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- Bachelor Thesis -

The Performance of SPI Stocks in Relation to their P/E Ratios

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Management Summary

The efficient market hypothesis (EMH) asserts that stock markets are price efficient, meaning that in an efficient capital market, security prices fully reflect available information and no investor can make abnormal profit out of it. While there is substantial empirical evidence supporting the EMH, many still question its validity. Proponents of the price-earnings (P/E) ratio hypothesis claim that low P/E stocks tend to outperform high P/E stocks. Moreover, the returns of low P/E stocks tend to be larger than warranted by their underlying risks. This conclusion is difficult to reconcile with the efficient market hypothesis and is therefore often referred to as efficient market anomaly. The goal of this paper is to determine whether low P/E ratio stocks outperform high P/E ratio stocks (which is formally called the price/earnings ratio hypothesis) in the Swiss stock market by considering data spanning from 2005 to 2015. Moreover, this thesis intends to prove that low P/E portfolios are able to generate excess returns compared to the market and to investigate the extent to which an abnormal return can be generated by investing in the portfolio with the lowest price/earnings ratio (in terms of the CAPM). For any given year under consideration, four portfolios consisting of 25 stocks with similar P/E ratios were formed. Each of these portfolios can be seen as a mutual fund having a strategy of purchasing securities in the given P/E quartile on January 1, holding the portfolio for one year, and then liquidating and reinvesting the proceeds in the same quartile portfolio (on January 1) in the following year. The research is split into two parts: In a first step, the returns are compared on a absolute performance basis, whereas the second part adjusts the returns to their corresponding risks and subsequently splits the results into a pre- and post-financial crisis section. During the 11-year period under investigation (2005–2015) the low P/E portfolios earned higher average absolute and risk-adjusted rates of return (considering total- and systematic risk) than the high P/E portfolios. Furthermore, low P/E portfolios were able to generate significant excess returns compared to the market. While the price/earnings ratio hypothesis is not fully confirmed by the pre-financial crisis section, the post-financial crisis section does underline the higher absolute and risk-adjusted returns of the low P/E portfolios. Nonetheless, the low P/E portfolios managed to outperform the market significantly in both sections. In conclusion, the “P/E effect” seemed to exist for stocks within the Swiss Performance Index during the period 2005-2015, and therefore the price/earnings ratio hypothesis may be considered as validated. Furthermore, the

findings of this paper suggest that P/E ratio information was not “fully reflected” in security prices as postulated by the efficient market hypothesis. Further research could apply other risk-based models, such as multifactor asset pricing models, to verify if the derivations from CAPM are truly due to mispriced securities or simply a result of a failed risk adjustment procedure of CAPM.

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1 Introduction

The investment into stocks was bound to be a disorganized activity until the crash of the stock market in 1929. Aiming to tackle this problem, Columbia Business School professors Benjamin Graham and David Dodd started to create a robust framework for stock market investments. Graham and Dodd (1934) developed a few basic principles to analyze a company's fundamentals, and established a concept of value investing and security analysis in their famous work called *Security Analysis*. Value investors invest in stocks that are trading below their intrinsic value. The difference between a stock's intrinsic value (i.e., price a well informed investor would pay) and the market value is called the margin of safety. The higher the margin of safety, the lower is the chance of losing money with an investment. Value strategies call for investing in companies which have low prices relative earnings, dividends, book assets or other measures of value (Lakonishok, Shleifer, & Vishny, 1994). In the past decades, many academics and practitioners have shown a great interest for testing the performance of the so-called value strategies.

Different ratios, used as valuation measures, have been examined to determine whether value stocks are able to outperform growth stocks (see Basu, 1977; Banz, 1981; Fama and French, 1988, 1992; Chan et al., 1991; Lakonishok et al., 1994; Hejazi and Oskouei, 2007; Abhyankar et al., 2008; Larkin, 2009).

A substantial part of the academic literature identifies extensive evidence that value strategies generate excess returns. A distinctive difference between the returns of value portfolios and growth portfolios has been recognized across various time periods and in several equity markets around the world. More precisely value stocks or stocks with low ratios of market-to-book (MB), price-to-earnings (PE), or price-to-cash flow (PCF) earn higher average returns than growth stocks, meaning stocks with high corresponding ratios (e.g. Rosenberg et al., 1985; Chan et al., 1991; Fama and French, 1992; Lakonishok, Shleifer, and Vishny, 1994).

Whereas studies were initially limited to US stock market data, growing international evidence also underpinned the existence of a value premium (see Chan et al., 1991, 1993; Capaul et al., 1993; Fama and French, 1998). While there is some agreement that value strategies work, there are still considerable debates about the

reasons behind the value premium that is observed. Existing literature mainly distinguishes between risk-based and behavioral-based explanations.

On the one hand De Bondt and Thaler (1985) and Haugen (1995) argue that value strategies might work because they are different than the naive strategies followed by other investors. These naive strategies might range from extrapolating past earnings growth into the future and following a trend in stock prices to overreacting to certain news; some simply equate a good investment with a well-run company without considering the price. Regardless of the reason, some investors tend to falsely put their focus on stocks that have done very well in the past. As a result, these 'glamor stocks' immediately become overpriced. Similarly, investors may overreact to stocks that have done very badly by overselling them, which results in these out-of-favor value stocks becoming underpriced.

Contrarian (value) investors go against the strategies of naive investors. They invest disproportionately in out-of-favor stocks because the stocks offer good investment opportunities, and they underinvest in stocks that are overpriced. This can be seen as one reason why they outperform the market (Lakonishok, Shleifer, & Vishny, 1994).

On the other hand, Fama and French (1992) and Ball and Kothari (1989) argue that the reason why value strategies work might be that they are fundamentally riskier. Particularly traders investing in value stocks such as high book-to-market stocks, tend to bear higher fundamental risk. In other words, their higher-than-average returns simply compensate for this extra risk. Whether value strategies work because they are contrarian to naive strategies or because they are fundamentally riskier, this remains a much-debated issue.

Furthermore, the value premium can also be associated with survivorship bias (Kothari, Shanken, & Sloan, 1995) and data snooping biases (Lo & MacKinlay, 1990).

The assumption that stocks with low ratios of market-to-book, price-to-earnings, or price-to-cash flow outperform stocks with high corresponding ratios, even if returns are adjusted for portfolio beta, is quite contradictory to the efficient market hypothesis and is therefore often referred to as efficient market anomaly. Ultimately, this would confirm that the market systematically mis-prices stocks according to these ratios. This would be an extremely disturbing conclusion to many, because any information that could be used to predict stock performance should already be reflected in the stock

price, and therefore a relationship between these ratios and the subsequent returns should not exist if the market is efficient.

To the best of my knowledge, no attempt has been made thus far to examine the well-known market anomaly of the "P/E effect" in the Swiss stock market. Against this background, the goal of this Bachelor's thesis is to determine whether low P/E ratio stocks outperform high P/E ratio stocks (which is formally called the price/earnings ratio hypothesis) in the Swiss stock market by considering data spanning from 2005 to 2015. Above all, this paper aims to review the validity of the price/earnings ratio hypothesis in the 21st Century in a persistent low- or zero-interest environment and in a period of slow economic growth. Moreover, this thesis intends to prove that low P/E portfolios are able to generate excess returns compared to the market and to investigate the extent to which an abnormal return can be generated by investing in the portfolio with the lowest price/earnings ratio (in terms of the CAPM).

This paper is organized as follows: Firstly, certain fundamentals of the P/E ratio and the efficient market hypothesis (EMH) are described. In the second part, the existing literature related to this topic is analyzed and discussed. This section is split into two parts: In a first step, the focus is on research results within the American market, in a second step, findings for the rest of the world are discussed. Next, the data set produced for this thesis and the research methodology is explained in detail. The data set is analyzed and findings are presented and discussed in the subsequent chapter. Absolute performance figures are compared, multiple risk-adjusted performance measures within the CAPM are calculated and the accuracy of the hypothesis is closely examined. The paper concludes by a summary of the findings and some final thoughts on the issue.

2 Theoretical Background

To a better understanding of the interdependencies and the further steps in this paper, certain essentials are outlined.

2.1 Fundamentals of the P/E Ratio

Fundamental analysts use models to uncover mispriced securities. In practice, these models estimate the fair market value of a corporation's stock from observable market data and from the financial statements of the firm and its competitors. These valuation models differ in the specific data they use, but most of them use the notion of valuation by comparables: They look at the relationship between price and various determinants of value for similar firms and then extrapolate that relationship to the firm in question (Bodie, Kane, & Marcus, 2013, p. 406). The price/earnings ratio, commonly called the P/E ratio, is probably the most widely used measure of valuation amongst fundamental analysts and investment advisory services. It is simply calculated by dividing the current market price of the stock by the latest twelfth-month earnings and indicates how much a stock purchaser is willing to pay per dollar of the past earnings.

Although focusing on the balance sheet provides useful information about a firm's liquidation value or its replacement costs, the analysts usually must turn to quantitative models to estimate the value of a common stock based on expected future cash flows. Mispriced securities are traded below their intrinsic values – so if the stock is underpriced compared to its intrinsic value, it provides more than a fair rate of return relative to its risk (in terms of CAPM it is a positive alpha stock). The intrinsic value of a stock is defined as the preset value of all cash payments to the investor in the stock, including dividends as well as the proceeds from the ultimate sale of the stock, discounted at the appropriate risk-adjusted interest rate (k). The dividend discount model (DDM) uses only the expected future dividends to determine the intrinsic value of a stock. The reason is not that capital gains are ignored but it assumes that those capital gains will be determined by dividend forecasts at the time the stock is sold (Bodie, Kane, & Marcus, 2013, p. 407-408). Due to the impossibility to forecast yearly dividends into the indefinite future, Gordon and Myron introduced some simplifying assumptions in their constant-growth DDM. It is assumed that dividends (D) are trending upwards at a stable growth rate (g). Ultimately, the intrinsic value is calculated as follows:

$$V_0 = \frac{D_0(1+g)}{1+k} + \frac{D_0(1+g)^2}{(1+k)^2} + \frac{D_0(1+g)^3}{(1+k)^3} + \cdots$$

This equation can be simplified to

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

If the constant-growth DDM formula, where g = ROE * b, is now accompanied with the definition of, b = proportion of retained earnings, and the fact that dividends equal the earnings that not reinvested in the firm, $D_1 = E_1 * (1 - b)$, the P/E ratio can be formulated as follows:

$$\frac{P_0}{E_1} = \frac{1-b}{k-(ROE*b)}$$

ROE = Return on equity

b = plowback ratio (proportion of earnings that is not paid out as dividend)

When the ROE increases, simultaneously the P/E ratio raises, as high ROE projects offer growth opportunities for the firm. Furthermore it can be verified that the P/E ratio increases for higher plowback, b, as long as ROE surpasses k. Thus, a firm is rewarded with a higher P/E ratio when good investment opportunities can be seen (Bodie, Kane, & Marcus, 2013, p. 422).

