate has been collected from the central bank in Sweden's webpage as an average throughout the respective years, and the beta values have been calculated on the basis of 48 months historic data. The third variable, market premium, has been collected from PricewaterhouseCoopers (PWC) for each respective year.

Jensen's index, also known as Jensen's alpha, was then used to risk adjust the low P/E as well as both market portfolios. By using the expected return calculated by CAPM and the following formula for Jensen's index a better comparison could be made allowing for portfolio risk.

$$\alpha_i = R_i - (r_f + \beta_i[\bar{R}_m - r_f])$$
(*Equation 10*)

4.9 Significance Test

In order to decide if the low P/E portfolio is a working strategy, a comparison between the two given indices, Affärsvärlden and SIX Returns, and the low P/E portfolio had to be conducted. Due to the fact that the given portfolio and the indices will have different risks, the risk adjusted returns will have to be used. There exists a thorough explanation of how the risk adjusted return is calculated under section "expected return" on page 20.

The purpose of this study is to examine whether it is possible to make abnormal returns using an investment strategy in which only stocks with low P/E ratios are purchased. When computing a statistical test to check if there is a statistical significant difference between the low P/E portfolio and both indices a hypothesis must be formulated.

> **H$_0$:** There exists *no* significant difference between the risk adjusted low P/E portfolio and two risk adjusted indices;
>
> **H$_1$:** There exists *a* significant difference between the risk adjusted low P/E portfolio and two risk adjusted indices.

After formulating the hypotheses a series of different significant tests can be carried out. In this examination a T-test will be conducted at a 99% significant level, or a risk level of 1%, due to small number of observation in the given sample. This in other words, means one out of a hundred times one will find a statistically significant difference, even when there actually is none.

To calculate the means, the following formula is used:

$$X = \frac{x_1 + x_2 + \ldots + x_n}{n}$$
(*Equation 11*)

To calculate the standard deviation, the following formula is used:

$$S = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(X_i - X)^2}$$
(*Equation 12*)

As mentioned earlier in this study, normally distributed returns are assumed. Given the condition that the returns are normally distributed, it is possible to conduct a T-test to test whether the means are statistically different, again at a 99% confidence level. The following formula is used to compute the T-value.

$$T = \frac{(X - \mu)}{S/\sqrt{n}}$$
(*Equation 13*)

The computed T-value is then used to find a P-value, also known as a critical value, in a table of significance. If the P-value is lower than the statistical significance chosen, the null hypothesis is discarded. (Wahlgren, and Körner 162-165)

5.0 Results

5.1 Actual Returns

Below the performance of the low P/E portfolio, OMXAFGX and SIXRX index is presented in a table displaying the actual return at the end of each successive period.

Date (Period)	Low P/E Actual Return	OMXAFGX Actual Return	SIXRX Actual Return
29.12.2000	28,8287 %	-12,7380 %	-11,3476 %
31.12.2001	6,7132 %	-16,6679 %	-14,8422 %
31.12.2002	-10,9875 %	-37,2640 %	-35,9030 %
31.12.2003	49,1884 %	29,7335 %	34,1523 %
31.12.2004	49,0312 %	18,4062 %	20,7501 %
30.12.2005	52,9357 %	26,9595 %	35,4117 %
29.12.2006	31,8879 %	24,4236 %	27,9993 %
31.12.2007	12,9596 %	-6,8187 %	-2,5962 %
31.12.2008	-33,0574 %	-42,0552 %	-39,0501 %
31.12.2009	121,0371 %	46,4132 %	52,5079 %
Average	30,8537 %	3,0392 %	6,7082 %

