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Investement Strategies Evaluation

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I certify that this is entirely my own work and that all collaboration or material from other sources has been clearly attributed in accordance with the requirements of the module and the university regulations.

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Abstract

Efficient Markets Hypothesis has been recently more often challenged on base of the empirical evidence which was suggested not be consistent with the theory such as excess volatility, market seasonalities, autocorrelation and predictability of equity returns. There is still ongoing discussion on relevancy and interpretation of these phenomenons and its consequences in investment strategy.

This work link empirical data gathered from equity markets to equity markets theory and investment strategy framework. Importance of the work lies in providing guidance to investors on capital allocation on equity markets.

Utility of three investment strategies was evaluated in this work which were buy&hold (index), contrarian and momentum. Research is focused on research of mutual funds and custom portfolios in regard to their returns and investment strategy. In mutual funds research the funds were categorized on base of their investment strategy and performance parameters were evaluated to generalize which strategies provided the best results. In research of stock returns three portfolios were constructed and returns analyzed in search for mean reversion and autocorrelation patterns. Using automation of some calculations provided by VBA programming language enabled processing of large data sets for more than 70 stock with daily trading data mostly back to 1990.

Research output suggests superiority of buy&hold strategy which is linked to Efficient Market Hypothesis. Buy&hold was shown to produce best risk-adjusted returns. This apply to both mutual funds and stock portfolios returns. Some less common patterns were observed in stock portfolios and possible explanation suggested within Efficient Markets Hypothesis framework.

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Introduction

Since establishment of the first modern stock exchange in Amsterdam in 1602 investors and speculators have formulated various investment strategies aimed to maximize investment returns. While many of them had not been proven to be workable failures and successes led to increase of understanding of how equity markets operate. Effort of traders had later been joined by academics and led to establishment of new disciplines within financial economics such as portfolio, risk management. Since then stock markets has emerged as leading institutions mediating capital allocation and risen to the most prominent place in advanced economies.

In financial economics there is ongoing discussion on efficiency of equity markets. This issue has principle importance in economic science as it relates to rational expectations theory which is one of backbones of modern economy science. Nonetheless are practical implications as market efficiency form has direct consequences in acceptance of a investment strategy.

Today still mainstream view explaining equity markets behavior is Efficient Markets Hypothesis (EMH) contributed by many authors and rising to prominence in 1960s. EMH states that equity markets operate with high degree of efficiency. At each point of time all securities of the same risk are priced to offer the same expected rate of return. This imply that under high market efficiency it is not possible to earn risk unadjusted returns. Maximal possible returns are defined by risk and this relationship constitutes efficient frontier suggested by Markowitz in his Portfolio Theory. EMH is backed by sophisticated mathematical models and great amount of evidence from equity markets trading.

However, some empirical evidence is suggested not be consistent with efficient markets. On the other hand also most of EMH authors admit that absolutely efficient markets can exist only in academic theory. On this bases EMH has been challenged by theories that deal with EMH weaknesses. One of most prominent recently emerging financial school is Behavioral Finance that compiles evidence of both economics and human psychology to explain some phenomenons that it suggests can not be explained by EMH.

These theories are closely related to investment strategies as they deal with risk-return relationship and predictability of returns what are primary points of focus in investing. Most common investment strategies applied in nowadays portfolio management – buy&hold, momentum and contrarian have

justification in the mentioned theories. Buy&hold (and its index modification) is relatively low risk approach most consistent with EMH and often claimed to provide the best risk adjusted results. Momentum strategy is approach the most often practiced by current portfolio managers. There are some indications that momentum provides higher returns but at expense of much higher risk. Contrarian strategy is especially popular among some Behavioral Finance proponents although some authors suggested that it may be consistent with EMH as well.

This theoretical framework and the three investment investment strategies are used as theme of this work. Its aims are practically oriented with outcomes applicable in portfolio management. Using more analyses and research cases utility of the investment strategies are evaluated on basis of their risk adjusted returns. The work focus on comparison of index investing and mean reversion research as mean reversion is unifying idea of momentum and contrarian strategies. Empirical data are analyzed and plotted against trends expected on base equity market theories or corresponding investment strategies. Specific target or research question of this work is to answer which investment strategy is best fitting given market circumstances. This work does not have ambition to evaluate overall efficiency of equity markets although empirical evidence will always play important role in formulating theories on equity markets functioning.

Analyses which were searching evidence of utility of the investment strategies were evaluation of mutual funds performance, analysis of mutual funds on base of their investment strategy, construction and evaluation of portfolios expected to produce mean reversion patterns in their returns. Returns analysis is coupled with risk analysis where appropriate.

In analyses of mutual funds performance sample consisting of 63 mutual funds with substantial assets was chosen. Their results were categorized and statistically evaluated. Valuation and size were bases for categorization using Morningstar methodology. Funds of the sample which do not fully fit given categories were further evaluated on base of their value and portfolio measures. Data tracking up to 10 years was used where available. In line with EMH returns should follow primarily by investment risk. There is also focus on index funds and their assumed ability to over perform actively managed funds in long term in the analysis. More of observed measures are correlated one against other in search for returns determinants.

The second scope is evidence for investment strategies utility from stock portfolios. Tests are conducted on three portfolios They are derived from current composition of Dow Jones Industrial

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Average, Nasdaq 100 index and the third portfolio is not bounded to any index. Most calculations were performed using VBA (Visual Basic for Applications) programming language. Patterns that are assumed to point to mean reversion if present were analyzed and are summarized in presented tables. One year and two year periods were used for the calculations. Using more than one time frame is justified by claims of some authors that mean reversion presents differently depending on time series observed. Portfolios used track data back to 1990 were available. Time end point for the analyses is January 2008. Presence of mean reversion would favor momentum and/or contrarian strategies over buy&hold. Otherwise returns distribution corresponding to expected volatility is pointing to market efficiency and superiority of index investing.

Answers to research questions as they are possible to be generalized from the analyses outputs point to buy&hold as most efficient investment strategy. In this connection research limitations should be recognized. Data credibility depends on its sources – mostly Yahoo! Finance and Morningstar. However, these providers are accepted as trustworthy by financial professionals. Data availability may be considered as restriction as incomplete portfolios from older time series (mostly in Nasdaq index) complicates determination of deciles structure of the portfolio. This is reason why sections where complete data are not present are not plotted one against another for comparison. Reason why data for some companies in Nasdaq 100 index are not available is their IPO after 1990. Also scope of the research is less complex compared to published works. Larger funds sample, more portfolios included would provide results with higher statistical power.

Restriction that is not within scope of the work methodology is based on assumption that overall market efficiency may change over time. It is generally accepted that stock markets operate now more efficiently then few decades ago. Market understanding, technologies facilitating market research and higher number of analysts are accounted for the change. As mean reversion is in some contexts related to market inefficiencies its effect may diminish in future as suggested in case of some other market anomalies. Therefore future utility of findings of this research are dependent also on future market circumstances.

Critical Review of Literature

Efficient Markets Hypothesis

Discussion on effectiveness of capital markets remain fundamental and unresolved issue. It is obvious that scale of this discussion has wide theoretical and practical implications. From theoretical point of view efficient capital markets confirm rational expectations theory that is centerpiece of current economic models. Practical implications of market efficiency lay in preference of corresponding investment and trading strategies and possibility or inability to “outperform the market”.

Today mainstream academic views hold position that capital markets operate with high degree of efficiency what is expressed in Efficient Market Hypothesis (EMH). The hypothesis was introduced by Louis Bachelier’s *The Theory of Speculation* (1900) but the work was ignored for a long period. The efficient market hypothesis emerged as a prominent theoretic position in the mid 1960s. Works of Paul Samuelson and Eugene Fama who published further evidence supporting the hypothesis and became their well known proponents. Fama also defined forms of efficiency as described bellow. Intertemporal Capital Asset Pricing Model (ICAPM) (Merton, 2003) showed how to generalize the Capital Asset Pricing Model (CAMP) to a comprehensive intertemporal general equilibrium model.

ERM maintains that the relevant information is quickly and accurately reflected in share prices. At each point of time all securities of the same risk are priced to offer the same expected rate of return. This is claimed to be a fundamental characteristic of prices in well functioning markets. This presumptions imply that it is not possible to consistently outperform the market. There is no consensus to what degree markets are efficient. However, there are not many supporters of idea of perfect market efficiency. As suggested by Fama, there are three commonly distinguished these three forms of efficiency:

The weak form of efficiency - The weak form reflects the situation where movements in share prices follow a random path. Current share price movements are independent of past share price movements and any information contained in past share prices will already be reflected in current share prices.

The semi-strong form of efficiency - Describes the situation where all publically available

information, including past share prices, is reflected in the current share price. Any publically available information is quickly absorbed by the market.

Strong form of efficiency - Is the ultimate form of efficiency and describe the situation where share prices fully reflect all available information, whether or not it is publicly available. This mean that the share price will be a good approximation to the “true” value of the share

In frame of EMH Random Walk Hypothesis (RWH) explains price movements in equity markets which follow random path. It asserts that price movements do not follow any patterns or trends and that past price movements cannot be used to predict future price movements. Mathematical methods of testing market efficiency include Dickey-Fuller test, runs test. Dickey-Fuller test version for a unit root can be written as:

$$y_t = \rho y_{t-1} + u_t$$

where y_t is the variable of interest, t is the time index, ρ is a coefficient, and u_t is the error term.

The runs test is a non-parametric test, in which the number is calculated and compared against its sampling distribution under RWH. It is important that not all equity markets pass the RWH tests and therefore can not be considered efficient. Tas and Dursungolu (2005) tested stock prices sequences of Istanbul Stock Exchange using augmented Dickey-Fuller and run tests with results rejecting random walk thus market efficiency. This is the case of more emerging markets. On the other hand the test are proof of efficiency of developed equity markets (Pukthumthong et al, 2007).

In rational pricing approaches alternative to ICAPM (CAPM) is Arbitrage Pricing Theory (APT). The Arbitrage Pricing Theory is a one-period model, in which preclusion of arbitrage over static portfolios of these assets leads to a linear relation between the expected return and its covariance with the factors. The APT, however does not preclude arbitrage over dynamic portfolios. The APT is a substitute for the Capital Asset Pricing Model (CAMP) in that both assert a linear relation between assets expected returns and their covariance with other random variables. In the CAMP, the covariance is with the market portfolio's return. The covariance is interpreted as a measure of risk that investors cannot avoid by diversification. The slope coefficient in the linear relation between the expected returns and the

covariance is interpreted as a risk premium.

Black-Scholes model applies mostly in pricing of options. It may be written as

$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

where the price of the underlying instrument S_t follows a geometric Brownian motion with constant drift and volatility σ .

The efficient markets hypothesis reached the height of its dominance in academic circles around the 1970s. Faith in this theory was eroded by a succession of discoveries of anomalies many in the 1980s, and evidence of excess volatility of returns.

Seasonalities and Excess Volatility

The seasonality of stock returns has received a great amount of attention for the last two decades. Early studies by Cross (1973), French (1980), and Keim and Stambaugh (1984) find negative and significant Monday returns in the US stock market. Recent studies by Chang et al. (1993), Dubois and Louvet (1996), and Brusa et al. (2003), document seasonality of daily returns of other national markets. These excess returns are variable in time are believed to be insignificant in the US in recent years while still present on other markets. Hiraki et al. (1998) Aggarwal and Rivoli (1989) find that in some Pacific Rim markets, especially Japan and Australia, the returns on Tuesdays instead of on Mondays are negative and significant. Study conducted by Huang et al (2006) investigated day of week effect on Taiwan Stock Exchange. Based on data from 1991 to 2004 their results indicate that the Taiwan stock market exhibits a strong day of the week effect. In particular, the return on Tuesday is negative and significant from 1991 to 2000, and th returns on weekend are positive and significant from 1991 to 1997 and from 2001 to 2004. They try to explain the effect in Taiwan by stock liquidity.

The day of the week effect largely remains an unresolved phenomenon. Some possible explanations were presented like those by Chen and Singal (2003) as they empirically show that the short sellers speculative trading partially contributes to the weekend effect in the US market. Since there is no over the weekend trading, the weekend imposes special risk to short sellers. The speculators are likely to

close their positions on Fridays and reestablish new short positions on Mondays. Therefore, stocks with high short-sale level (measured by the short interest ratio) will have higher negative Monday returns and higher positive Friday returns (after controlling for market capitalization).

Another well known and evidenced stock market effect is abnormal rise of stock prices in January coined January effect. The effect is mostly associated with smaller companies. It is assumed that tax reasons play a substantial role in year turn trading. Holiday effect is associated with increased returns during the day before a holiday period observed in many major markets (Agrawal and Tandon, 1994; Ariel, 1990;, Brockman and Michayluk, 1997). There are also other more “effects” that attracted less interest with some poorly evidenced. It should be noted that playability of the effects have been questioned by some fundamental EMH proponents.

Some research points out to excessive returns when utilizing negative autocorrelation of stock markets. Basic assumptions on mean reversion are based on empirical knowledge of processes such as rebound after sharp decline (e.g. market crash) or contrary falls after series of impressive growth (“bubble burst”). One factor that has been linked to the presence of autocorrelation is the presence of feedback traders in the market. Feedback traders are class of investors who naively base their trading decisions on past price movements. Positive trading is thought to induce negative autocorrelation and the converse is true for negative feedback traders.

Also substantial academic interest has been attracted to the phenomenon in recent years. Well known is Fama (1965) study that find support for a small positive relationship between successive returns but find not correlation in longer return intervals. However, later studies bring contradictory results (Fama, 1991; Fama and French 1988, 1989, 1995) with suggestion that mean reversion in stock returns is consistent with time-varying risk premia or expected returns and, thus with efficient markets.

Mean reverting can be mathematically modeled using multivariable Ornstein-Uhlenbeck process, where prices fluctuate around a time-varying expected return governed by a set of variables (e.g. macroeconomic variables).

$$dr_t = -\theta(r_t - \mu)dt + \sigma dW_t$$

where θ , μ and σ are parameters and W_t denotes the Brownian motion (Wiener process). The multivariable Ornstein-Uhlenbeck process is capable of producing an autocorrelation pattern consistent

with empirical observations, that is, positive autocorrelation in short-horizon returns and negative autocorrelation in long-horizon returns.

Works of Shiller (1981) and LeRoy and Porter (1981) suggested that the stability of the present value of stock market through time suggest that there is excess volatility in the aggregate stock market, relative to the present value implied by the efficient markets hypothesis. These claims were made on base of comparison of present value subsequent to that year of the real dividends paid on the Standard & Poor's Composite Stock Price Index discounted by a constant real discount rate equal to the geometric average real return 1871 – 2002 on the index, one finds that the present value, if plotted through time, behaves remarkably lie a stable trend. In contrast, the S&P Composite Stock Price Index gyrates wildly up and down around this trend. Implication of this research is that ex post analyses reveal substantial mispricing challenging EMH. The evidence regarding excess volatility seems, to some observers at least, to imply that changes in prices occur for no fundamental reason at all. Excess volatility was found also in other markets. Bellow are presented prices vs. ex-post stock values of London Stock Exchange as published by DeLong and Grossman (1993).

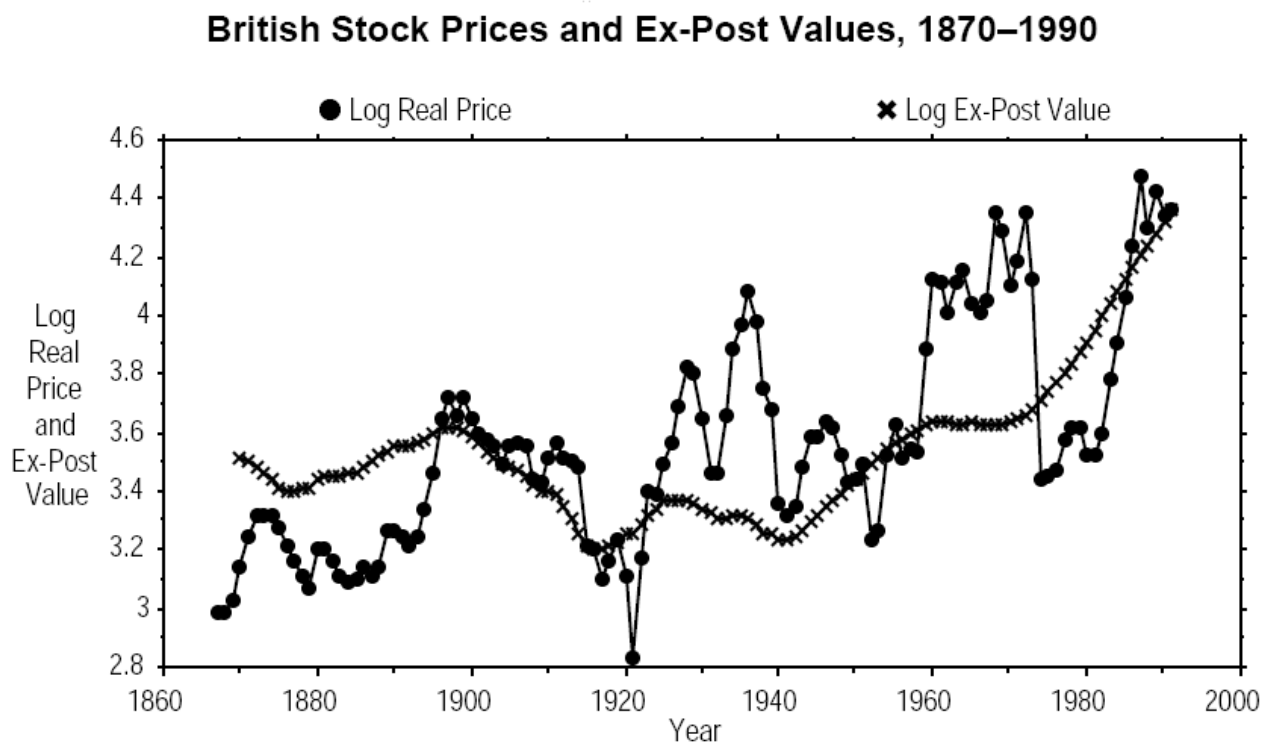


Figure 1: Excess volatility as observed on data from LSE (DeLong and Grossman1993)

Behavioral Finance and New Views on Market Efficiency

Based on these and other market anomalies EMH became increasingly questioned. One of emerging concepts is behavioral finance school. Its principal sources are cognitive psychology and the limits of arbitrage. Behavioralists point out to psychology research that confirm that people make systematic errors in investment decision making. These include inadequate loss aversion, overconfidence in opening positions, overestimation of recent experience, overreaction to both positive and negative news. After all it is not disputed that general public participating on equity markets lack knowledge on their functioning. One of points of interest of behavioral finance are market bubbles which are sometimes according to behavioralists present market inefficiency and explain them by concept of feedback trading. It means some traders irrationally estimate future returns on base of historical prices. Therefore stock or index can gain momentum and its continual rise is fed by irrational traders. Unsustainability of this trend lead to sudden fall (bubble burst) while the trend can persist for substantial time. EMH assume presence of irrational investors but expect to other groups to profit out of them and correct market inefficiencies. According to behavioralists financial misvaluation is common but it is not easy to make abnormal profits of these misvaluations. Its because some misvaluations tend to be long-term in nature and it is uneasy to short them.