An important implication of any equity valuation model is that riskier stocks will have lower P/E ratios (holding all else equal). To make this clear, the above formula is simplified as follows:

$$\frac{P}{E} = \frac{\frac{D}{E}}{k-g}$$

The lower P/E ratio is caused by the fact that riskier firms will have higher required rates of return (k). This also holds true beyond the constant-growth model, because any expected cash flow stream results in a lower present value for higher perceived risk.

Even the evidence that many small, highly risky start-up companies have very high P/E ratios does not contradict our assumptions that P/E multiples should fall with risk. Instead, it is triggered by the market's expectations of high growth rates. For this reason the assumption included *holding all else equal* (Bodie, Kane, & Marcus, 2013, p.

425). Summarizing the above, the P/E ratio reflects investors' expectations about the growth potential and risk of a stock. However, it is possible that growth prospects offset the risk and thus lead to higher P/E ratios. Ahmed (2003, p. 3) provides a fitting example to this debate: "The Internet companies that were so popular in the late 1990s were clearly extremely risky, but investors valued their potential and growth prospects very highly, and were willing to pay very high prices for these companies".

Programs as Bloomberg or Morningstar calculate the so-called trailing ratio. They consider the stock's earnings of the previous twelve months, representing historical data. In this thesis, however, data for trailing P/E ratios have been implemented.

As mentioned at the beginning of this section, this backward-looking ratio is based on the firms' financial statement and should not be confused with the forward-looking P/E multiple emerging from a dividend discount model.

As we now know the P/E ratio indicates how much a stock purchaser is willing to pay per dollar of the past earnings. So, if the P/E ratio of a firm is low, earnings can be acquired more cheaply. They can be cheap because they are in serious financial trouble; a lower rate of return or a decrease in future cash flows is expected. In a minority of cases they may be unfairly under-rated. The latter are the ones that appeal to value investors, who invest in stocks trading below their intrinsic value. Value investor Warren Buffet, for example, has made a fortune with investing in underpriced stocks.

Different P/E ratios among companies

P/E ratios are affected by many factors, especially through interest rates and business cycles. This explains the considerable fluctuations in P/E ratios which companies and industries may experience across certain time periods. Jones (2000) finds a strong correlation between P/E ratio of individual stocks and the stock market as a whole; he shows that P/E ratios rise during bull markets and shrink during bear markets.

Expectations of future performance can hence be established as a determinant of a company's P/E ratio. Without doubt investor's opinions about the future growth of a company's earnings impacts its P/E ratio; as stock prices reflect market expectations about earnings. Nevertheless, interest rates should not be neglect, since they also play a vital role in the P/E ratios of a stock. In a scenario of declining interest rates, there is an enormous impact on the P/E ratios because future earnings need to be discounted with lower rates.

Drawbacks of the P/E Ratio

Although the P/E ratio is very helpful for security analysis, it should be applied in a reasonable manner for any investment decisions. An investor, who reaches his investment decision based on only this single magic number, is likely to be disappointed by his performance.

Ahmed (2003, p. 14) states that the P/E ratio's value is important but limited. While the P/E ratio understates the price for companies with a lot of debt, the ratio can also dramatically overstate the price of companies that have lots of cash and no debt, since any cash a company is carrying beyond its operating needs could theoretically be paid out to shareholders. The true economic price of a company must therefore be adjusted by the according amount. This ambiguous nature of the price can make companies appear wrongly less attractive to value investors because of their higher P/E.

2.2 Efficient Market Hypothesis (EMH)

Since the P/E ratio is often referred to as an anomaly of the efficient market hypothesis, it is certainly important to outline this well-debated issue in the financial world. The EMH essentially states that the stock market is price efficient and no investor can make abnormal profit[1] out of it. More generally, any information that could be used to predict stock performance should already be reflected in stock prices. As soon as there is any information indicating that a stock is underpriced and is therefore offering a profit opportunity, investors immediately buy the stock and thus bid up its price to a fair level, where only ordinary rates of return can be expected. These "ordinary rates" are simply rates of return commensurate with the risk of the stock (Bodie, Kane, & Marcus, 2013, p. 235). For this reason, the EMH predicts that fundamental analysis is useless. If the analyst relies on publicly available earnings and industry information, the evaluation of the firm's prospects is not likely to be significantly more accurate than those of rival analysts. There are many well-informed firms conducting market research, what makes it very difficult to uncover data, which has not already been scrutinized by other analysts. Fundamental analysis is much more demanding than only identifying well-run firms with good prospects. Finding a good firm does not bring about any achievement if the rest of the market also knows the value of the firm. This is simply because the

[1] Abnormal profit it used to describe a return generated by a security/portfolio that is superior from the expected rate of return (estimated based on an asset pricing model).

investor is constrained to pay a high price for this firm and will therefore not realize a superior rate of return. In summary, it is not enough to identify good firms, since significant profit is only made if the own analysis is better than that of the competitors. The difficulty of this lies in the fact that the market reflects all commonly available information. On the other hand, poorly run firms can turn out to be bargains if they are not as bad as their stock prices indicate (Bodie, Kane, & Marcus, 2013, p. 240).

Proponents of the EMH believe that active management is largely wasted effort and unlikely to justify the expenses incurred. For that reason, they promote a passive investment strategy, which makes no endeavor to overperform the market, but rather establishes a well-diversified portfolio of securities without trying to find under- or overvalued stocks. The EMH does not exactly awaken enthusiasm in the community of professional active portfolio managers, who believe in rather inefficient markets (Bodie, Kane, & Marcus, 2013, p. 243). This assumption is supported by the fact that several easily accessible statistics, such as the P/E ratio or market capitalization, seem to predict abnormal risk-adjusted returns. Suchlike findings are difficult to reconcile with the efficient market hypothesis and are therefore often referred to as efficient market anomalies. The so-called "P/E effect" will be reviewed later in the historical overview.

A difficulty in interpreting these abnormal risk-adjusted returns is that usually portfolio returns need to be adjusted for portfolio risk to evaluate the success of a strategy (Bodie, Kane, & Marcus, 2013, p. 247). If CAPM[2] is used to adjust portfolio returns for risk, "inappropriate adjustments may lead to the conclusion that various portfolio strategies can generate superior returns, when in fact it simply is the risk adjustment procedure that has failed" (Bodie, Kane, & Marcus, 2013, p. 247). To express it differently, tests of risk-adjusted returns are joint tests of the efficient market hypothesis and the risk adjustment procedure. If a portfolio strategy generates superior returns, it must be chosen between rejecting the EMH and rejecting the risk adjustment technique. Due to the fact that the risk adjustment technique is based on more-questionable assumptions than the EMH, it is more likely to reject the adjustment procedure. Ultimately, drawing conclusions about market efficiency (Bodie, Kane, & Marcus, 2013, p. 247).

[2] See 4.4 Method of Analysis for a more detailed explanation of CAPM.

3 Historical Overview

The historical overview is separated into two parts. Whereas the first part focuses on research results within the American market, the second part concentrates on findings in the rest of the world.

3.1 The P/E Ratio and Stock Returns in the USA

Previous empirical research has established a number of the so-called market anomalies, constituting the basis of value investing. Thus, multiple academic studies prove that low P/E ratio strategies have historically generated, on average, above-normal returns.

Basu (1977) investigated the investment performance of common stocks in relation to their price/earnings ratios. His study covered NYSE listed companies, about 500 stocks annually, over a 14-year period, from 1957 through 1971. Beginning at the end of 1956, he computed the P/E ratio of every sample security. The ratio was defined as follows: The numerator as market value of common stock (market price times number of shares outstanding) as of December 31 and the denominator as reported annual earnings available for common stockholders. These ratios were ranked and five portfolios were created. Basu computed the portfolios the P/E ratio as of December 31, although it is unlikely that investors would have access to the firm's financial statements and exact earnings figures at that time. Even though several researchers indicate that the market reacts as though it possesses such information. Due to the fact that most of the firms release their financial reports within three months of the fiscal year-end, the portfolios were assumed to be purchased on the following April 1. He furthermore computed the monthly returns on each of these portfolios for the next twelve months assuming an equal initial investment in each security. This procedure was repeated on an annual basis on each April 1 from April 1957 to March 1971. Basically each of these portfolios can be seen as a mutual fund with the policy of acquiring securities in a given P/E class on April 1, holding them for one year, and then reinvesting the proceeds in the same class in the following year. To take into consideration both risk and return, he moreover applied Jensen's alpha, Sharpe ratio and Treynor ratio to his data file.

His findings are imposing. One million dollars invested in the lowest price/earnings ratio group would have increased to $8,282,000 with an average annual rate of return of 16.3% over the 14-year study period. Compared to an investment of

one million dollars in the highest price/earnings ratio, which would have increased to $3,473,000 with an annual rate of return of 9,3% over the same period, a huge difference can be observed. This higher return of the lowest P/E portfolio was not associated with a higher level of systematic risk, as Jensen's measure indicates. The low P/E portfolio earned about 4,5% more per annum than implied by the level of risk, while the highest P/E portfolio earned 3% less per annum than implied by the level of risk.

Basu's research indicated that low P/E ratio portfolios earn superior risk-adjusted returns, consequently proving the assertion of the P/E ratio hypothesis to be valid. Although the efficient market hypothesis denies the possibility of earning excess returns, due to the assumption that publicly available information is embedded in security prices; there seem to be delays in the adjustment process. These delays can be seen in the P/E ratios and offer opportunities for investors to earn abnormal returns.

Absurdly, using a sample of NYSE firms, Banz (1981) documented that stocks of small firms (growth stocks) earned higher risk-adjusted returns than stocks of large firms (value stocks). Likewise, Reinganum (1981) also found abnormally large risk-adjusted returns for small firms (growth stocks) in his sample of NYSE and AMEX stocks. The findings of Banz and Reinganum prove exactly the opposite of the P/E ratio hypothesis by showing that higher P/E ratios (growth stocks) tend to earn higher returns.