Table 1: **Low P/E portfolio, OMXAFGX and SIXRX index
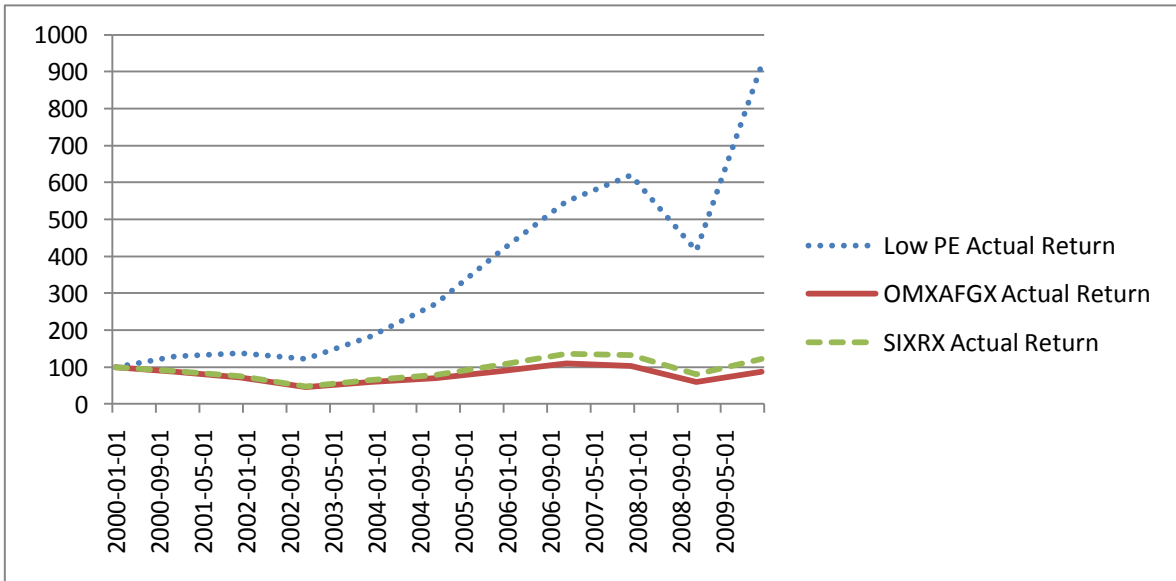actual return for periods (2000-2009)**

Table: 1 clearly indicates that the low P/E portfolio outperformed the two comparison indices with an average actual return of 30, 8% in respect to 3, 0% and 6, and 7%. Another interesting aspect regarding these results is how much the OMXAFGX and SIXRX differ, emphasizing the significance of dividend payments.

Table 2: Shows the accumulated actual return of each investment. Investing 100 dollars in the low P/E portfolio, OMXAFGX and SIXRX in year 2000 would have totaled a worth of $917, 27, $87, 51 and $123, 01 by 2009 respectively. As anticipated there is a giant leap between the low P/E portfolio and both indices. However, it is worth noting the accumulated return of OMXAFGX is negative going down from $100 to $87, 51. This illustrates that the above average is merely an average of the different periods return and not an average of the investments return, which in this case would be -12,5%.

Date (Period)	Low P/E Actual Return	OMXAFGX Actual Return	SIXRX Actual Return
01.01.2000	100	100	100
29.12.2000	128,8286828	87,26198705	88,65242189
31.12.2001	137,4772129	72,71727518	75,49445248
31.12.2002	122,3718733	45,61993339	48,38965977
31.12.2003	182,5646928	59,18431471	64,91586504
31.12.2004	272,0784347	70,07792371	78,38597089
30.12.2005	416,1051346	88,970613	106,1437933
29.12.2006	548,7922377	110,7003997	135,8632666
31.12.2007	619,9136702	103,1520942	132,3360336
31.12.2008	414,9866247	59,77130689	80,65868994
31.12.2009	**917,2746016**	**87,51307188**	**123,010841**

Table 2: **Low P/E portfolio, OMXAFGX and SIXRX index accumulated actual return for periods (2000-2009)**

The accumulated actual return for each respective investment can also be presented in a period versus returns graph.

Graph 1: **Low P/E portfolio, OMXAFGX and SIXRX index accumulated actual return for periods (2000-2009)**

5.2 Risk Adjusted Returns

Table 3: The risk adjusted returns for each of the three alternatives are presented. In this table the actual return has been adjusted using CAPM and Jensen's Performance Index. With respect to risk, it is still clear that the low P/E portfolio performed better than its other counterparts.

