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PORTFOLIO SELECTION VIA COMPOSITE MEASURE ANALYSIS:

EVIDENCE FROM THE U.S. STOCK MARKET

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ABSTRACT

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Title:	Portfolio Selection via Composite Measure Analysis: Evidence from the U.S. stock market.
Faculty:	LUT, School of Business
Major:	Finance
Year:	2014
Master's Thesis	56 pages, 2 figures, 8 tables and 1 appendix
Examiners (1st and 2nd)	Professor Eero Pätäri, Dr.Timo Leivo

Keywords: Value premium, valuation multiples, value strategies, Composite value measure, valuation ratio, TOPSIS.

The aim of this research is to examine the pricing anomalies existing in the U.S. market during 1986 to 2011. The sample of stocks is divided into decile portfolios based on seven individual valuation ratios (E/P, B/P, S/P, EBIT/EV, EVITDA/EV, D/P, and CE/P) and price momentum to investigate the efficiency of individual valuation ratio and their combinations as portfolio formation criteria. This is the first time in financial literature when CE/P is employed as a constituent of composite value measure. The combinations are based on median scaled composite value measures and TOPSIS method. During the sample period value portfolios significantly outperform both the market portfolio and comparable glamour portfolios. The results show the highest return for the value portfolio that was based on the combination of S/P & CE/P ratios. The outcome of this research will increase the understanding on the suitability of different methodologies for portfolio selection. It will help managers to take advantage of the results of different methodologies in order to gain returns above the market.

Acknowledgments

First, I would like to express the deepest appreciation to my supervisor Professor Eero Pätäri for his support, important comments and suggestions. Without his supervision and constant help this thesis would not have been possible. In addition, a big thanks to Ville Karel for his continuous guidance during the practical phase. I would like to thank to my second supervisor Dr. Timo Leivo, your doctoral dissertation provided valuable guidance.

I would like to thank Abdollah Noorizadeh, who as a good friend was always willing to help and give his best suggestions. Moreover, thanks to Thomson Reuters' customer service for providing needed information on time. I should admit I have nerve seen such a good support from any companies.

The most importantly, I would like to thank my parents who devoted all their life to raise me up with their heart and allowing me to realize my own potential. All the support they have provided me over the years was the greatest gift anyone has ever given me.

Very special thanks to Hamid & Farnoush. You both go above and beyond the call of duty to the point where you almost seem like a second parents to me. I am so lucky to have you in my life. I am forever grateful.

Finally, Thanks to Samuli who was always there cheering me up and stood by me through the good times and bad. And thanks to his family who made my studies in Finland a very pleasant one.

Lappeenranta, December 1st, 2014

Sara Mostafshar

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List of abbreviations

EMH	Efficient Market Hypothesis
OTC	Over-The-Counter
B/P	Book - to- Price
E/P	Earnings - to- Price
CE/P	Cash & Equivalent- to- Price
D/P	Dividend- to-Price
EV	Enterprise value
EBIT	Earnings Before Interest and Tax
EBITDA	Earnings Before Interest, Tax, Depreciation, and Amortization
TOPSIS	Technique for Order preference by Similarity to Ideal Solution
DEA	Data Envelopment Analysis
AHP	Analytic hierarchy process
MCDM	Multi-criteria Decision Making

1 INTRODUCTION

Prediction of stock market and gaining returns above average has attracted a tremendous amount of research which has important implications for investment managers. One critical issue for investment managers is portfolio optimization, which is a well-known and difficult problem in the financial world. The problem involves choosing a group of well-diversified assets in order to outperform a main composite index, which requires minimizing risk and maximizing return.

One of the well-known methodologies is Mean-variance efficiency model introduced by Harry Markowitz (1952) that considers only two parameters for optimization (risk and return). Using this model, investors choose the efficient portfolio which has the minimum variance for the given mean return among all other portfolios or for the given variance has the maximum mean return. After Markowitz various methodologies have been presented to deal with this problem to improve the portfolio selection model (Table 1). Because portfolio selection is more difficult and different from Markowitz model for the reason that in selecting securities multiple criteria involves which makes the selection truly complicated.

In addition, recently scholars found that managers can improve the efficiency of their portfolios by using investment means which combine both value and momentum strategies (Leivo & Pätäri 2011; Pätäri et al. 2012). These two strategies represent a very different investment philosophy. The negative correlation between value and momentum indicate that investors who combine these two strategies are closer to the efficient frontier. This is the true power of diversification.

Combining these two strategies can be highly beneficial for fund managers. The biggest benefit is that the approach can improve entry and exit points for the most undervalued stocks. Combining these two strategies can boost overall returns by filtering out the low-performing stocks. This does not require value investors to change their strategy, but it incorporates a timeliness assessment to further improve performance (Trendrating, 2014).

Therefore, I apply two more complex portfolio systems, which are composite value measure (Dhatt et al., 2004) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), (Pätäri et al.,2014) as multi-criteria decision making(MCDM) models that

determine the best units out of group of inputs and outputs. These methods will be used to combine value stock and momentum strategy in portfolio formation. Moreover, the individual valuation ratios will be checked based on seven individual valuation ratios (E/P, B/P, S/P, EBIT/EV, EVITDA/EV, D/P, and CE/P) and price momentum. This is the first time in financial literature when CE/P is employed as a constituent of composite value measure

Table 1.Different proposed methods for portfolio selection

METHOD	MODEL	AUTHOR
stochastic environment	The mean-lower-partial-moments model	Harlow & Rao, 1989
	The mean absolute deviation model	Simaan,1977
	The maximizing probability model	Williams,1997
	mean -variance models	Best & Hlouskova, 2000; Deng et al., 2005; Ghezzi,1999)
Fuzzy environment	The fuzzy goal programming model	Parra et al., 2001
	The admissible efficient portfolio selection model	Zhang & Nie,2004
	The possibility approach model with highest utility score	Carlsson et al., 2002
	The upper and lower exponential possibility distribution based model	Tanaka & Guo, 1999
	The model with fuzzy probabilities	Tanaka et al.,2000
Multi-criteria decision model	The multi-criteria linear goal programming	Ogryczak,2000
	preference disaggregation methodology	Zopunidies et al.,1999

My interest in this avenue of research stems from Pätäri et al (2012) who combined for the first time value strategy and momentum strategy using Data Envelopment Analysis (DEA) to separate value stock and growth stock in Finnish stock market. Recently, Pätäri et al. (2014) applied TOPSIS for the same purpose in the U.S. Stock market. Since the literature is relatively silent on the use of MCDM methodology to separate good and bad stock, TOPSIS method as MCDM will be observed in addition to the individual valuation ratios and composite value measure in the U.S. market which can provide a great sample of data for a comprehensive result.

1.1 Research questions

This research investigates following questions

1) Is there a value premium in the US market?
2) What is the effectiveness of individual value measures to explain return?
3) How can composite value measure and TOPSIS be used to separate the good stocks from the bad ones?
4) Does Cash and Equivalent–to-Price ratio explain market return in the U.S.?

1.2 Structure of the thesis

The thesis is divided into six sections. The aim of first section is present the reader with the background of the thesis. Section2 reviews the literature which is related to value investing, momentum investing, fundamental anomalies, and composite value measure in portfolio selection. Section 3 describes the data and the employed methodology. The performance measure of portfolio will be explained in section 4. Section 5 explains empirical result and section 6 concludes with limitation and suggestion for future research.

2 Literature review

2.1 Market efficiency

The concept of market efficiency, introduced by Fama (1970), is central to finance. The theory involves defining an efficient market as one in which trading on available information fails to provide an abnormal profit. In other words, the stock market prices are largely driven by new information rather than present and past prices. Since news cannot be predicted stock market prices follow the random walk pattern. According to this definition, real-world financial market such as US market is actually efficient (Shleifer, 2000).

A number of economists believe in the efficiency market hypothesis (EMH). For example, Burton (2003) argues that if prices were predictable then investment funds could be done easily. He believes a blindfolded chimpanzee throwing darts at the stock pages could select a portfolio as well as experts. Thus, EMH is the first consequence of equilibrium in competitive markets with fully rational investors. Market efficiency is divided into three parts. The weak form of the efficient market hypothesis asserts that prices fully reflect the past information, the semi-strong form claims that prices reflect all relevant information that is publicly available, and strong market efficiency hypothesis assert the prices reflect all the public and private information.

On the other hand, there are a number studies which prove that stock prices can deviate from fundamental values for prolonged periods of time (Shleifer, 2000) and criticize EMH (Burton et al, 2003) from different perspectives such as Socionomic Theory of finance (STF) (Prechter & Parker, 2007), behavioral economics (Smith, 2003) and behavioral finance (Nofsinger, 2005). Moreover, numerous evidence shows that stock prices do not follow a random walk and they are predictable, if market can be predicted and exhibit no trace of random walk it implies market inefficiency (Butler& Malaikah 1992, Hoque& Kim, 2007).

The evidence of market inefficiency implies there is an opportunity and threat to gain and lose in a market (Zunino et al. 2009). Consequently, different investment strategies have been introduced which can provide abnormal return for investors. These strategies are using value investing instead of growth investing, considering momentum and also using fundamental ratios. There is solid body of research that investigated the result of these strategies separately but considering all these strategies at the same time is rare. Next, I will review the

literature on value investing, momentum and valuation measure as a basis for investment strategies.

2.2 Value investing vs. growth investing

It is well-known that value stocks have historically earned higher return than growth stocks, and it is frequently touted as the best strategy for equity investing. The focus in this research is on value stock as a result of richness in empirical evidence (Stattman 1980, Rosenberg, Reid, & Lanstein 1985, Fama & French, 1998, Bird & Whitaker, 2004; Chan & Lakonishok, 2004; Fama & French, 2006). Value stocks are those stocks that are traded at a low price relative to their fundamentals, which means that such stocks are undervalued. However, a lively debate is exists over the question of whether value premium exists in value stocks because they are riskier or because the market is inefficient. Greenwald et al, (2001) reports investors who follow this strategy believe that market is not always efficient, and they can find stock at a lower price that they are worth. Chen & Zhang (1998) argue that value stocks are riskier. Value stocks are more conductive to financial statements analysis and suggest investors to invest in undervalued stock respect to valuation multiple, which will be introduced later.

2.3 Momentum

Momentum is related to the tendency of recent winner stocks to generate abnormal returns in the near future. Research Affiliates based on data from Ken French's database mention that Market beta (MKT– RF), value (HML), small size (SMB), momentum (MOM), and low volatility (BAB) are the commonly accepted equity risk factors, but momentum shows the highest return and Sharpe ratio among them during 40 years.

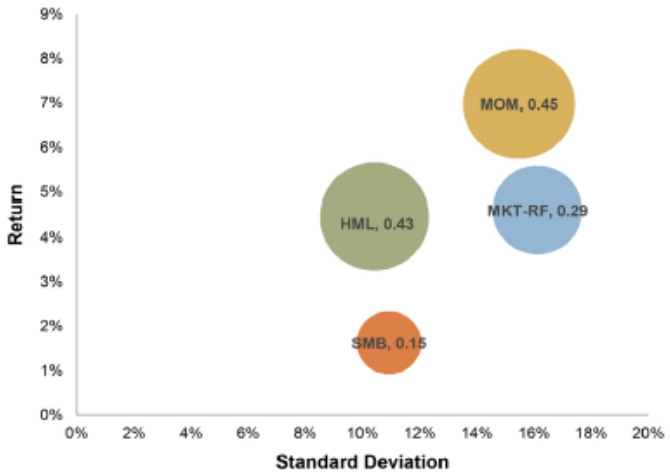

Figure 1 Risk factor Sharpe ratios, January 1970_June 2013. Source: Research Affiliates based on data from Ken French's database

There is a solid body of literature documenting that momentum, which is in the field of technical analysis, is a robust and pervasive feature in market. This is especially true in the US, which is a sign of anomaly.

Jegadeesh & Titman (1993) examine trading strategy in the US market during sample period 1965-1989. According to this strategy, buying the stock that has best return over the previous 3 to 12 months and selling the stock with worst return over the same period can generate significant return which is not due to systematic risk. Sagi & Seasholes (2007) apply enhanced momentum strategy to measure sensitivity of the company performance to different parameter. They assert that momentum is stronger among firms with high revenue growth volatility, low cost of goods and high market-to-book value. Other researchers have also focused on specific characteristic of the company; and found for example, that momentum is stronger among firms with lower credit (Avramov. et al, 2007), stronger among small firms (Hong, et al, 2000), and that momentum anomaly works better in illiquid, smaller cap stocks (Fama & French,2012).