There are some well documented examples where stocks were inadequately valuated but as they were not shortable imbalances persisted. Royal Dutch and Shell are world leading oil producers that merged in 1901 with their interest on a 60-40 basis. It is easy to show that whenever the stock prices are not in a 60-40 ratio arbitrage opportunity arise. They are large companies with substantial trading volumes and therefore there is assumption of efficient pricing.

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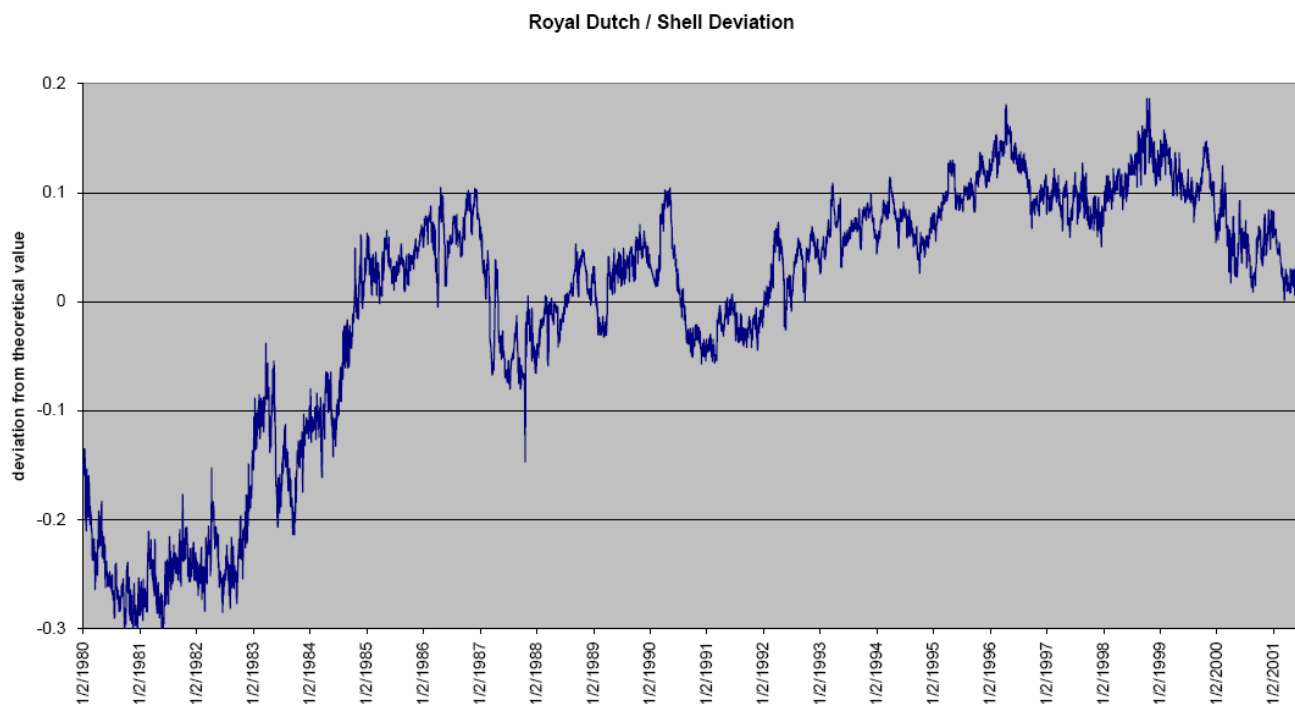


Figure 2: Royal Dutch/Shell deviation from parity from January 1980 to December 2001, Froot and Dabora (1999) and Froot (2001).

For the last 22 years the course demonstrates substantial deviations from the theoretical relation. In 1998 LTCM hedge fund shortened Shell to buy Royal Dutch but prices diverged further from parity and LTCM in liquidity needs was forced to sell out positions and brought the fund to collapse. LTCM position would prove be right in long horizon but is explainable for often failing arbitrages. Another well publicized case is 3Com sale of Palm. In March 2000 3Com sold via IPO 5 percent of Palm subsidiary. The price that Palm obtained was so high, when compared with the price of 3Com shares, that if one subtracts the implied value of remaining 95 % of Palm from the 3Com market value, one finds that the non-Palm part of 3Com had a negative value. Since the worst possible price for 3Com after Palm sale was completed would be zero, there was thus a strong incentive for investors to short Palm, and buy 3Com. But the interest cost of borrowing Palm shares reached 35 percent by July 2000, putting a damper on the advantage to exploiting the mispricing. Even an investor who knew for certain that the Palm shares would fall substantially may have been unable to make a profit from this

knowledge. In this light it is not surprising that speculators who tried to short bubble peaks of late 1980s Tokyo Stock Exchange or 2000 tech bubble suffered terrible losses.

Technical Analysis

There are some points why technical analysis is worth of few remarks in this work. It deals with returns prediction and is commonly used by traders. It is understood that technical analysis principles contradicts efficient markets and it is challenged by EMH. Technical analysis has evolved independently on mainstream academic equity market concepts and has never been fully accepted within economic science. Its beginnings trace back to Japan commodities market of 18th century but its western roots are present in Dow Theory. It was further developed by traders rather than academics. Technical trading has been often subject of hot debate and even ridicule within academic circles. In general there is mixed evidence in studies on the analysis profitability and substantial skepticism about its techniques persist. However, until now technical analysis belongs to core trading tools and is used by majority of traders. This can be illustrated by the Taylor and Allan (1992) survey in which 90% of London foreign exchange market claimed to use some technical analysis input. Fama and Blume (1966) as firm EMH supporters conclude that there are not advantages to using technical analysis. However, Brock, Lakonishok and LeBaron (1992), and more recently Bessembinde and Chan (1995) report that some sets of simple trading rules do provide excess returns. Also Sharpe points out that success of technical strategies offer a challenge to those who content that the stock market is highly efficient.

Technical analysis can be defined as study of any market that utilize price and volume information only in order to forecast future price movements and trends. Underlying all of technical analysis are the following assumptions:

- Values, and thus prices, are determined by supply and demand
- Supply and demand are driven by both rational and irrational behavior
- Security prices move in trends that persist for long period of time
- While the cause for changes in supply and demand are difficult to determine, the actual shifts in supply and demand can be observed in market price behavior

Technicians use either chart patterns and ratios in search for signals to entry or exit positions. This include large number of instruments. Just for example trendlines, resistance and support lines, moving average and other chart patterns are aimed to project trends. Other non chart instruments important in technical analysis are volumes, money flow, momentum, rate of change (ROC) among others.

One of innovations in technical trading is use of Artificial Neural Networks (ANN) which are artificial intelligence adaptive software systems that can learn to detect complex patterns in data. This not only removes the need for human interpretation of charts or the series of rules for generating entry/exit signals but also provides a bridge to fundamental analysis as the variables used in fundamental analysis can be used as input.

Portfolio Theory and Risk Measure

Theoretical investment approaches are based on Modern Portfolio Theory (MPT) and subsequently Post-Modern Portfolio Theory (PMPT). MPT proposes how rational investors will use diversification to optimize their portfolios, and how a risky asset should be priced. The basic concepts of the theory are Markowitz diversification, CAMP, alpha and beta coefficients, Capital Market and Securities Market lines. It is assumed that investors are risk averted and risk can be described via a quadratic utility function (volatility). Investor is assumed to be indifferent to other characteristics of the return distribution such as skewness and kurtosis. Under this model portfolio return is the proportion-weighted combination of the constituent as tests returns and its volatility is a function of the correlation of the component assets.

In the model return is equal to:

$$\mathbf{E}(R_p)\sigma_p = \sqrt{\sigma_p^2} \mathbf{E}(R_i)$$

And portfolio volatility:

$$\sigma_p = \sqrt{\sigma_p^2}$$

Under Markowitz Portfolio theory there is only one possible asset combination plotted in risk-return space that is said to be an efficient frontier.

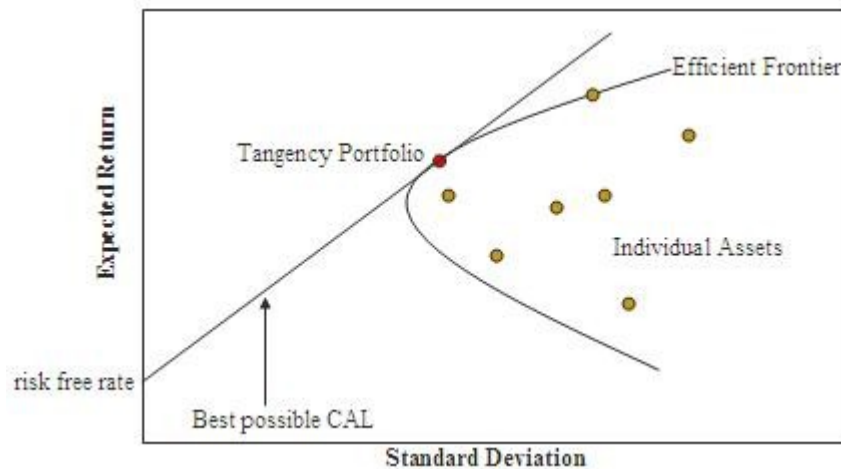


Figure 3: Efficient Frontier and Capital Allocation Line

Characteristics of efficient frontier are that it is convex and portfolios can be constructed only lying on the frontier or below the frontier. The efficient frontier is convex because the risk-return characteristics of a portfolio change in a non-linear fashion as its component weightings are changed. Regarding portfolio allocation if this is below the curve it is either inefficient while by the same risk higher return is achievable. Capital allocation line is a straight line of expected return plotted against risk that connects all portfolios that can be formed using a risky asset and a riskless asset.

The principal extension of PMPT is different approach to risk measurement as variance of portfolio return is not considered satisfactory measure of investment risk. Outcomes of the theories is to construct diversified portfolios. An investor can reduce portfolio risk simply by holding instruments which are not perfectly correlated. In other words, investor can reduce their exposure to individual asset risk by holding a diversified portfolio of assets. Diversification will allow for the same portfolio return reduced risk.

Most common instrument in risk adjustments of returns is Sharpe ratio:

$$S = \frac{E[R - R_f]}{\sigma} = \frac{E[R - R_f]}{\sqrt{\text{var}[R - R_f]}}$$

However, Sharpe ratio use is problematic in non-Gaussian returns distribution. Other alternatives has been proposed to deal the problem. These include Mean Absolute Deviation (MAD), the Minimax ratio, the Stable ratio, Value at Risk (VaR) or Conditional Value at Risk (CVaR). However, all above mentioned ratios attribute a symmetrical weight to the upside and downside returns (Farinelli et al. 2008). To overcome this Zentios (1995) and Dembo and Mausser (2000) proposed to use assymmetric weights to upside and downside returns.

Investment Strategies

Principle that investor should construct portfolio with volatility corresponding to expected return became generally accepted. However, there are differing opinions on principles of portfolio construction. Strategy most prominently associated with EMH is “indexing”. EMH imply that timing doesn't matter, it is waste of time to search for undervalued equities, equities are priced adequately. Therefore passive following of a given index should produce better returns. There is very strong evidence supporting correctness of the approach. Most notably the fact that mutual funds that passively hold portfolios copying a stock market index outperform in a long run actively managed funds (Atril, 2006). Increased transaction costs are usually attributed to inferior performance of actively trading funds. There is some disagreement whether active trading would produce superior results when not including transaction cost but this question is not significant in real world conditions. It is not surprising that index strategy also attracts considerable criticism. One of the points is empirical observation of stock price change associated with index inclusion/exclusion. Stock price tend to rise when a share is included into index and drop when excluded. It is clear that these changes in prices do not relate to company fundamentals but can be well explained by the fact that portfolio managers adjusting passively managed portfolios. For example Royal Dutch in week of S&P exclusion dropped 17 %. There is also evidence of subsequent rebound in prices of stocks excluded from stock indices. Difference between Index and Buy&Hold strategy should be remarked. Index portfolios are adjusted when index composition changes while Buy&Hold portfolios are even more stable with further transaction costs minimization. Wilkens et al (2006) suggest that Buy&Hold strategy outperform indexing. Indexing and Buy&Hold are said to be consistent with EMH. However, there are many more

“alternative” investment strategies and some of them have claim to deliver superior returns. Momentum and contrarian strategies will be discussed in some more details. Base for both momentum and contrarian strategies are consistent with assumption of autocorrelated stock returns (but also further strategy bases apply).

Applying momentum (or growth) strategies mean to buy assets as they rise in value and sell assets as they fall. Grinblatt et al. (1995) find that 77 percent of the mutual funds in their sample followed momentum strategy and realized better performance than those funds that did not. The opposite is contrarian strategy. There were more studies examining contrarian strategy as this strategy as some empirical evidence and theoretical concepts backed its assumptions. Contrarians often claim to “go against crowd”. Finding “undervalued” stocks (on base of fundamental analysis) is sometimes also associated with contrarian strategy although it is not its core principle (often referred as value investing). Contrarian approach may be justified in behavioral view according to which investors overreact to both positive and negative news and tend to feedback trading. Negative autocorrelation was also subject of research of Fama (1965) and Fama and French (1988) who frame the phenomenon within EMH. According to Wilkens et al (2006) unadjusted returns from the contrarian (momentum) strategy are greater than those from the other strategies when the mean reversion parameter, α , is greater than (less than) one. The risk level of the contrarian strategy is the lowest at essentially all levels of mean reversion and the risk-adjusted returns from the contrarian strategy, measured by both the Sharpe and the Treynor ratios, dominate those from other strategies.

There is a clear connection between theoretical concepts of market efficiency and investment strategies. Different approaches in investing represent application of current most accepted theoretical concepts of equity markets – Efficient Markets Hypothesis and Behavioral Finance. While proponents of efficient markets tend to indexing or Buy&Hold contrarian strategy is recognized by behavioralists. Therefore research in investment strategies can bring new light on market efficiency and vice versa knowledge on market efficiency has its implications on investment strategies. Another reason for further research of investment strategies is some inconsistency and paradoxical results such as support for both momentum and contrarian strategies and claims of superiority for both while they are utilize the opposite algorithms.

There is also another broadly defined framework for investment strategies which is known as value and growth investment strategies. These strategies are roughly opposing in view of assessing future

cash flows. While value investment prefer current and certain income, growth investors are prepared to wait for future growth in exchange for higher returns. While this framework is not much used in current professional nor academic portfolio research not connected to other modern portfolio theory concepts its importance lies in fact that average investors and mutual funds themselves position their investment products in this ways as this concept is well established and easy to understand.

Value investing is a broad concept that has evolved over time. There are more definitions of this investment approach. Investopedia.com (2008) states that value investing is the strategy of selecting stocks that trade for less than their intrinsic values. Value investors actively seek stocks of companies that they believe the market has undervalued. They believe the market overreacts to good and bad news, resulting in stock price movements that do not correspond with the company's long-term fundamentals. The result is an opportunity for value investors to profit by buying when the price is deflated. Typically, value investors select stocks with lower-than-average price-to-book or price-to-earnings ratios and/or high dividend yields.

Damodaran (2008) offers these value investing definitions :

Conventional definition: A value investor is one who invests in low price-book value or low price-earnings ratios stocks

Generic definition: A value investor is one who pays a price which is less than the value of the assets in place of a firm

In general substance of value investing is that investment should follow intrinsic investment value and the intrinsic value proxies should be base for fundamental analysis. Therefore value investors stress importance of some of such a proxies like Price/Earnings, Price/Book ratios. Some other such as PEG (Projected Growth in Earnings) has been applied specifically in value investing. The PEG is calculated by dividing the P/E ratio by the projected growth in earnings for the coming year.