Convinced of Basu's findings, Ibbotson (1986) ranked all stocks listed on the NYSE according to price/earnings ratios at each year end from 1966 through 1983, and sorted them into deciles. The investment returns were measured for each year at the end of the year, over an 18-year period. His results show a compound annual return of 14,08% for an investment in the group with the lowest price/earnings ratio. One million dollars invested would have increased to $12,220,000. Whereas one million dollars invested in the highest price/earnings ratio would only have increased to $2,810,000 with a compound annual return of 5.58%. It should be taken into account that during the 18-year period the compound annual returns for the NYSE and U.S. Treasury bills were 8.6% and 7.4%, respectively.

Oppenheimer (1984) scrutinized the investment performance of the low price/earnings ratio stock selection criteria developed by Benjamin Graham. His stock selection criteria called for the purchase of securities with an earnings-to-price ratio at least twice the AAA bond yield and total debt less than the companies' book value.

Graham moreover advised that each security should be held for either two years, or until 50% price appreciation occurred. Over the period 1974-1980 Oppenheimer screened the New York and American Stock Exchange to find securities for possible investments. His study reached the conclusion that an investor who had employed Graham's "low price/earnings ratio" stock selection criteria in this period of time generated an average annual return of 38% in comparison to 14% per year from the market index.

Following Basu's footsteps, Jaffe et al. (1989) re-examined the effect of the P/E ratio in the US with a substantially longer sample period, 1956 – 1986. In contrast to Basu's research, they also included companies with negative earnings arranging these into an own portfolio. Furthermore they ranked the stocks in total ten portfolios according their P/E ratio. These portfolios were then divided into five subgroups according to their size. This scenario was repeated on a yearly basis, per March 31. Jaffe et al. (1989) report significant P/E and size effects when estimated across all months during the test period. In all size groups, however, the lowest P/E portfolio produced highest return.

Lakonishok et al. (1994) had done similar research on this topic. They investigated the effects of price/earnings ratios on investment returns. The professors arranged all on the NYSE and the AMEX listed companies based on the price/earnings ratios and assorted the companies into deciles. The ratio for all the stocks was initially calculated on April 30, 1968, and new ratios were formed on each subsequent April 30. The period of studies ended on April 30, 1990. Equal investments were made in each stock and it was assumed that the portfolios were held for five years. Their analysis reveals an enormous difference between the highest and the lowest portfolio. While the average annual five-year investment return of the lowest price/earnings ratio was 19%, the portfolio with the highest price/earnings ratio only made 11,4%. Due to this yearly difference the divergence of the average cumulative five-year returns were immense. The portfolio with the highest ratio achieved a return of 71,7%, which is quite low compared to 138,8% of the highest price/earnings ratio.

As can be seen in these studies, the P/E ratio anomaly, as has already been discussed, can offer potential strategies for investors to produce returns superior to many alternatives. One of the greatest investors advocates this strategy and even goes a step further.

Dreman (1994) proposed that investors should ignore expensive professional investment advice and select stocks only based on low P/E ratios. His idea was that

these stocks may currently be unwanted, but if they provide strong finances, high yields, and good earnings records, they almost always do well. In Dreman's analysis, a sample of 1,200 stocks, low P/E stocks outperformed high P/E stocks for the 20-year period through 1993. Whereas the lowest quintile produced an average annual rate of return of 22,9%, the highest quintile returned 11,3% annually. Interestingly, the low P/E strategy showed low performance in turbulent markets as well as in periods of slow economic growth, Dreman concluded. Nevertheless he gave evidence that the stocks may perform well in a "full-blown" bear market due to the higher dividend yield. In summary, Dreman advises that the strategy should be used for a long time horizon, in good and bad market situations.

3.2 The P/E Ratio and Stock Returns in the Rest of the World

The research of Chisholm (1991) focused on price in relation to earnings and investment results for companies in the United Kingdom, France, Germany and Japan. His study described the data record as consisting out of liquid, buyable companies. The data set was rated at the end of each year according to the price/earnings ratio and arranged into quintiles. The entire period of studies lasted 15 years, from the end of 1974 until the end of 1989. The study assumed that the investment in every single stock is weighted equally and the shares are being sold after one-year holding period. The investment returns were displayed in USD. The most significant gap between the lowest price/earnings quintile and the highest quintile for the countries investigated was found in the United Kingdom. An annual compound return of 33% in comparison to 24.5% implied an excess return of 8,5%. UK was followed by France and Japan with an excess return of the lowest price/earnings quintile of 6,5% and 6%, respectively. Germany showed the smallest gap from the countries under investigation with 3,1% annually.

Levis (1988) examined market size, P/E ratios, dividend yield and share prices in the United Kingdom. He was particularly interested in the connection between price/earnings ratio and the investment returns from 1961 to 1985. The companies of the London Share Price database, for which earnings information was accessible, were ranked according to their price/earnings ratios on each April 1 from 1961 to 1985 and separated into quintiles. Based on this data, annual investment returns and the cumulative value of £1 million invested at the beginning of the 24-year time period was calculated. As anticipated, the results proved that the lowest price/earnings ratio had the

highest average annual investment return. A yearly return of 17,76% and a cumulative value of £50,600,000 at March 1985 impressively demonstrated that it is worthwhile to invest along this strategy. During this timespan the market index generated an annual return of 12,48% and a cumulative value of £16,800,000 which is only slightly better than the quintile with the highest price/earnings ratio (10,8% / £11,700,000).

Goodman and Peavy (1985) analyzed investment returns of stocks ranked according to price/earnings ratios within each stock's respective industry. After dividing the companies up into more than hundred industries, the companies were sorted in quintiles within the industry. At every year-end this procedure was repeated. During the 18 years period from the end of 1962 until the end of 1980, 2600 companies were investigated each year. Furthermore the study computed annual investment returns and the cumulative return for the five quintiles. Once again their results establish the highest returns of the lowest quintile. It has been identified that 23,61% average annual investment return compared to 5,42% in the highest price/earnings ratio can be achieved. Over the entire time horizon, the lowest P/E portfolio earned 2.8% more than suggested by systematic risk level, whereas the highest P/E portfolio earned 2.4% less than implied by its beta risk. Furthermore, one million dollars invested at the beginning of this 18 year period would have increased to $45,390,000. By investing in the second lowest quintile, the money would only have increased to $20,500,000. Fewest of all was generated by the highest price/earnings ratio quintile with $2,600,000.

There is considerable evidence from this review that low P/E ratio strategies are able to outperform high P/E strategies (and in some cases also the market). This underlines the assertion of the existence of the so-called P/E effect. More precisely it demonstrates that value stocks, identified with the P/E ratio, are able to generate higher returns compared to growth stocks, even on a risk-adjusted basis. According to Dreman, low P/E strategies do not seem to work in turbulent markets nor in periods of slow economic growth. Therefore, above-normal returns in turbulent markets, as in the period under investigation, are questionable.

4 Data and Methodology

The first section of this chapter starts with the procurement of the data. In a second step, a general description of the data is made. Since the analysis is carried out on the basis of equity portfolios, the third step accurately describes the portfolio formation process. After looking at the portfolio construction, section 4.4 defines the methodology for the performance evaluations.

4.1 Data Base & Sample Selection Criteria

The data used for the empirical analysis is drawn from Bloomberg. Since Bloomberg is a major provider of financial information, it can be assumed that the data is accurate. The database includes the market capitalizations, the P/E ratios and the monthly total returns of all companies listed to the SIX Swiss Exchange and included in the Swiss Performance Index (SPI). The time period examined lasts from January 2005 to December 2015.

The relevant key figures under investigation are defined as follows:

1) Market Capitalization: "HISTORICAL_MARKET_CAP"
    - Total market value of all of a company's outstanding shares at period end in the fundamental currency: Shares outstanding * Last closing price
2) Price/Earnings Ratio: "PE_RATIO"
    - Calculated as last price divided by trailing 12M EPS (P/E ratio is not computed if the EPS is negative)
3) Monthly Total Returns: "CUMULATIVE_TOT_RETURN_GROSS_DVDS"
    - Total return for the holding period assuming dividends are reinvested at spot price (Gross dividends and no commissions)

For any given year under consideration, the following criteria were used for the selection of sample firms: (i) the firm is traded on the SPI on December 30; (ii) the relevant market capitalization and P/E ratio data of the firm are available as of December 30. Thus, no consideration of firms displaying "N/A" for these two criteria, due to the uncertainty whether it is caused through a negative EPS or simply through missing data; and (iii) the monthly total returns are available for the respective fiscal year. Hence, in case of inaccessible data, the next lower capitalized firm replaces the firm concerned.

4.2 Data Description

On average, every year between three and four companies have been excluded from the analysis due to missing or unavailable data. As described above, they were replaced with the next lower capitalized firms. It is worth mentioning that UBS AG was not considered from 2009-2011 and 2014 because of their immense losses during these periods. Throughout the entire period, UBS AG was the only excluded firm with a market capitalization of over 10 billion. In contrast, several firms with a market capitalization of over 1 billion were replaced due to missing data (2005: Pargesa Holding SA, SIG Combibloc Group AG and Dorma + Kaba Holding AG; 2006: Edmond de Rothschild Suisse SA and Basilea Pharmaceutica AG; 2007: Basilea Pharmaceutica AG, Speedel Holding AG and Merck Serono SA; 2008: BKW Energie AG, Basilea Pharmaceutica AG and Hiestand Holding AG; 2009: Basilea Pharmaceutica AG and Ciba Holding AG; 2010: Clariant AG, Petroplus Holdings AG and Rieter Holding AG; 2011: Petroplus Holdings AG; 2012: EFG International AG and Synthes Inc; 2013: Romande Energie Holding SA; 2014: Basilea Pharmaceutica AG).

4.3 Portfolio Formation

Starting on December 30, 2004, the market capitalization of every sample security was computed. Since insiders and speculators are able to provoke enormous price fluctuations (with relatively little capital) in firms with low market capitalizations, only the 100 highest capitalized companies were taken into consideration. This reduces the number of outliers to a minimum and hence provides more accurate results. Likewise, as of December 30, the P/E ratio for each stock was computed. In a further step, the stocks were ranked from lowest to highest and four equal-sized portfolios, each containing 25 stocks, were formed. Contrary to Basu (1977), the ranking was conducted with the P/E ratio and not with its reciprocal, since no negative P/E ratios are considered. Furthermore, the monthly returns of the stocks were calculated for the next twelve months from January 2005 to December 2005. And finally, the monthly average returns (assuming equal weighting of the stocks within the portfolio) for each of the four P/E portfolios were computed for the entire fiscal year.