Leivo & Pätäri (2011) examined the enhancement of value portfolio by considering momentum during 1993-2008 in Finnish market. To form the portfolio they consider D/P, B/P and EBITDA/EV as composite value and combined them with 6-month price momentum. The results show that considering momentum in valuation of stocks adds value in portfolio by 5 percent and decreases the volatility by 0,86 percent. Later in 2012, Leivo increased the

sample period and added year 2009 which considers the crisis of financial market and added different conditions in stock market during 1993 to 2009, which showed that in bullish market conditions momentum adds positive value to investors while in bearish market conditions it causes negative value. Bearing in mind the above literature related to momentum makes this variable critical to consider in portfolio selection.

2.4 Fundamental analysis & valuation multiple

Various studies have focused on the usefulness of financial statement analysis in predicting future realizations of both earnings and returns. Fundamental analysis is one method for valuation of stock which focuses on analyzing the financial statement of companies and can help investors earn excess returns. The idea of this analysis is that the stock prices reflect publicly available information. Investors who follow this strategy believe that possibly stock has been priced wrongly either by being overvalued or undervalued. Since markets tend to move toward intrinsic value it is important to determine the present value of stocks and gain the abnormal return in a way that if the stock is undervalued, it should be bought; and if it is overvalued, it should be sold.

Several studies support the usefulness of fundamental analysis. Penman (1989) uses multivariate analysis of financial ratios during 1973 to 1983 to examine whether combining information in individual ratios can predict the future earnings. The results show the ability of fundamental analysis to predict stock market. Lev & Thiagarajan (1993) utilize 12 financial indicators during 1974-1988 to find value relevance. The findings illustrate that fundamental information is actually powerful to explain earnings with respect to excess returns. The same financial indicators were again tested by Abarbanell & Bushee (1997) who find that these factors can explain both future earnings changes and future analyst revisions. They found significant abnormal return based on these 12 factors.

Later Francis & Schipper (1999) investigated whether financial statements have lost their relevance to investors. They tested relation between returns, earnings and book values of assets and liabilities to explain market value of equity in the US stock market during 1952 to 1994. The results showed that the relation between returns and earning had declined. However, the test didn't show any decline in the power of the explanatory variables, which were the book value of assets and liabilities either alone or combined with earnings to determine the market equity value. They also found that the value relevance of book value

has increased. Piotroski (2000) used 9 fundamental signals to form a composite score (F-SCORE) to distinguish the winners and losers in the US stock market. He found that investors can form a value portfolio by using financial statement information. Among the findings was that high book to market firms can increase the return by 7,5% annually . Beneish et al. (2001) documented two approaches toward financial statements to distinguish between losers and winners, based on market signals and fundamental signals. The results showed the importance of carrying out fundamental analysis. Bird & Gerlach (2006) tested fundamentals in the US, UK and Australian stock markets with the conclusion that fundamentals have the capability to predict stock returns.

The result of these studies shows fundamental analysis is quite relevant to explain market return. According previous research, the most popular fundamental analysis tools used are: book to price (B/P), earnings to price (E/P), sales to price (S/P), dividend yield (D/P), Cash flow to price (CF/P), Enterprise value (EV), and recently, EBITDA/EV and EBIT/EV.These valuation ratios will be introduced next.

2.4.1 Book to Price (B/P)

The Book-to-Market ratio which is used to find the value of the company is probably one of the first factors which have been considered in financial markets. It compares the book value of company to price of the stock - inverse of P/B ratio. A stock with a high B/P ratio can be interpreted as undervalued stock, which is desirable from the value investors' viewpoint

Many studies show the superiority of this ratio as a measure to select stocks. For example, Chan et al (1991) studied CF/P, E/P, B/P, and size effect as portfolio criteria in the Japanese stock market during 1971-1988 and find support to B/P ratio as the best criteria. The effect of book to market value on stock returns during 1963-1990 in the US market also was studied by Fama & French (1992) and their results showed that high B/P stocks outperformed the low B/P stock in terms of the return. Fama & French also (1998) studied B/P, CF/P, E/P, and D/P in 13 stock markets during 1975-1995 and found that B/P ratio responds positively to value premium. The same criteria were tested by Bauman et al. (1998) in 21 countries during 1986-1996, and once more B/P ratio shows the highest value premium. These results are in line with other researches which showed the power of B/P ratio (e.g. Bird & Whitaker, 2003; Fama & French, 1992; Chen & Zhang, 1998)

2.4.2 Earnings yield (E/P)

The E/P (earnings yield) ratio is commonly used by financial analysts to justify their stock recommendations. Basu (1977) examined whether the investment performance of stocks is related to their E/P ratio in the US market. The result showed that stock with high E/P subsequently tends to have higher average return than stocks with low E/P. However, Banz, (1981) argued E/P anomaly is explained by small-cap anomaly, and small-cap firms outperform large-cap firms in terms of the return. However, Cook & Rozeff (1984) argued that stock return is related to both size and E/P ratio. Jaffe et al. (1989) showed significant effect for E/P and size across all months during 1951 to 1986, which is consistent with the results of Cook & Rozeff (1984), who also found significant effect in all 12 months for this ratio. Moreover, Jaffe et al. (1989) report high return for companies with negative earnings. In general, the E/P anomaly has been noticeable in different market and different period with makes this ratio central to consider. (Chen & Zang 2007, Athanassakos 2011)

2.4.3 Sales-to-Price (S/P)

S/P ratio is an excellent valuation indicator to compare stock with the historical valuation of other stock in the same industry since they have similar capital structures and profit margins. Sales are difficult to change during accounting and they are not as sensitive as earnings during different economic conditions. However; the disadvantages of this ratio comes up when company has high sale while losing a high amount of money. In this situation using this ratio as bases of decision making is wrong.

Many studies show S/P anomaly in stock market (e.g. Dhatt et al. 2004; Bird & Casavecchia, 2007a, 2007b; Gharghor et al, 2013). Barbee et al. (1996) studied S/P and B/P ratios in the U.S. stock market. They argued that sales-to-price (S/P) is positively related to stock return, and is a more reliable indicator of a firm's relative market valuation than B/M since sales figures are less affected by company specific factors than the book value of equity. The same result was found by Suzuki (1998) in Tokyo Stock exchange. He found the superiority of S/P ratio in comparison to E/P and B/P ratio, especially during economic recovery. However, latter Guerard et al. (2006) documented that S/P ratio has lost its significance in the Japanese stock market.

On the other hand Pätäri (2011) found no S/P anomaly in Finnish stock market during 1993-2008. He argues that if S/P anomaly exists in Finnish stock market it heavily depends on the sample.

2.4.4 Dividend yield (D/P)

Dividend yield, which is calculated by dividend divided by price, measures how much a company pays out in dividends each year relative to its share price.

There are numerous studies (Litzenberger and Ramaswamy 1979, Fama & French, 1988) assert that stocks with high dividend yield tend to outperform the market average. In other words if dividend yield is high, then the stock generates more return. Brennan (1970) who proposed the tax effect hypothesis believes that risk adjusted pre-tax returns should be positively correlated to dividend yield. A very strong D/P anomaly was found by Pätäri et al.(2009), Leivo et al. (2009,2001) and), Leivo (2002) in Finnish stock market. Authors documented D/P criterion as the greatest value premium among six individual valuation ratios in Finnish stock market.

On the other hand, Black & Scholes (1974) who proposed the dividend–neutrality hypothesis reject the relationship between return and dividend yield. The authors state that if investors demanded higher returns to compensate for higher-yielding stocks, corporations will adjust dividend policies to lower the cost of capital.

2.4.5 EBITDA/EV

EBITDA/EV is one strong single factor that it is not affected by changes in the capital structure. The ratio is calculated as (equity value, preferred stock, and debt, minus cash) divided by (Earnings Before Interest, Depreciation, Taxes, and Amortization). This ratio can be used to compare profitability of different companies and industries with different leverage.

Leivo et al. (2009) who published for the first time the performance of EBITDA/EV- ranked quintile portfolios and compare it with common individual valuation ratio in Finnish stock market during 1991-2006 found the top performance for high EBITDA/EV stocks. However; Leivo et al. (2009) explains the use of EBITDA/EV multiple might cope with the problem of spurious undervaluation which comes from the characteristics of the earing multiple.

The result of Leivo et al. (2009) is in line with the results of Gray and Vogel (2012) that studied portfolio formation in the US market during 1971 to 2010 according to valuation ratio and found the finest performance for high EBITDA/EV stocks. Loughran & Wellman, (2011) also examined the effect of EBITDA/EV ratio in the US market during 1963-2009 shows that high EBITDA/EV outperforms low EBITDA/EV.

2.4.6 EBIT/EV

EBIT/EV ratio is calculated as operating profits divided by enterprise value. The earnings yield compares the profit generated with the market's valuation of the company. However; this ratio is considered as more accurate valuation of companies but literature related is scarce. Recently, Pätäri et al (2014) studied selection of value portfolio in Finnish stock market during 1996-2013 based on four individual valuations (E/P, B/P, S/P, EBIT/EV). Among them EBIT/EV shows its superiority in the Finnish stock market and E/P, S/P show their weakness to find value stocks in Finnish stock market.

2.4.7 Cash & Equivalent- to-Price (CE /P)

Cash & equivalent is an item in balance sheet that shows the assets of company that are cash or can be transferred to cash immediately. To calculate the ratio cash & equivalent per share should be divided by price per share in a company. It is noticeable that firms with positive ratio of cash to price may have negative ratios when short-term liabilities are considered.

Considering recent market volatility, many investors consider that the ultimate safeness of a company is the amount of cash that they have. Since healthy cash position of the firm provides flexibility and safety in a company and it decreases the probability of bankruptcy or gaining the control of the firm by debtor.

Also firms with high cash positions can distribute the excess cash as dividend to shareholders. However; double taxation is a weakness to the high payout strategy and to avoid the double tax, many firms have chosen to use excess cash to repurchase shares on the open market which increased the share price in short term. Firms with excess cash return can increase their product lines or diversify into new parts. These firms also have opportunity for acquisitions. (Bajkowski, 1996)

According to the above facts I decided to consider this ratio as a value measure to check if this ratio is able to show value premium. To my best knowledge there is no published research has used this ratio as a value measure. However, there are a few articles which talk about CE/P. For example, Robbins (2011) tests 10 valuation ratios (Cash Flow-to-Price, Book Value-to-Price, Sales-to-Price, Earnings-to-Price, Assets-to-Price, Price divided by earnings per share plus expected growth, Cash-to-Price, EBITDA-to-EV, Sales-to-EV, and Estimated Growth Rates) during 2000 to 2011. He found Cash Flow-to-Price as the best single valuation metric and E/P, EBITDA/EV, S/P and BV/Price as the next four top ratios based on returns. He could not found any significant result based on Cash-to-Price. He also tested various combinations of the top five ratios but he could not find any combination that outperformed Cash Flow-to-Price by itself.

2.5 Composite value measure in portfolio selection

Dhatt et al. (2004) were the first who reported the result of composite value measure. They compared the result of individual valuation ratio with composite value measure in the U.S market during 1980-1998. They used three ratios (E/P, B/P, and S/P) as bases of composite valuation ratio. Standardized valuation ratios were used to compute, composite value measure. Composite valuation measures were computed as simple averages of different combinations of relative valuation ratios. The result of their research shows combination based on E/P and S/P ratios has the highest return. They concluded that using this method can add value in portfolios.

Powers & McMullen (2000) used Data Envelopment Analysis (DEA) (BCC model) to select desirable securities in the US market. They utilized a total of eight items as outputs and inputs - five outputs which are EPS, (Return 1, 3, 5 and 10 year) and three inputs which are (price-earnings, beta and sigma). The results showed that DEA provides a single composite score for each security and defines how much improvement is needed for each security to become efficient. They also show DEA is capable to define which securities are consistently the best when several variables are considered.