Damadaran (2008) presents that investment into bottom P/E quantile brings yearly premia as following in the observed markets:

France	6.4 %
Japan	7.3 %
United Kingdom	2.4 %

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Ideas of value investing may be traced in practice and published works of Benjamin Graham which include *Security Analysis* and *Intelligent Investor* (1949). He established “Graham screens” that were rather strictly set criteria based on accounting data and derived financial ratios which included:

- P/E of the stock has to be less than 40 % of the average P/E over the last 5 years
- Dividend yield is higher than two-thirds of the AAA corporate bond yield
- Price is lower than two-thirds of book value
- Debt-equity ratio has to be less than one
- Current assets are higher than twice current liabilities
- Current assets are lower than twice current liabilities
- Historical growth in EPS (over last 10 years) higher than 7%
- No more than two years of negative earnings over the previous ten years

Based on these measures rigid decisions on inclusion of a stock into portfolio had been made. However, it was stellar portfolio manager of Berkshire Hathaway – Warren Buffet and his successes in value creation that brought attention to value approach as it has been attributed to his investment style. Although Buffet initially adhered to the Graham principles he soon formulated much broader criteria such as:

- Consistent operating history
- Favorable long term prospects
- High return on equity
- High and stable profit margins

Which he combined with fundamental analyses instruments such as financial ratios. However, technology change of 1990s brought much easier access to financial data and trading statistics and is assumed to erode advantage of screeners using fundamental analysis. Presumably in this context Berkshire Hathaway changed its strategy in favor of approach termed by Damodaran (2008) as *Activist Value Investor*. That is search for poorly managed and poorly run companies take shareholder stake there and then try to change the way companies are run. As substantial capital is required for the “activist” approach accumulated wealth may provide Berkshire Hathaway last competitive advantage

faced with current equity markets efficiency. However, long term performance of the company which had easily outperformed all benchmark indices is often pointed out as example of investor beating the market.

On base of P/E ratio many investment and timing strategies have been proposed. They include switching to safer investment instruments such as T-bill on base of a particular P/E value and vice versa. Another option is to extend trading rules by dividend yield as this is also parameter used in value investing. Workability of these strategies was tested among others by Fisher and Statman (2005) while they find that it is in general difficult to overcome buy&hold strategy. However, they find that possible when transaction costs are not considered under some circumstances and on some world markets. Results for 1970 – 2002 period for the US market are included as appendix No. 1.

Conversely the strategy seen as opposite to the value is growth investing. Investopedia.com (2008) states that growth investing is a strategy whereby an investor seeks out stocks with what they deem good growth potential. In most cases a growth stock is defined as a company whose earnings are expected to grow at an above-average rate compared to its industry or the overall market. Damodaran (2008) generic definition is that growth investor is one who buys growth companies where the value of growth potential is being underestimated. In other words, both value and growth investors want to buy undervalued stocks. The difference lies mostly in where they think they can find these bargains and what they view as their strengths. However, there is disagreement whether growth investing profits are excess or justified by higher risk associated with small companies. Growth stocks are characterized by high P/Es but naturally this can not criterion in growth portfolio selection. Income growth indicators, company and industry prospects are judged but substantial facts that it is hard to estimate future returns and overall more problematic to research small companies should be recognized.

It is not surprising that some approaches tries to balance both above mentioned strategies in order to utilize their advantages. One of them is GARP (Growth at A Reasonable Price) but other principles were formulated as well. GARP investors look for companies that are showing consistent earnings growth above broad market levels (a tenet of growth investing) while excluding companies that have very high valuations (value investing). The overarching goal is to avoid the extremes of either growth or value investing; this typically leads GARP investors to growth-oriented stocks with relatively low price/earnings (P/E) multiples in normal market conditions.

In fact value-growth dimension presents rather broad descriptive framework for investors and mutual

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funds to define their strategies. As this concept is quite simple and understandable to general public it is one of most common points on which funds position themselves. Absence of adequate risk adjustment methods is not compatible with formulating up to date strategies compatible with modern portfolio theory. After all at there is no convincing scientific evidence of ability of value nor growth strategies to produce excess returns and it is even problematic to clearly define these strategies. Therefore value-growth divide should be viewed rather as broad category and not as a strategy based on exact principles. This is also how the subject is handled in this work.

Some analysis from Value-Growth point of view has been conducted and is presented in this work. It is based on Morningstar Style Box (MSB). Market research company Morningstar constructed Morningstar Style Box (MSB) graphic tool aimed to provide easy orientation in core portfolio characteristics that determine investment risk. The box presents two dimensional matrix composed of Investment valuation (P/E ratio) and Size (market capitalization) with nine possible output categories. This is applicable to any portfolio e.g. mutual funds investing in stocks, stock index and is indicative on overall market move.

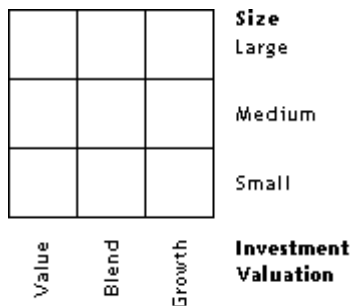


Figure 4: Morningstar Style Box

Mutual funds

Mutual funds (MFs) present rapidly growing sector and most affordable option for general public how to participate on equity markets.. Market liberalization, sociological and technology factors have fueled rapid growth in last decades in developed countries and recently also in emerging markets. Within EU MFs assets total €3503 B. American Investment Company Institute counts more than 8200 MFs compared to about 7800 companies listed on NYSE and NASDAQ stock exchanges. Mutual funds in developed countries are subject of state regulation which put some limits on portfolios construction such as inclusion of derivatives or leverage. However, these instruments are utilized by hedge funds which finds way how to evade the regulation in order to provide higher although risky returns.

The basic MFs divide with respect to portfolio construction is on active and passive portfolio management. Active portfolio managers seek stocks which they believe have potential of over average returns. In general mean variance weighted framework is theoretical background for creation of active portfolios. However, as documented by academic research these principles are often not applied in MFs management.

Passive investing may be identified with index funds. There are three portfolio construction strategies typically used to manage an index fund: linear optimization/stratified sampling, quadratic optimization, and full replication. Ultimate goals are low tracking error and low turnover to deliver the index return at the lowest possible cost.

Full replication, where every stock in the portfolio is held at its exact weight in the index, is not a feasible strategy for managing a portfolio of institutional size. Low liquidity for the smaller capitalization stocks in the index make them very expensive if not impossible to own. Further, it is not necessary to invest in the lower tiers of capitalization to successfully deliver the index return, as long as the portfolio has the correct exposure to the characteristics of the index that drive performance. Quadratic optimization is a tool most often used by active managers for portfolio construction. Stratified Sampling has been developed by Wilshire Associates. The sampling approach divides the index into cells which usually represent industry sectors and market capitalization rankings. The number of cells necessary to define an index is directly proportional to the number of stocks that comprise that index.

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The literature on mutual fund performance is consistent with the contention that on average the portfolio management skills provided by mutual fund managers are of little value to investors. Evidence that the average mutual fund underperforms a passive benchmark portfolio suggests that investors who believe fund managers have superior stock selection ability are naive. Day et al., (2001) performed analyses where they investigated causes of underperformance of mutual funds portfolios. Their conclusions are that:

- Most managers do not choose to hold optimally weighted portfolios. The explanation is that most fund managers are either skeptical or unaware of quantitative portfolio allocation strategies.
- The average monthly risk-adjusted returns for mutual funds in the aggressive-growth and growth-income categories are negative and statistically significant, with respective monthly alphas of -0.253 % and -0.075%. The overall average alpha for the funds in the sample is -0.083% per month, risk-adjusted return of roughly -1.0% per year.
- Fund managers rely too heavily on momentum strategies that call for buying past winners and selling past losers
- The negative correlation between portfolio turnover and pre-expense risk-adjusted performance is not consistent with the hypothesis that portfolio turnover is generated as by mutual fund managers with superior information. In fact, the results suggest that above average turnover may contribute to the pre-expense underperformance
- Efficiency and pre-expense performance for the mutual fund in the sample would have been substantially improved by using ex ante mean-variance efficient weights. In particular, the hypothetical portfolios that they constructed would have improved the performance of the average mutual fund in the sample by 0.92 % per year.

Methodology and Data Collection

Mutual Funds Investment Strategies

In this part sample of US mutual funds was chosen to be categorized based on Morningstar Style Box (MSB) typology and subsequently analyzed sample return patterns. The sample consist of 63 mutual funds marketed in the US. Observed parameters in the sample were 3, 5, 10 years returns, Standard deviation (volatility), Sharpe ratio, alphas, betas and P/Es. In cases of some mutual funds 5 and 10 years returns were not available. Availability of 3 year return value was prerequisite of sample inclusion. Data traits back three years and were collected on January 2008. Morningstar methodology was accepted in defining MSB categories. As the morningstar methodology is not generally accepted mutual funds claims in some cases differ from morningstar typization. For instance Vanguard Large Cap Index is categorized as large blend according to Morningstar methodology. The source of data is Morningstar and complete list of funds and set of input data is included in appendices under number 2.

Sample inclusion criteria were availability of all required data, funds with higher total assets of established fund families were preferred. Sample was designed to be representative for each Morningstar Style Box category. However, this is not easily achievable as some categories of funds are much more common as others. Large growth and large value funds are most common funds in the US and are also relatively overrepresented in the sample. On the other hand medium size value and medium blend are most scare and as there are only two and three respectively included in the sample. For these categories output data are assumed to have lower statistical power. For sample to be standardized vast majority of the funds allocate their portfolios in US equity markets and S&P 500 is used as standard index unless otherwise specified. Potential bias is in preferring larger and established funds but on the hand this layout well corresponds to average investment target and results are justified to have indicative value.

The second analyses of mutual funds connects MSB evaluation but seeks funds with distinctive investment strategies. Two funds of the same sample are chosen on base of their claims on their investment strategy. Both funds claim to utilize behavioral finance research and apply it in their investment strategies. Tools of secondary research are used in this case while Morningstar and the funds are source of data. Portfolio parameters and returns of the funds are evaluated and conclusions formulated.

Portfolios Returns and Mean Reversion

Source of data for portfolio analysis is Yahoo! Finance. Data sets include daily trading prices trailing back to at least 1993 but most of records begin in 1990 (Yahoo! Finance provides data series starting in 1960s for many stocks). Despite availability of older data series in order to receive standardized sample in the analyses only complete series were used i.e. only portfolios with the same number of titles were compared to each other. Closing prices are used in the analyses.

After manual download data series were extracted and processed using Visual Basic for Applications (VBA) programming language and automated MS Excel functions. VBA source code is included in appendices as number 4. Basic operations automated by programming language include:

1. Extracting end year closing price
2. Calculation of yearly returns – data are organized in table
3. Creation of “decile” table – the tables which are included in appendices are output of the processes and base for further calculations merely performed by excel functions. Term decile table refer here to table where stock are sorted ascending on base of their yearly returns. Deciles can be easily picked and analyzed from the table.

Performance of 1st and 10th deciles and their subsequent (following year) performances are calculated using excel functions and organized into table. The same apply for their averages.

Number of stocks in portfolio (30) was chosen as this amount of data can still be relatively easily handled while providing adequate representative sample. This also match extent of DJIA and are subsequently compared against its portfolio. DJIA portfolio copy Dow Jones Industrial Average index composition as of April 2008. It means that DJIA portfolio of this work does not exactly copy the index back to time as composition partially changed several times. Nasdaq 30 portfolio was chosen as stock of 30 companies of Nasdaq 100 with highest market capitalization as of April 2008. In case of this index the problem of data availability is most evident as more of the stock included had their IPOs in later than in 1990 what is time where most of data series used in the analysis start. As mentioned above this is reason why only later years of Nasdaq 30 are used in the analysis. The third portfolio is named P1 and does not copy any established market index. Criteria for the portfolio creation was firstly data availability back to at least 1993 on Yahoo! Finance. However, most records track back to 1990 (or

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earlier but series starting 1990 are used). Most of the companies are large corporations. Portfolio includes technology companies that has expanded during the observed time series. There were no predefined parameters for the portfolio while idea was to create portfolio with attributes somewhere between DJIA and Nasdaq. There is potential for survivorship bias in P1 portfolio. Portfolios comparison including its risk, return measures and capitalization are included in Research Findings and Analysis chapter.

Table of subsequent deciles returns evaluated on two year bases was created using the same algorithms. The difference is in the second point (above) executed by VBA source code where operation to count up following pairs of years was added. Other processing steps are the same.

Economic Background of the US Equity Market 1990 - 2008

Analyses of this work in general focus on time series from 1990 to 2008. Corporate profits were proven to be the single most important determinant of stock prices. It is understood as the prices of stocks are considered to be discounted value of future company profits. However, other factors like interest and currency exchange rates have substantial impact on the stock market value. The brief economy development outline of that period is sketched to provide framework for returns of the observed portfolios and bigger picture of development within equity markets.

The US were in mild recession in early 1990s. However, international trade liberalization and more importantly technological change led to longest economic expansion in postwar US history. This period was defined with an acceleration in the growth rates of output, employment, investment and wages. In this period market value of firms was driven up by the increase in the expected discounted value of profits. This subsequently led to financing boom from which profited startup and expanding companies. All these developments stressed with rise in productivity and application of new technologies created sense of upcoming “New Economy”. 1990s were also period of advancing globalization and worldwide equity markets liberalization. Over the course of business cycle the US stock market grew by 279 %. There is disagreement on to what extent this rise was justified by rise in productivity. In late 1990s market believed sustainability of the growth when US stocks were traded with well over-average P/E values. Expansion was at the most associated with technology and internet companies with spectacular rise of Nasdaq index in 1999.

That time it was becoming clear that the sharp rise in tech stock prices had resembled stock market bubble. FED tried to cool the market raising interest rates six times over 1999. Especially small tech companies failed to deliver economic profit what became evident in early 2000. This triggered bubble burst in March 2000. Nasdaq Composite lost about 50 % of its value through March to end 2000. Difficult year 2001 when the US faced the terrorist attacks just increased uncertainty and volatility. FED reaction to falling stock market was decrease in interest rates. Slashed rates reached 50 years low in 2002 and remained on extraordinary low levels for approximately three years. The stock market reached its bottom in 2002 and supported by low interest rates reached solid gains until 2007.

In around 2003 trend of rise in commodity prices have been established. Most significant to equity markets have been moves in prices of oil and gold. Rise in prices of oil started approximately in time of

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US Iraq invasion. The invasion itself is not considered to be the primary cause which is rather thought output decline in many producing countries. Oil surpassed \$ 40 per barrel in 2004. After partial decrease in late 2006 it skyrocketed in 2007 and 2008 reaching \$ 115 per barrel as of April 2008. However, one of the causes in rise of commodities have been steady fall of US dollar most significantly against the European currency. At the dollar highs it was valued 1.11 euros in 2001 while since than its value fell to 0.64 euros in mid 2008. Beside huge US trade deficit other factors may be establishment of euro as world currency or capital flow from the US to emerging markets.

US economy went into trouble in late 2007 when rising commodity prices combined with the subprime mortgage crisis and eventually triggered recession. Low interest rates led to sharp rise in subprime and adjustable rate mortgages after 2002. Fall of housing prices and rising interest rates triggered mortgages refinancing problems. This caused massive losses for lenders and collapse of some banks and broader liquidity problems in financial sector.



Figure 5: Dow Jones Industrial Average in 1990 – 2008 period (Yahoo! Finance, 2008)

Research Findings and Analysis

Mutual Funds Investment Strategies

Measure of risk clearly match anticipated values. Most risky are small growth stocks and large value are associated with lowest risk. It may be interesting that large growth were less risky than small value.

Morningstar Style Box – SD (volatility) averages			
9.16	9.86	12.09	Large
9.01	11.77	13.78	Mid
12.28	12.67	14.07	Small
Value	Blend	Growth	

Table 1: Volatility averages

When comparing risk to 3y pa returns some patterns corresponds to underlying risk analysis. For each size returns increase toward growth valuation. As expected riskier stocks with less certain future profits brought higher returns in 3y run. However, anomaly on the vertical scale is evident. Smaller size investments although riskier did not bring higher returns during last three years.

Morningstar Style Box – 3y pa averages			
6.36	7.03	7.17	Large
4.66	5.78	6.29	Mid
4.41	4.23	4.61	Small
Value	Blend	Growth	

Table 2: 3y pa averages

Somehow puzzling are also 5y returns as there are not clear trends. It is worth to note that in the sample there are included some mutuals that operate for less than five years. Therefore 5y returns averages table include only figures of 52 funds compared to 63 of full sample what may result in lower representativeness of 5y returns.

Morningstar Style Box – 5y pa averages			
13.84	14.65	12.69	Large
15.55	16.50	13.39	Mid
14.95	14.51	15.69	Small
Value	Blend	Growth	

Table 3: 5y pa averages

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However, when medium value and blend results are not considered as there are only two funds for the both contrary to 3y returns table figures point out to higher returns associated with lower size. Substantial fact on all risk and returns data is its high dispersion. It can be well observed on the chart further bellow relating P/E to 3y returns.

