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Portfolio returns based on the Price-To-Earnings ratio

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Abstract

This research aims to investigate if it is possible to outperform the market portfolio with a portfolio based on stocks with low P/E ratios. This research is focused only on U.S. companies that are publicly traded on the stock market. These U.S. companies were divided into 10 equally weighted decile portfolios based on their P/E ratio. The decile portfolios were rebalanced every quarter and observed from the 31st of December 1999 to the 31st of December 2019. The results show that the portfolios with the lowest P/E ratio stocks outperform the market portfolio as well as the portfolios with the highest P/E ratio stocks. Even after adjusting for its risk, the portfolio with the lowest P/E ratio stocks is superior to the other portfolios. Besides, the Fama-French adjusted alpha difference between the lowest and highest P/E ratio portfolio is 11.4%. A possible explanation for the outperformance of low P/E ratio stocks could be that investors suffer from behavioural biases.

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1. Introduction

Every investor who wants to outperform the market must learn the art of stock valuation. Stock valuation is, in essence, a way of evaluating a stock's intrinsic value. The stock's intrinsic value is not the same as its current market price on the stock exchange. By finding out the stock's intrinsic value, investors can determine if the stock is under- or overvalued at its current market price. When a certain stock is undervalued, it may be attractive for the investor to buy this stock and add it to his portfolio. However, stock valuation can be extremely hard and complicated. The complexity comes from the huge amount of available information that can be used for stock valuation. As a result, investors must be able to separate useful information from irrelevant noise. Furthermore, investors should be aware of the most common stock valuation methods as well as the contexts in which they are used.

In general, there are two main types of stock valuation namely absolute and relative stock valuation. Absolute stock valuation is based on the fundamentals of a company. The most common absolute stock valuation methods are the Dividend Discount Model and the Discounted Cash Flow Model.

In relative stock valuation, a company is compared with similar companies. This comparison can be done by comparing financial ratios that are derived from the financial statements of a company. Since there are so many different financial ratios, investors need to make a choice which ratio to use.

Among stock analysts, the Price-to-Earnings (P/E) ratio can be considered the most widely used valuation tool and this ratio plays a crucial role in investment decisions and academic research (Wu, 2014). The P/E ratio is calculated by dividing the company's share price by its earnings per share. One of the advantages of the P/E ratio is that it is easy to calculate and the P/E ratio can be applied to any profit-making company. However, if a company is making a loss, the P/E ratio cannot be used to value a stock price (Damodaran, 2002).

The value of the P/E ratio can tell an investor a lot about the company. Companies with high P/E ratios are considered to be growth stocks. These stocks show a higher growth than other stocks and investors are willing to pay more for this stock. Therefore, these stocks are expensive compared to their current earnings.

Companies with low P/E ratios are considered value stocks. The price of a value stock is low

compared to its earnings. So, these stocks can be seen as undervalued.
If an investor only looks at the P/E ratio of a stock, it would seem wise to only invest in stocks that are relatively cheap compared to their earnings. Hence, only investing in stocks with a low P/E ratio. This paper is going to research an investment strategy based purely on the P/E ratio of stocks. The research question of this paper is as follows:

Is it possible to outperform the market portfolio with a portfolio based on U.S. companies with low P/E ratios?

In this research all publicly traded U.S. companies will be considered and ranked based on their P/E ratios. The research will cover a time period of 20 years; from the 31st of December 1999 till the 31st of December 2019. All U.S. companies that were publicly traded during this time period are going to be divided into 10 equally weighted decile portfolios.
In order to evaluate the decile portfolio returns, the Fama-French adjusted alpha will be calculated.
The alpha of an investment indicates the performance of that investment compared to a benchmark. This means that if the alpha of an investment is 2.0%, the return of this investment is 2.0% higher than the benchmark. The benchmark that is being used in this research is the value weighted average stock return of all U.S. companies.
In order to calculate alpha, the beta of the stocks need to be known. The beta of an investment shows the systematic risk of the portfolio compared to the market as a whole.
Finally, this research will calculate the Sharpe Ratio of each decile portfolio and market portfolio. The Sharpe Ratio is often used by investors to assess the performance of an investment compensated by its risk. In general, the higher the Sharpe ratio, the more appealing the risk-adjusted return.

Over the past decades many researchers have researched the relationship between stock returns and P/E ratios. Nicholson (1960) researched whether the P/E ratio of a company can be related to stock performance. Nicholson compared the P/E ratios of large companies with each other to see if companies with low P/E ratios can receive higher stock returns than companies with high P/E ratios. The results of this study showed that companies with low P/E ratios perform significantly better then companies with high P/E ratios.