Chen (2008) created a portfolio using DEA (BCC & CCR) to find whether it is possible to earn abnormal return in Taiwan Stock Exchange (TSEC). He applied financial data from eight major industries in TSEC from the second quarter of 2004 to second quarter of 2007, scanned the size effect as a strategy to select stock. The outcome showed that DEA has the

ability to generate abnormal return in TSEC with both methods (BCC & CCR). However, he found that size effect is not an appropriate method for TSEC. Bahrani et al. (2013) created a portfolio of the efficient companies with two models of DEA (BCC & CCR) in Tehran Stock Exchange (TSE) during 2001-2007 across seven industries showing that using the BCC model creates abnormal return in industry in contrast to the CCR model. They also argued that a portfolio that was generated by small companies offers higher return due to the effect of company size and book value to market value on stock return in TSE which is in contrast of Chen's (2008) findings, since the size effect appears appropriate as stock selection strategy in TSE.

Edirisinghe & Zhang (2007) created an index to determine the optimal security weights that could satisfy risk-return favorites of investors. This is called relative financial strength indicator (RFSI) that was established to have high correlation with the stock returns. To select inputs and outputs they proposed a generalized DEA by maximizing the correlation between the DEA score and the exogenous performance index. They used quarterly financial statements and gathered 18 financial ratios related to profitability, asset utilization, liquidity, leverage, valuation, and growth for the period 1996-2002 over 230 firms across six industries on the US technology sector. Their result showed that RFSI is an appropriate method to select a portfolio. Later, Edirisinghe & Zhang (2010) applied DEA on 827 firms covering all stocks on the S&P500 index across 9 major sectors' quarterly data during 1997-2004. The aim of their research was to select the correct input/output in the RFSI model. They utilized the same 18 financial ratios as previous research and argued that profitability, valuation and growth can only be used as output variables while asset utilization, liquidity and leverage can only be used as input variables.

Singh et al (2010) compared DEA with ordered weighted averaging (OWA)-heuristic algorithm methodology to form an optimal portfolio of stocks from 45 stocks listed in National Stock Exchange (NSE) of India from January 2005 to December 2007. However; the result showed the securities that were generated by DEA provided higher return, but (OWA)-heuristic algorithm could provide better performance.

Ismail et al. (2012) studied the basic model of DEA (CCR) on portfolio selection in Malaysian stock market over all listed companies in property sector during 2004 to 2005. Nine variables are chosen as input data (trading volume, dividend yield, size, book to market, risk, price-earnings, liquidity, leverage, and asset utilization) and three variables are defined as output

(return, return on equity, return in asset). The results showed the efficiency of DEA as a tool to select portfolios in the Malaysian stock market.

Pätäri et al. (2010) applied DEA in Finnish stock market during 1993-2008 to combine three valuation ratios (E/P, B/P, D/P) as a basis of portfolio formation criteria. Later, Pätäri et al. (2012) examined DEA (CCR & super-efficiency, cross-efficiency model) to form equity portfolio in Finnish stock market during 16 years (1994-2010). They found that value stocks remained undervalued for an extended period of time. Hence, it would be worthwhile to have an indicator to find the best time for buying stock. Therefore, Pätäri et al. (2012) combined momentum and value investing in order to find its contribution in portfolio formation. Two parameters were chosen as input variables (stock price and enterprises value) and five parameters as output variables (book value, dividend, EBITDA, momentum, EPS). The result showed the capability of DEA to separate the best-performing stocks from their worst-performing counterparts. However, price momentum was proven to add value on the stock selection. The findings indicated that top- tercile DEA portfolios lose their value less than bottom portfolios during bearish conditions.

Recently, Lim et al. (2014) investigated DEA (cross-efficiency evaluation model) to form a portfolio with a well-diversified performance in Korean stock market during 9 years (2002-2011) among 490-557 listed firms. They addressed standard cross-efficiency evaluation with a new approach which developed the mean variance framework of portfolio selection based on cross-efficiency evaluation. This was done to solve the problems of standard methods, which are “ganging-together” (Tofallis, 1996) and poor diversification. The financial metrics that they examined were equal to those employed by Edirisinghe & Zhang (2007). The results showed the effectiveness of their approach to select portfolios.

Finally, Hsu (2014) applied three different methodologies: Data envelopment analysis (DEA), Artificial Bee Colony (ABC) and Genetic Programming (GP) to optimize portfolios in Taiwan stock market during 2007 to 2011. In this paper first DEA was used to find the most profitable stocks based on historical data, which decreases the risk of investment. ABC algorithm was then used to determine the optimal capital weightings of stocks and lastly the GP algorithm was used to construct the stock price forecasting model. The methodology showed its potential to make an average 9,31% return for 6 month on investment.

2.6 Summary of literature

The above literature states that no market is entirely efficient; therefore, there would be an opportunity to make return and threat to lose (Zunino et al. 2009). Fundamental analysis and applying value investing strategy are considered as the best approaches to enhance the portfolio performance as well as combining value indicators, also known as composite value measures. Additionally, the momentum indicator has been shown to be important, which is worth to consider. To combine these criteria researchers suggest the use of multi-criteria decision-making (MCDM) which has shown its capability in many fields.

3 Research design

3.1 Sample description

In this research, financial data[1] (Table 2) was obtained from DATASTREAM[2] to construct the valuation ratio for all the available companies in the US market: New York Stock Exchange (NYSE), National Association of Securities Dealers Automated Quotations (NASDAQ), and American Stock Exchange (AMEX) during 1986 to 2011 (26 years). Data are collected based on yearly basis for the valuation ratios and monthly basis for estimating momentum[3]. The results reflect the whole sample of 21611 companies which includes delisted firms in order to avoid survivorship bias. The basic descriptive statistics of the data show that there are a number of outliers. The outliers are removed according criteria which are shown in Table 3. OTC companies also were excluded from the sample since they are out of the exchange market. Finally, firms with missing data were excluded according to eight criteria (E/P, B/P, S/P, EBIT/EV, EVITDA/EV, D/P, CE/P, and 6month momentum). We got the total sample of 377 companies in 1986 to 1328 companies in 2011(Table 7).In total, 3591 companies were included in this sample which is comprehensive in a sense that it included all the possible companies in the US market and it covers 26 years.

To analyze the performance of equity portfolios monthly returns[4] and three month treasury-bill as risk free are used and Portfolios are formed in 20th trading day of May[5]. The performance of portfolios is evaluated based on the annual return, the Sharpe ratio, and SKASR. Statistical tests are carried out with SKASR to determine statistically significant risk-adjusted returns that will be introduced in section 4. The performance of each portfolio is contrasted with that

[1] Monthly total return, 6-month momentum, dividend per share, price per share, earning per share, book value per share, sales per share, earnings before interest and tax per share, earnings before interest, taxes, depreciation, and amortization per share, cash and equivalent per share.

[2] Data are screened for the problems of Datastream according to the research by Ince& Porter(2006) who call for caution in handling data errors in Datastream

[3] To calculate 6 month momentum monthly data for price was obtained from DataStream and price on 20th May was divided by price on 20th of November. It is also important to notice data for price also were obtained in 20th of month.

[4] Return is driven from the 20th day of each month

[5] Portfolio cannot be formed before April since many firms are not made public until the fourth month after the fiscal year-end. (Fama & French, 1992)

of the market portfolio and the performance of each value portfolio (P1) is compared to that of the comparable glamour portfolio (P10)

Table 2 Definition of applied valuation ratios

NAME	SYMBOL	EXPLANATION
BOOK VALUE PER SHARE	X(WC054)	BOOK VALUE PER SHARE represents the book value (proportioned common equity divided by outstanding shares) at the company's fiscal year end for non-U.S. corporations and at the end of the last calendar quarter for U.S. corporations.
EBIT	X(WC181)	EARNINGS BEFORE INTEREST AND TAXES (EBIT) represents the earnings of a company before interest expense and income taxes. It is calculated by taking the pre-tax income and adding back interest expense on debt and subtracting interest capitalized.
EBITDA	X(WC181)	EARNINGS BEFORE INTEREST, TAXES, and DEPRECIATION & AMORTIZATION (EBITDA) represent the earnings of a company before interest expense, income taxes and depreciation. It is calculated by taking the pre-tax income and adding back interest expense on debt and depreciation, depletion and amortization and subtracting interest capitalized.
ENTERPRISE VALUE	X(WC181)	Market Capitalization at fiscal year-end date + Preferred Stock + Minority Interest + Total Debt minus Cash. Cash represents Cash & Due from Banks for Banks, Cash for Insurance Companies and Cash & Short Term Investments for all other industries. For companies with more than one type of ordinary shares, Market Capitalization represents the total market value of the company calculated as total number of listed and unlisted common equivalent shares multiplied by the price of the primary issue at fiscal year-end date
EPS	(W05202)	EARNINGS PER SHARE - FISCAL PERIOD END represent the earnings for the 12 months ended the last calendar quarter of the year for U.S. corporations and the fiscal year for non-U.S. corporations. It represents the fully diluted earnings per share (field 10030) for US companies and basic earnings per share (field 05210) for other companies.
MARKET CAPITALIZATION	X(WC072)	MARKET CAPITALIZATION (U.S.$) represents the total market value of the company based on year-end price and number of shares outstanding converted to U.S. dollars using the year end exchange rate.
NET INCOME	X(WC017)	NET INCOME USED TO CALCULATE EARNINGS PER SHARE represents the net income the company uses to calculate its earnings per share. It is before extraordinary items.
PRICE	P	Data type (P) represents the official closing price. This is the default data type for all equities and ETF’s.
SALES	X(WC010)	NET SALES OR REVENUES represent gross sales and other operating revenue less discounts, returns and allowances.

SHARES OUTSTANDING	X(WC053)	COMMON SHARES OUTSTANDING represents the number of shares outstanding at the company's year-end. It is the difference between issued shares and treasury shares.
TOTAL RETURN	RI	A return index (RI) is available for individual equities and unit trusts. This shows a theoretical growth in value of a shareholding over a specified period, assuming that dividends are re-invested to purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date. .
COMMON DIVIDEND (CASH)	WC05376	COMMON DIVIDENDS (CASH) represent the total cash common dividends paid on the company's common stock during the fiscal year, including extra and special dividends. If the company has ESOP preferred stock, the dividends paid will be the full amount shown on the cash flow. It excludes: Dividends paid to minority shareholders
CASH AND EQUIVALENT	X(WC020)	Cash & Due from Banks for Banks, Cash for Insurance companies and Cash & Short Term Investments for all other industries

Table 3 Range of criteria to remove the outliers

VARIABLE	MIN	MAX
E/P	-1	2
S/P	0,01	100
B/P	0,033333	20
D/P	-0,0001	1
EBITDA/EV	-0,6	2,5
EBIT/EV	-0,6	2,5
CE/P	-1	2
Momentum	0,05	5

3.2 Methodology

The first step was running the financial data in Matlab program and ranking the data based on individual valuation ratios, composite value measures, and TOPSIS from high to low. Top values were classified as undervalued stocks in contrast to bottom values which were classified as overvalued stocks. The sample was divided into 10 parts based on the ranks of each classification criteria. The valuation multiples used in forming portfolios were E/P, B/P, S/P, EBIT/EV, EVITDA/EV, D/P, CE/P, and 6-month momentum. The performance evaluation of decile portfolios was based on monthly return time series.

After checking the robustness of individual valuation multiple, the efficiency scores of stocks were calculated based on twenty different composite valuation measures and TOPSIS. Eight of these combinations are based on two valuation ratios and twelve of them are based on three valuation ratios. Table 4 shows different combinations of portfolios that were formed in this research.

Table 4 Different combinations of portfolio formation

Combination	Valuation ratios		
1	S/P	CE/P	
2	S/P	EBITDA/P	
3	CE/P	BV/P	
4	CE/P	EPS/P	
5	BV/P	EPS/P	
6	CE/P	EBIT/P	
7	CE/P	EBITDA/P	
8	CE/P	S/EV	
9	CE/P	EPS/P	M*P/P
10	CE/P	S/P	EBITDA/P
11	CE/P	S/P	M*P/P
12	CE/P	S/P	EPS/P
13	CE/P	BV/P	M*P/P
14	EBITDA/EV	EBIT/EV	S/EV
15	CE/P	S/EV	M*EV/EV
16	EPS/P	S/EV	M*EV/EV
17	CE/P	EPS/P	S/EV
18	EBITDA/EV	EBIT/EV	D/P
19	CE/P	M*P/P	D/P
20	BV/P	M*P/P	D/P

3.2.1 Composite value

Many of the key concepts in investment are complex and cannot be indicated just with a single variable. So it is important to see the effect of all potential variables which can have a significant effect.