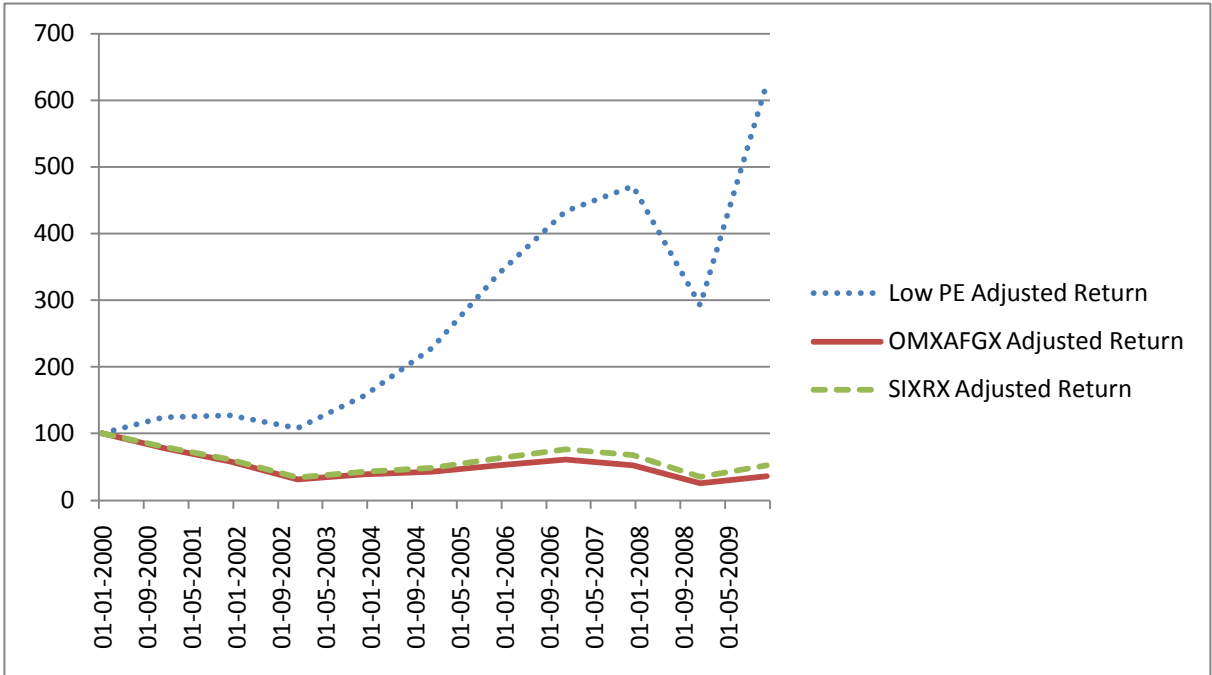| Date (Period)	Low P/E Adjusted Return	OMXAFGX Adjusted Return	SIXRX Adjusted Return
29.12.2000	0,244413615	-0,215352129	-0,201447781
31.12.2001	0,023426248	-0,252931669	-0,234674996
31.12.2002	-0,154238394	-0,460937675	-0,447328257
31.12.2003	0,454444719	0,220633527	0,264822486
31.12.2004	0,455816559	0,117848434	0,141286984
30.12.2005	0,489821912	0,207742449	0,292264224
29.12.2006	0,276822552	0,171806551	0,207563568
31.12.2007	0,087042649	-0,148968795	-0,106743638
31.12.2008	-0,380226587	-0,507331688	-0,477280926
31.12.2009	1,137012673	0,404420812	0,465367589
Average	**26,3434 %**	**-4,6307 %**	**-0,9617 %**

Table 3: **Low P/E portfolio, OMXAFGX and SIXRX index risk adjusted return for periods (2000-2009)**

Table 4: Presents the accumulated risk adjusted return, which helps to understand how the investment strategies truly performed. Investing 100 dollars in the low P/E portfolio, OMXAFGX and SIXRX in 2000 would have totaled a total worth of $624, 63, $35, 93 and $52, 06 by 2009 respectively. Investing in the market portfolio index, the return is negative while for the low P/E portfolio it is still very positive.

Date (Period)	Low P/E Adjusted Return	OMXAFGX Adjusted Return	SIXRX Adjusted Return
01.01.2000	100	100	100
29.12.2000	124,4413615	78,46478705	79,85522189
31.12.2001	127,3565558	58,61855749	61,11519801
31.12.2002	107,7132851	31,59905589	33,77664298
31.12.2003	156,6630187	38,57086704	42,72145753
31.12.2004	228,0726169	43,11638331	48,7574434
30.12.2005	339,7875822	52,07348636	63,00749976
29.12.2006	433,8484478	61,02005243	76,08556123
31.12.2007	471,611766	51,92996874	67,96391161
31.12.2008	292,292434	25,58425006	35,52603294
31.12.2009	**624,6326359**	**35,93105325**	**52,05869723**

Table 4: **Low P/E portfolio, OMXAFGX and SIXRX index accumulated risk adjusted return for periods (2000-2009)**

The graph below shows the accumulated adjusted return for each of the following investment alternatives during the period examined.