When finding clues for returns distribution it may be useful to draw developments of market defining indeces in last 3 years. Bellow is the chart comparing returns of Dow Jones Industrial Average and S&P 500. Basic fact is that S&P 500 has lower average capitalization than DJIA that consist of 30 large US companies. S&P 500 is a match for large blend in terms of MSB methodology but the trend is clear. S&P 500 has inevitably higher risk but provided some lower returns in the last three years. The margin is even more evident in medium and small size equivalent indeces such as Russel 2000.

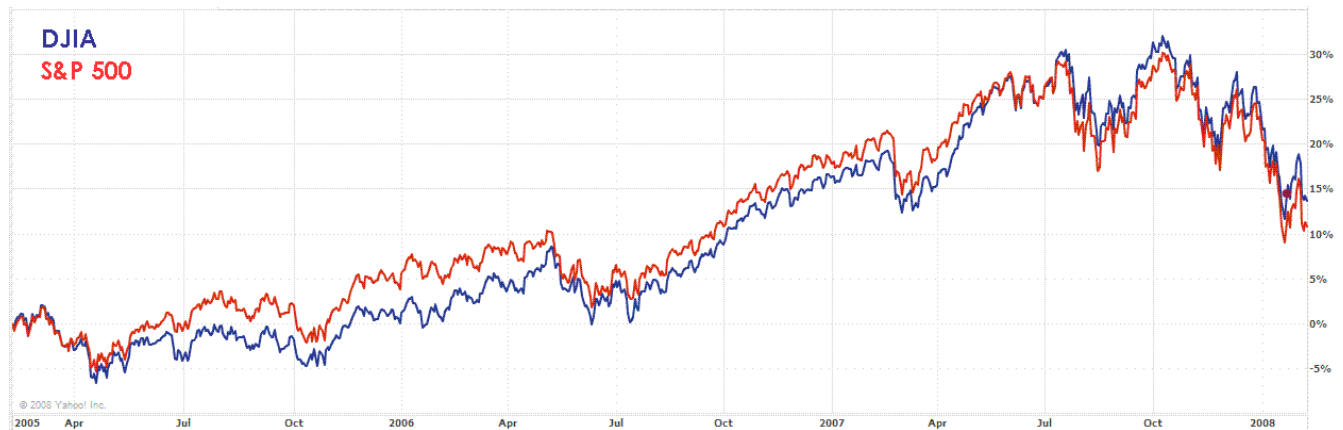


Figure 6: DJIA and S&P 500 comparison

Consequences of unexpectedly low returns in small size can be clearly traced in alpha values as well. Values for the small categories show distinctively negative values. Alphas just show what is evident from figures shown above. That low small size returns are low compared to risk.

Morningstar Style Box – average alphas			
0.42	0.88	0.51	Large
-0.78	-0.29	-0.07	Mid
-1.72	-1.90	-1.30	Small
Value	Blend	Growth	

Table 4: Average alphas

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However, it is not easy to generalize on low returns of small size. Considering that three years is short time to assess equity returns fact that they do not match long term average is not surprising. This is also confirmed by 5y returns that are closer to expected relations. There is not a reason to expect that risk/returns distribution patterns will be different in future and therefore the fact of small size under performance can hardly have any indicative value. At least according to assumptions of Efficient Markets Hypothesis (EMH) of course. The one pitfall (within scope of EMH) is measurement of risk as volatility is increasingly criticized not to be the best indicator of investment risk. Anyway, one clear conclusion is that investor might be confused when superficially assessing alphas and may have been discouraged to invest into small sizes equivalents on this base while the alphas fundamentally do not relate to actual relative fund performance in this case..

The data show that there is not substantial difference in returns in value vs. growth strategies. There is not a difficulty to point to higher risk to justify slightly higher returns of growth portfolios. This is in line with previous observations and efficient markets hypothesis claims that portfolios with the same risk provide the same returns..

Further investigating P/E return relationship bellow is graphic representation of P/E and 3y return dependence. Correlation between P/E and the return is in fact weak when equal to 0.105. This can be seen on the trend line which relates lower P/E with lower returns and vice versa. High dispersion is noticeable as well. This can be concluded that increasing of portfolio P/E lead to slightly higher returns and there is no distinct justification for value nor growth strategies as superior in returns.

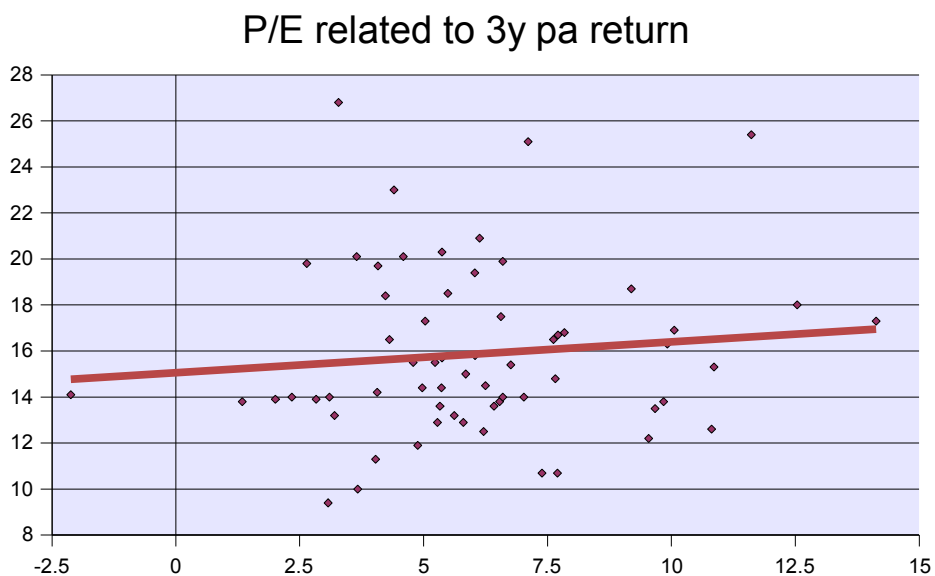


Figure 7: P/E related to 3y pa return

Many of the findings of the mutual funds returns analysis supports image of efficient markets but there may be one exception. Index funds seems to be less successful in the sample as some other research claims. In risk unadjusted returns 57.14 % of the funds overperformed S&P 500 index. The explanation is higher risk premia that is taken by the funds. Average beta of the sample is 1.16 indicating 16 % higher risk taken by the funds compared to the index. Average alpha is -0.15 what is slightly bellow to S&P 500 index funds (-0.07 and -0.06 for index funds in the sample). This corresponds to 46.03 % of mutual funds overperforming the index when their returns are risk adjusted. Considering statistical constraints there is virtually no difference between active and passive portfolio management in produced investment returns.

However, there are some indirect points which may be interpreted as skeptical evidence on active portfolio management. They are statistical insignificance of differences in portfolio managers performance and absent correlation of time series of mutual funds returns.

Some investors (especially those who trust active portfolio management) may assume that it is substantial to choose the best portfolio manager and it may sound for them reasonable that some fund family will have reproducibly different results over time depending on their experience. By investigating the sample for investment success in relation to fund family (portfolio manager) table shown bellow is produced. In the table only fund family with at least five funds (in the sample) is

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included to lower statistical error. However, as the variations do not exceed 0.41 SD for the alpha and 0.31 SD for Sharpe ratio variables they are not statistically significant anyway. In the fund family table alpha values dispersion is much lower than in Morningstar Style Box average values what also points out that fund manager is not major determinant of the performance.

Fund family	Average Sharpe ratio	Average Alpha
Vanguard	0.38	-0.74
Pioneer	0.28	-0.85
Fidelity	0.41	0.84
JPMorgan	0.30	-0.46
Alianz	0.39	0.72
USAA	0.35	0.23

Table 5: Fund families performance

Much stronger and more interesting indicator is correlation of fund performance in following time series. Morningstar provides 10, 5, 3 years and shorter returns for the funds. As mentioned above not all funds of the sample have 5y performance and even less have 10y performance figures. Anyway, crucial assumption of active portfolio management is a certain stability in returns as it is assumed to be provided by the portfolio manager experience. Correlation in equities time series is one of central and unresolved issues in market research with dramatic consequences on views on market efficiency. For this reason many much more sophisticated measures had been performed by various economists. The correlation in the sample is 0.596 for 3y to 5y returns and 0.276 for 3y to 10y. These values are of course not worthwhile until subtracted from the overlapping parts. Interpolated values are -0.004 for 3y to 5y and -0.034 for 3y to 10y or virtually equal to zero. Therefore it can be assumed that historical returns of the mutual funds does not have any future indicative value.

Analyses of Funds with Distinctive Investment Strategies

Roughly it can be said that categories presented by Morningstar Style Box imply basic positioning of investment strategies by the US mutual funds. However, this is not the case in many other countries. For example in Europe mutual funds often construct their portfolios and market themselves on base of a different principles. MSB based positioning is now standard in the US and only low number of US funds pick investment strategies out of this framework. In the fund sample there are few regional funds. Although their investment strategies could be coined distinctive by US standards they will not be focus of this analyses while there is no point how to define this investment strategy in terms of expected risk adjusted returns.

Two funds suitable for this analyses are Undiscovered Managers Behavioral Value and Undiscovered Managers Behavioral Growth funds. These funds claim to base their investment strategies on behavioral finance. From this point of view it is also good point for this work as it deals with market efficiency and behavioral finance school that has recently emerged as major stream challenging Efficient Market Hypothesis.

Undiscovered Managers Behavioral Value Fund describes its strategy in its information leaflet as following:

“Looks for investors behavioral biases that may cause the market to overreact to old, negative information about a company and under react to new positive information”

“Seeks companies with bellow-average price to earnings ratios or decreasing stock values”

“Selects stock based on recent underperformance relative to the market, share purchases by company insiders or stock repurchase activity by the company ”

Undiscovered Managers Behavioral Value also states that it seeks companies where psychological biases apply but except of value approach it states its growth orientation to be based upon:

“Analyzes companies that have recently announced higher-than-expected earnings and seeks to determine whether the company stocks value fully reflects expectations for future earnings and growth prospects”

Top portfolios holdings are included in appendices under number 3. Following table research what are fundamental differences of the funds portfolio valuations compared to benchmark index and the category.

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Undiscovered Mgrs Behavioral Value A			
	Stock Portfolio	Rel. to S&P 500	Rel. to Category
Price/Prospective Earnings	12.3	0.9	0.8
Price/Book	1.5	0.6	0.8
Price/Sales	0.8	0.6	0.9
Price/Cash Flow	6.7	0.8	0.9
Dividend Yield	2.0	0.9	1.6
Undiscovered Mgrs Behavioral Growth A			
	Stock Portfolio	Rel. to S&P 500	Rel. to Category
Price/Prospective Earnings	20.2	1.5	1.1
Price/Book	2.9	1.3	1.0
Price/Sales	1.5	1.1	0.9
Price/Cash Flow	14.1	1.6	1.2
Dividend Yield	0.1	0.1	0.2

Table 6: Undiscovered Managers Behavioral Value and Undiscovered Managers Behavioral Growth funds portfolio valuations measures (datasource: www.morningstar.com, 2008)

The fund hold portfolio of lower average P/E compared to the category. The same applies to other valuation ratios Price/Book, Price/Sales and Price/Cash Flow. On the other hand it clearly prefers holdings associated with higher dividend yield. Higher dividend yield is also the only attribute implied from the table above that clearly distinguish the fund from the category. All its characteristics match value investment approach.

When evaluating Undiscovered Managers Behavioral Value fund performance what is the most striking is its risk adjusted performance which is equal to -4.61. This figure is by far the worst in the sample. Beta value 1.33 is also over the average. Consequently 3y returns are low when the fund yielded 1.34 % pa. However, the fund leaflet provide 5y returns which are not reported by Morningstar.com or other financial information portals. 5y pa returns claimed by the fund are much better when equal to 15.58 %. Risk adjusted returns are not provided by the fund. There is no possibility to independently verify 5y figure. Overall Undiscovered Managers Behavioral Value fund can be evaluated as providing one of the worst results to investors and its investment strategy may be assessed as poor.

The second fund in the sample that identifies itself with behavioral strategy is Undiscovered Managers Behavioral Growth. Table of investment valuations shows there are not substantial differences when compared to its category. Its portfolio has some lower Price/Prospective Earnings and

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Price/Cash Flow ratios and some lower average for Price/Sales. Similarly to its value counterpart its dividends what makes it different while in this case they are lower compared to the category or S&P. Adjusted risk although not as bad as in the case of the previous funds are also quite poor. Alpha value of -1.93 is still much below the sample average. Its beta is among highest equal to 1.58 but it is not such surprising for growth funds. The fund claim 5y pa return of 13.86 % and 3y pa 4.4 %. The 3y figure is confirmed by Morningstar. Risk adjusted results of Undiscovered Managers Behavioral Growth also points to under average performance.

While the two funds claim to rely on behavioral investment principles their strategies seems to earn no value for their investors. It may be interesting to add comparison of other behavioral oriented mutual funds of other families to make picture more comprehensive. However, as it was mentioned only small number of mutual funds position their investment strategies outside Morningstar Style Box categories and that kind of funds are not present in the analyzed funds sample.

Portfolios Returns and Mean Reversion

Three portfolios were constructed in order to research their mean reversion. First two portfolios are based on leading US stock market indeces – Dow Jones Industrial Average and Nasdaq 100. The last portfolio was selected according to criteria described in the methodology. Table bellow summarizes basic characteristics of the portfolios.

	DJIA	Nasdaq 30	P 1
Average return	17.95	18.40	22.92
Median return	16.30	14.80	15.35
Volatility	17.32	28.29	20.29
Average market capitalization (in billions of USD, as of April 2008)	139.15	51.80	49.40

Table 7: Analyzed portfolios characteristics

Pattern of relationship between risk and returns is seen in the table. As DJIA includes largest US corporations it has correspondingly the highest average capitalization equal to \$ 139.15 B. Smaller companies are more abundant in the other two indeces. Higher risk associated with smaller capitalization is rewarded by some higher returns. However, the differences are not great while Nasdaq 30 is overperforming DJIA by just only half a percent. Important fact is that Nasdaq 30 data and statistics in the table and bellow are tracked just since 2000. This is because more of Nasdaq 30 companies had their IPO in late 1990s and as they have not been traded before the sample would not be coherent for DJIA which is traced back to 1990 in this work. When analyzing returns it is worth to mark that in all cases return medians are lower than the averages pointing to non-Gaussian distribution of returns and suggesting positive skew. Returns dispersion is thought to be higher in P 1 portfolio as there is the difference more significant.

The second step was generation of table of returns in which companies are lined up ascending according to their return in corresponding year. These tables for all three portfolios with all returns data are present in appendices under numbers 5 to 7. In case of Nasdaq 30 the point mentioned above applies when analyzed are data beginning by year 2000. However, as data are present for some

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companies also from earlier years, these are included in the appendices but not used in subsequent analysis. Overview of returns distribution can be easily generated from the previous table. The returns of 10th and 1st decile tells us how returns are distributed in the portfolios.

	DJIA			P 1		
	10 th Dcl	1 st Dcl	Index return	10 th Dcl	1 st Dcl	Index return
2007	-31.57	36.00	7.73	-49.71	81.26	7.74
2006	-5.36	54.15	21.69	-20.67	46.42	14.24
2005	-28.81	32.29	1.04	-35.45	84.77	11.29
2004	-25.53	28.37	6.80	-15.14	104.69	25.41
2003	-6.32	87.93	32.39	-16.19	163.08	45.26
2002	-47.11	10.82	-17.39	-58.27	22.59	-14.59
2001	-36.96	46.12	-4.01	-40.97	105.96	8.12
2000	-41.53	48.68	-1.81	-50.91	101.17	14.70
1999	-15.90	88.82	28.59	-33.18	232.02	42.37
1998	-17.78	110.22	31.50	-30.27	126.45	30.66
1997	0.00	79.58	36.46	-30.31	109.11	33.27
1996	-1.27	95.83	33.21	-37.13	57.96	15.35
1995	6.20	83.88	44.85	-23.09	353.27	64.10
1994	-17.29	37.29	9.28			
1993	-20.54	68.07	14.79			
1992	-24.77	72.58	16.30			
1991	-12.06	132.06	43.69			

Table 8: Returns distribution

P1 returns have more extremes what illustrates higher risk of the portfolio. Almost in all cases returns of 10th decile are more negative for P1 compared to DJIA and vice versa in case of 1st decile. Some common patterns are evident and both portfolios follow similar trends. Their correlation coefficient is 0.84. Also stock market trends history should be considered in explaining the development with its defining trends – bull market of 1990s, tech bubble and its burst in 2000, globalization of markets and weakening US dollar in second half of 2000s. Also it is not surprising that some companies much more

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commonly reach extremes of returns. For example in P1 companies with little volatility returns like Walgreen or Sara Lee have never reached extreme returns decile. On the other hand others like Apple, Imclone, AMD have been repeatedly positioned in that space. These findings are not surprising, just point to the fact of long term differences in returns volatility. Low volatility of McDonald's or Sara Lee can be explained also by nature of its business. They are both engaged in mature industries with low changes in demand. On the other hand technology companies operate in fast changing environment with high strategic stakes. On the other hand as potential profits are very high volatility express changes in valuation according to companies prospects. To provide complete picture bellow are returns of each decile in 2007. There is no other significant different in patterns of DJIA plotted against P1 except the mentioned fact of larger range stemming from higher portfolio risk.