In this research composite value measures (Dhatt et al. 2004) was chosen as one of the techniques to combine the indicators. Composite value is related to combining some indicators to add value for the portfolio. If combined indicators are not highly correlated to each other it is possible that this technique enhances the portfolio performance. Composite valuation measure is a simple average of different combinations. For example, combination number one is obtained by standardizing first each valuation multiple (i.e., S/P, CE/P) by its median from the beginning date and from every rebalancing data, and calculating then the simple average of these two ratios for each stock in the sample.

3.2.2 TOPSIS method

TOPSIS (Technique for Order preference by Similarity to Ideal Solution) method was developed as a Multi-Criteria Analysis Model technique by Hwang & Yoon in 1981.The basic concept is to define the ideal solution from the negative ideal solution.

This method considers two artificial alternatives hypothesis. First one is the ideal alternative which has the best level for all attributes considered, and the second one is a negative ideal alternative which has the worst attribute values. TOPSIS selects the alternative that is the closest to the ideal solution and farthest from negative ideal alternative.

This research adopts Hwang & Yoon (1981) proposal of TOPSIS. The detail steps as follows:

Step 1: Construct normalized decision matrix.

This step transforms various attribute dimensions into non-dimensional attributes, which allows comparisons across criteria.

Normalize scores or data as follows:

$$r_{ij} = x_{ij} / (\Sigma x^2_{ij}) \quad \text{for } i = 1, \ldots, m; j = 1, \ldots, n \qquad (1)$$

Step 2: Construct the weighted normalized decision matrix.

Assume we have a set of weights for each criteria w_j for j = 1,…n.

Multiply each column of the normalized decision matrix by its associated weight.

An element of the new matrix is:

$$v_{ij} = w_j r_{ij} \quad (2)$$

Step 3: Determine the ideal and negative ideal solutions.

Ideal solution.

$$A^* = \{ v_1^*, \ldots, v_n^* \}, \text{ where} \quad (3)$$

$$v_j^* = \{ \max (v_{ij}) \text{ if } j \in J ; \min (v_{ij}) \text{ if } j \in J' \}$$

Negative Ideal solution.

$$A' = \{ v_1', \ldots, v_n' \}, \text{ where} \quad (4)$$

$$v_j' = \{ \min (v_{ij}) \text{ if } j \in J ; \max (v_{ij}) \text{ if } j \in J' \}$$

Step 4: Calculate the separation measures for each alternative.

The separation from the ideal alternative is:

$$S_i^* = [\Sigma (v_j^* - v_{ij})^2]^{1/2} \qquad i = 1, \ldots, m \quad (5)$$

Similarly, the separation from the negative ideal alternative is:

$$S_i' = [\Sigma (v_j' - v_{ij})^2]^{1/2} \qquad i = 1, \ldots, m \quad (6)$$

Step 5: Calculate the relative closeness to the ideal solution C_i^*

$$C_i^* = S_i' / (S_i^* + S_i') , \qquad 0 < C_i^* < 1 \quad (7)$$

Select the option with C_i^* closest to 1.

3.3 A summary of methodology

Following picture shortly explains the overall research process

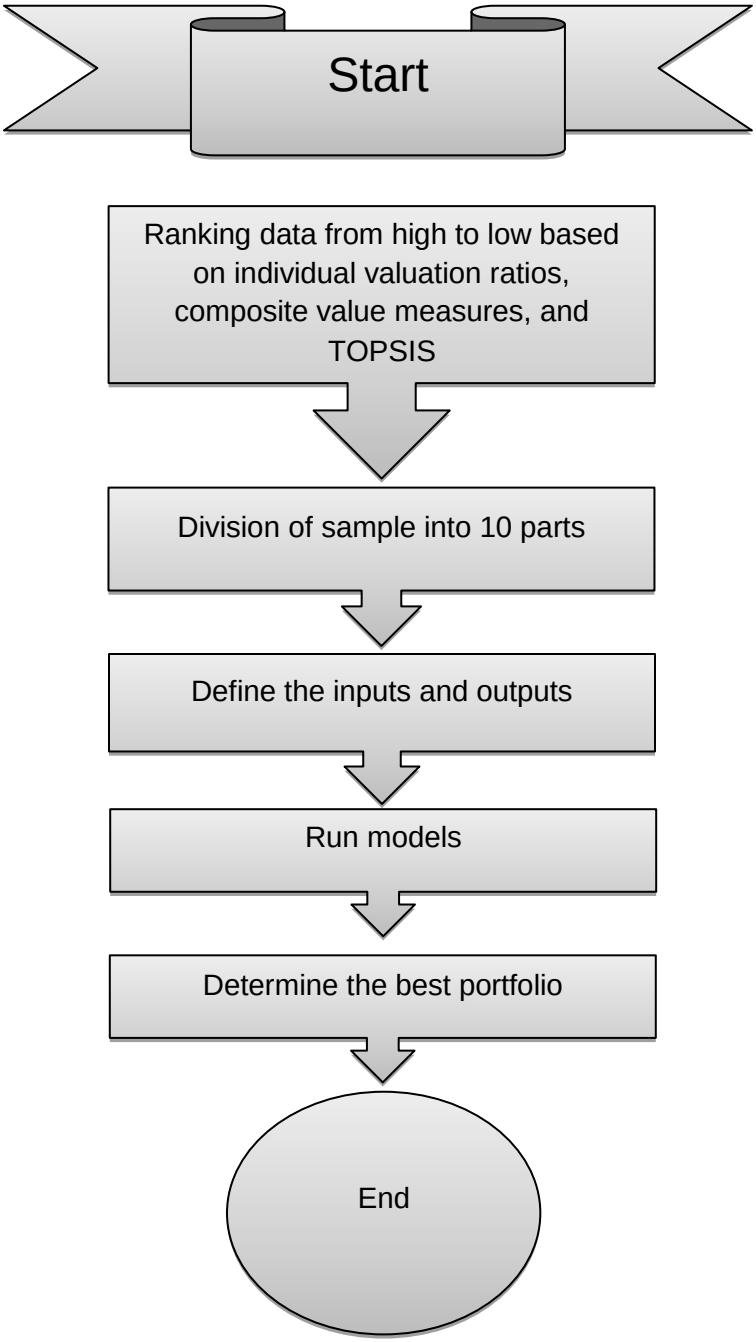

Figure 2: Overall research process

4 The performance measures

4.1.1 Volatility

Volatility is a measure for variation of price of a financial instrument over time. Historic volatility is derived from time series of past market prices. A volatile market presents higher risk to investors. It should be noted volatility does not measure the direction of price changes.

$$Annualized\ volatility = \frac{\sigma_i}{\sqrt{T}}$$

Where,

$\sigma_i = the\ standard\ deviation\ of\ portfolio\ i\ in\ time\ period\ T$

$\sqrt{T} = the\ trading\ days\ in\ time\ period\ T$

4.1.2 The Sharpe ratio

The Sharpe ratio is developed by Sharpe (1966) to measure risk adjusted performance. This ratio often used for evaluation of the portfolio performance. The Sharpe ratio identifies how much excess return investors can get for the extra volatility they bear for holding a riskier portfolio - the higher Sharpe ratio the better. Sharpe ratio is especially reasonable when compared to the market of the other portfolios. The ratio helps to make the performance of one portfolio comparable to that of another portfolio by making an adjustment for risk.

To calculate Sharpe ratio, risk free rate should be deducted from the rate of return for a portfolio and dividing by standard deviation; however there is a problem with negative Sharpe ratio which means negative excess return while risk free asset provides better return. To avoid the problem we use modified Sharpe ratio by Israelsen (2005).

$$Sharpe\ ratio = \frac{R_i - R_f}{\sigma_i^{\left(\frac{ER}{|ER|}\right)}} \tag{8}$$

Where,

$R_i = The\ average\ monthly\ rturn\ of\ portfolio\ i$

$R_f = The\ average\ monthly\ risk\ free\ of\ rturn$

$ER = The\ average\ excess\ return\ of\ portfolio\ i$

$\sigma_i = The\ standard\ deviation\ of\ the\ average\ excess\ return\ of\ portfolio\ i$

4.1.3 SKASR

One of the performance metrics that is used in this thesis is SKASR (skewness and kurtosis adjusted Sharpe ratio) which was presented by Pätäri (2011) as an extension to the traditional Sharpe ratio. Pätäri (2011) asserts that it is important that both skewness and kurtosis considered in risk metrics.

To determine modified Value-at-Risk first adjusted Z value (Z_{CF}) is calculated. (Cornish & Fisher, 1937)

$$Z_{CF} = Z_C \frac{1}{6}(Z_C^2 - 1)S + \frac{1}{24}\left(Z_C^3 - 3Z_C\right)K - \frac{1}{36}\left(2Z_C^3 - 3Z_C\right)K - \frac{1}{36}(2Z_C^3 - 5Z_C)S^2 \quad (9)$$

Where

$Z_C = Critical\ value\ for\ probability\ based\ on\ standard\ normal\ distribution$

$S = skewness$

$k = kurtosis$

Consequently, skewness and kurtosis are calculated as follows:

$$S = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{r_{it} - \bar{r}_i}{\sigma}\right)^3 \quad (10)$$

$$K = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{r_{it}-\bar{r}_i}{\sigma}\right)^4 - 3 \quad (11)$$

Where

$N = number\ of\ outcomes$

$\bar{r}_i = average\ return$

$\sigma = standard\ deviation$

In the next step, to calculate skewness-kurtosis-adjusted deviation (SKASR) standard deviation is multiplied by Z_{CF}/Z_C. Favre & Galeano (2002), use -1,96 for the value of Z_C which is also used in this thesis. Finally, we replace the SKASR with standard deviation in equation (1) and we get SKASR equation used by Pätäri (2011) which avoids the problem of negative excess returns (Israelsen, 2005)

$$SKASR = \frac{R_i - R_f}{SKAD_i^{\left(\frac{ER}{|ER|}\right)}} \quad (12)$$

5 Empirical Results

5.1 Individual valuation ratio

Table 5 shows the results for 7 individual valuation ratios and price momentum (CE/P, E/P, EBITDA/EV, S/P, B/P, D/P, EBIT/EV, and Momentum).

The results indicate that value stocks outperform growth stock, and top decile outperforms bottom decile. The differences of annual return between top decile and bottom decile for some ratios are quite significant. CE/P shows the highest value premium which is equal to 17,47%, and S/P represents the second highest value premium equal to 17,34%. These two ratios also show quite high return in comparing to average market which is 9.87%. The third and fourth high value premiums are related to B/P and Momentum, respectively. While the lowest return for the top- decile portfolio is given to D/P ratio (8.70%). the return for top-decile portfolio in D/P is smaller than average market and it shows negative value premium (-1.80%) which is not desirable. In other words the rank order of all individual valuation ratios are perfectly consistent with the value premium hypothesis on the basis of several performance metrics employed (i.e., average returns, the Sharpe ratio) except in D/P which shows negative value premium.

Considering volatility, top-decile portfolio shows lower volatility then bottom-decile portfolio in all cases, which means that the remarkable return difference, is not explained by higher risk of value portfolios. The highest volatility is given to momentum (24.12%) for the top-decile portfolio and the lowest volatilities are given to E/P & EBIT/EV which are equal to 16,16% and 16,66%, respectively. The lowest volatilities are quite close to market volatility (16.44%). It should be noted that differences between top- decile portfolio volatility and bottom- decile portfolio in E/P and EBIT/EV are quite significant (over 11%).

Analyzing Sharpe ratios show the S/P and CE/P as the best criteria with the highest Sharpe ratio for the top- decile portfolio 0.26 and 0.25, respectively. This is quite significant in comparison to average market Sharpe ratio which is 0.16. The lowest Sharpe ratios are about 0.14 that is given to Momentum and D/P which is smaller than average market Sharpe ratio (0,16).

Based on SKASR the significant level at the1% is documented for CE/P and S/P in both top and bottom- decile portfolios. Moreover, B/P shows its significance for top and bottom- decile

portfolios at the 10% level. In general, the performances of all the valuation criteria are significant for the top- decile portfolios except for D/P and Momentum which are not significant even at the 10% level. This phenomenon can be interpreted as the inability of these two ratios to outperform individually.