Basu (1977) assumed the portfolios to be purchased on April 1 due to the unlikeliness of the investors having access to the firm's financial statements and exact earnings figures on December 30. Although his approach is correct, Ball and Brown

(1968) have provided evidence that the market reacts as though it possess such information. They conclude that it seems rather improbable that unexpected earnings announcements would be so predominant to significantly change the portfolio grouping. For this reason, an equal initial investment in each security of the portfolios was assumed to be made on January 1 and held until December 31.

This procedure was repeated annually on each January 1, resulting in 11 years (January 2005 - December 2015) of return data for each of the P/E portfolios. Every portfolio can be seen as a mutual fund having a strategy of purchasing securities in the given P/E quartile on January 1, holding the portfolio for one year, and then liquidating and reinvesting the proceeds in the same quartile portfolio (on January 1) in the following year.

In order to obtain a better idea of the composition of the portfolios, every stock was classified into a sector. This was done according to the GICS sector (Global Industry Classification Standard) classification of Bloomberg. Figure 1 shows the yearly average sample for each of the four P/E portfolios (1 = lowest P/E, 2, 3 and 4 = highest P/E)[3]:

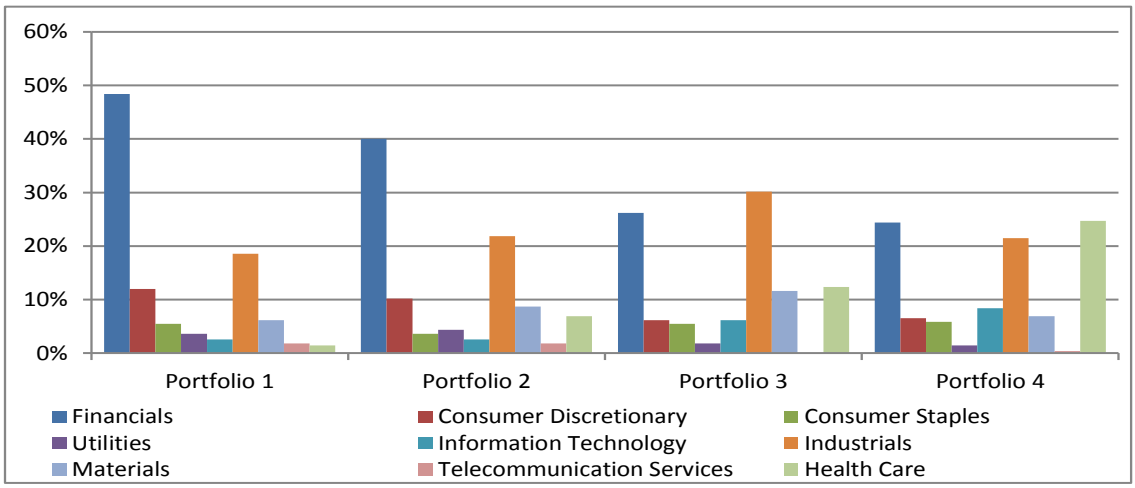

Figure 1: Yearly average composition by sectors

The financials, industrials and health care are strongly represented in the sample. The percentage of which each portfolio is composed of financial shares decreases steadily from portfolio 1 to 4. Likewise does the percentage of consumer discretionary shares. The opposite trend can be observed in the percentage of health care shares,

[3] See appendix for yearly sector classifications.

increasing from portfolio 1 to 4. Similarly, a slight growth in the percentage of industry shares is apparent from portfolio 1 to 4, with an exception in portfolio 4.

Figure 2 depicts the median price/earnings ratio for each of the four P/E portfolios over the 11-year period ending December 31, 2015[4]:

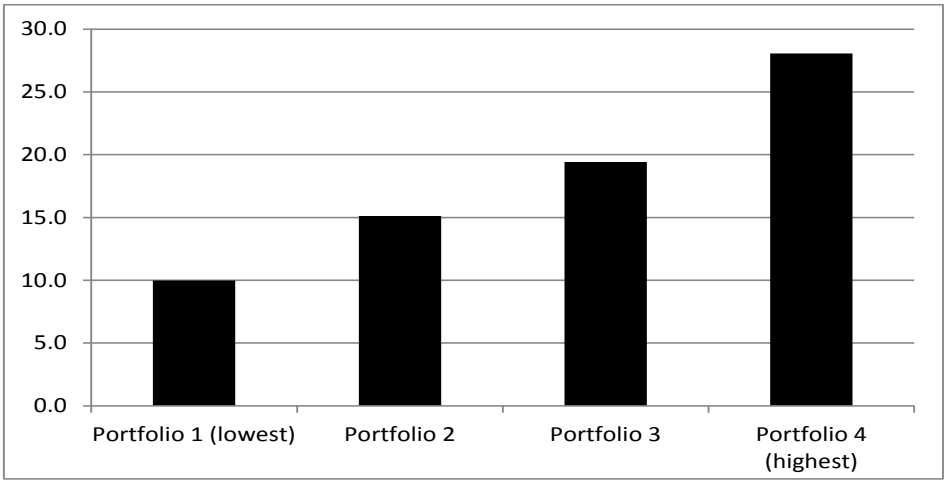

Figure 2: Median price/earnings ratios of the four portfolios

The lowest average yearly P/E ratio was 6.2 (portfolio 1) and the highest yearly average P/E ratio was 255.5 (portfolio 4), considering the eleven years observation period. Due to these apparent outliers, the standard deviations and the inter-quartile ranges of the P/E ratios were investigated and represented in table 1:

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
Standard deviation	2.8	2.2	2.6	277.6
Inter-quartile range	0.96 - 15.54	9.02 - 19.08	12.08 - 24.56	17.4 - 4362.5

Table 1: Statistics of the P/E portfolios

The high standard deviation and inter-quartile range of portfolio 4 was primarily caused by Kuoni Reisen Holding AG (4362.5) and Adecco SA (960) in 2010. A comparably high P/E ratio was achieved by Von Roll Holding AG (853) in 2012. GAM Holding AG (0.96) and Rieter Holding AG (2.47) realized the lowest P/E ratios in 2010 and in 2009, respectively.

[4] See appendix for yearly average P/E ratios.

4.4 Method of Analysis

Absolute Performance Evaluation

Firstly, the average returns per annum and the total returns for the 11-year holding period of the four portfolios were compared on an absolute performance level. These results were then compared to the returns of the Swiss Performance Index (SPI).

This section derives the calculation of the past geometric returns ($\bar{R}$) of the portfolios and does not consider any associated risks. After computing the monthly returns for each of the four P/E portfolios, the yearly average returns were calculated in two steps:

Step 1: Yearly return calculation from 2005-2011

$$\bar{R}_{py} = \prod_{m=1}^{12}[1 + R_{pm}] - 1$$

where $\bar{R}_{py}$ is the return on P/E portfolio p in year y, and R_{pm} is the monthly return

Step 2: Yearly average return calculation

$$\bar{R}_p = \sqrt[11]{\prod_{y=1}^{11}(1 + \bar{R}_{py})} - 1$$

where $\bar{R}_p$ is the yearly geometric average return for portfolio p, and $\bar{R}_{py}$ are the yearly returns from 2005-2015

The same procedure was used for the yearly geometric average return of the SPI. In terms of the risk-free rate, the yearly average return of the 1-year CHF "Obligation der Eidgenossenschaft" from 2005 to 2015 was used. (Source: Swiss National Bank)

Risk-adjusted Performance Evaluation

Since performance evaluation only based on average returns is not very meaningful, returns must be adjusted for risk before they can be compared. Firstly, the total returns were compared to their corresponding total risk (σ_p) and systematic risk (β_p). To replace the two-parameter measure of performance (return and risk) with a single measure, which combines the two dimensions and adjusts for differences in risk, the Sharpe ratio, Treynor ratio and Jensen's alpha were used. The investigated period of time was

enormously affected by the financial crisis of 2008, where the world experienced the biggest economic crisis since the Great Depression and stock prices dropped further than they had in a single year since the 1930s (Cheffins, 2009). Due to this momentous event, the investigation was subsequently split into a pre-financial crisis (2005-2007) and a post-financial crisis (2008-2015) section. No investigation was conducted during the financial crisis (2009-2012), since the timeframe was not suitable to make any meaningful assertions.

This section on the one hand derives the figures needed for the risk-adjusted return evaluation and on the other hand explains the relevant risk-adjusted measures. Using the monthly returns for each of the four P/E portfolios, the yearly average returns were calculated differently than above:

Step 1: Monthly average return calculation for 132 returns from 2005-2011[5]

$$R_{pm} = \frac{R_{pm(1)} + R_{pm(2)} + R_{pm(3)} + \cdots + R_{pm(131)} R_{pm(132)}}{132}$$

where R_{pm} is the monthly average return on P/E portfolio p, and $R_{pm(x)}$ are the monthly returns

Step 2: Annualization of the monthly average return

$$R_p = R_{pm} * 12$$

where R_p is the is the yearly average return for portfolio p

The yearly average return of the SPI was calculated equally[6]. For the risk-free rate, the monthly average return of the 1-year CHF "Obligation der Eidgenossenschaft" from 2005 to 2015 was used[7]. (Source: Swiss National Bank)

[5] R_{pm} for the pre-fin. crisis (05-07) is limited to 36 monthly returns ($R_{pm(x)}$) and divided by 36, R_{pm} for the post-fin. crisis (08-15) is limited to 96 monthly returns ($R_{pm(x)}$) and divided by 96

[6] The yearly average return of the SPI for the pre- & post-fin. crisis analysis was calculated as explained under footnote 5.

[7] The risk-free rate for the pre- & post-fin. crisis period was limited to monthly average returns within their corresponding years.

Moreover, the standard deviation, variance and covariance needed to be annualized. This was done as follows:

$$\sigma_p = \sigma_{pm} * \sqrt{12}$$

where σ_p is the yearly standard deviation/volatility for portfolio p, and σ_{pm} is the monthly standard deviation

$$\sigma^2{}_p = \sigma^2{}_{pm} * 12$$

where $\sigma^2{}_p$ is the yearly variance for portfolio p, and $\sigma^2{}_{pm}$ is the monthly variance

$$cov(R_p, R_m) = cov(R_{pm}, R_{mm}) * 12$$

where $cov(R_p, R_m)$ is the yearly covariance of the portfolio p and the market m, and $cov(R_{pm}, R_{mm})$ is the monthly covariance between these two.