	10	9	8	7	6	5	4	3	2	1
DJIA	-31.57	-15.84	-7.22	-0.74	6.41	16.65	21.21	23.94	28.49	36.00
P1	-49.71	-18.09	-15.15	-8.33	0.49	11.14	16.15	23.51	36.21	81.26

Table 9: Average returns of each decile of DJIA and P1 portfolios in 2007

The goal of this analysis of returns distribution is to observe changes in deciles in connection with particular stocks or in other words evaluate possible mean reversion. It has been suggested by some authors that stocks returns have some autocorrelation patterns as described in Critical Literature Review chapter in more details. Arguments for presumed mean reversion are also frequent among ordinary investors. Recommendations to open positions after steep fall or close after strong rise express application utility of the idea. While behavioral explanation of feedback traders is common to justify the the presumed stocks/portfolio behavior there is also explanation of autocorrelation pattern of underlying economic factors what is more consistent with Efficient Markets Hypothesis. Mean reversion implies that stocks that were placed in extreme quantiles should subsequently change their position and tend to be placed in opposite space of returns distribution. Or simpler said the stocks that were in lower quantiles should may be expected to make over average returns in subsequent period and conversely stock positioned in highest quantiles may be expected to be placed lower in following time series. Methodology based on deciles is the most common in mean reversion and similar effects research.

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Following table summarizes what was subsequent performance of stocks in 10th and 1st decile in subsequent year.

	DJIA			Nasdaq 30			P1		
	10 th Dcl	1 st Dcl	Av	10 th Dcl	1 st Dcl	Av	10 th Dcl	1 st Dcl	Av
2007	2.66	9.18	7.73	17.49	37.09	24.43	2.47	23.19	7.74
2006	39.47	14.72	21.69	3.85	27.01	14.25	31.90	21.04	14.24
2005	0.51	10.23	1.04	0.74	23.78	15.29	-20.85	60.25	11.29
2004	5.90	-7.53	6.80	31.45	66.05	33.77	23.24	38.70	25.41
2003	70.83	26.42	32.39	40.35	98.92	76.14	153.65	40.98	45.26
2002	-4.81	-14.28	-17.39	-48.98	8.97	-16.38	-23.25	1.74	-14.59
2001	10.25	-29.62	-4.01	-8.09	0.71	5.69	41.35	-19.40	8.12
2000	14.87	-5.74	-1.81	38.84	-22.46	-6.01	14.45	50.74	14.70
1999	32.24	69.24	28.59				81.23	43.01	42.37
1998	6.08	56.86	31.50				98.99	34.28	30.66
1997	32.21	34.32	36.46				8.72	24.14	33.27
1996	13.21	67.40	33.21				4.25	-11.00	15.35
1995	43.77	46.21	44.85				259.84	62.24	64.10
1994	5.77	-4.11	9.28						
1993	2.71	16.59	14.79						
1992	-3.85	17.82	16.30						
Average	16.99	19.23	17.95	9.46	30.01	18.40	52.00	28.45	22.92
Median	8.17	15.65	16.30	10.67	25.39	14.77	23.24	34.28	15.35
SD	20.99	29.27	17.32	29.75	38.17	28.29	80.06	25.53	20.29

Table 10: Subsequent performance of 1st and 10th deciles

In general all indices and their deciles follow some general trends reflecting market development. Correlation of the indices is high and relationship between overall market returns and subsequent decile returns is observable. Volatility of returns is within expected values. However, Nasdaq 30 brought only narrowly higher returns although it is riskier than DJIA. In case of P1 there are more of extreme values within results what is also reflected in bigger differences between averages and medians for its categories. This fact make it somehow more difficult to formulate conclusions on this portfolio.

However, in general returns are consistent with risk of the observed portfolios.

In searching for signs of mean reversion there is not any visible point clearly pointing to the phenomenon. And there is also nothing clearly pointing to “momentum”. Average subsequent returns of the both observed deciles are close to market returns. Measured by averages both deciles outperformed market in case of DJIA and P1. However, in case of Nasdaq 30 this is the case only for 1st decile. When median is applied as measure of performance it is interesting that subsequent returns of 1st decile tended to outperform 10th decile. Furthermore the difference between deciles is substantial. It is larger in riskier portfolios of Nasdaq 30 and P1. In these portfolios 10th decile subsequent returns also outperformed the market while underperformed it in case of DJIA. Considering the fact that averages for both deciles are higher than market averages is suggesting explanation that as both deciles consist of stock associated with higher than average risk it is well justified that they will offer over-average returns at the end. Also it can be seen that Nasdaq 30 is portfolio which produce returns little bit out of expectations. The difference in averages of subsequent 1st and 10th decile is more than 20 points. Medians confirm the pattern although making it not so distinctively large. Also contrary to other portfolios in Nasdaq 30 case 10th decile subsequently only once in the observed period outperformed the 1st decile. At the same time 10th decile only once in 8 years outperformed the market. Another point is volatility (SD) in each category which do not follow expected values in each case. There is no problem in volatility of average returns as the figures match expectations rising from DJIA to P1 and Nasdaq 30. It is also clear that volatility of 1st and 10th deciles is much higher compared to average returns. This provides evidence of higher risk of extreme quantiles and base for higher risk adjusted returns. Interesting point is higher volatility of 1st decile in both DJIA and Nasdaq 30. 1st decile volatility is lower in case of P1 but as many extreme values are present in subsequent 1st decile P1 performance I do think that it is better to not consider this portfolio in volatility analysis. Higher risk associated with 1st decile is not easy to be explained. This issue will be also discussed in conclusions chapter.

However, limitations associated with Nasdaq 30 evaluation shall be recognized. One of them is evident in the table - that is shorter analyzed time series what have been mentioned above. Also it should be stressed that the index (Nasdaq 30) was constructed on basis of market capitalization data of April 2008. As Nasdaq 100 (which was chosen as base for Nasdaq 30) stocks are quite volatile list of 30 companies with highest market capitalization would be different eight years ago what is starting

point for the analysis. Also some extreme values are present in underlying Nasdaq 30 decile table (Qualcom gained 2623 % in 1999) and the results would be different if extreme values were not considered. However, the results point out that there are no signs of mean reversion in the observed portfolios. On the other hand using momentum strategy may produce overaverage returns in riskier portfolios. Momentum is not expected to make risk unjustified returns in low risk portfolios. In case of all portfolios investment of extreme quantiles might produce higher risk justified returns. Effect of over-average risk justified returns seems to be absent in case of Nasdaq 30 10th decile subsequent returns.

The graph bellow illustrates effects of three basic investment strategies – contrarian, momentum and index. P1 portfolio and time period 2000 – 2007 was chosen. Contrarian strategy is equal to buying stocks of 10th decile and selling at year end when changing to 10th decile of the last year. Conversely momentum strategy represents 1st decile returns.

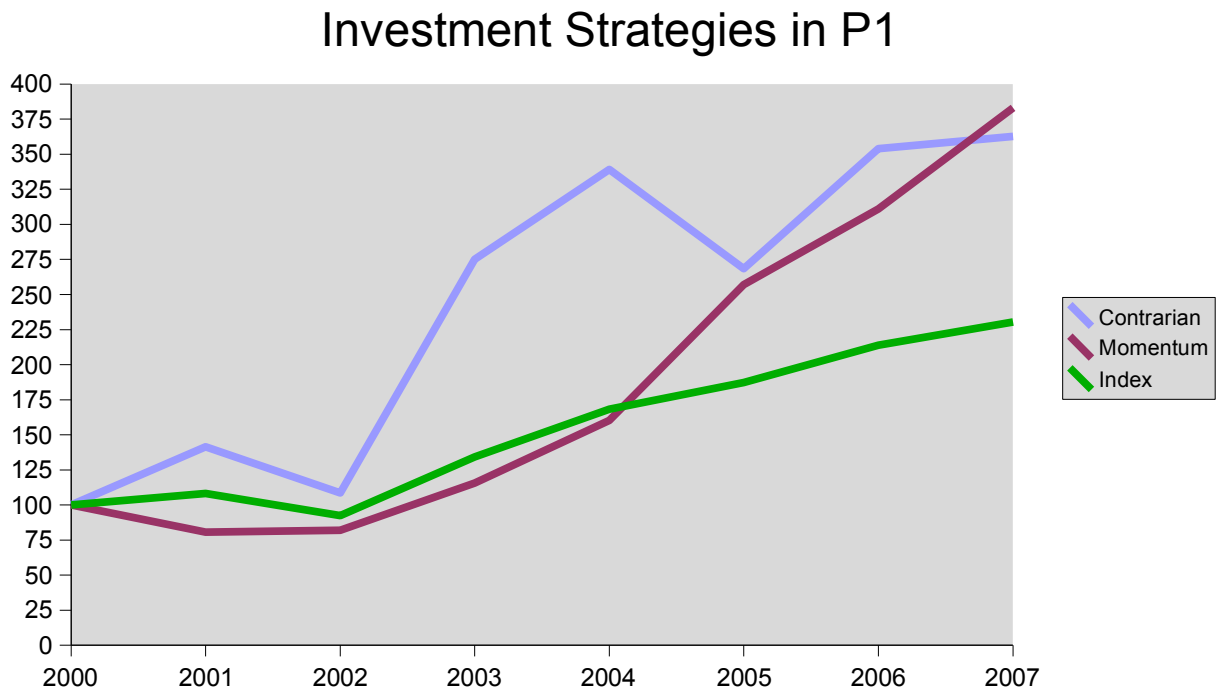


Figure 8: Returns of basic investment strategies for P1 portfolio in 2000 – 2007 period

Fact evident from the graph is better performance of both contrarian and momentum strategies against index investment. It is also clear that returns utilizing contrarian and momentum strategies would be

lower in real world conditions as fees and commissions applies in portfolio changes. On the other hand there would be no further losses for index investment

	10th Dcl	1st Dcl	Av
2007 - 2006	44.92	40.00	29.42
2005 - 2004	3.43	14.25	7.84
2003 - 2002	25.65	6.77	15.00
2001 - 2000	-1.86	-15.08	-5.82
1999 - 1998	36.97	118.13	60.09
1997 - 1996	62.72	83.64	69.66
1995 - 1994	77.82	59.19	54.13
1993 - 1992	20.65	44.56	31.09
Average	33.79	43.93	32.68
Median	31.31	42.28	30.26
SD	27.62	43.22	26.74

Table 11: Subsequent performances of 1st and 10th deciles of DJIA portfolio in two years periods

Some authors have suggested that mean reversion phenomenon does not demonstrate to the same extent in all time series. In other words mean reversion may be better observable in half year and two year periods than in one year periods. However, this opinion is not shared by many economists. To make conclusions of this work more evidentiary returns of DJIA portfolio were recalculated also on basis of two year time period. The same methods applies and there is no other change in evaluation apart from the time frame. Figures are summarized the table above showing DJIA many similarities to portfolio evaluated on one year basis. However, there are some minor differences most visible in subsequent performance of 10th decile which seems to be somehow better. 10th decile slightly outperformed portfolio average while it was lagging 1 point in case of one year period evaluation. The difference is much more visible in medians. Both medians and averages outperformed DJIA portfolio return. Volatility patterns are identical when highest in subsequent performance of 1st decile and 10th decile SD approximately equal to SD of the portfolio. Although data based on two years periods seems to be little bit closer to support for contrarian strategy as 10th decile produces somehow better results but overall evidence for advantages of contrarian investing is missing. It rather supports findings of one year based evaluations of risk justified higher returns of both 1st and 10th decile. However, it also

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suggests higher risk associated with subsequent 1st decile returns and possibly justifying higher subsequent returns of 1st decile.

Conclusions and Recommendations

This work presents research considering empirical evidence on investment strategies. Assumptions of contemporary investment strategies are linked with theories explaining equity markets functioning, most notably Efficient Markets Hypothesis. It may be summarized that EMH claims that markets work efficiently and there are not risk unjustified profits because market correct its inefficiencies. Contrary Behavioral Finance stress assumed market inefficiencies while in agreement with the weak form of efficiency of equity markets. It suggests it is not possible to profit from market inefficiencies in most cases but in some. In this regard some limiting or disputed ideas elated to equity markets should be recognized such as unexplained part of equities returns, limitations of CAMP application on equity markets such as size effect anomalies, interpretation of efficient frontier and others.

Particular aim of this research or the research question was to evaluate which from common investment strategies is suitable for application in circumstances of the investigated portfolios. The strategies concerned are buy&hold (index), momentum and contrarian as backed by established concepts in financial economics. One of critical points is consistency of the latter two strategies with efficient markets which is also related to outcomes of this work. Fama suggested that the strategies may be consistent with EMH on basis of autocorrelation of underlying economic patterns. Other suggestion is that rise of stock price alone may bring better prospects for the company as this is subsequently in better position in raising new capital in stock market. It may be disputed whether chances for positive autocorrelation are the same for the negative one when EMH consistency is considered. However, it may be reasonable to expect that ability of raising new capital is affected about the same for both companies that suffer modest and sharper decrease as none of them is expected to issue new shares facing falling prices. Regarding returns correlation caused by economic factors these may be also differentiated depending on business in which the company operates, company size or others. It may be speculated that autocorrelation of these economic parameters (such as market size, sales margins, gross sales at the end) may be higher in fast growing markets. An example may be micro chip industry where market size increase led to better economies of scale in producers lower prices which in end supported the market growth. Market size growth was feeding itself as a upward cycle. However, the same downward cycle might occur in drastic fall of market size most probably in declining industries. As share prices reflect economic prospects (or more precisely discounted future profits) this development

would result in returns with autocorrelated patterns. On the other hand behavioralists tend to rely on feedback traders as explanation for any return autocorrelation.

These presumptions may justify within EMH scope finding of either positive or negative momentum lacking mean reversion. The other question is whether something like this may be possible within Behavioral Finance framework. BF assume mean reversion as a mechanism of finding equilibrium between overvalued and undervalued markets. As it admits some inefficiencies on the market theoretically the equilibrium may not be reached by negative reversion of returns but might be demonstrated by long returns stagnation. However, this kind of explanations seems not to be very popular among behavioralists. More likely suggestion would be reaching the opposite extreme if it is possible for market to correct the inefficiency (such as it is shortable). In other words this development may be accepted by BF but as it does not relate to “crowd psychology” is less probable to be suggested. Also strictly said, while behavioralists focus on market moves created by trading but surely do not deny underlying economy influence on portfolios returns there is no obstacle for accepting economy sourced autocorrelation in behavioral view although this will not be relevant in the context. These reflections are closely related to the research findings which are presented below.

Investment strategies evaluation consisted of two major analyses while the first focused on mutual funds and the latter on mean reversion of stock portfolios. 63 Mutual funds marketed in the US were selected to be evaluated for their returns, risk and other measures as described in methodology chapter. Principal points of mutuals funds analyses are summarized in following points:

- Long term average returns of mutual funds with portfolios allocated in the US market are close to 7 % pa. In last three years riskier investments of smaller size provided lower returns but returns distributions are closer to expected values in 5 years run.
- There is no “special” advantage from neither value nor growth investment strategy (in terms of abnormal profits) – the market seems to discounts against risk only. Slightly higher average returns of growth funds can be achieved by accepting higher P/Es but the relationship is weak. In the sample there are not “exceptional” performers and alternative investment strategies seems to be problematic.
- Index investing provide lower than average risk and according to this research only slightly higher risk adjusted returns compared to managed funds. Most of mutual funds take higher investment risk

than those of S&P 500 index

- There seems not to be any correlation patterns of past returns in line with other research. In general findings points out that the market works quite efficiently and has difficulty to produce abnormal profits.
- Non-market circumstances like fees, taxation play substantial role rather than market timing or other attempts to over perform the market but are not included in the analyses itself.

These findings are in general consistent with previous research of other authors. Mutual funds returns should be viewed within frame of stock market development in recent years. The analysis is very skeptical on “value investing” as there is any evidence supporting this concept. Some research suggest that index funds perform even better than suggested by this research. However, conclusion that index funds provide best risk-adjusted returns is supported by the analyses. Fact that most actively managed funds employ higher investment risk compared to the index and produce risk unadjusted returns similar to index funds is rarely stressed. Fact that those fund that over perform index are not capable to sustain their performance over longer period is also documented These findings are supportive to the ideas of passive portfolio management and efficient markets.

As mutual funds are easy way to participate on equity markets and many investors use this option these findings are relevant for substantial number of current or potential investors. Following sections include transformation of the findings into recommendations to MFs investors.

Index funds are clearly shown as the safe bets. This is in contradiction with common popular belief that skilled portfolio managers are capable to efficiently manage equity portfolios and less surprisingly also in contradiction with marketing claims of the managed funds. Although belief in efficiency of actively managed fund is definitely naive an the end their risk unadjusted results may show higher returns because of taking higher risks. However, there are good reasons not to look for higher returns of the managed funds as they are hardly to be utilized in any investment. Firstly investment “strategies” of managed funds are usually not clearly defined an may change over time. After all it may be argued by portfolio managers that different investment strategy is required in new market circumstances. This results in changing investment risk for the managed funds over time. While stock index average volatility can also change over time these changes tend to be marginal and the volatility values more stable. Rational investor should base his/her decisions on risk-return relationship defined by the

efficient frontier of the portfolio theory. Unless there are not given future expected risk levels this is not possible for managed funds. The second well-known and evidenced fact are lower risk-adjusted returns for actively managed funds. Therefore investors looking for higher returns and willing to accept higher investment risk should look for index funds linked to indices with higher volatility.