Table 5 performance comparison of 10-decile individual valuation ratio during the full sample period (1986-2011)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average	value premium P1-P10
						CE/P						
Annual Return %	**18,04 %**	15,75 %	11,81 %	12,94 %	9,31 %	8,54 %	7,94 %	7,52 %	5,37 %	0,57 %	9,78 %	**17,47 %**
Annual volatility %	18,58 %	19,87 %	19,22 %	17,62 %	16,70 %	16,47 %	15,83 %	15,75 %	15,09 %	18,68 %	17,38 %	-0.10%
Sharp ratio	0,2595	0,2138	0,1684	0,2004	0,1544	0,1442	0,1398	0,1333	0,1003	0,0087		
SKASR	0,1942	0,1564	0,1206	0,1526	0,1117	0,1053	0,1015	0,0972	0,0724	0,0065		
SKASR (sig)	0,0000	0,0089	0,5599	0,0090	0,9004	0,7867	0,6257	0,4792	0,0777	0,0000		
						E/P						
Annual Return %	14,46 %	11,52 %	9,42 %	8,55 %	8,84 %	8,42 %	6,94 %	6,49 %	8,86 %	11,89 %	9,54 %	2,56 %
Annual volatility %	16,16 %	13,27 %	14,20 %	13,89 %	14,96 %	16,29 %	18,33 %	19,49 %	24,15 %	27,29 %	17,80 %	-11.13%
Sharp ratio	0,2425	0,2384	0,1836	0,1710	0,1641	0,1437	0,1060	0,0935	0,1019	0,1194		
SKASR	0,1882	0,1725	0,1306	0,1204	0,1104	0,0952	0,0749	0,0705	0,0844	0,1048		
SKASR (sig)	0,0007	0,0230	0,3969	0,6867	0,9767	0,4291	0,0401	0,0210	0,2521	0,8252		
						EBITDA/EV						
Annual Return %	13,96 %	13,21 %	11,50 %	10,71 %	9,55 %	8,26 %	7,82 %	6,09 %	5,63 %	8,95 %	9,57 %	5,02 %
Annual volatility %	18,17 %	16,25 %	14,67 %	15,18 %	15,63 %	14,98 %	15,40 %	17,39 %	21,59 %	27,93 %	17,72 %	-9.76%
Sharp ratio	0,2087	0,2215	0,2150	0,1944	0,1691	0,1535	0,1416	0,0984	0,0734	0,0889		
SKASR	0,1576	0,1572	0,1634	0,1359	0,1113	0,1075	0,0955	0,0695	0,0599	0,0809		
SKASR (sig)	0,0226	0,0114	0,0112	0,1815	0,9801	0,8776	0,4576	0,0234	0,0270	0,3228		
						S/P						
Annual Return %	**20,11 %**	13,29 %	11,26 %	11,43 %	8,82 %	8,37 %	7,23 %	8,34 %	5,09 %	2,77 %	9,67 %	**17,34 %**
Annual volatility %	20,39 %	17,83 %	16,72 %	15,79 %	15,59 %	15,48 %	15,20 %	17,17 %	18,19 %	25,31 %	17,77 %	-4.92%
Sharp ratio	0,2615	0,2031	0,1850	0,1987	0,1570	0,1503	0,1330	0,1351	0,0790	0,0312		
SKASR	0,2039	0,1514	0,1416	0,1428	0,1095	0,1031	0,0940	0,0982	0,0550	0,0263		
SKASR (sig)	0,0002	0,0349	0,1025	0,0752	0,9573	0,6741	0,3658	0,5389	0,0088	0,0077		
						B/P						
Annual Return %	15,07 %	11,99 %	10,71 %	10,37 %	8,50 %	9,97 %	7,04 %	8,49 %	7,87 %	6,82 %	9,68 %	8,24 %
Annual volatility %	17,87 %	14,71 %	14,58 %	15,65 %	15,58 %	16,61 %	18,35 %	20,86 %	20,90 %	22,08 %	17,72 %	-4.21%
Sharp ratio	0,2280	0,2233	0,2024	0,1828	0,1516	0,1658	0,1072	0,1131	0,1049	0,0865		
SKASR	0,1771	0,1698	0,1371	0,1301	0,1107	0,1180	0,0775	0,0836	0,0804	0,0691		
SKASR (sig)	0,0211	0,0270	0,1968	0,2836	0,9905	0,6539	0,0604	0,1104	0,1157	0,0969		
						D/P						
Annual Return %	**8,70 %**	9,84 %	9,53 %	9,58 %	10,04 %	8,33 %	8,33 %	10,60 %	9,51 %	10,49 %	9,49 %	-1,80 %
Annual volatility %	16,84 %	16,96 %	17,57 %	17,44 %	18,29 %	17,89 %	18,14 %	19,41 %	20,70 %	19,43 %	18,27 %	-2.58%
Sharp ratio	0,1434	0,1604	0,1500	0,1521	0,1517	0,1296	0,1277	0,1504	0,1272	0,1489		
SKASR	0,1039	0,1110	0,1054	0,1068	0,1088	0,0946	0,0988	0,1232	0,1039	0,1149		
SKASR (sig)	0,8242	0,9988	0,8266	0,8727	0,9263	0,4321	0,6343	0,6421	0,8100	0,8794		

EBIT/EV												
Annual Return %	13,82 %	10,49 %	9,74 %	9,80 %	9,75 %	8,73 %	7,84 %	7,11 %	8,74 %	9,63 %	9,57 %	4,19 %
Annual volatility %	16,66 %	15,36 %	14,16 %	14,29 %	14,38 %	15,38 %	17,02 %	18,27 %	23,59 %	27,81 %	17,69 %	-11.15%
Sharp ratio	0,2255	0,1882	0,1903	0,1896	0,1876	0,1577	0,1284	0,1089	0,1029	0,0958		
SKASR	0,1700	0,1330	0,1384	0,1340	0,1302	0,1084	0,0865	0,0788	0,0830	0,0867		
SKASR (sig)	0,0034	0,2952	0,1888	0,2718	0,3576	0,8836	0,2346	0,0472	0,2288	0,4092		
Momentum												
Annual Return %	12,93 %	9,86 %	10,43 %	8,61 %	9,18 %	9,39 %	9,93 %	9,30 %	10,19 %	5,72 %	9,55 %	7,21 %
Annual volatility %	24,12 %	17,73 %	14,83 %	14,91 %	14,13 %	14,57 %	15,47 %	17,20 %	19,02 %	24,71 %	17,67 %	-0.59%
Sharp ratio	0,1463	0,1537	0,1940	0,1605	0,1801	0,1785	0,1774	0,1498	0,1478	0,0651		
SKASR	0,1303	0,1151	0,1365	0,1110	0,1302	0,1265	0,1235	0,1031	0,1083	0,0528		
SKASR (sig)	0,2709	0,2367	0,2107	0,2155	0,1954	0,2056	0,2222	0,2498	0,2596	0,3046		
Market Average												
Annual Return %	9,87 %											
Annual volatility %	16,44 %											
Sharp ratio	0,1659											
SKASR	0,1106											
SKASR (sig)	0,0001											

5.2 Composite value

The overall results of Table 6 show that using composite value measures improves the performance of value portfolios.

Based on return value portfolio that is formed on the bases of two-composite value measures (CE/P, S/P) outperform among those entire value portfolios that outperformed the stock market portfolio. The second and third best combinations based on return are (CE/P and S/EV), and (CE/P, S/P and EBITDA/P). All these combinations are superior not only to that of the general stock market, but also to that of the corresponding middle portfolio. Results for volatility shows the remarkable return difference is not explained by higher risk of value portfolios since volatility is distinctly lower for P1 and 10.

The lowest return among the top portfolios is given to those combinations where dividend is included. However, in all combinations P1 outperform the stock market very clearly except in combination number 18 (D/P, CE/P, and M*P/P). Moreover, based on the Sharpe ratio all the value portfolios outperformed the stock market portfolio except for those combinations where dividend is added.

On the basis of SKARS, almost each combination is significant at the level 5% for the first top-two portfolios. However, the top three combinations (S/P, CE/P), (EBITDA/P.S/P, CE/P), and (CE/P, S/EV) are significant for the top-two portfolios and bottom-two portfolios at the level 1%. Based on SKARS those combinations where dividend is added are considered as the worst combinations since they are not significant even at the level 10%. Those combinations where dividend is added did not show desirable result in any of the performance metrics. Therefore, it can be strongly suggested that dividend cannot add value to composite value measure.

Table 6 performance comparison of 10-decile composite value measure during the full sample period (1986-2011)

	Number	Input	Output	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average	value premium P1-P10
	Annual Return %	**P**	**S**	19,80 %	16,85 %	11,78 %	10,74 %	11,24 %	9,51 %	7,95 %	6,69 %	3,51 %	-0,90 %	9,72 %	**20,70 %**
	Annual volatility %		**CE**	19,66 %	18,76 %	19,15 %	17,00 %	16,76 %	15,78 %	14,79 %	15,20 %	16,53 %	22,48 %	17,61 %	**-2,82 %**
1	Sharp ratio			0,267	0,241	0,169	0,174	0,184	0,167	0,150	0,123	0,060	0,000		
	SKASR			0,203	0,174	0,127	0,130	0,139	0,118	0,109	0,085	0,043	0,000		
	SKASR(sig)			0,000	0,000	0,358	0,235	0,119	0,642	0,998	0,284	0,001	0,000		
	Annual Return %	P	EBITDA	19,43 %	14,11 %	9,57 %	10,62 %	9,53 %	7,90 %	7,22 %	7,11 %	4,96 %	5,17 %	9,56 %	14,27 %
	Annual volatility %		S	18,93 %	16,91 %	15,53 %	14,90 %	14,68 %	14,91 %	15,64 %	17,29 %	20,88 %	28,75 %	17,84 %	-9,81 %
2	Sharp ratio			0,273	0,227	0,171	0,196	0,180	0,148	0,129	0,115	0,067	0,051		
	SKASR			0,209	0,164	0,122	0,144	0,124	0,099	0,088	0,082	0,052	0,047		
	SKASR(sig)			0,000	0,009	0,542	0,098	0,515	0,573	0,243	0,090	0,011	0,057		
	Annual Return %	P	BV	18,60 %	16,17 %	12,79 %	10,09 %	10,60 %	9,32 %	8,79 %	5,17 %	4,08 %	1,63 %	9,72 %	16,97 %
	Annual volatility %		CE	18,87 %	19,33 %	17,81 %	17,38 %	15,98 %	14,82 %	15,70 %	15,50 %	17,73 %	22,44 %	17,56 %	-3,58 %
3	Sharp ratio			0,263	0,225	0,196	0,160	0,183	0,174	0,155	0,094	0,065	0,021		
	SKASR			0,193	0,170	0,146	0,115	0,132	0,133	0,110	0,066	0,049	0,016		
	SKASR(sig)			0,000	0,001	0,043	0,777	0,213	0,237	0,994	0,052	0,001	0,000		
	Annual Return %	P	CE	17,45 %	14,53 %	12,85 %	11,28 %	9,30 %	8,90 %	8,14 %	5,00 %	1,94 %	6,80 %	9,62 %	10,65 %
	Annual volatility %		EPS	18,51 %	17,38 %	17,13 %	15,83 %	15,26 %	14,61 %	14,46 %	16,30 %	19,63 %	27,57 %	17,67 %	-9,05 %
4	Sharp ratio			0,252	0,227	0,205	0,196	0,169	0,169	0,157	0,087	0,028	0,069		
	SKASR			0,186	0,168	0,147	0,137	0,125	0,124	0,108	0,060	0,021	0,062		
	SKASR(sig)			0,000	0,000	0,037	0,125	0,499	0,565	0,932	0,005	0,000	0,078		
	Annual Return %	P	BV	14,88 %	10,90 %	10,60 %	9,08 %	6,90 %	8,64 %	9,60 %	7,15 %	6,30 %	11,12 %	9,52 %	3,77 %
	Annual volatility %		EPS	16,02 %	13,52 %	13,72 %	14,01 %	15,04 %	16,41 %	18,24 %	19,83 %	23,81 %	28,47 %	17,91 %	-12,45 %
5	Sharp ratio			0,251	0,222	0,213	0,180	0,128	0,146	0,146	0,101	0,074	0,107		
	SKASR			0,199	0,163	0,150	0,128	0,085	0,099	0,103	0,073	0,060	0,097		
	SKASR(sig)			0,001	0,062	0,131	0,421	0,221	0,523	0,615	0,040	0,026	0,629		
	Annual Return %	P	EBIT	18,70 %	14,79 %	12,56 %	10,59 %	10,46 %	9,11 %	8,07 %	6,15 %	3,24 %	2,76 %	9,64 %	15,94 %
	Annual volatility %		CE	18,43 %	17,96 %	17,29 %	16,00 %	15,23 %	14,83 %	14,62 %	16,03 %	19,30 %	27,36 %	17,70 %	-8,93 %
6	Sharp ratio			0,270	0,223	0,198	0,182	0,189	0,170	0,154	0,108	0,048	0,029		
	SKASR			0,204	0,163	0,139	0,135	0,142	0,123	0,107	0,072	0,036	0,025		
	SKASR(sig)			0,000	0,002	0,107	0,160	0,112	0,555	0,892	0,053	0,000	0,003		