The Capital Asset Pricing Model (CAPM) developed by Treynor (1961), Sharpe (1964) and Lintner (1965) has provided a framework for a number of risk-adjusted performance measures for managed portfolios, three of which have been broadly adopted in the financial literature and are used in this paper. The Sharpe (1966) ratio is derived from the Capital Market Line, with the level of risk being measured by the standard deviation of portfolio returns. The Treynor (1966) ratio, where the level of risk is measured by the beta factor, and Jensen's (1968) alpha, defined as the portfolio's excess return over the required average return, are directly linked to the beta through the Security Market Line.

The Sharpe ratio is the most commonly used risk-adjusted performance measure in the financial practice. It is calculated by subtracting the risk-free rate from the rate of return for a portfolio and dividing the result by the standard deviation of the portfolio returns. The standard deviation represents the total risk of a single asset or a portfolio. It includes unsystematic (diversifiable) risk, which to a large extent can be eliminated through diversification, and systematic (nondiversifiable) risk (Bodie, Kane, & Marcus, 2013, p. 125):

$$S_p = \frac{R_p - R_f}{\sigma_p}$$

where

R_p = the yearly average return of portfolio p

R_f = the yearly average risk-free rate of return

σ_p = the volatility of the excess return of portfolio p

The Sharpe ratio reveals whether a portfolio's returns are the outcome of a superior investment strategy or an outcome of excess risk. A greater Sharpe ratio indicates a better reward per unit of volatility, in other word, a more efficient portfolio.

As noted above, Jensen's alpha and the Treynor ratio use the Security Market line derived by Treynor (1961), Sharpe (1964) and Lintner (1965). This line represents the expected total return of every security or portfolio p as a linear function of the return of the market portfolio m:

$$E(R_p) = R_f + \beta_p[R_m - R_f]$$

where

$E(R_p)$ = the expected return of portfolio p

R_f = the risk-free rate of return

R_m = the stock market return

$\beta_p = \frac{cov(R_p,R_m)}{\sigma^2(R_m)}$ is the beta coefficient of portfolio p

The beta factor is a measure of systematic (nondiversifiable) risk and describes how sensitive individual assets or portfolios react to fluctuations in the market or macro-economic factors (Bodie, Kane, & Marcus, 2013, p. 149). Since in this paper each portfolio contains 25 stocks, unsystematic risk should be largely diversified away. It is therefore more suitable to compare average excess returns to nondiversifiable or systematic risk. There should be a positive correlation between nondiversifiable market risk and expected returns because investors require higher returns as a compensation for taking higher risks.

Like Sharpe's measure, the Treynor ratio gives excess return per unit of risk, but it uses systematic risk instead of total risk (Bodie, Kane, & Marcus, 2011, p. 822).

$$T_p = \frac{R_p - R_f}{\beta_p}$$

where β_p is the beta coefficient of portfolio p

The higher the Treynor ratio, the better is the reward per unit of market risk. Thus, a portfolio with a higher Treynor ratio implies a better risk-adjusted return than portfolios with a lower ratio.

Jensen's alpha measures the excess return on a portfolio over its theoretical expected return predicted by the CAPM given portfolio's weighted beta and the average market risk premium. It is an absolute performance measure, meaning that it is measured in the same units as the return itself after the consideration for risk (Hübner, 2005, p. 418). A positive value of the alpha signifies a superior performance of the portfolio. Correspondingly, a negative alpha stands for an underperformance in terms of expected return indicated by the CAPM. Jensen's alpha is calculated as follows:

$$\alpha_p = R_p - R_f - \beta_p[R_m - R_f]$$

where α_p is Jensen's alpha of portfolio p

"If the CAPM holds and if markets are efficient, the alpha should not be statistically different from zero" (Hübner, 2005, p. 418).

Empirical findings of Fama and French (1993) and Carhart (1997) prove that the alpha of the CAPM deviates statistically from zero. They concluded that missing risk factors are the source of deviations and therefore introduced additional factors to improve the results. Fama and French (1993) show evidence that extending the CAPM with two other factors related to the firm's size and the firm's book-to-market better explains variations in average returns across stocks. Likewise, several years later Carhart (1997) documents that an extension of Fama/French's three-factor model with a fourth new momentum factor better explains the returns of mutual fund's portfolios than the CAPM does. Nevertheless, this paper focuses on CAPM and does not take any of these multifactor asset pricing models into account.

5 Empirical Research & Findings

This chapter comprises a findings part and a discussion part. The findings are split into two parts: At first, the returns are compared on an absolute performance basis, whereas the second part adjusts the returns to their corresponding risks and subsequently splits the results into a pre- and post-financial crisis section.

5.1 Absolute Performance of the P/E Portfolios

The highest and the lowest yearly returns were both achieved by portfolio 1. The highest return of 43,8% was realized in 2009 whereas the lowest return amounted -41.6% in 2008. The highest yearly return of portfolio 2 (39.4%) was achieved in 2009, whereas portfolio 3 (39.1%) and portfolio 4 (32.6%) reached their yearly highs in 2006 and 2005, respectively. Similar to portfolio 1 the other three portfolios performed the worst in 2008. On the other hand, the market (SPI) reached its peak in 2005 with 35.6% and hit its low of -34.1% in 2008. Taking a closer look on the high point of portfolio 1 in 2009, its highest monthly return of 23.6% was realized in April and was mainly caused by an 81.2% return of OC Oerlikon AG. On the other hand the low point of portfolio 1 in 2008 was attained in October (-19.4%) and was mainly due to a loss of -44.3% by Schmolz + Bickenbach AG. Likewise, portfolio 2 (-17,4%), 3 (-16.2%) and 4 (-19.7%) attained their highest monthly losses in October 2008.

Table 2 displays the yearly average returns of the four P/E portfolios (1 = lowest P/E, 2, 3 and 4 = highest P/E). The two low P/E portfolios, 1 and 2, earned on average 11,7% and 10% per annum respectively over the 11-year period; Whereas the two higher P/E portfolios, 3 and 4, earned 9.5% and 4.7% per year. All of the four rates were above the yearly risk-free rate of 0.71 percent used in this analysis. During the 11-year period, the annual investment return for the market was 7.2%. Only portfolio 4 attained lower rates than one would earn investing in the SPI. In fact, table 2 indicates that the average annual rates of return decline as the P/E ratios of the portfolios grow.

	1 (lowest)	2	3	4 (highest)	Market (SPI)	Risk free
Average annual return	0.1170	0.1004	0.0953	0.0471	0.0720	0.0071
Average annual excess return	0.1099	0.0933	0.0882	0.0400	0.0649	
Value of CHF 1 Mio after 11-year holding period	3'378'014	2'865'160	2'720'499	1'659'219	2'147'560	

Table 2: Absolute performance of the P/E portfolios

One million Swiss Francs invested in the lowest P/E portfolio over the 11-year study period would have increased to CHF 3’378’014. In comparison, an investment of one million Swiss Francs in the Swiss Performance Index (SPI) would have only increased to CHF 2’147’560. One million Swiss Francs invested in the highest and thus worst performing P/E portfolio would have increased merely to 1’659’219.

5.2 Risk-adjusted Performance of the P/E Portfolios

As already mentioned in the method of analysis, the performance figures needed for the risk-adjusted measurement of performance are based on different approaches of calculation than the absolute performance calculation.

The lowest P/E portfolio (portfolio 1) earned the highest average annual return of 12.7%. Portfolio 2 and 3 had a similar profitability of 10.7% and 10.2%, respectively. Portfolio 4 achieved the lowest return, yielding roughly half of the portfolios 2 and 3. The market, in comparison, earned an average of 7.8% per annum, meaning that only portfolio 4 was unable to outperform the market. As anticipated, portfolios 1-3 clearly outperformed the Swiss Performance Index. In summary, table 3 illustrates that average annual rates of return are higher for low P/E portfolios and lower for high P/E portfolios.

The rates of return of the higher yielding portfolios did not always correlate with higher levels of total risk (σ_p). Specifically, the low return portfolio 4 had the second highest standard deviation of 0.153. By contrast, the higher return portfolios 2 and 3 had a lower standard deviation of 0.1442 and 0.1439, respectively. As one might expect, the highest return portfolio 1 had the highest standard deviation (0.1773), whilst the market had the lowest (0.1313).

Contrary to the capital market theory, the higher portfolio returns neither always correlated with higher levels of systematic risk (β_p); the systematic risks of portfolio 2 (0.9368) and 3 (0.9326) were lower than the one of portfolio 4 (0.9587). On the other hand, consistent with the capital market theory, the highest yielding portfolio was associated with the highest level of systematic risk.

	1 (lowest)	2	3	4 (highest)	Market (SPI)
Average annual return (R_p)	0.1269	0.1066	0.1017	0.0581	0.0783
Average annual excess return (R'_p)	0.1197	0.0994	0.0946	0.0509	0.0712
Total risk (σ_p)	0.1773	0.1442	0.1439	0.1530	0.1313
Systematic risk (β_p)	1.1289	0.9369	0.9326	0.9587	1.0000
Sharpe ratio (S_p)	0.6752	0.6894	0.6576	0.3328	0.5422
Treynor ratio (T_p)	0.1061	0.1061	0.1014	0.0531	0.0712
Jensen's alpha (α_p)	0.0394	0.0327	0.0282	-0.0173	
Coefficient of correlation: $\rho(R_p,R_m)$	0.8359	0.8529	0.8512	0.8225	

Table 3: Risk-adjusted performance measures

Consistent with the risk-return relationships, there are significant differences between the scores of the four portfolios obtained using the Sharpe and Treynor ratio. In

terms of the Sharpe ratio, portfolios 1 and 2, with values of approximately 0.68 and 0.69 had the highest risk premium per level of total risk, followed by portfolio 3 with a ratio of approximately 0.66. Portfolio 4 was the lowest ranked portfolio, with a Sharpe ratio of 0.33. Moreover, all portfolios beside portfolio 4 had ratios higher than the Swiss Performance Index (0.54). Consequently, the Sharpe ratio shows that the performance of the low P/E portfolios is superior to that of their high ratio competitors. Similar results were found in terms of the Treynor ratio. Whereas portfolios 1, 2 and 3 were ranked above the market, portfolio 4 had a ratio below the market. Interestingly, portfolio 2 attained a higher value than portfolio 1, but when comparing return and total risk, the two portfolios indicate equality with regard to return and systematic risk.