However, it may be theorized that there is restricting feature in index investing – that is index definition. indices were constructed to provide picture on market development (and there are still substantial disputes how well they are doing it). Most traded/capitalized companies were picked and changes in weighted averages of their prices indicate index move. Or said otherwise their use as standards in portfolio investment its secondary function and it is questionable whether they are good instruments of the strategy. Back to portfolio theory the same applies here that investment should be projected upon the efficient frontier. Therefore an ideal formula for investment portfolio should be based on its risk characteristics and other functions are irrelevant. This approach has not yet been adopted by most index funds. An ideal sequence would be generation of custom “index” based on risk projections that would be utilized in buy&hold fashion. Anyway the question may arise how to deal with possible changes in volatility patterns of the custom indices as this is the more possible the more narrow is the index. Adjustment of the index would present moving away from buy&hold in direction that may be even close to an active management. In this view some pragmatic compromise would be necessary as to adjust when substantial drifts from projected volatility occur but otherwise follow buy&hold strategy.

It is clear that all core assumptions on mutual funds portfolios can be extrapolated to private portfolios. From this point of view the question of direct and indirect transaction costs is the only relevant for investor whether employing mutual funds is beneficial for investment It may be reasonable to assume that for vast majority of investors this is the case and funds utilizing principles mentioned above are usually better option than individual portfolio.

The second part of the results consist of analyses of stock portfolios. The analyses is focused on returns distribution and signs of mean reversion and related phenomenons. Presence of mean reversion belong to assumptions of Behavioral Finance which consider it quite abundant while EMH is rather skeptic Problems in detecting mean reversion are the same as problems with fair valuation or determining intrinsic value of equities. Several portfolios were constructed while two of the portfolios were based on current composition of major US stock indices. The crucial test was evaluation of

subsequent performance of extreme deciles. Extreme deciles has been focus of researchers investigating mean reversion, momentum and contrarian strategies for some time. Mean reversion associated phenomenons would be demonstrated by “abnormal” patterns of returns in extreme deciles i.e. significant inconsistencies with the index averages. Findings of the analyses are summarized as follows:

- Values of core portfolio characteristics meet the expected values. This applies to indeces correlations, expected returns and their distributions, volatility. These measures should be viewed in connection with market development in recent time.
- Stocks of extreme deciles tended to overperform the market, this trend is more evident in indeces with higher average volatility. These returns seems to be justified by higher risk associated with extreme deciles.
- Subsequent performance of 1st decile was better than subsequent performance of 10th decile in most cases also better than market average returns. 1st decile had also higher volatility compared to both 10th decile and market average.
- No convincing evidence of mean reversion was found. However, there are some findings that may be seen as indication of positive autocorrelation These presumed positive autocorrelation patterns are associated with risky portfolios only.
- In general buy&hold strategy seems to be the best fit also in the portfolios investment analyses. There are not points justifying contrarian strategy but momentum strategy would be probably good fit in some portfolios and some time series. Further investigation would be necessary to conclude whether data on the momentum are within statistical significance area.

Findings of the stock portfolio analyses support assumptions of EMH. EMH expectations are met in almost all measures – returns and volatility of deciles and index averages Subsequent performance of extreme deciles is higher justified by risk. However, some ambiguity may be seen in subsequent performance of 1st decile in risky portfolios. Important point in this regard are also limitations of the research which are discussed in detail in methodology section. While it is not clear to what degree the subsequent performance of 1st decile is relevant it is the same difficult to provide possible explanations. The important point is also that while positive autocorrelation may be present there are not any

indications for negative autocorrelation or mean reversion. The positive autocorrelation is related to technology companies – mostly in Nasdaq and less significantly in P 1 portfolios. From behavioral point of view these are the kind of companies that were assumed to be undervalued and subsequently “mean reverted” during the tech bubble. In other words they are viewed susceptible for misvaluations. May be because current valuation is less predictive and their future profits are harder to be estimated. However, there are not any indication of mean reversion among these stocks neither in other evaluated portfolios. If fundamental analyses is employed we can rather observe that rise of 1st decile Nasdaq companies was rather justified by their ability to increase profits. This may more clearly point to suggested positive autocorrelation consistent with EMH based on autocorrelation of underlying economic determinants. In beginning of this chapter I speculated on possibilities under which within EMH framework autocorrelation is present without mean reversion. In this case suggested possibilities might be in place – companies were in better position in raising capital stock market as they shares soared. This enabled them to fund further expansion in fast growing market and might produce crucial competitive advantage. The advantage at the end might eliminate competition and led to further rise in sales and equity returns of the companies concerned. Although this explanation rely on some speculative presumptions it sounds to be the best to be justified when considering the research output data and facts on market development over last years.

In conclusions for stock investors apply similar point as in case of the mutual funds. They are some more free to apply buy&hold strategy as not required to use market indeces as proxies. The stock investor should be ruled by efficient frontier and transaction costs in projecting stock portfolios.

All the evidence of this work point to efficient markets. But it is not possible to state that markets work efficiently on base of this research as its methods are not enough sensitive to be able to confirm such presumption. However, the results are suggesting superiority of buy&hold investment strategy when measured by risk adjusted returns. It is clear that buy&hold strategy is linked to EMH. Also some less usual patterns found by this research can be better explained within EHM framework compared to alternative theories.

Abbreviations

APT – Arbitrage Pricing Theory
CAMP – Capital Asset Pricing Model
CVaR – Conditional Value at Risk
DJIA – Dow Jones Industrial Average
EPS – Earnings per Share
FED – Federal Reserve System
GARP – Growth at A Reasonable Price
ICAMP – Intertemporal Capital Asset Pricing Model
IPO – Initial Public Offering
LSE – London Stock Exchange
MAD - Mean Absolute Deviation
MFs – Mutual Funds
MPT – Modern Portfolio Theory
MSM – Morningstar Style Box
NYSE – New York Stock Exchange
P/E – Price/Earnings
PEG - Projected Growth in Earnings
PMPT - Post-Modern Portfolio Theory
RWH – Random Walk Hypothesis
SD – Standard Deviation
VaR – Value at Risk
VBA – Visual Basic for Applications

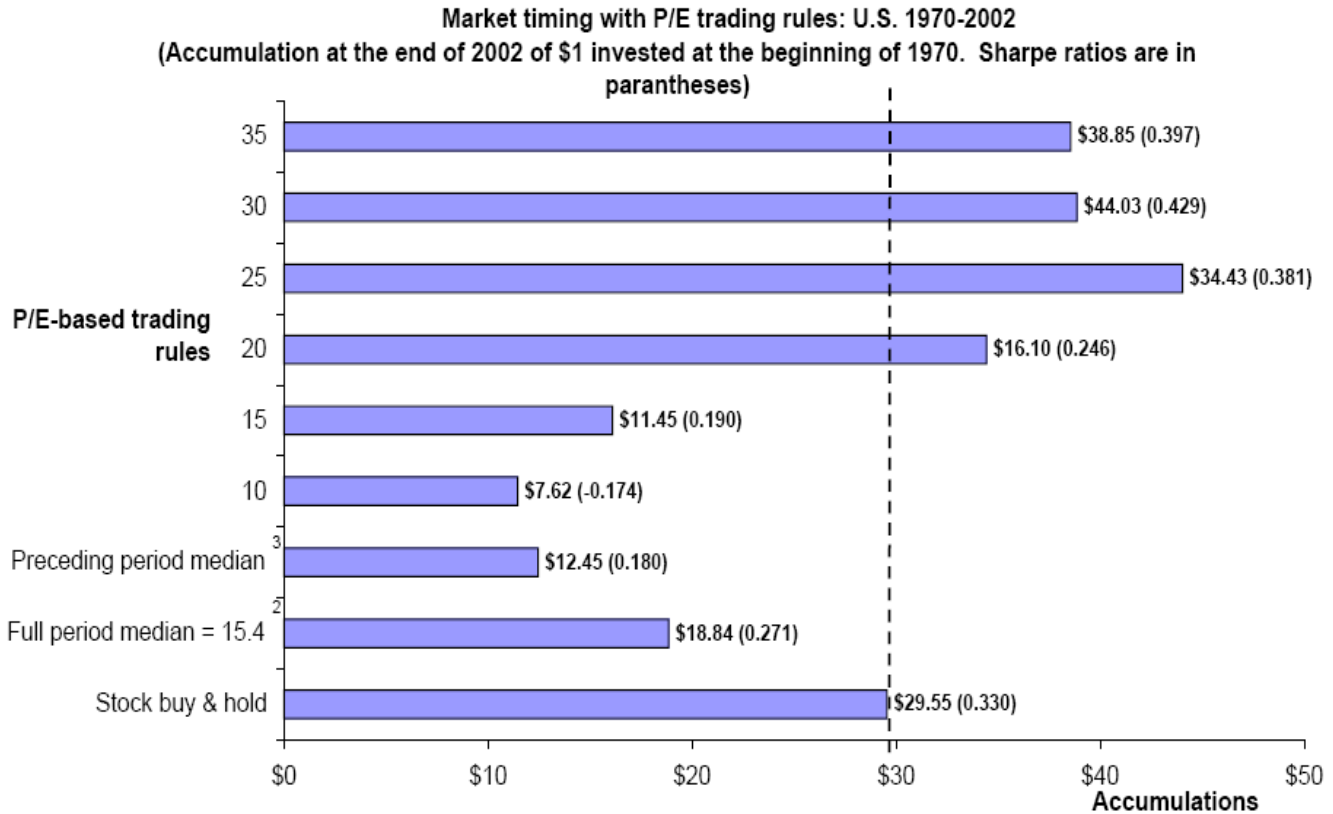
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Appendices



Trading rules: Investors have \$1 at the beginning of 1970 and that money accumulates over time as it is invested in stocks or T-bills. Investors switch from T-bills to stocks when the P/E ratio is lower than the P/E ratio in the trading rule and back to T-bills when it is higher.¹ For example, the trading rule associated with a P/E ratio of 25 calls for switching from T-bills to stocks when the P/E ratio is lower than 25 and back to T-bills when the P/E ratio is higher. Investors who were to follow that rule from the beginning of 1970 to the end of 2002 would have seen their initial \$1 accumulate to \$44.03. Investors who bought stocks with their \$1 at the beginning of 1970 and held them through the end of 2002 would have accumulated \$29.55. We examined trading rules with P/E as integers from 5 to 40, but we report only some, including the one with the highest accumulation.

¹P/E at the end of the preceding year. P/E is calculated as price at the end of the year divided by earnings during the year.

²The P/E in the trading rule is the median P/E ratio during the entire period.

³The P/E in the trading rule is the median P/E ratio during the years preceding the switching decision.

Appendix 1: Market timing with P/E trading rules (Fischer and Statman, 2005)

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Title	Ticker	M Style	3y	5y	10y	SD	Sharpe	Beta	Alpha	P/E
Dreyfus Premier Core Value C	DCVCX	LV	5.28	11.75	5.28	8.82	0.33	0.99	-0.17	12.9
Dreyfus Premier Core Value T	DCVTX	LV	5.80	12.29	N/A	8.84	0.39	1.00	0.32	12.9
Vanguard U.S. Value	VUVLX	LV	3.20	11.63	N/A	9.31	0.14	1.04	-1.93	13.2
Vanguard Windsor Fund	VWNDX	LB	4.06	12.76	6.79	9.36	0.22	1.03	-1.17	14.2
Vanguard Tax-Managed Grth & Inc	VTGIX	LB	5.37	11.88	5.14	8.51	0.36	1.00	-0.07	15.7
Vanguard Pacific Stock Index	VPACX	LB	10.06	16.81	5.47	11.82	0.63	0.89	-0.88	16.9
Vanguard Larga Cap Index	VLACX	LB	6.04	N/A	N/A	8.58	0.43	1.01	0.52	15.8
Vanguard Growth Equity	VGEQX	LG	7.11	12.68	3.98	13.01	0.38	1.33	0.78	25.1
Vanguard Global Equity	VHGEX	LV	10.81	19.30	11.68	11.67	0.72	0.99	-0.92	12.6
Vanguard Explorer	VEXPX	MG	4.23	14.51	8.56	13.53	0.16	1.41	-2.23	18.4
Janus Adviser Large Cap	JDGAX	LG	6.56	N/A	N/A	9.90	0.41	1.09	0.73	17.5
Janus Adviser Mid Cap Growth A	JDMAX	MG	12.54	N/A	N/A	11.57	0.81	1.20	5.65	18.0
Janus Adviser Small Company Value A	JDSAX	SV	5.62	N/A	N/A	13.05	0.24	1.27	-0.71	13.2
HSBC Inestor Value A	HIVAX	LV	7.66	N/A	N/A	9.47	0.53	1.01	1.91	14.8
Goldman Sachs Small Cap Value A	GSSMX	SV	3.10	14.10	8.54	12.00	0.04	1.16	-3.10	14.0
Goldman Sachs Small Cap Value C	GSSCX	SV	2.34	13.26	7.71	11.99	-0.02	1.16	-3.85	14.0
Goldman Sachs Strategic Growth B	GSWBX	LG	2.64	7.50	N/A	10.8	0.01	1.18	-3.51	19.8
Goldman Sachs Structured Small Cap Eq I	GCSIX	SB	-2.12	10.74	4.95	14.34	-0.27	1.43	-8.28	14.1
Laudus U.S. MarketMasters Inv	SWOGX	LG	5.23	12.18	5.13	9.73	0.29	1.10	-0.56	15.5
Swchab Core Equity	SWANX	LB	6.76	13.36	6.18	8.90	0.52	1.01	1.48	15.4
Pioneer Mid-Cap Growth A	PITHX	MG	4.79	11.80	3.72	11.93	0.18	1.22	-1.66	15.5
Pioneer Mid-Cap Value R	PCMRX	MB	5.85	N/A	N/A	9.85	0.33	1.02	0.05	15.0
Pioneer Small-Cap Value A	PIMCX	SB	2.83	14.06	9.84	12.74	0.04	1.29	-3.43	13.9
Pioneer Small-Cap Value C	PSVCX	SB	2.01	13.17	N/A	12.72	-0.02	1.29	-4.22	13.9
Pioneer Fundamental Growth A	PIGFX	LG	5.37	11.78	N/A	8.81	0.28	0.92	-0.41	20.3
Pioneer Equity Income A	PEQIX	LV	6.42	13.02	6.38	8.24	0.47	0.88	1.13	13.6
Pioneer Cullen Value A	CVFCX	LV	9.54	16.51	N/A	7.71	0.90	0.83	4.41	12.2
Pioneer Oak Ridge Small Cap Growth A	ORIGX	SG	4.59	14.68	6.97	12.69	0.21	1.28	-1.31	20.1
Pioneer Oak Ridge Small Cap Growth B	ORIBX	SG	3.65	N/A	N/A	12.70	0.14	1.28	-2.21	20.1
Fidelity Advisor Biotechnology A	FBTAX	MG	4.88	10.29	N/A	15.52	0.17	0.90	-0.21	11.9
Fidelity Advisor Mid Cap A	FMCDX	MG	5.49	15.19	11.39	14.54	0.21	1.45	-1.40	18.5
Fidelity Advisor Small Cap A	FSCDX	SB	7.71	17.98	N/A	10.78	0.44	1.02	1.64	16.7
Fidelity Advisor Small Cap Value A	FCVAX	SB	7.02	N/A	N/A	13.51	0.36	1.34	0.72	14.0
Fidelity Advisor Technology A	FADTX	LG	3.28	11.97	4.07	20.45	0.15	1.85	-2.67	26.8
Fidelity Advisor Value Strategies A	FSOAX	MB	4.97	17.25	8.79	13.91	0.22	1.44	-1.38	14.4
Fidelity Blue Chip Value	FBCVX	LV	6.21	N/A	N/A	9.81	0.42	1.11	0.72	12.5
Fidelity Europe	FIEUX	LG	14.13	24.71	8.69	13.57	0.83	1.16	0.51	17.3
Fidelity Select Industrials	FCYIX	LB	10.86	20.04	9.94	12.00	0.70	1.21	4.58	15.3
Fidelity Select Pharmaceuticals	FPHAX	LG	9.92	10.51	N/A	10.69	0.62	0.88	3.92	16.3
Fidelity Select Software & Comp	FSCSX	LG	11.61	14.56	11.72	17.62	0.51	1.43	4.54	25.4
Fidelity Spartan 500 Index Investor	FSMKX	LB	5.36	11.85	5.01	8.52	0.36	1.00	-0.06	14.4
Fidelity Small Cap Stock	FSCLX	SG	6.13	16.16	N/A	12.63	0.30	1.22	0.02	20.9
JPMorgan Large Cap Growth A	OLGAX	LG	6.60	10.88	2.25	12.15	0.34	1.23	0.27	19.9
JPMorgan Market Expansion Index A	OMEAX	MB	6.53	15.74	N/A	11.56	0.36	1.18	0.45	13.8