	Annual Return %	P	EBITDA	19,03 %	14,97 %	12,15 %	11,76 %	9,98 %	9,69 %	8,29 %	6,57 %	3,20 %	0,99 %	9,66 %	18,04 %
	Annual volatility %		CE	18,76 %	18,05 %	18,39 %	16,42 %	15,85 %	14,70 %	14,76 %	15,52 %	17,77 %	26,37 %	17,66 %	-7,61 %
7	Sharp ratio			0,270	0,224	0,181	0,196	0,174	0,182	0,156	0,119	0,051	0,011		
	SKASR			0,200	0,168	0,126	0,142	0,131	0,133	0,108	0,081	0,037	0,009		
	SKASR(sig)			0,000	0,001	0,340	0,064	0,242	0,251	0,926	0,118	0,001	0,001		
	Annual Return %	**P**	**S**	19,86 %	14,76 %	11,94 %	12,67 %	10,12 %	8,56 %	7,49 %	6,29 %	4,31 %	1,34 %	9,73 %	18,53 %
	Annual volatility %	**EV**	**CE**	19,77 %	18,60 %	19,67 %	18,15 %	17,30 %	15,09 %	15,04 %	14,97 %	15,38 %	21,16 %	17,51 %	-1,39 %
8	Sharp ratio			0,267	0,215	0,166	0,191	0,161	0,158	0,139	0,118	0,079	0,018		
	SKASR			0,204	0,158	0,124	0,147	0,114	0,112	0,101	0,085	0,056	0,014		
	SKASR(sig)			0,000	0,009	0,434	0,039	0,799	0,916	0,626	0,189	0,008	0,000		
	Annual Return %	P	CE	17,75 %	13,78 %	12,78 %	10,01 %	11,04 %	7,73 %	7,75 %	4,62 %	3,29 %	7,68 %	9,64 %	10,06 %
	Annual volatility %		EPS	18,41 %	17,75 %	17,10 %	16,21 %	15,74 %	14,41 %	14,91 %	15,34 %	19,08 %	26,91 %	17,59 %	-8,49 %
9	Sharp ratio		M*P	0,258	0,211	0,204	0,171	0,193	0,150	0,145	0,085	0,049	0,080		
	SKASR			0,188	0,159	0,149	0,117	0,146	0,111	0,100	0,059	0,036	0,070		
	SKASR(sig)			0,000	0,006	0,025	0,674	0,078	0,962	0,675	0,015	0,000	0,144		
	Annual Return %	**P**	**EBITDA**	19,57 %	15,98 %	12,38 %	11,57 %	9,07 %	10,78 %	8,22 %	5,95 %	2,92 %	0,40 %	9,68 %	**19,17 %**
	Annual volatility %		**S**	19,10 %	18,83 %	17,47 %	16,52 %	15,14 %	15,46 %	14,55 %	15,22 %	18,14 %	26,12 %	17,65 %	**-7,03 %**
10	Sharp ratio		**CE**	0,272	0,229	0,194	0,192	0,166	0,192	0,157	0,110	0,046	0,004		
	SKASR			0,202	0,170	0,142	0,139	0,124	0,145	0,106	0,075	0,034	0,004		
	SKASR(sig)			0,000	0,001	0,055	0,089	0,434	0,049	0,850	0,091	0,000	0,000		
	Annual Return %	P	S	19,00 %	17,96 %	11,03 %	10,68 %	10,79 %	9,69 %	6,74 %	5,66 %	4,63 %	1,40 %	9,76 %	17,60 %
	Annual volatility %		CE	19,51 %	19,05 %	18,74 %	17,25 %	17,33 %	16,22 %	14,62 %	15,07 %	15,92 %	20,75 %	17,45 %	-1,24 %
11	Sharp ratio		MP	0,259	0,252	0,162	0,170	0,171	0,165	0,129	0,106	0,082	0,019		
	SKASR			0,193	0,184	0,120	0,130	0,126	0,120	0,092	0,076	0,057	0,015		
	SKASR(sig)			0,000	0,000	0,544	0,215	0,346	0,557	0,392	0,063	0,006	0,000		
	Annual Return %	P	CE	18,47 %	15,64 %	11,92 %	10,33 %	10,62 %	10,67 %	5,92 %	5,97 %	2,23 %	4,18 %	9,60 %	14,29 %
	Annual volatility %		EPS	18,69 %	17,99 %	17,22 %	14,80 %	15,77 %	15,07 %	14,80 %	16,29 %	19,53 %	27,66 %	17,78 %	-8,97 %
12	Sharp ratio		S	0,264	0,235	0,190	0,193	0,186	0,195	0,113	0,103	0,033	0,043		
	SKASR			0,198	0,172	0,139	0,140	0,128	0,143	0,082	0,068	0,024	0,038		
	SKASR(sig)			0,000	0,001	0,113	0,168	0,407	0,129	0,215	0,046	0,000	0,015		
	Annual Return %	P	BV	18,20 %	17,08 %	12,51 %	9,77 %	10,11 %	9,49 %	6,89 %	5,80 %	4,04 %	3,85 %	9,77 %	14,36 %
	Annual volatility %		CE	18,83 %	19,15 %	18,63 %	17,12 %	16,43 %	15,31 %	15,55 %	16,35 %	16,89 %	20,31 %	17,46 %	-1,48 %
13	Sharp ratio		M*P	0,258	0,239	0,184	0,158	0,170	0,172	0,124	0,100	0,068	0,054		
	SKASR			0,189	0,178	0,134	0,114	0,124	0,133	0,090	0,070	0,049	0,041		
	SKASR(sig)			0,000	0,000	0,194	0,796	0,417	0,220	0,264	0,022	0,003	0,004		

	Annual Return %	EV	EBITDA	14,91 %	13,40 %	12,05 %	11,21 %	7,50 %	7,28 %	8,12 %	8,18 %	5,01 %	7,91 %	9,56 %	6,99 %
	Annual volatility %		EBIT	18,32 %	17,22 %	15,82 %	15,01 %	14,76 %	14,69 %	15,12 %	16,86 %	20,57 %	28,61 %	17,70 %	-10,28 %
14	Sharp ratio		S	0,220	0,212	0,209	0,205	0,142	0,138	0,150	0,135	0,069	0,077		
	SKASR			0,167	0,153	0,151	0,146	0,100	0,096	0,102	0,091	0,053	0,070		
	SKASR(sig)			0,006	0,016	0,036	0,053	0,588	0,507	0,660	0,314	0,005	0,201		
	Annual Return %	P	CE	19,03 %	15,46 %	12,64 %	11,48 %	11,74 %	9,03 %	7,42 %	4,91 %	3,82 %	1,69 %	9,72 %	17,35 %
	Annual volatility %	EV	S	19,40 %	19,11 %	18,56 %	17,97 %	17,28 %	15,52 %	14,96 %	14,45 %	16,02 %	21,88 %	17,52 %	-2,48 %
15	Sharp ratio		M*EV	0,261	0,218	0,186	0,175	0,186	0,161	0,139	0,096	0,068	0,022		
	SKASR			0,196	0,163	0,141	0,130	0,138	0,117	0,097	0,067	0,048	0,017		
	SKASR(sig)			0,000	0,007	0,075	0,218	0,088	0,657	0,529	0,053	0,001	0,000		
	Annual Return %	P	EPS	15,20 %	13,19 %	11,98 %	9,50 %	8,25 %	7,53 %	6,79 %	6,40 %	6,06 %	11,33 %	9,62 %	3,87 %
	Annual volatility %	EV	S	18,89 %	16,61 %	15,73 %	15,15 %	15,27 %	14,62 %	15,55 %	16,84 %	20,75 %	27,58 %	17,70 %	-8,69 %
16	Sharp ratio		M*EV	0,218	0,217	0,209	0,173	0,150	0,144	0,122	0,107	0,082	0,113		
	SKASR			0,166	0,166	0,141	0,124	0,105	0,101	0,084	0,077	0,062	0,100		
	SKASR(sig)			0,008	0,006	0,144	0,521	0,772	0,615	0,135	0,048	0,013	0,700		
	Annual Return %	P	CE	18,25 %	14,22 %	13,39 %	11,10 %	9,79 %	10,01 %	6,79 %	4,22 %	3,63 %	5,03 %	9,64 %	13,22 %
	Annual volatility %	EV	EPS	18,74 %	18,11 %	18,12 %	15,13 %	15,28 %	15,18 %	14,48 %	15,92 %	18,72 %	27,28 %	17,70 %	-8,55 %
17	Sharp ratio		S	0,260	0,213	0,201	0,202	0,177	0,182	0,131	0,075	0,055	0,052		
	SKASR			0,199	0,154	0,151	0,147	0,117	0,133	0,096	0,051	0,040	0,046		
	SKASR(sig)			0,000	0,010	0,026	0,061	0,703	0,319	0,504	0,006	0,000	0,024		
	Annual Return %	P	D	9,20 %	9,34 %	9,52 %	10,49 %	10,32 %	10,52 %	9,82 %	8,17 %	6,69 %	10,65 %	9,47 %	-1,45 %
	Annual volatility %	EV	EBITDA	17,07 %	16,51 %	17,68 %	17,98 %	18,16 %	16,21 %	16,06 %	17,79 %	20,52 %	24,23 %	18,22 %	-7,16 %
18	Sharp ratio		EBIT	0,149	0,157	0,149	0,161	0,157	0,179	0,169	0,128	0,091	0,121		
	SKASR			0,110	0,108	0,104	0,115	0,112	0,121	0,124	0,097	0,077	0,102		
	SKASR(sig)			0,962	0,896	0,768	0,843	0,952	0,612	0,552	0,561	0,246	0,801		
	Annual Return %	P	D	10,55 %	12,58 %	12,27 %	10,62 %	10,52 %	10,11 %	7,72 %	8,81 %	6,08 %	6,80 %	9,61 %	3,76 %
	Annual volatility %		CE	18,50 %	18,29 %	18,60 %	18,16 %	18,15 %	15,94 %	15,08 %	16,96 %	18,33 %	20,08 %	17,81 %	-1,58 %
19	Sharp ratio		M*P	0,157	0,188	0,180	0,161	0,160	0,175	0,143	0,144	0,093	0,095		
	SKASR			0,114	0,136	0,129	0,120	0,119	0,119	0,104	0,108	0,071	0,078		
	SKASR(sig)			0,838	0,162	0,345	0,602	0,683	0,615	0,784	0,928	0,108	0,263		
	Annual Return %	P	BV	10,15 %	10,15 %	9,07 %	9,63 %	10,54 %	8,51 %	7,68 %	9,39 %	8,74 %	10,78 %	9,47 %	-0,63 %
	Annual volatility %		D	17,19 %	16,54 %	17,73 %	17,47 %	18,28 %	16,47 %	17,01 %	17,85 %	19,91 %	22,92 %	18,14 %	-5,73 %
20	Sharp ratio		M*P	0,163	0,170	0,142	0,153	0,159	0,144	0,126	0,146	0,122	0,130		
	SKASR			0,118	0,117	0,099	0,109	0,113	0,103	0,095	0,116	0,095	0,106		
	SKASR(sig)			0,779	0,799	0,638	0,946	0,883	0,677	0,471	0,815	0,584	0,891		

	Annual Return %	Market portfolio	9,87 %
	Annual volatility %		16,49 %
21	Sharp ratio		0,165
	SKASR		0,110
	SKASR(sig)		0,000

5.3 TOPSIS

The results for TOPSIS (Table 6) are consistent with the value premium hypothesis almost in each combination. This is true at least for the top-two portfolios for all combinations except combination number 19 (D/P, CE/P, M*P/P). The discrepancies stems from the fact that in combination number 19 both the Sharpe ratio and return for P1 is smaller than P2.