Graph 2: **Low P/E portfolio, OMXAFGX and SIXRX index accumulated risk adjusted return for periods (2000-2009)**

It can be seen that the adjusted accumulated return of the low P/E portfolio follows the same trend as both indices. During the period 2002-2007 both indices show a positive growth, however, the low P/E portfolio has a much higher return, and leaves a big gap between the two. In the financial crisis all three loose great value, but the low P/E quickly recovers and during the stimulation packages of 2009-2010 takes off again.

Whether the low P/E strategy beats index will have to be statistically proven. However, the fact that the portfolio outperformed index in every period the result should already at this point be quite evident**.**

5.3 Significance Test

In order to assess whether the low P/E portfolio outperformed both its comparison indices a T-test was conducted. The risk level, or levels of significance was first set to 10, 0% and if the difference proved to be significant another test with a lower risk level was done. The tables below show that the "t Stat-value" (p-value) of the low P/E portfolio exceeds the chosen "t Critical two-tail-value". This proves that the low P/E portfolio is significantly different to both indices at a risk level of 1, 0%.

T-test: Paired Two Sample for Means (1,0% Risk Level)	Low P/E	SIXRX
Mean	0,263434	-0,0096171
Variance	0,173988	0,10768706
Observations	10	10
Pearson Correlation	0,914237	
Hypothesized Mean Difference	0	
df	9	
t Stat	4,873361	Significant
P(T<=t) one-tail	0,00044	
t Critical one-tail	2,821438	
P(T<=t) two-tail	0,000879	
t Critical two-tail	3,249836	

T-test: Paired Two Sample for Means (1,0% Risk Level)	Low P/E	OMXAFGX
Mean	0,263434	-0,04630702
Variance	0,173988	0,09774959
Observations	10	10
Pearson Correlation	0,918106	
Hypothesized Mean Difference	0	
df	9	
t Stat	5,452205	Significant
P(T<=t) one-tail	0,000202	
t Critical one-tail	2,821438	
P(T<=t) two-tail	0,000405	
t Critical two-tail	3,249836	

6.0 Analysis

In the first part of the results when merely looking at actual returns, a $100 investment in the low P/E ratio portfolio was worth $917,27 after 10 periods compared to $87,51 (AFMGX) and $123,01 (SIXRX) for the respective comparison indices. After risk adjusting the actual return, the results were equivalent. A $100 investment in the low P/E ratio portfolio was worth $624, 63 compared to $35, 93 and $52, 06 respectively. Even after adjusting the risk factor the low P/E portfolio out performed both indices. Graphs 1 and 2 illustrate all three investment strategies performance both before and after risk adjusting, and the result is unambiguous.

The result after conducting a test of significance, at a risk level of 1, 0 %, was that a statistically significant difference was found between the low P/E portfolio and both the AFMGX- and SIXRX-index. In other words, with a 99, 0% probability there exist a price per earnings effect on the Stockholm Stock Exchange during the time period mentioned and studied.

Having reached the following results, can one confirm the existence of a P/E effect? According to Maurice Kendall and his proposition of the efficient market hypothesis stocks follow a random pattern and move independently of each other. If this is true it should be impossible to foresee future price movements, as the best predictions of tomorrows price, equals today's price. Does this mean that the Swedish Stock Market is not as efficient as it theoretically should be? Before discussing these very important questions I will address the factors mentioned under "1.3 limitations" that might have affected the final result.

Transaction costs and taxes

Transaction costs and taxes have been excluded, which was one of the limitations in this study. However, I would like to point out the importance of doing so. The portfolio is restructured every year, adding to 50 transactions annually, the total brokerage would add up to a substantial amount. The Swedish government also taxes dividend payments and net profits by 30, 0%. Neither dividends nor any profits have been subjected to tax, thus positively affecting the final outcome.

Survivorship and look-ahead bias

The biggest bias influencing the result is the so called survivorship-bias. Companies that performed badly or went bankrupt and were de-listed from the stock exchange as a result, never entered the database. This way the possibility of investing in such badly performing

stocks was impossible. For this very reason the survivorship-bias increases the potential return of the low P/E portfolio.