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Title	Ticker	M Style	3y	5y	10y	SD	Sharpe	Beta	Alpha	P/E
JPMorgan Mid Cap Value A	JAMCX	MV	6.25	14.62	N/A	8.21	0.42	0.87	0.78	14.5
JPMorgan Small Cap Equity A	VSEAX	SB	7.84	18.26	8.86	12.14	0.48	1.22	2.08	16.8
JPMorgan U.S. Equity A	JUEAX	LB	6.60	13.11	N/A	9.08	0.42	1.04	0.60	14.0
Undiscovered Mgrs Behavioral Value A	UBVAX	SV	1.34	N/A	N/A	13.64	-0.04	1.33	-4.61	13.8
Undiscovered Mgrs Behavioral Growth A	UBGAX	MG	4.40	N/A	N/A	16.70	0.18	1.58	-1.93	23.0
JPMorgan Large Cap Value A	OLVAX	LV	4.03	12.21	4.66	9.19	0.20	1.02	-1.28	11.3
Allianz NFJ All-Cap Value A	PNFAX	LV	3.67	13.77	N/A	8.85	0.14	0.91	-1.56	10.0
Allianz NFJ Large Cap Value A	PNBAX	LV	7.39	14.04	N/A	8.86	0.57	0.98	2.02	10.7
Allianz NFJ Small Cap Value A	PCVAX	SV	9.67	17.48	10.54	10.71	0.64	1.02	3.67	13.5
Allianz CCM Mid Cap A	PFMAX	MG	7.70	15.17	7.06	12.69	0.40	1.25	1.27	10.7
Allianz NACM Growth A	NGWAX	LG	7.62	11.18	N/A	11.35	0.46	1.24	1.32	16.5
Allianz OCC Growth B	PGFBX	LG	9.19	12.62	3.49	10.32	0.63	1.11	3.02	18.7
Allianz OCC Opportunity A	POPAX	SG	4.08	16.22	5.92	18.25	0.20	1.73	-1.68	19.7
Allianz OCC Renaissance A	PQNAX	MV	3.07	16.47	11.45	9.80	0.09	1.04	-2.33	9.4
USAA Aggressive Growth	USAUX	LG	6.03	12.32	4.21	11.06	0.30	1.14	-0.23	19.4
USAA S&P 500 Index Reward	USPRX	LB	5.33	11.80	N/A	8.53	0.36	1.00	-0.07	13.6
USAA Small Cap Stock	UCAX	SB	4.31	12.87	N/A	12.46	0.17	1.28	-1.82	16.5
USAA Growth & Income	USGRX	LG	5.03	12.02	4.79	9.73	0.29	1.09	-0.58	17.3
USAA Capital Growth	USCGX	LB	9.84	20.21	N/A	13.26	0.61	1.35	3.83	13.8
Average Values			6.05	14.06	6.94	11.50	0.34	1.16	-0.15	15.87

Appendix 2: Mutual funds sample – performance measures

	P/E	% Net Assets
Undiscovered Mgrs Behavioral Growth A		
Intuitive Surgical	105.26	5.94
Priceline.com	36.63	5.66
Illumina		3.83
Perrigo Company	36.1	2.94
Warnaco Group	17.24	2.89
Undiscovered Mgrs Behavioral Value A		
Informatica Corporations	35.34	2.53
Health Net	34.72	2.36
Chiquita Brands Intl.		2.35
McCormick & Co	22.42	2.27
MTS Systems Corp.	18.62	2.13

Appendix 3: “Behavioral” funds portfolio holdings

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Sub WriteTable(Sindex) 'end year table writing sub

```
Dim ws, wsoutput As Worksheet
Dim sYD As String
Dim YearReturn(30) As Variant
Dim i, ii As Long
Dim vsYD As Integer
Set ws = ThisWorkbook.Worksheets(Sindex)
Set wsoutput = ThisWorkbook.Worksheets("Table")
wsoutput.Cells(1, Sindex + 1).Value = ws.Name
sYD = 8
vsYD = 1
i = 2
ii = 2
Do Until ws.Range("A" & i).Value = ""
    Do Until sYD <> Right(ws.Range("A" & i).Value, 1)
        i = i + 1
        YearReturn(vsYD) = ws.Range("G" & i).Value
    Loop
    sYD = Right(ws.Range("A" & i).Value, 1)
    wsoutput.Range("A" & ii).Value = 2008 - vsYD
    wsoutput.Cells(ii, Sindex + 1).Value = YearReturn(vsYD)
    ii = ii + 1
    vsYD = vsYD + 1
Loop
End Sub
```

Function CountSheets() As Integer 'sheets counting sub

```
Dim NoSheets As Integer
NoSheets = ThisWorkbook.Sheets.Count
If ThisWorkbook.Worksheets(NoSheets).Name = "Table" Then NoSheets = NoSheets - 1
CountSheets = NoSheets
End Function
```

Sub WriteQTable(ByVal Line1 As Double, ByVal Line2 As Double) 'decile table writing sub

```
'Dim Line2 As Integer
Dim ws As Worksheet
Set ws = ThisWorkbook.Worksheets("Table")
ws.Range(Cells(Line1, 1), Cells(Line1, 31)).Copy
ws.Range(Cells(Line2, 1), Cells(Line2, 31)).PasteSpecial
ws.Range(Cells(Line2, 2), Cells(Line2, 31)).Sort Key1:=ws.Range(Cells(Line2, 2), Cells(Line2, 31)),
Orientation:=xlSortRows
i = 2
ii = 1
Do Until ws.Cells(Line2, i) = ""
    Do Until ws.Cells(Line2, i) = ws.Cells(Line1, ii)
        ii = ii + 1
    Loop
    ws.Cells(Line2 - 1, i) = ws.Cells(1, ii)
    ii = 1
    i = i + 1
Loop
End Sub
```

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```
Private Sub Worksheet_Activate() 'drawing end year values table
Dim NoSheets As Integer
NoSheets = CountSheets
For x = 1 To NoSheets
WriteTable (x)
Next x
End Sub