Examining the annual return defines the highest value premium, which is more than 20% for combination number 1 (S/P, CE/P) this result is in line with, the composite value measure technique which is strongly significant based on SKASR for the top-two portfolios and bottom-two portfolios. This result shows a significant difference not only compared to their bottom portfolio but also compared to the average market return, which is equal to 9.87%. Therefore, during sample period the investor would have benefited from employing the value strategy based on this combination. Also according to risk- adjusted performance this combination outperforms better than individual valuation multiple.

The second and third best combinations based on value premium are number 11 (S/P.CE/P, M*P/P) and 10 (EBITDA/P, S/P, CE/P) with value premiums of 16.60%, and 16%, respectively. One common thing in all three top combinations is the contribution of S/P and CE/P ratios.

Analyzing the volatility shows that the volatility for bottom portfolio is higher than top portfolios. This can be explained by negative relationship between return and volatility. Haugen & James, (1972) documented the lack of a positive relationship between risk and return. Recently, Haugen & Baker,(2012) claim that High risk stocks only outperform low-risk stocks for very brief periods of time on a rolling three-year basis. One of such brief periods was during the IT bubble. Also Ang et al. (2006) find that U.S. stocks with high volatility have abnormally low returns. After controlling for size and value, Ang, et al. (2009) find stocks with past high idiosyncratic volatility have low future returns over 23 developed markets.

Table 7 performance comparison of 10-decil TOPSIS method, during the full sample period (1986-2011)

Number		Input	Output	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average	value premium P1-P10
	Annual Return %	**P**	**S**	**20,50 %**	15,20 %	13,00 %	10,80 %	10,30 %	10,00 %	6,90 %	5,70 %	5,20 %	-0,30 %	9,70 %	**20,80 %**
	Annual volatility %		**CE**	19,90 %	18,90 %	18,00 %	17,20 %	15,60 %	15,50 %	15,10 %	15,30 %	18,30 %	23,30 %	17,70 %	**-3,40 %**
1	Sharp ratio			0,274	0,217	0,197	0,172	0,183	0,178	0,127	0,105	0,08	0		
	SKASR			0,205	0,167	0,149	0,131	0,134	0,125	0,088	0,073	0,055	0		
	SKASR(sig)			0,000	0,004	0,038	0,238	0,184	0,41	0,246	0,084	0,004	0,000		
	Annual Return %	P	EBITDA	20,10 %	11,50 %	10,70 %	9,90 %	9,00 %	8,80 %	8,00 %	5,80 %	4,90 %	6,80 %	9,50 %	13,30 %
	Annual volatility %		S	18,70 %	16,00 %	14,90 %	14,90 %	14,40 %	14,90 %	16,10 %	18,20 %	21,60 %	28,80 %	17,80 %	-10,10 %
2	Sharp ratio			0,285	0,197	0,198	0,183	0,173	0,165	0,138	0,09	0,065	0,066		
	SKASR			0,214	0,144	0,14	0,127	0,123	0,114	0,092	0,065	0,052	0,061		
	SKASR(sig)			0,000	0,096	0,179	0,434	0,541	0,855	0,348	0,008	0,01	0,122		
	Annual Return %	P	BV	18,00 %	15,40 %	12,20 %	9,00 %	10,70 %	8,60 %	8,50 %	6,30 %	4,40 %	4,20 %	9,70 %	13,80 %
	Annual volatility %		CE	18,90 %	17,60 %	16,10 %	15,60 %	15,80 %	15,90 %	16,50 %	18,00 %	19,90 %	22,10 %	17,60 %	-3,20 %
3	Sharp ratio			0,255	0,236	0,207	0,16	0,186	0,15	0,143	0,098	0,063	0,053		
	SKASR			0,189	0,179	0,157	0,112	0,135	0,107	0,101	0,069	0,048	0,042		
	SKASR(sig)			0,001	0,003	0,023	0,905	0,139	0,883	0,612	0,027	0,001	0,01		
	Annual Return %	P	CE	17,40 %	13,10 %	11,10 %	9,10 %	8,40 %	8,20 %	6,80 %	5,30 %	5,40 %	10,90 %	9,60 %	6,50 %
	Annual volatility %		EPS	17,60 %	14,80 %	14,00 %	13,90 %	14,60 %	15,60 %	17,00 %	19,40 %	22,90 %	27,50 %	17,70 %	-9,90 %
4	Sharp ratio			0,265	0,241	0,218	0,181	0,161	0,146	0,112	0,078	0,067	0,109		
	SKASR			0,196	0,175	0,157	0,129	0,114	0,097	0,076	0,059	0,054	0,098		
	SKASR(sig)			0,000	0,001	0,042	0,384	0,851	0,53	0,078	0,003	0,011	0,647		
	Annual Return %	P	BV	14,60 %	12,90 %	8,70 %	8,50 %	8,20 %	8,30 %	9,70 %	6,10 %	7,30 %	11,10 %	9,50 %	3,50 %
	Annual volatility %		EPS	16,10 %	13,60 %	13,80 %	13,60 %	15,40 %	16,50 %	17,90 %	19,90 %	23,70 %	28,20 %	17,90 %	-12,10 %
5	Sharp ratio			0,246	0,258	0,175	0,174	0,147	0,14	0,15	0,086	0,087	0,108		
	SKASR			0,192	0,194	0,127	0,118	0,099	0,094	0,109	0,063	0,068	0,097		
	SKASR(sig)			0,002	0,002	0,529	0,776	0,515	0,352	0,904	0,011	0,044	0,634		

	Annual Return %	P	EBIT	16,70 %	13,00 %	9,80 %	10,60 %	10,40 %	8,40 %	7,90 %	5,80 %	5,20 %	7,70 %	9,60 %	9,00 %
	Annual Volatility %		CE	17,10 %	14,90 %	14,60 %	14,60 %	14,40 %	15,60 %	16,90 %	18,90 %	22,90 %	28,10 %	17,80 %	-11,00 %
6	Sharp ratio			0,262	0,239	0,186	0,2	0,199	0,151	0,131	0,087	0,064	0,077		
	SKASR			0,186	0,185	0,133	0,141	0,136	0,101	0,091	0,064	0,052	0,07		
	SKASR(sig)			0,002	0	0,318	0,099	0,24	0,627	0,271	0,008	0,012	0,172		
	Annual Return %	P	EBITDA	18,00 %	13,40 %	10,30 %	10,20 %	9,80 %	11,20 %	7,60 %	5,90 %	3,40 %	5,90 %	9,60 %	12,10 %
	Annual Volatility %		CE	18,00 %	16,60 %	15,00 %	14,80 %	14,70 %	15,10 %	15,50 %	17,80 %	22,10 %	28,20 %	17,80 %	-10,20 %
7	Sharp ratio			0,267	0,219	0,189	0,19	0,185	0,203	0,137	0,092	0,044	0,059		
	SKASR			0,197	0,156	0,134	0,142	0,123	0,143	0,093	0,066	0,034	0,056		
	SKASR(sig)			0	0,017	0,226	0,125	0,543	0,087	0,387	0,009	0	0,085		
	Annual Return %	P	CE	18,20 %	15,20 %	12,20 %	12,20 %	10,40 %	7,60 %	6,00 %	6,40 %	4,80 %	4,10 %	9,60 %	14,10 %
	Annual Volatility %	EV	S	19,90 %	19,80 %	18,30 %	17,40 %	15,70 %	15,90 %	14,10 %	15,50 %	16,70 %	22,70 %	17,80 %	-2,80 %
8	Sharp ratio			0,245	0,207	0,182	0,192	0,183	0,134	0,12	0,116	0,081	0,051		
	SKASR			0,191	0,156	0,136	0,142	0,134	0,094	0,089	0,081	0,055	0,041		
	SKASR(sig)			0,000	0,018	0,099	0,049	0,228	0,362	0,284	0,121	0,005	0,014		
	Annual Return %	P	CE	16,40 %	13,20 %	10,00 %	9,90 %	8,40 %	7,90 %	7,90 %	4,70 %	5,90 %	11,40 %	9,60 %	5,00 %
	Annual Volatility %		EPS	17,60 %	14,90 %	14,40 %	13,90 %	14,20 %	15,70 %	17,00 %	19,20 %	22,50 %	27,60 %	17,70 %	-10,00 %
9	Sharp ratio		M*P	0,25	0,242	0,191	0,196	0,165	0,14	0,13	0,069	0,073	0,114		
	SKASR			0,186	0,173	0,137	0,14	0,116	0,094	0,09	0,052	0,058	0,101		
	SKASR(sig)			0,000	0,003	0,251	0,178	0,791	0,411	0,202	0,001	0,017	0,748		
	Annual Return %	**P**	**EBITDA**	**20,50 %**	11,90 %	11,50 %	9,80 %	9,70 %	9,50 %	8,60 %	7,10 %	2,30 %	4,50 %	9,60 %	**16,00 %**
	Annual Volatility %		**S**	19,30 %	16,30 %	15,50 %	15,00 %	14,80 %	14,60 %	15,60 %	17,30 %	20,80 %	28,60 %	17,80 %	**-9,30 %**
10	Sharp ratio		**CE**	0,281	0,201	0,204	0,181	0,181	0,181	0,153	0,115	0,031	0,044		
	SKASR			0,205	0,15	0,142	0,131	0,13	0,128	0,096	0,082	0,024	0,042		
	SKASR(sig)			0,000	0,076	0,09	0,305	0,31	0,366	0,48	0,063	0	0,034		
	Annual Return %	**P**	**S**	**20,30 %**	15,40 %	11,70 %	11,20 %	9,70 %	8,40 %	7,70 %	4,60 %	5,10 %	3,70 %	9,80 %	**16,60 %**
	Annual Volatility %		**CE**	19,90 %	19,20 %	18,10 %	17,70 %	16,70 %	15,20 %	15,90 %	15,00 %	15,90 %	21,40 %	17,50 %	**-1,50 %**
11	Sharp ratio		**MP**	0,27	0,216	0,177	0,173	0,161	0,153	0,135	0,086	0,09	0,049		
	SKASR			0,197	0,17	0,133	0,132	0,123	0,107	0,092	0,061	0,062	0,038		
	SKASR(sig)			0,000	0,002	0,176	0,175	0,446	0,867	0,311	0,005	0,02	0,006		