A comparison of Jensen's alpha shows a broadly similar ranking as with the Sharpe and Treynor ratio. With exception to portfolio 4, each portfolio earned rates higher than implied by their levels of risk. The results indicate that, if we ignore tax effects regarding dividends and capital gains, the two low P/E portfolios, 1 and 2, as well as portfolio 3, earned about 4%, 3.3% and 2.8% per annum more than implied by their levels of risk. Meanwhile the high P/E portfolio 4 earned 1.7% per annum less than implied by its level of risk. Figure 3 demonstrates a comparison of the portfolios between the average annual excess returns and the corresponding alphas.

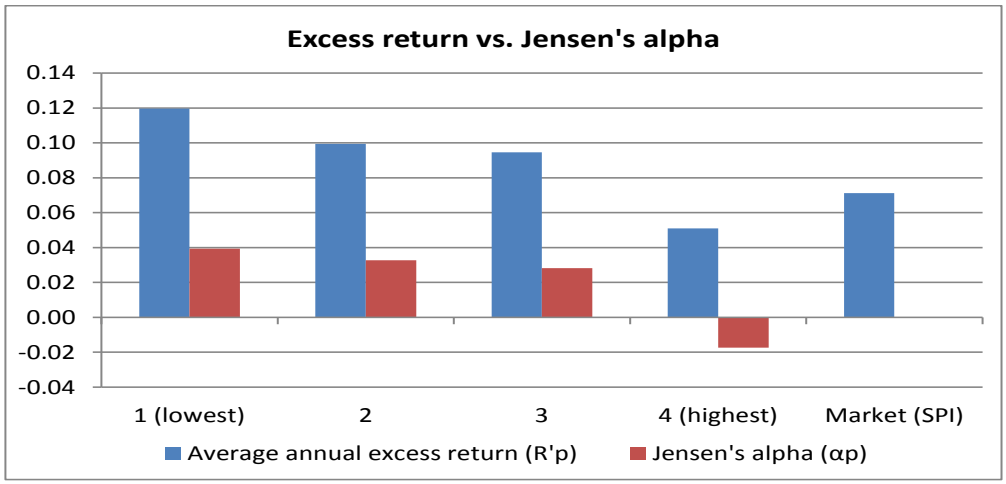

Figure 3: Return comparison (2005-2015)

Finally, the quality of the regression results is reasonably good. The Swiss Performance Index as an explanatory variable was significant for all the portfolios and the correlation coefficients ranged between 0.82 and 0.85.

5.2.1 Pre- and Post-Financial Crisis

To pinpoint differences between the time before and the time after the crash, the investigation was split into two sections: (i) a pre-financial crisis, 2005-2007 and (ii) a post-financial crisis, 2008-2015.

Pre-financial crisis

As demonstrated in table 4, the sustained increase of the share prices and the associated high return figures confirm the existence of a bull market between 2005 and 2007.

Firstly, portfolios 1, 2 and 3 earned similar average annual returns of around 22%. With 20% portfolio 4 yielded only a slightly lower annual return than the other portfolios. The market, in comparison, earned 17% per annum, which is significantly less than all of the four portfolios formed according to their P/E ratios. The hypothesis of higher average annual rates of return for low P/E portfolios is not clearly confirmed during the bull market from 2005 to 2007, because portfolio 3 also achieved a comparably high return.

Secondly, there are differences in total risk levels (σ_p). Although portfolio 2 earned the highest average annual return, it was associated with the lowest total risk of 0.1022, whereas the lowest P/E portfolio, yielding only the third highest return, was associated with the highest standard deviation (0.1339) of the four portfolios. As might be expected, the market had the lowest standard deviation with a score of 0.0991.

Thirdly, just as for the entire timespan, the higher portfolio returns did not always correlate with higher levels of systematic risk (β_p). Only portfolio 1 had a beta greater than 1, indicating a 4% higher volatility than the market. Despite posing higher risks than the rest, portfolio 1 was not able to offer a higher rate of return. The volatilities of the other portfolios were all clearly below the market. It is interesting to note that, against the rules of the capital market theory, the highest yielding portfolio 2 showed the smallest beta score, implying a volatility of 20% less than the market.

	1 (lowest)	2	3	4 (highest)	Market (SPI)
Average annual return (R_p)	0.2239	0.2277	0.2272	0.2047	0.1698
Average annual excess return (R'_p)	0.2061	0.2098	0.2093	0.1868	0.1520
Total risk (σ_p)	0.1339	0.1022	0.1156	0.1141	0.0991
Systematic risk (β_p)	1.0412	0.7917	0.9178	0.9160	1.0000
Sharpe ratio (S_p)	1.5391	2.0527	1.8108	1.6368	1.5337
Treynor ratio (T_p)	0.1979	0.2650	0.2280	0.2039	0.1520
Jensen's alpha (α_p)	0.0478	0.0895	0.0698	0.0476	
Coefficient of correlation: $\rho(R_p,R_m)$	0.7706	0.7674	0.7868	0.7954	

Table 4: Risk-adjusted performance measures (pre-financial crisis)

Fourthly, the risk/return combined single measures Sharpe ratio and Treynor ratio allow a better comparison than the two-parameter measure of performance. The Sharpe ratio shows the logical consequence of the findings discussed in the above two paragraphs. Portfolio 2 exposed the highest risk premium per level of total risk with a value of 2.05, followed by portfolio 3 (1.81) and portfolio 4 (1.63). Remarkable is that in this case portfolio 1 (1.54) achieved the lowest Sharpe ratio. Finally, it is almost equal to the market. In terms of the Treynor ratio, the ranking of the portfolios is identical for the Sharpe ratio, with the sole difference that portfolio 1 was better off than the Swiss Performance Index. This can notably be explained by the high return of portfolio 1 compared to its comparatively small beta.

Fifthly, all four portfolios were able to generate a positive alpha. This means that all portfolios earned higher rates of return than implied by their levels of risk. While portfolio 2 and 3 earned almost 9% and 7% per annum respectively more than implied by their levels of risk, portfolio 1 and 4 earned about 5% more than implied by their levels of risk. Figure 4 depicts a comparison of the portfolios between the average annual excess returns and the corresponding alphas within the pre-financial crisis.

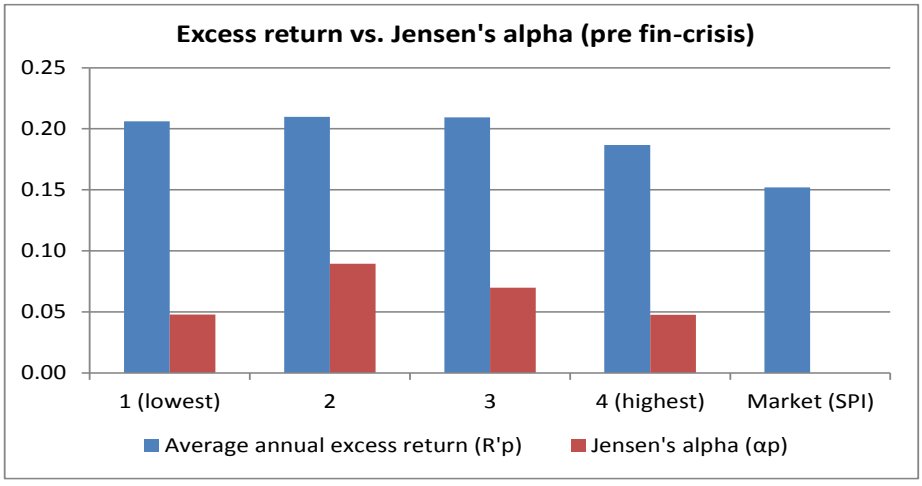

Figure 4: Return comparison (pre fin-crisis)

Lastly, the correlations with the market are lower compared to the timeframe 2005-2015. Coefficients of correlation for the monthly returns in the pre-financial crisis 2005-2007 ranged between 0.76 and 0.80.

Post-financial crisis

In 2008 the worldwide financial crisis put an end to the bull market. As investors anticipated losses and started selling stocks, the share prices declined sharply. This can be considered as the typical entry into a bear market. Most affected from this bear market were the cyclical stocks, being imploded up until the end of the investigation period. Table 5 gives clarification about the performance effects of the crisis and the subsequent recovery.

Firstly, despite the significant losses in 2008 and 2011, all four portfolios earned positive average annuals returns. Particularly the lowest P/E portfolio turns out to be the by far most successful portfolio. With an average rate of return of 9% it generated 3% higher returns than all the other portfolios. Similar to the timespan 2005-2015, the returns declined as the P/E ratios of the portfolios rose. Furthermore, only portfolio 4 was unable to outperform the market.

Secondly, the higher returns were associated with higher levels of total risk (σ_p) for portfolio 1, 2 and 3. Portfolio 4 on the other hand showed the second highest total risk combined with the lowest rate of return. The market once again implied the lowest standard deviation.

Thirdly, the levels of systematic risk (β_p) behaved very similar to the total risk component. As expected, portfolio 1 exhibits a beta greater than 1, and is 14% more volatile than the market. As before the crisis, the volatilities of the other portfolios were all clearly below the market. Whereas portfolio 2 and 4 have a similar market risk, portfolio 3 has the lowest beta of the portfolios.

	1 (lowest)	2	3	4 (highest)	Market (SPI)
Average annual return (R_p)	0.0905	0.0611	0.0547	0.0031	0.0440
Average annual excess return (R'_p)	0.0874	0.0580	0.0516	0.0000	0.0409
Total risk (σ_p)	0.1906	0.1555	0.1514	0.1630	0.1407
Systematic risk (β_p)	1.1462	0.9563	0.9273	0.9546	1.0000
Sharpe ratio (S_p)	0.4582	0.3730	0.3407	-0.0001	0.2907
Treynor ratio (T_p)	0.0762	0.0607	0.0556	0.0000	0.0409
Jensen's alpha (α_p)	0.0405	0.0189	0.0137	-0.0391	0.0000
Coefficient of correlation: $\rho(R_p,R_m)$	0.8458	0.8649	0.8614	0.8240	

Table 5: Risk-adjusted performance measures (post-financial crisis)

Fourthly, the Sharpe ratios of the portfolios were in accordance to their average annual returns. Whereas portfolio 1 displayed a value of 0.46 and the highest risk premium per level of total risk, portfolio 2 and 3 were next in rank with values of 0.37 and 0.34. Due to the extremely low rate of return of portfolio 4, the Sharpe ratio is close to zero. Thus, it makes an investment greatly unattractive. The market with a value of 0.29 positions itself better than portfolio 4 but worse than the other 3 remaining portfolios. As in the full time period under investigation, the Sharpe ratio shows a superior performance of the low P/E portfolios to that of their high ratio counterparts. The same holds true for the Treynor ratios. The numbers fall, the higher the P/E ratios get. Similar to the Sharpe ratio, portfolio 4 is rated lower than the market.