The second bias, though not directly affecting the result, is the look-ahead bias. P/E ratios are calculated using year-end stock prices divided by last year's earnings. The company's annual reports stating last year's earnings usually are not released until a few months after the fiscal year end which means the computed P/E ratio would not be available to the public on the 1st January. By investing in these stocks in early January, one is basing the investment decision merely on information that is actually not yet available.

Industry effect

In this study such an industry effect has not been taken into account for the very reason that it is outside the scope of this study. Companies have been known to jump between industries during the year, further complicating the study, and another reason for not taking this into account.

However, companies from the same industry tend to cluster around fairly similar multiples and thus many of the stocks included in the low P/E portfolio might be from the same industry. This will definitely affect the diversity of the portfolio, although determining whether the effects are negative or positive is difficult. Over representing one specific industry will increase the portfolio's risk and one may argue that Jensen's alpha will correct this bias.

Banz and Breen found that in a bias-free database the P/E effect was not statistically significant, however it was found to be significant in the COMPUSTAT database. They reached the conclusion that a P/E effect was created merely by the biases existing in the COMPUSTAT database. Using a database suffering from the exact same biases as Banz and Breen parallels between their findings and mine can be drawn. Trying to quantify how much these factors influenced my results would prove extremely difficult; however it is clear that there has been an overall positive effect. It is now possible to clarify the questions earlier left unanswered. The result in this study clearly provides evidence for the existence of a P/E effect. It is very unlikely that the effect created by these biases exceeds the percentage by which the low P/E portfolio outperformed both indices, again confirming the existence of a

P/E effect. Being able to outperform the market index by using historic data also proves that the Stockholm Stock Exchange is somewhat inefficient. Eugene Fama argues that all markets are theoretically efficient. This is based on the assumption that the cost of acquiring information is zero; however, gathering and assessing information is in fact rather a costly exercise. Elton and Gruber argue that a stock's price will reflect the information to the point where the marginal costs of obtaining information equals the marginal benefit. For this very reason reaching the result that the Stockholm Stock Exchange is somewhat inefficient is a rather respectable result.

7.0 Conclusion

The purpose of the study was to assess whether a price per earnings effect existed on the Stockholm Stock Exchange during 2000-2009. A fictional low P/E ratio portfolio was constructed using ex-post data and then compared to two different indices. After confirming that the risk adjusted return of the low P/E portfolio was statistically significantly different to its comparison indices, at a risk level of 1, 0%, it is evident that a price earnings effect did indeed exist during the given time period above. However, it is of the outmost importance, to point out that these results are only justifiable under the circumstances subjected to the given assumptions and limitations.

After analyzing the results it became apparent that most of the assumptions and limitations had a positive effect on the results. Financial institutions, besides investing earn money from facilitating transactions between sellers and buyers so-called brokerage or transaction fees. Excluding such percentage fees from the low P/E portfolio resulted in an enhanced annual performance, when in fact it should in reality be a little percentage lower. The major bias in this study is, as discussed in the analysis, the survivorship bias. This bias is somewhat more difficult to quantify into a percentage, but due to its characteristics has definitely amplified the low P/E portfolio's total return.

The results indicated that the market is not as efficient as it theoretically ought to be. In theory, stock prices follow a random path and are therefore impossible to predict with historic data. An efficient market assumes that the costs of obtaining information are zero; however, these results might just prove that markets in reality are inefficient due to the fact that gathering and assessing information is actually quite costly. Thomson Reuters's whole business strategy for example evolved around the principal of selling information other companies might find valuable. Banks as well as funds pay large sums of money for applications such as instant news-feeds and access to enormous historic databases. This business has proven to be very lucrative and has generated billions of dollars in turnover, and provides a good example for the significance of acquiring information.

Further research might try to limit some of the restrictions and assumptions this study is based upon. Restructuring the portfolio more often would provide more observations, and thereby reducing the variance, and instead of assuming normally distributed returns one could conduct a test of normality to find out. It would also be interesting to construct a new database, in which a survivorship-bias does not exist, which is believed to be the main bias in the study. Storing and enabling access to daily historic data even for those companies that have previously gone bankrupt, merged or been de-listed would correct for this.

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