	Annual Return %	P	CE	18,00 %	14,70 %	10,60 %	9,10 %	9,10 %	8,50 %	5,40 %	6,20 %	4,20 %	10,00 %	9,60 %	8,00 %
	Annual Volatility %		EPS	18,40 %	15,60 %	14,30 %	14,20 %	13,80 %	15,40 %	16,10 %	18,60 %	23,40 %	28,00 %	17,80 %	-9,60 %
12	Sharp ratio		S	0,262	0,255	0,205	0,178	0,182	0,154	0,094	0,094	0,051	0,099		
	SKASR			0,199	0,185	0,146	0,126	0,127	0,101	0,065	0,068	0,04	0,09		
	SKASR(sig)			0,000	0,001	0,092	0,473	0,413	0,666	0,016	0,015	0,002	0,479		
	Annual Return %	P	BV	18,00 %	16,20 %	11,60 %	9,10 %	8,90 %	8,40 %	8,20 %	6,00 %	5,80 %	5,40 %	9,80 %	12,60 %
	Annual Volatility %		CE	19,10 %	18,10 %	15,90 %	16,00 %	16,90 %	16,10 %	17,20 %	17,80 %	18,40 %	20,30 %	17,60 %	-1,20 %
13	Sharp ratio		M*P	0,253	0,241	0,199	0,158	0,146	0,144	0,133	0,095	0,088	0,075		
	SKASR			0,188	0,183	0,151	0,114	0,108	0,098	0,094	0,07	0,064	0,059		
	SKASR(sig)			0,000	0,001	0,037	0,839	0,879	0,505	0,37	0,026	0,021	0,028		
	Annual Return %	EV	EBITDA	15,20 %	12,50 %	12,10 %	11,40 %	9,20 %	6,80 %	7,50 %	7,40 %	5,90 %	7,60 %	9,60 %	7,60 %
	Annual Volatility %		EBIT	18,40 %	16,80 %	15,80 %	14,60 %	14,40 %	15,10 %	15,60 %	17,10 %	21,10 %	28,50 %	17,70 %	-10,10 %
14	Sharp ratio		S	0,223	0,203	0,209	0,215	0,177	0,126	0,134	0,121	0,079	0,075		
	SKASR			0,168	0,149	0,157	0,154	0,127	0,086	0,088	0,082	0,062	0,069		
	SKASR(sig)			0,004	0,036	0,016	0,029	0,432	0,258	0,278	0,139	0,024	0,185		
	Annual Return %	P	CE	17,80 %	15,00 %	13,00 %	10,70 %	9,80 %	7,70 %	7,20 %	5,80 %	4,30 %	6,30 %	9,80 %	11,50 %
	Annual Volatility %	EV	S	20,00 %	20,00 %	18,30 %	17,50 %	16,50 %	15,40 %	15,70 %	14,90 %	15,70 %	21,80 %	17,60 %	-1,80 %
15	Sharp ratio		M*EV	0,238	0,203	0,193	0,169	0,164	0,14	0,128	0,11	0,077	0,081		
	SKASR			0,184	0,153	0,145	0,126	0,118	0,093	0,093	0,078	0,057	0,064		
	SKASR(sig)			0,001	0,024	0,046	0,329	0,654	0,363	0,361	0,073	0,014	0,095		
	Annual Return %	P	EPS	15,40 %	14,40 %	11,60 %	10,70 %	8,40 %	7,60 %	6,60 %	6,00 %	4,10 %	11,00 %	9,60 %	4,40 %
	Annual Volatility %	EV	S	18,50 %	16,40 %	14,90 %	14,70 %	14,20 %	15,00 %	16,30 %	17,70 %	22,10 %	27,80 %	17,80 %	-9,30 %
16	Sharp ratio		M*EV	0,225	0,238	0,213	0,2	0,165	0,142	0,113	0,095	0,053	0,109		
	SKASR			0,177	0,177	0,154	0,137	0,117	0,095	0,078	0,069	0,041	0,098		
	SKASR(sig)			0,002	0,001	0,062	0,207	0,796	0,436	0,072	0,014	0,001	0,671		
	Annual Return %	P	CE	16,30 %	15,80 %	12,30 %	11,40 %	9,50 %	6,80 %	6,30 %	4,00 %	3,70 %	9,80 %	9,60 %	6,50 %
	Annual Volatility %	EV	EPS	18,50 %	17,20 %	15,00 %	14,50 %	13,80 %	15,30 %	15,90 %	17,50 %	22,10 %	27,60 %	17,70 %	-9,10 %
17	Sharp ratio		S	0,237	0,248	0,225	0,216	0,191	0,124	0,111	0,065	0,048	0,098		
	SKASR			0,184	0,186	0,163	0,151	0,137	0,082	0,075	0,046	0,037	0,088		
	SKASR(sig)			0,000	0,000	0,008	0,039	0,219	0,224	0,08	0	0,001	0,449		

	Annual Return %	P	D	12,20 %	10,30 %	10,10 %	10,10 %	9,60 %	9,70 %	8,20 %	7,80 %	7,00 %	11,40 %	9,60 %	0,80 %
	Annual Volatility %	EV	EBITDA	16,50 %	14,30 %	16,00 %	15,10 %	16,20 %	17,50 %	16,90 %	18,70 %	21,20 %	24,80 %	17,70 %	-8,30 %
18	Sharp ratio		EBIT	0,202	0,199	0,174	0,184	0,164	0,153	0,136	0,116	0,092	0,127		
	SKASR			0,153	0,142	0,12	0,129	0,108	0,105	0,097	0,087	0,077	0,107		
	SKASR(sig)			0,051	0,188	0,645	0,387	0,865	0,692	0,437	0,171	0,147	0,891		
	Annual Return %	P	D	10,30 %	12,10 %	12,50 %	10,10 %	10,10 %	7,70 %	7,90 %	9,10 %	8,90 %	8,40 %	9,70 %	1,90 %
	Annual Volatility %		CE	16,40 %	15,60 %	16,70 %	15,80 %	16,30 %	17,70 %	17,40 %	18,10 %	19,00 %	20,40 %	17,30 %	-4,00 %
19	Sharp ratio		M*P	0,173	0,212	0,204	0,177	0,172	0,122	0,127	0,138	0,13	0,115		
	SKASR			0,128	0,151	0,147	0,126	0,122	0,084	0,095	0,105	0,099	0,091		
	SKASR(sig)			0,371	0,03	0,045	0,359	0,517	0,092	0,316	0,753	0,529	0,429		
	Annual Return %	P	BV	10,60 %	10,50 %	10,00 %	9,30 %	9,40 %	7,80 %	9,10 %	9,70 %	10,20 %	10,30 %	9,70 %	0,30 %
	Annual Volatility %		D	16,00 %	14,40 %	16,10 %	15,10 %	16,20 %	18,30 %	18,30 %	19,40 %	19,80 %	22,10 %	17,60 %	-6,10 %
20	Sharp ratio		M*P	0,183	0,201	0,172	0,17	0,161	0,119	0,138	0,138	0,142	0,128		
	SKASR			0,135	0,139	0,119	0,12	0,114	0,083	0,105	0,105	0,112	0,102		
	SKASR(sig)			0,29	0,2	0,679	0,684	0,851	0,109	0,719	0,724	0,978	0,73		
	Annual Return %	Market portfolio		9,87 %											
	Annual Volatility %			16,40 %											
21	Sharp ratio			0,167											
	SKASR			0,111											
	SKASR(sig)			0,002											

6 Conclusion

The aim of this research is to examine the pricing anomalies existing in the US market during 1986 to 2011. The sample of stocks is divided into decile portfolios, based on seven individual valuation ratios (E/P, B/P, S/P, EBIT/EV, EVITDA/EV, D/P, and CE/P) and price momentum to investigate the efficiency of individual valuation ratios and their combinations as portfolio formation criteria. This is the first time in financial literature when CE/P is employed as a constituent of composite value measure. The combinations are based on median scaled composite value measures and TOPSIS method. During the sample period, value portfolios significantly outperform both the market portfolio and comparable glamour portfolios.

The sample is gathered form DATASTREAM. The total number of companies included in this research is 3591. Data were ranked from high to low. Top portfolios were classified as undervalued stock (value stock), in contrast to bottom portfolios which were classified as overvalued stocks (glamour stock). The sample was divided into decile portfolios based on seven valuation ratios and 6-month momentum. To analyze the performance of equity portfolios, monthly returns for decile portfolios are formed on 20th day of May every year. The analysis shows the results for 20 different portfolio combinations which were evaluated based on annual returns, annual volatility, Sharpe ratio, and SKASR.

Overall, the results support that there is a value premium in the US market, and value portfolios outperform not only glamour portfolios but also outperform market portfolio. It was also shown that the value premium in the US Market is not explained by greater risk of value portfolios since the volatility for top-portfolios is lower than for bottom-portfolio. Moreover, consistent with the results of Dhatt et al. (1999), the results of this research support that the performance of value strategies based on individual valuation multiples could be enhanced by using the composite selection criteria.

During the sample period, S/P and CE/P ratios turned out to be the best among individual valuation multiples. Based on the results, combining these ratios add value into portfolio performance. This finding is interesting since this is the first time that CE/P used as a selection criterion for value portfolio. The results which shows superiority of S/P ratio is in line

with Barbee et al. (1996) and Dhatt et al. (2004) study in the U.S. stock return, and Bird and Casavecchia (2007a, 2007b) study in the European markets

Based on composite value measures the top three combinations are (S/P, CE/P), (EBITDA/P, S/P, CE/P), and (S/EV, CE/P); and based on TOPSIS ranking the top three combinations are (S/P, CE/P), (EBITDA/P, S/P, CE/P), and (S/P, CE/P, M*P/P). This is an interesting result since EBITDA and price momentum did not show their significance as a single selection criterion. Previously, Leivo et al. (2009) showed EBITDA/EV as the top-quintile portfolios among four individual valuation ratios in Finnish stock market while in this research EBITDA/P showed its significance in combined value measure. Moreover, similar to previous study (Leivo & Pätäri 2011) momentum showed it's significant. However, this time momentum did not show significant based on composite value measure but the significant was found just based on TOPSIS method.

In this research CE/P provided the most interesting result in both individual valuation ratios and combined value measure. It can be conclude that based on our hypothesis this ratio can explain stock market return. Because, High amount of cash increase the safeness of a company, it provides flexibility in a company and decreases the probability of bankruptcy or gaining the control of the firm by debtor. Also firms with high cash positions can distribute the excess cash as dividend to shareholders or repurchase shares on the open market which increased the share price in short term. Firms with excess cash return can increase their product lines or diversify into new parts. These firms also have opportunity for acquisitions.

Additionally, in contrast to European studies (Fama & French, 1998, Kyriazis & Diacogiannis 2007, and Leivo & Pätäri, 2009) which show the significance of D/P ratio as individual valuation criterion for portfolio formation, this research documented inferiority of the D/P ratio in comparison with individual valuation ratios. This result is in line with most international studies and the differences may be explained by differences in tax treatment of dividend and capital gains.

6.1 Implications

The results of this research increase the understanding on the suitability of different methodologies for portfolio selection. It helps managers to take advantage of the results of different methodologies in order to gain returns above the market. Moreover, it allows

managers to identify stocks which are likely to be the most profitable for the company or individual

The existing literature is relatively silent on the use of these methodologies to separate good stocks from bad stocks. One of the main strengths of these methodologies is that they allow managers to consider multiple inputs and outputs. These methods were examined in the US stock market, which has a great sample of data that can provide comprehensive results.

6.2 Research limitations & Future research

The first limitation of the thesis is that transaction cost and taxes are not included. Therefore result could benefits those investors that do not pay taxes or those investors who have a low transaction cost.

The second limitation was the original data that was obtained from Datastream. However, Thomson Datastream (TDS) is a powerful database but it is not meant to have the perfect data for the US market. In this research I tried my best in filtering data according to the research that was done by Ince& Porter (2006) to compare Thomson Datastream (TDS) with Center for Research in Security Prices (CRSP). Thus, I cannot say this was a big limitation during the process since one purpose of this thesis is to check whether this data base shows its strength and validity.

The third limitation is related to the methodology that should be considered. In TOPSIS, to compare the relative importance of the alternatives, it is important to assign attribute weights. A frequently used method is that each attribute has the equivalent weight. But if the weights are assigned the same importance, we can barely get scientific weights during the portfolio selection process. To overcome the disadvantages of this method a commonly used method is that the attribute weights are determined by Analytic Hierarchy Process (AHP)[6] (Saaty, 1988) and then the alternatives are ranked by TOPSIS. In this way, the huge computation

[6]Analytic Hierarchy Process (AHP) is a structured technique for organization to optimize decision making based on mathematics and psychology. It was developed by Thomas Saaty is the 1970s. The technique assigned to each criteria through pairwise comparison. To compare the criteria words such as Equal, Moderate, Strong, Very Strong, and Extreme is used. Thus, one of the questions that one may ask when using pairwise comparison is how important is each factor for analyzing portfolio.

required in AHP can be significantly reduced, while the weight in TOPSIS can be effectively settled.

For future research, the same data should be run with different methodologies. Leivo (2012) asserted in his dissertation that combining value and momentum indicators cannot be done by means of any of the methods that previously has been done except DEA. Therefore, it would be valuable to apply the same data with different methodology to understand the differences of the methods. DEA (BCC, Additive model) and AHP methods as MCDM are strongly suggested to compare the results with previous researches. Also, to progress, research using a fresh methodology Stochastic Non-smooth Envelopment of Data (StoNED) which was recently introduced by Kuosmanen and Kortelainen (2012), is suggested.

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Appendix 1

Table 8 Number of participated company each year according 8 criteria (E/P, B/P, S/P, EBIT/EV, EVITDA/EV, D/P, CE/P, and 6month momentum)

year	number of companies
1986	377
1987	439
1988	497
1989	540
1990	528
1991	610
1992	660
1993	717
1994	880
1995	1041
1996	1158
1997	1328
1998	1481
1999	1605
2000	377
2001	439
2002	497
2003	540
2004	528
2005	610
2006	660
2007	717
2008	880
2009	1041
2010	1158
2011	1328