Fifthly, a comparison of Jensen's alpha shows the same ranking as with the Sharpe and Treynor ratios. With the exception of portfolio 4, all portfolios earned rates higher than implied by their levels of risk, with P/E portfolio 1 earning the highest. Figure 5 displays a comparison of the portfolios between the average annual excess returns and the corresponding alphas within the post-financial crisis.

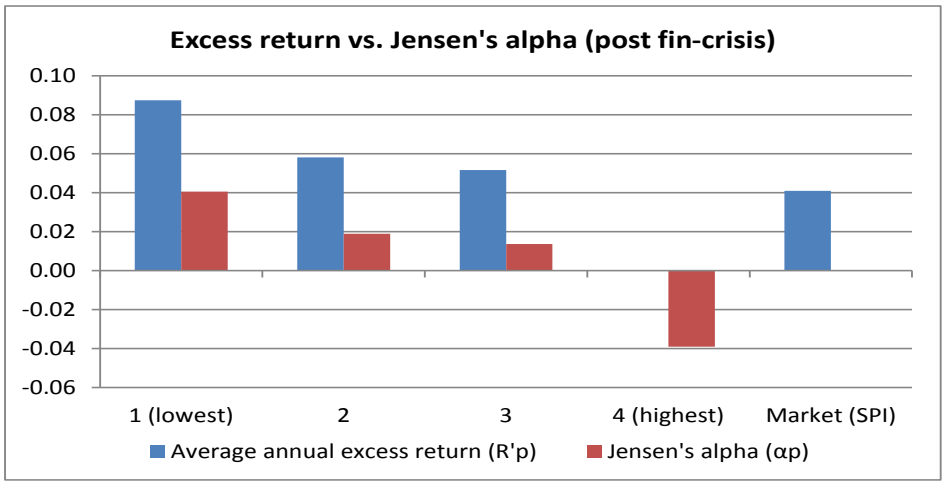

Figure 5: Return comparison (post fin-crisis)

At last, the portfolios of the post-financial crisis time frame exhibit the strongest overall correlation with the market. Coefficients of correlation for the monthly returns in the post-financial crisis 2008-2015 ranged between 0.82 and 0.87

5.3 Discussion of the Findings

It has been found that between 2005 and 2015, stocks with low P/E ratios earned higher absolute and risk-adjusted (testing Sharpe- and Treynor ratio as well as Jensen's alpha) returns than stocks with high P/E ratio. Furthermore, low P/E portfolios were able to generate excess returns compared to the market. These findings underline the results of previous studies in the USA as well as in the rest of the world, but contradict the results of Banz and Reinganum, who documented abnormally large risk-adjusted returns for higher P/E ratios (growth stocks). The risk-return relationships within the porfolios confirm the approach of Fama and French and Ball and Kothari, with the exception of portfolio 4. Whereas the lowest P/E portfolio showed highest total- and systematic risk, the risk decreased as the P/E ratios rose, with the exception of the highest P/E portfolio (portfolio 4), which revealed the second highest total- and systematic risk.

The return results of the pre-financial crisis timeframe from 2005 to 2007 do not exactly confirm the vast majority of literature, since the low P/E portfolios did not earn higher absolute nor higher risk-adjusted returns than the high P/E portfolios. According to Dreman's advice that the strategy should only be used for a long time horizon (in good and bad market situations), it may be concluded that the time frame was too short. Albeit, it has been proved that all of the four portfolios performed extremely well, and surpassed the market significantly. Fama and French's and Ball and Kothari's assumption that higher returns of value stocks are due to higher risks, was disproved by portfolio 2, combining the highest return with the lowest total- and systematic risk. On the other hand, portfolio 1 implied the highest total- and systematic risk performing only third best.

The 8 years of the post-financial crisis section once again confirm the great majority of the literature, since stocks with low P/E ratios earned higher absolute and risk-adjusted returns (proven by all of the three risk-adjusted performance measures) than stocks with high P/E ratios. Moreover, the three lowest P/E portfolios outperformed the market. In contrast to Dreman's assertion that this strategy does well neither in turbulent markets nor in periods of slow economic growth, this paper shows that the opposite is the case. Equally to the overall period being observed, and in line with Fama and French's and Ball and Kothari's expectations, the risk fell continually as the P/E ratios increased, excluding the highest P/E portfolio (portfolio 4), which showed the second highest total- and systematic risk.

6 Conclusion

In this paper an effort was made to determine the relationship between the investment performances of equity securities and their P/E ratios. Whereas the efficient market hypothesis denies a relationship between P/E ratios and subsequent returns, and also the associated possibility of earnings excess returns, the P/E ratio hypothesis asserts that P/E ratios may be indicators of future investment performance.

During the 11-year period under investigation (2005–2015) the low P/E portfolios earned higher average absolute and risk-adjusted rates of return (considering total- and systematic risk) than the high P/E portfolios. Furthermore, low P/E portfolios were able to generate significant excess returns compared to the market. Over the entire time horizon, the average yearly excess return on the lowest P/E portfolio was 4.0 percent higher than the average return suggested by its systematic risk level, whereas the highest P/E portfolio showed 1.7 percent less average yearly excess return than that implied by its beta risk. While the price/earnings ratio hypothesis is not fully confirmed by the pre-financial crisis section, the post-financial crisis section does underline the higher absolute and risk-adjusted returns of the low P/E portfolios. Nonetheless, the low P/E portfolios managed to outperform the market significantly in both sections.

The empirical finding that the intercepts of the CAPM deviate statistically from zero suggest a violation of the joint hypothesis, meaning that either the risk adjustment procedure of the CAPM has failed or the behavior of the security prices were not consistent with the efficient market hypothesis. While the CAPM was chosen deliberately because of the assumption that it assesses its risk correctly, the asset pricing model can be seen as valid.

Therefore, the findings of this paper suggest that P/E ratio information was not "fully reflected" in security prices as postulated by the efficient market hypothesis. Instead, the period studied suggests a disequilibria in capital markets, proposing that the securities considered seem to have been inappropriately priced, and opportunities for earning "abnormal" returns were afforded to investors. Active investors, convinced of the existence of inefficient markets, have been proved right and could have taken advantage of the market disequilibria by purchasing low P/E stocks on an annual basis.

However, despite the assumption of a correct risk adjustment procedure of the CAPM, it is not 100% clear if the superior returns in the 11-year period studied are really due to inappropriately priced securities. Nevertheless, the "P/E effect" seems to

exist for stocks within the Swiss Performance Index during the period 2005-2015, and therefore the price/earnings ratio hypothesis is considered as validated. Moreover, the findings underline that the P/E ratio hypothesis is confirmed even in a persistent low- or zero-interest environment, during times of turbulent markets and in periods of slow economic growth. Finally, it must be added that the strategy has shown best results when used over a long time horizon, during good and bad market situations.

6.1 Limitations of this Paper

This work only focused on P/E ratio as valuation measure to determine whether value stocks are able to outperform growth stocks in the Swiss stock market. Further ratios as market-to-book or price-to-cash flow, which have attracted much attention in the literature of security valuation, have not been taken into consideration. In addition, the data sample does not represent the market entirely, as only the 100 highest capitalized companies of the Swiss Performance Index have been considered. Furthermore the pre-financial crisis section was limited to three years return data which is a comparatively short timespan for significant assertions. This might have led to the fact that the pre-crisis returns turned out to be unusually high. Moreover, this paper did only make use of the Sharpe-Lintner capital asset pricing model (CAPM) to measure risk-adjusted performance. An attempt to assign the derivations from CAPM to missing risk factors by using other risk-based models, such as multifactor asset pricing models, was not made.

6.2 Outlook

This paper presents evidence that value stocks selected by low P/E ratios are able to generate excess returns in the Swiss stock market. Therefore, additional ratios in the context of value strategies in the Swiss Performance Index could be further analyzed. Furthermore, the timeframe of data collection before the financial crisis might be expanded to generate more valid return figures. Finally, additional factors could be introduced to examine if missing risk factors are the source of the deviations from CAPM.