Private Sub Worksheet_Activate()
Dim ws As Worksheet
Dim i, ii, NoSheets As Integer
Set ws = ThisWorkbook.Worksheets("Table")
ws.Range(ws.Cells(2, 1), ws.Cells(18, 1)).Copy
ws.Range(ws.Cells(25, 1), ws.Cells(41, 1)).PasteSpecial
i = 1
ii = 2
NoSheets = CountSheets
Do Until ii = NoSheets + 2 'writing year returns table
Do Until ws.Cells(2 + i, ii) = 0
ws.Cells(24 + i, ii).Value = ((ws.Cells(1 + i, ii) / ws.Cells(2 + i, ii)) - 1) * 100
i = i + 1
Loop
i = 1
ii = ii + 1
Loop
i = 25
ii = 50
Do Until ws.Cells(i, 1).Value = "" 'writing deciles table
WriteQTable i, ii
i = i + 1
ii = ii + 2
Loop
End Sub
```

Appendix 4: VBA source code in deciles performance calculations

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2007	C	HD	BAC	AIG	GM	AXP	PFE	JPM	DD	DIS	BA	GE	JUN	WMT	MMM	IBM	PG	CAT	T	MSFT	VZ	HP	AA	XOM	UTX	KO	CVX	INTC	MCD	MRK	
		-44.75	-31.13	-18.82	-17.71	-16.44	-13.38	-8.16	-6.88	-4.78	-0.11	2.68	3.61	4.88	10.73	12.84	16.64	20.47	20.60	20.82	22.20	23.38	24.14	24.29	30.47	30.54	34.25	36.39	37.36		
2006	INTC	WMT	HD	MMM	AA	AIG	CAT	GE	JUN	PG	UTX	PFE	MSFT	DD	AXP	C	IBM	BAC	KO	JPM	BA	CVX	VZ	MCD	XOM	MRK	DIS	HP	T	GM	
		-17.20	0.13	0.99	2.98	3.64	6.06	7.87	9.36	13.86	13.86	15.26	15.87	18.63	19.08	19.57	19.78	20.69	23.10	25.65	28.41	33.70	34.60	34.65	39.08	42.70	44.26	45.23	53.19	64.04	
2005	GM	VZ	IBM	DIS	PFE	DD	WMT	HD	AA	MMM	JUN	GE	MSFT	KO	T	BAC	MRK	C	AIG	AXP	JPM	PG	MCD	INTC	UTX	CVX	XOM	CAT	BA	HP	
		-48.41	-22.19	-15.83	-12.87	-10.64	-10.30	-4.34	-3.81	-3.51	-3.36	-1.45	-0.94	-0.65	0.22	2.40	4.04	4.63	4.82	5.26	5.71	7.20	7.35	8.12	10.05	11.56	11.79	20.67	37.90	38.32	
2004	MRK	INTC	PFE	GM	KO	AA	HP	MMM	AIG	WMT	C	T	IBM	MSFT	JPM	DD	UTX	PG	AXP	CAT	DIS	VZ	GE	HD	BAC	BA	JUN	CVX	XOM	MCD	
		-27.77	-26.55	-22.28	-21.41	-16.13	-15.77	-7.30	-1.74	-0.52	0.50	2.78	7.19	9.13	9.95	10.42	10.72	12.36	17.58	19.72	20.24	20.28	20.88	21.46	21.54	24.91	25.18	25.53	28.06	31.50	
2003	MRK	VZ	JUN	T	WMT	MSFT	DD	AIG	PFE	KO	PG	BAC	IBM	XOM	BA	GE	HP	CVX	AXP	MMM	C	DIS	HD	GM	UTX	MCD	JPM	AA	CAT	INTC	
		-11.21	-5.67	-2.08	1.66	5.74	6.79	12.01	15.04	17.73	18.12	18.50	20.14	20.49	20.64	30.40	30.75	34.54	35.34	37.71	40.63	41.57	44.43	49.03	52.74	55.40	56.85	60.61	70.98	86.19	106.61
2002	HD	INTC	MCD	GE	IBM	AA	JPM	T	AIG	C	CVX	PFE	MSFT	GM	DIS	VZ	WMT	CAT	XOM	JUN	AA	JUN	GE	UTX	MRK	AXP	DD	MMM	PG	BAC	
		-52.62	-50.32	-38.40	-37.70	-35.46	-34.55	-30.79	-28.31	-26.94	-23.92	-22.16	-21.95	-20.78	-20.32	-15.18	-13.88	-13.38	-11.76	-9.79	-8.87	-7.88	-5.49	-2.70	-1.19	0.14	3.03	6.41	11.50	14.56	
2001	BA	MRK	AXP	HP	DIS	KO	MCD	AIG	JPM	UTX	T	GE	PFE	DD	XOM	VZ	GM	C	MMM	PG	INTC	AA	WMT	CVX	HD	CAT	JUN	BAC	IBM	MSFT	
		-40.43	-35.97	-34.48	-33.97	-27.85	-21.76	-21.40	-19.29	-17.35	-16.74	-16.08	-15.04	-12.47	-9.11	-7.80	-2.55	-0.92	0.05	0.19	3.09	4.91	7.85	8.95	9.27	12.05	13.86	14.02	42.65	43.02	52.89
2000	MSFT	HD	HP	GM	PG	INTC	DD	WMT	IBM	AA	VZ	MCD	JPM	GE	BAC	DIS	AXP	T	CVX	CAT	KO	XOM	JUN	UTX	C	MMM	AIG	MRK	PFE	BA	
		-62.84	-33.30	-28.45	-27.86	-27.07	-26.88	-24.48	-22.78	-20.84	-17.99	-16.17	-15.11	-10.05	-6.03	-4.45	-0.37	-0.27	0.09	0.54	4.14	5.99	10.25	14.24	22.68	23.56	26.26	37.00	41.76	43.07	61.21
1999	PFE	BAC	KO	MRK	T	DIS	CAT	MCD	CVX	JPM	JUN	XOM	VZ	IBM	UTX	PG	GM	DD	BA	INTC	AIG	MMM	GE	AXP	HP	MSFT	HD	C	WMT	AA	
		-21.51	-14.01	-12.17	-7.50	-7.41	-1.46	4.66	5.45	7.35	11.67	12.48	12.58	17.04	17.57	20.94	21.56	26.14	26.88	28.70	38.11	40.15	41.12	53.59	63.42	67.73	68.33	68.94	70.09	70.46	125.90
1998	BA	MMM	DD	DIS	C	CAT	BAC	KO	AA	HP	CVX	AXP	PG	GM	XOM	VZ	JUN	JPM	AIG	GE	MRK	T	UTX	MCD	PFE	INTC	IBM	WMT	HD	MSFT	
		-32.48	-11.07	-9.79	-8.50	-6.80	-3.04	1.28	1.32	7.59	10.65	11.00	15.89	15.86	21.29	22.39	22.52	28.96	32.92	33.62	41.01	41.31	49.72	51.57	61.79	68.95	68.99	77.49	107.56	108.44	114.86
1997	BA	MMM	MCD	INTC	UTX	AA	GM	CVX	HP	JPM	BAC	KO	XOM	DD	CAT	JUN	MRK	IBM	DIS	VZ	T	PG	GE	AIG	MSFT	AXP	WMT	HD	C	PFE	
		-7.08	1.21	5.88	7.49	11.72	11.88	19.41	22.13	25.30	25.57	27.31	27.85	28.44	30.33	31.29	34.32	35.68	38.97	42.88	45.18	45.56	50.51	50.93	51.20	56.51	59.89	74.66	76.92	79.89	81.93
1996	T	MCD	VZ	WMT	HD	GM	AIG	JUN	DIS	HP	AA	MRK	XOM	CVX	CAT	PG	MMM	PFE	BA	DD	AXP	GE	UTX	KO	BAC	C	JPM	IBM	MSFT	INTC	
		-6.32	1.20	1.32	3.10	5.46	8.63	17.44	18.11	19.06	21.08	22.61	23.95	25.38	28.50	31.07	32.16	33.46	33.94	37.64	38.31	39.74	40.35	42.32	43.25	44.40	46.80	55.70	67.67	68.39	131.44
1995	HD	WMT	CAT	CVX	AA	IBM	MMM	DD	GM	DIS	PG	XOM	VZ	AIG	AXP	MSFT	GE	KO	T	UTX	MCD	JUN	BAC	PFE	JPM	HP	BA	MRK	INTC	C	
		4.27	5.60	8.74	22.21	24.35	25.72	28.46	28.65	28.67	29.06	36.76	39.43	41.33	42.15	42.84	43.52	45.20	46.25	47.02	55.05	55.31	59.10	59.85	66.73	68.72	89.40	89.63	76.46	78.14	97.05
1994	GM	C	WMT	VZ	JPM	BAC	GE	XOM	T	MMM	INTC	MCD	UTX	CVX	DIS	BA	PG	AIG	AXP	MRK	PFE	HD	KO	DD	JUN	CAT	AA	HP	IBM	MSFT	
		-21.98	-15.42	-14.47	-11.64	-6.47	-4.41	0.16	0.83	1.04	1.51	3.39	3.53	4.45	6.77	8.67	11.20	11.37	12.21	13.53	14.88	15.19	16.88	17.40	20.11	25.06	27.63	28.24	32.23	51.40	
1993	HD	WMT	MRK	JUN	MSFT	PFE	BAC	AA	DIS	DD	JPM	XOM	KO	PG	BA	MMM	AIG	HP	IBM	T	MCD	VZ	GE	AXP	UTX	INTC	C	CAT	GM		
		-21.80	-21.50	-18.31	-8.96	-5.31	-2.28	-1.36	-0.89	-0.32	6.11	7.34	8.01	8.31	8.74	10.68	11.43	14.01	14.51	15.76	16.45	17.80	19.91	26.04	28.52	30.70	33.11	42.74	63.33	67.49	73.40
1992	IBM	MRK	BA	PFE	JUN	UTX	DD	XOM	CVX	KO	WMT	MMM	VZ	AA	MSFT	GE	GM	PG	AIG	T	CAT	HP	C	AXP	MCD	BAC	HD	DIS	INTC	JPM	
		-40.04	-20.32	-13.95	-11.87	-10.20	-8.06	4.63	5.27	5.70	5.80	9.06	9.20	12.39	13.90	14.72	15.10	16.11	16.78	18.60	19.96	23.66	24.08	25.00	25.18	30.50	50.60	51.20	78.42	88.14	
1991	IBM	GM	VZ	CAT	CVX	AXP	BA	PG	DIS	AA	MMM	UTX	T	XOM	INTC	AIG	DD	MCD	GE	JUN	C	KO	HP	BAC	MRK	WMT	JPM	PFE	MSFT	HD	
		-17.53	-13.35	-5.32	-4.15	-0.71	3.54	7.40	11.08	13.47	14.79	15.13	17.81	21.53	23.25	27.52	28.63	31.85	31.93	37.42	62.22	74.19	75.43	80.78	85.63	88.95	95.46	107.54	112.39	121.35	162.45

Appendix 5: DJIA components performance table (ascending)

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2006	YHOO	EBAY	TEVA	INTC	AMZN	DELL	ESRX	AMGN	GENZ	QCOM	ERTS	AMAT	COST	BIB	GOOG	ADBE	MSFT	AAPL	SPLS	SYMC	GILD	JAVA	INFY	DISH	ORCL	PCAR	CSCO	CMCSA	CELG	RIMM		
	-34.81	-30.43	-27.13	-17.20	-16.31	-16.23	-14.56	-13.36	-13.00	-11.31	-3.73	3.89	7.91	8.64	11.00	11.26	15.87	18.01	18.59	19.14	23.55	29.36	36.92	39.89	40.38	46.92	59.64	63.36	77.56	93.69		
2005	SYMC	BIB	DELL	EBAY	JAVA	CMCSA	RIMM	DISH	ERTS	CSCO	ORCL	PCAR	MSFT	SPLS	QCOM	COST	YHOO	AMAT	AMZN	INTC	INFY	ADBE	GENZ	AMGN	TEVA	GILD	GOOG	ESRX	AAPL	CELG		
	-32.07	-32.02	-28.93	-25.70	-22.26	-22.12	-19.91	-18.24	-15.19	-11.39	-11.01	-10.42	-0.94	1.90	2.49	3.20	3.98	5.49	6.46	8.12	17.13	17.86	21.89	22.93	45.28	50.17	115.19	119.26	123.26	144.34		
2004	INTC	AMAT	QCOM	AMZN	DISH	CMCSA	ORCL	AMGN	TEVA	MSFT	ESRX	GENZ	CELG	GILD	JAVA	DELL	SPLS	ERTS	COST	PCAR	INFY	SYMC	QCOM	ADBE	YHOO	EBAY	BIB	RIMM	AAPL			
	-26.56	-23.81	-20.26	-15.63	0.81	1.47	3.70	3.82	6.03	9.13	15.05	17.81	18.18	20.11	20.99	24.01	24.36	29.36	31.13	47.31	47.90	49.33	60.18	60.74	67.39	80.04	81.50	146.59	201.22			
2003	MSFT	BIB	ORCL	DELL	AMGN	COST	INFY	ESRX	CMCSA	JAVA	TEVA	QCOM	SPLS	AAPL	DISH	ADBE	GENZ	SYMC	GILD	AMAT	CSCO	PCAR	EBAY	ERTS	INTC	CELG	YHOO	AMZN	RIMM			
	6.79	10.64	22.50	27.08	27.82	32.52	37.96	38.30	38.14	43.73	47.92	49.16	49.30	52.73	57.85	66.69	70.29	71.41	72.15	84.96	88.79	90.62	91.56	106.61	109.94	175.18	178.56	408.68				
2002	JAVA	BIB	GENZ	INTC	RIMM	COST	AMAT	AAPL	CMCSA	CELG	QCOM	CSCO	MSFT	ORCL	ADBE	DISH	ERTS	AMGN	YHOO	SPLS	DELL	EBAY	ESRX	GILD	PCAR	INFY	SYMC	TEVA	AMZN			
	-74.72	-51.88	-50.60	-50.32	-44.56	-36.78	-35.01	-34.61	-34.53	-32.71	-27.94	-27.66	-21.95	-21.80	-20.00	-18.97	-16.98	-14.35	-7.78	-2.11	-1.62	1.32	2.74	3.41	9.13	12.64	22.20	25.95	74.69			
2001	RIMM	JAVA	CSCO	ORCL	ADBE	YHOO	QCOM	INFY	AMZN	TEVA	CMCSA	AMGN	ESRX	CELG	INTC	AMAT	BIB	COST	DISH	GENZ	PCAR	ERTS	AAPL	MSFT	DELL	SPLS	GILD	SYMC	EBAY			
	-70.37	-56.87	-52.65	-52.48	-46.56	-40.98	-38.55	-32.62	-30.46	-15.49	-12.86	-11.73	-8.53	-1.72	4.91	5.02	9.08	11.14	20.73	33.11	36.79	40.89	47.18	52.89	55.85	59.34	58.69	98.80	102.79			
2000	YHOO	AMZN	AAPL	DELL	MSFT	DISH	QCOM	EBAY	INFY	SYMC	SPLS	AMAT	CSCO	JAVA	INTC	CMCSA	COST	ERTS	ORCL	AMGN	PCAR	CELG	GILD	ESRX	RIMM	ADBE	BIB	GENZ	TEVA			
	-86.11	-79.56	-71.05	-65.80	-62.84	-53.33	-47.28	-44.07	-43.11	-43.09	-39.71	-28.86	-28.02	-26.88	-13.71	-12.46	1.48	3.75	6.46	16.72	39.28	53.25	59.75	73.12	73.22	92.95	99.87	104.83				
1999	SPLS	GENZ	ESRX	PCAR	COST	GILD	INTC	DELL	AMZN	ERTS	EBAY	CMCSA	MSFT	TEVA	AMGN	CSCO	AAPL	SYMC	ADBE	AMAT	JAVA	YHOO	ORCL	BIB	CELG	DISH	QCOM					
	-28.75	-6.52	-4.65	13.59	26.40	31.52	39.11	39.34	42.17	49.68	55.72	66.81	68.33	77.04	129.76	130.66	151.22	169.49	189.25	196.81	261.78	265.19	289.57	318.26	355.47	706.44	2623.05					
1998	PCAR	TEVA	SYMC	QCOM	GILD	ADBE	BIB	AMAT	ERTS	COST	INTC	GENZ	CMCSA	CELG	AMGN	ORCL	MSFT	JAVA	ESRX	SPLS	CSCO	DISH	AAPL	DELL	YHOO	AMZN						
	-17.53	-13.22	-0.73	7.32	7.53	14.03	36.65	41.78	48.47	61.76	68.99	79.23	81.10	82.86	93.20	93.28	114.66	114.69	123.73	136.19	149.73	188.52	211.89	248.57	584.06	966.53						
1997	AAPL	CELG	DISH	ORCL	TEVA	AMGN	INTC	ADBE	ERTS	QCOM	GENZ	CSCO	BIB	SYMC	GILD	SPLS	JAVA	PCAR	MSFT	ESRX	AMAT	COST	CMCSA	DELL	YHOO							
	-37.16	-24.73	-23.75	-19.83	-5.48	-0.51	7.49	11.95	26.34	26.43	27.66	31.40	44.70	51.38	53.21	53.63	55.18	56.40	56.51	67.41	67.43	77.59	82.18	216.27	509.86							
1996	ADBE	SYMC	AAPL	GENZ	ESRX	GILD	CELG	DISH	AMAT	AMGN	QCOM	CMCSA	TEVA	SPLS	JAVA	ERTS	BIB	ORCL	COST	PCAR	CSCO	MSFT	INTC	DELL								
	-39.08	-37.80	-34.50	-30.28	-29.78	-22.00	-16.22	-9.43	-8.60	-8.42	-7.35	1.05	8.75	11.14	12.62	14.55	21.85	47.77	64.71	68.56	70.36	88.39	131.44	207.41								
1995	AAPL	PCAR	CMCSA	COST	SYMC	ERTS	MSFT	ORCL	SPLS	DELL	INTC	QCOM	AMAT	TEVA	GENZ	AMGN	ADBE	CSCO	CELG	JAVA	GILD	BIB										
	-17.32	-2.58	15.79	18.39	32.88	35.76	38.70	43.52	44.04	47.74	68.75	78.14	78.83	86.33	93.17	98.03	101.22	110.20	112.82	136.17	156.98	238.98	828.57									
1994	BIB	CMCSA	ERTS	COST	PCAR	GILD	TEVA	CELG	QCOM	SYMC	INTC	AMAT	CSCO	GENZ	AMGN	JAVA	AAPL	ADBE	SPLS	MSFT	ORCL	ESRX	DELL									
	-63.54	-36.09	-35.87	-33.05	-24.93	-21.33	-19.42	-18.97	-9.27	-3.95	3.39	8.94	8.94	14.69	19.22	21.98	35.20	35.77	45.54	51.40	53.62	56.46	82.86									
1993	DELL	AAPL	CELG	GENZ	GILD	BIB	AMGN	JAVA	SPLS	MSFT	COST	PCAR	SYMC	TEVA	INTC	ADBE	ESRX	ERTS	CSCO	CMCSA	ORCL	QCOM	AMAT									
	-53.33	-50.45	-46.79	-39.27	-37.50	-34.25	-29.90	-13.33	-7.39	-5.31	6.19	9.39	34.12	38.00	42.74	43.65	44.12	46.35	64.22	90.39	102.86	118.84	130.39									
1992	SYMC	ADBE	BIB	COST	GENZ	CELG	AMGN	QCOM	AAPL	MSFT	CMCSA	JAVA	PCAR	SPLS	INTC	AMAT	ORCL	ERTS	TEVA	CSCO	DELL											
	-89.42	-51.21	-32.72	-27.87	-22.94	-14.17	-6.76	-1.43	6.91	14.72	17.68	18.31	20.44	46.50	78.42	92.45	94.44	115.90	133.64	136.96	177.78											
1991	INTC	COST	CMCSA	AAPL	JAVA	DELL	PCAR	AMAT	TEVA	ORCL	GENZ	MSFT	ADBE	CELG	SPLS	CSCO	SYMC	AMGN	ERTS													
	27.52	28.07	29.70	32.35	32.96	42.11	53.07	60.61	67.19	89.47	105.05	121.35	127.61	135.19	153.23	187.50	232.93	265.64	305.08													

Appendix 6: Nasdaq 30 components performance table (ascending)

Vladimir Patras: Investment Strategies Evaluation

2007	GM	WAG	LEH	EK	AXP	PFE	SLE	IP	BA	ADBE	SO	MMMM	IBIM	SGP	ROK	EIX	VZ	PEP	UTX	CVX	MCD	GILD	AMPH	IMCL	AAPL
	-16.44	-16.34	-15.49	-13.63	-13.38	-8.16	-3.45	-2.34	-0.11	3.92	9.86	10.73	12.84	13.65	14.86	19.93	22.2	23.88	24.45	30.54	36.39	41.7	49.61	60.89	133.47
2006	WAG	IP	ROK	FDX	EIX	PEP	ADBE	SO	EK	UTX	SGP	PFE	AAPL	AXP	SYMC	IBIM	ODP	LEH	GILD	BA	CVX	VZ	MCD	AMPH	GM
	4.34	4.51	4.77	5.4	7.05	7.86	11.26	11.89	12.53	13.66	14.62	15.26	18.01	19.08	19.14	19.78	21.56	22.75	23.55	28.41	33.7	34.6	34.65	40.56	64.04
2005	SLE	IP	IBIM	PFE	MMMM	SGP	LUV	AXP	FDX	MCD	SO	UTX	CVX	PEP	WAG	ADBE	AMPH	ROK	BA	AMID	EIX	LEH	GILD	ODP	AAPL
	-18.53	-17.48	-15.83	-10.64	-3.51	0.99	1.05	5.26	5.33	7.35	7.54	10.05	11.56	15.24	15.96	17.86	20.83	21.29	37.9	38.98	39.64	47.66	50.17	80.88	123.26
2004	ODP	WAG	IBIM	UTX	PEP	LEH	AMPH	SLE	SO	IMCL	AXP	GILD	VZ	SGP	BA	CVX	EK	MCD	ROK	FDX	AMID	SYMC	EIX	ADBE	AAPL
	3.89	6.02	7.19	10.72	13.81	14.24	14.93	15.01	16.16	16.19	17.58	20.11	20.28	21.55	24.91	25.53	27.9	31.5	41.77	46.39	47.79	49.33	52.12	60.74	201.22
2003	PEP	ODP	LUV	PFE	IBIM	FDX	WAG	IP	BA	CVX	AXP	MMMM	LEH	AAPL	GM	UTX	MCD	ADBE	AMPH	SYMC	GILD	ROK	EIX	AMID	IMCL
	12.04	13.21	16.3	17.73	20.49	24.92	25.27	26.62	30.4	35.34	37.71	40.63	46.02	49.3	52.74	55.4	56.85	57.85	68.29	70.29	71.41	76.48	85.15	130.85	273.45
2002	AAPL	LUV	CVX	PFE	EIX	AMPH	GM	ODP	ADBE	LEH	VZ	BA	WAG	PEP	IP	UTX	AXP	GILD	SLE	FDX	MMMM	SO	ROK	SYMC	EK
	-34.61	-24.71	-23.07	-22.16	-21.53	-20.96	-20.78	-20.39	-20	-19.74	-15.18	-13.38	-12.92	-12.13	-11.12	-2.7	0.14	3.41	4.2	4.82	6.41	17.61	20.06	22.2	25.5
2001	MCD	WAG	LUV	UTX	PFE	SLE	EIX	VZ	GM	LEH	PEP	MMMM	ROK	IP	IMCL	CVX	AMID	AMPH	FDX	SO	IBIM	AAPL	GILD	SYMC	ODP
	-21.4	-19.18	-17.25	-16.74	-12.47	-8.99	-3.44	-2.55	-0.92	-0.84	-0.55	0.19	1.16	1.46	5.59	9.27	14.84	22.61	29.82	32.27	43.02	47.18	58.69	98.8	160.39
2000	GM	IP	IBIM	VZ	MCD	AMID	FDX	AXP	CVX	ROK	SLE	AMPH	UTX	MMMM	SGP	PEP	PFE	WAG	SO	GILD	LEH	BA	ADBE	LUV	IMCL
	-27.88	-26.75	-20.84	-16.17	-15.11	-4.56	-2.39	-0.27	0.54	2.65	15.76	17.8	22.58	26.26	35.54	42.63	43.07	43.56	50.73	53.25	60.72	61.21	73.22	108.18	122.11
1999	SO	FDX	EK	EIX	AMID	WAG	MCD	LUV	CVX	VZ	IBIM	UTX	GM	BA	IP	GILD	MMMM	AXP	ROK	LEH	AMPH	AAPL	SYMC	ADBE	IMCL
	-10.42	-8.2	-5.62	-2.85	-0.21	0.36	5.45	6.72	7.35	17.04	17.57	20.94	26.14	28.7	31.12	31.52	41.12	63.42	68.95	94.73	120.27	151.22	189.49	189.25	337.31
1998	SYMC	SLE	EIX	GILD	IP	CVX	IMCL	ADBE	PEP	AXP	GM	EK	VZ	SO	LUV	FDX	UTX	ODP	MCD	AMID	PFE	IBIM	SGP	WAG	AAPL
	-0.73	3.67	6.35	7.53	8.63	11	11.58	14.03	14.3	15.69	21.29	21.79	22.52	24.85	38.47	46.05	51.57	54.82	61.79	63.29	68.95	77.49	79.61	87.86	211.89
1997	MMMM	MCD	IP	UTX	ADBE	GM	CVX	ROK	SO	ODP	PEP	FDX	IBIM	EIX	VZ	SYMC	GILD	SLE	WAG	AXP	LEH	LUV	PFE	SGP	AMPH
	1.21	5.88	11.21	11.72	11.95	19.41	22.13	25.51	30.23	33.89	36.48	37.22	38.97	42.45	45.18	51.38	53.21	57.4	57.43	59.89	64.52	68.22	81.93	95.05	150.36
1996	AMPH	LUV	MCD	VZ	SO	PEP	GM	IP	FDX	SGP	EIX	ROK	SLE	EK	IMCL	CVX	MMMM	PFE	WAG	BA	AXP	UTX	LEH	AMID	IBIM
	-8.31	-4.25	1.2	1.32	3.8	6.21	8.63	12.5	20.45	20.86	20.92	21.1	22.03	22.34	28.08	28.5	33.46	33.94	36.32	37.84	39.74	42.32	50.11	56.12	67.67
1995	CVX	FDX	IBIM	EIX	MMMM	GM	SYMC	SLE	LUV	WAG	SO	VZ	AXP	EK	LEH	SGP	UTX	MCD	PEP	ROK	PFE	BA	ADBE	GILD	IMCL
	22.21	22.64	25.72	25.94	28.46	28.67	32.88	33.72	37.54	39.31	40.22	41.33	42.84	44.17	47.06	51.87	55.05	55.31	56.74	57.59	66.73	69.63	110.2	238.98	710.64
1994	FDX	VZ	PEP	SYMC	MMMM	MCD	ROK	SO	UTX	CVX	ODP	SLE	WAG	EK	BA	SGP	AXP	PFE	IP	IBIM	AAPL	ADBE	AMID	AMPH	
	-14.99	-11.64	-9.53	-3.95	1.51	3.53	3.8	4.41	4.45	6.77	7.1	7.35	8.53	11.17	11.2	11.48	13.53	15.19	17	32.23	35.2	35.77	40.09	45.37	
1993	EIX	PFE	AMID	PEP	IP	SGP	BA	MMMM	IBIM	MCD	VZ	AXP	FDX	CVX	SO	UTX	SYMC	ROK	ADBE	EK	ODP	GM	LUV	AMPH	
	-3.42	-2.28	-1.99	0.07	7.45	10.54	10.68	11.43	15.76	17.8	19.91	28.52	30.06	30.7	31	33.11	34.12	38.35	43.65	43.87	48.8	73.4	90.53	135.63	
1992	BA	EK	PFE	UTX	SGP	IP	EIX	AMID	CVX	AAPL	SLE	MMMM	VZ	GM	WAG	ROK	PEP	AXP	MCD	SO	ODP	FDX	LUV		
	-13.95	-12.02	-11.87	-8.06	-0.85	-0.51	-0.46	3.54	5.7	6.91	8.27	9.2	12.39	16.11	16.5	16.67	24.19	25.18	29.45	31.6	34.22	40.57	72.73		
1991	BA	ROK	FDX	MMMM	UTX	EK	EIX	MCD	PEP	AAPL	IP	WAG	SO	SGP	SLE	LUV	PFE	ADBE	ODP	SYMC	AMID				
	7.4	8.06	14.48	15.13	17.81	21.29	31.54	31.93	32.35	32.35	40.09	50.36	51.52	51.99	93.89	96.43	112.39	127.61	223.81	232.93	258.61				

Appendix 7: P 1 components performance table (ascending)