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8 Appendix

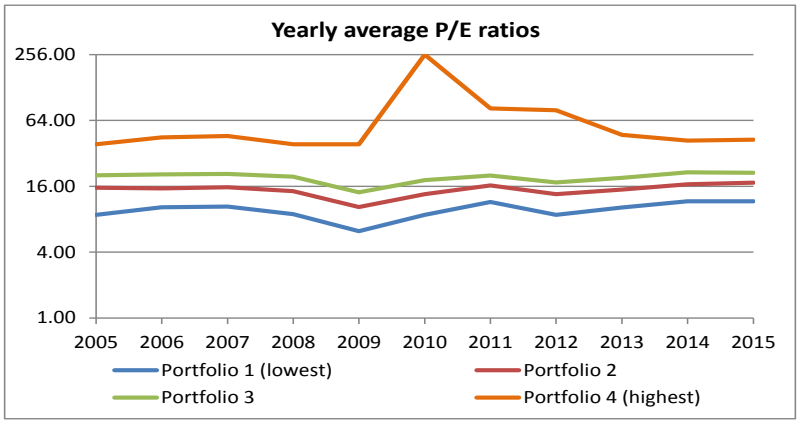

Figure 6: Yearly average P/E ratios of the four P/E portfolios

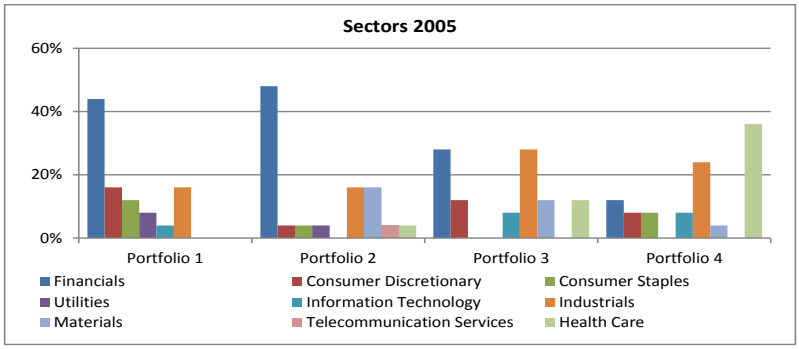

Figure 7: Sector breakdown 2005

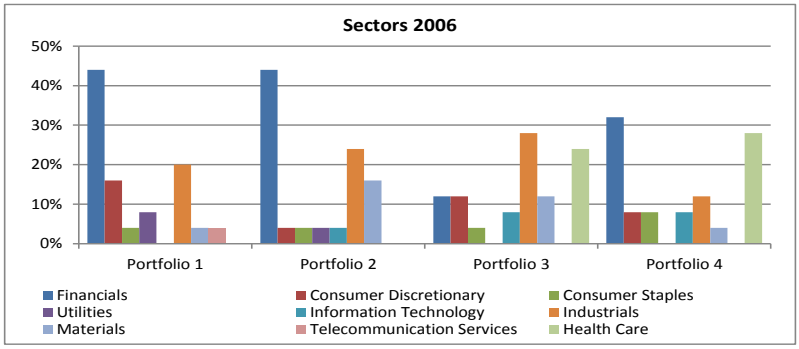

Figure 8: Sector breakdown 2006

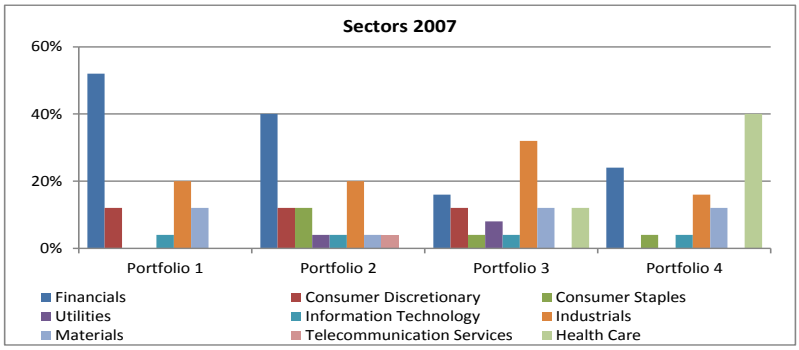

Figure 9: Sector breakdown 2007

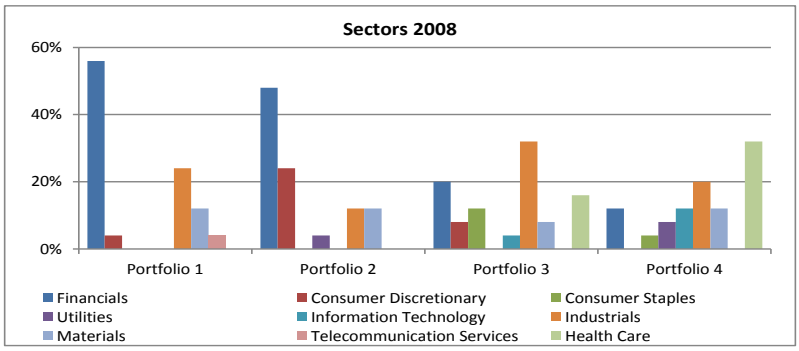

Figure 10: Sector breakdown 2008

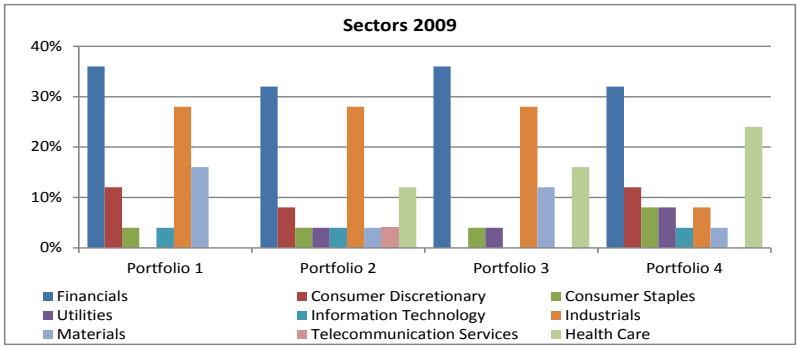

Figure 11: Sector breakdown 2009

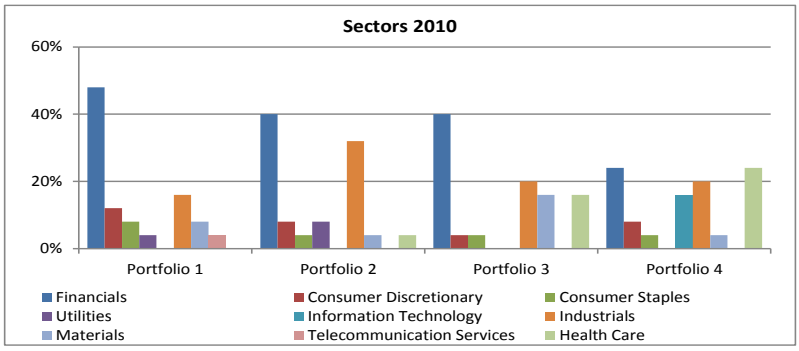

Figure 12: Sector breakdown 2010

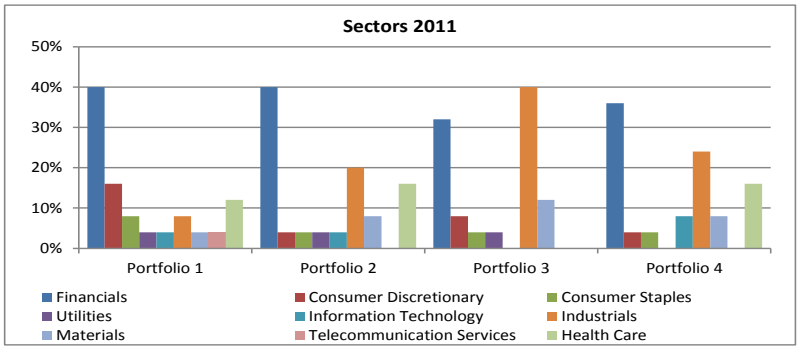

Figure 13: Sector breakdown 2011

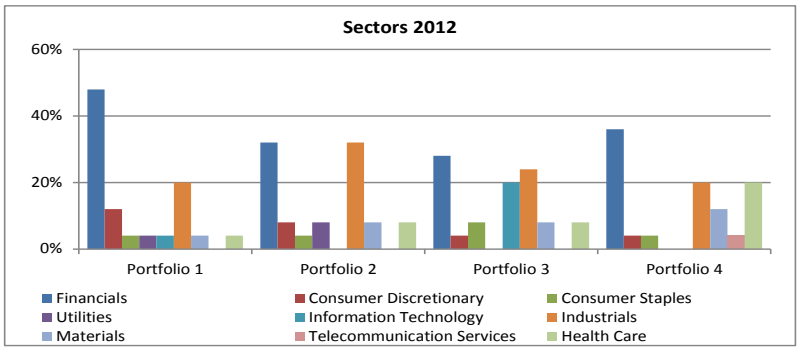

Figure 14: Sector breakdown 2012

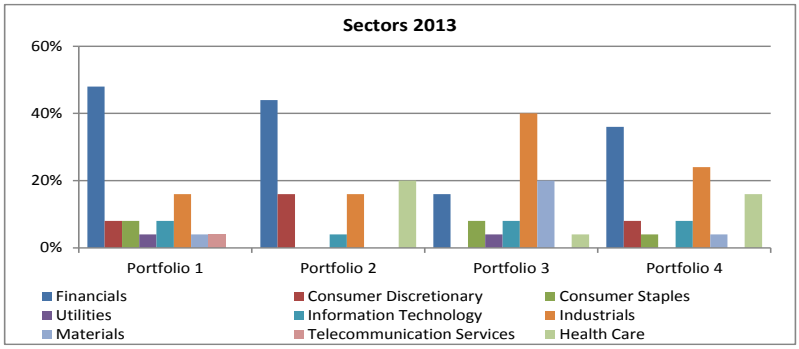

Figure 15: Sector breakdown 2013

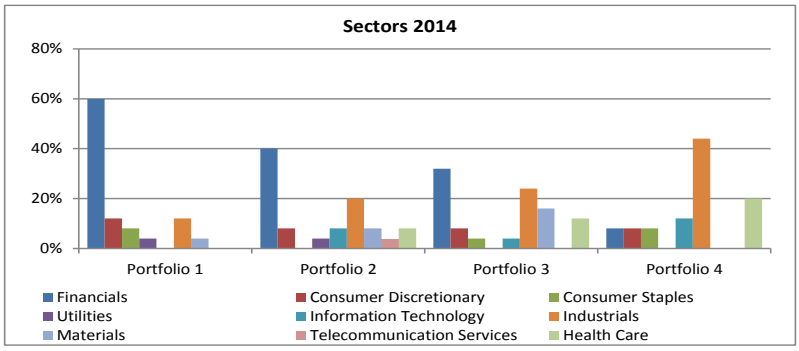

Figure 16: Sector breakdown 2014

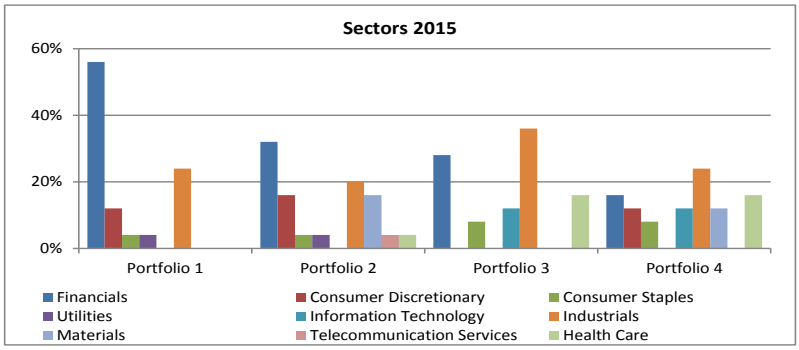

Figure 17: Sector breakdown 2015