A possible reason for the underperformance of high P/E ratio stocks is that investors are not rational when making investment decisions. Lakonishok, Schleifer, and Vishny (1994) show that investors are too focused on past events and suffer from extrapolation bias. This results in a high demand for growth stocks, which makes them overvalued compared to value stocks. Since usually the expected growth rate of growth stocks, based on past events, cannot be maintained in the long-run, these growth stocks will underperform.

Basu (1975) also researched the effect of P/E ratios on stock returns. In his study, he included more than 1,000 firms that were traded on the New York Stock Exchange. He divided all these firms in 5 different portfolios based on their P/E ratios. The results of this study showed that the portfolios with low P/E ratios outperformed the stock analysist predictions. With these results Basu contradicted the efficient market hypothesis. The efficient market hypothesis claims that share prices reflect all information. Hence, it would be impossible to earn any abnormal (or excess) returns using publicly available P/E ratios.

The idea of this research came from the low volatility paper by Blitz and van Vliet (2007). In this paper Blitz and van Vliet showed that stocks with low historical volatility earn higher risk-adjusted returns than the market portfolio. In their research they created equally weighted decile portfolios by ranking the stocks on the past 3-year volatility of weekly returns. These decile portfolios were rebalanced at the end of every month in order to keep the low volatility stocks in the lower decile portfolios. Interestingly, the portfolio with low volatility stocks outperformed in terms of risk-adjusted returns, based on the Sharpe ratio and alpha.
Based on these researches, a hypothesis is formed:

Hypothesis: Portfolios with low P/E ratio U.S. stocks will outperform portfolios with high P/E ratio U.S. stocks.

The remainder of this paper is structured as follows. In Section 2 the relevance of the P/E ratio as a valuation tool will be discussed. Besides, Section 2 will further evaluate the study of Nicholson and Basu about the performance of stocks based on their P/E ratio. Also, Section 2 will provide more evidence of the behavioural biases that are present in the

investment decisions of investors.

Section 3 will explain the research method and describe the data that is being used. Section 4 will present the results of the research. Finally, Section 5 gives the conclusion of this paper in which the research question is answered and the hypothesis is discussed. The conclusion will also present the limitations of this research and recommendations for further research.

2. Theoretical framework

2.1 P/E ratio as a valuation tool

The P/E ratio is a financial ratio used in relative stock valuation. The P/E ratio of a company can be used to compare its stock price to that of other companies or to the market. Many money managers form investment strategies based on the P/E ratio (Wu, 2014).
The P/E ratio is not only useful for investment strategies, stock recommendations can be justified by the P/E ratio as well. Therefore, the P/E ratio is a really popular financial ratio among stock analysts (Wu, 2014).
Bradshaw (2002) shows that in nearly two-thirds of the sample reports, stock analysts use target prices, and higher target prices are associated with favorable stock recommendations. In addition, the favorable stock recommendations are 76% of the time justified by the P/E ratio. The P/E ratio is with a difference of 39%, the highest variable that is being used in stock recommendations by analysts. In Turkey, even the banks and intermediary institutions find the P/E ratio most useful for valuation methodology (Sezgin, 2010). These banks and intermediary institutions use the P/E ratio to compare the potential profitability of different firms and industries.

2.2 Study of Nicholson

Nicholson (1960) wrote a paper about the effect of the P/E ratio on a company's stock performance. In his paper he conducted two different studies.
In the first study, he researched 100 common stocks which included many large companies, but he excluded any utilities, banks, finance or insurance stocks. The percentage of price appreciation of the company' stock was compared in 11 different time periods, all between 1939 and 1959. He observed that the 20 companies with the lowest P/E ratios showed more price appreciation in all 11 time periods than the 20 companies with the highest P/E ratios. Also, the stocks that appreciated in price more than average were almost all stocks with low P/E ratios.
In addition, the individual stocks that did not appreciate in price or even showed a loss were mainly stocks with high P/E ratios.
The low P/E ratio stocks did not only perform well in comparison to the high P/E ratios

stocks, the middle P/E ratio stocks also underperformed compared to the low P/E ratio stocks.

The second study of Nicholson was focused on 29 chemical common stocks, where the percentage of price appreciation was measured, this time between 1937 and 1954. This study consisted of three different time periods: 3-year time periods, 6-year time periods and 10-year time periods.
The companies with a P/E ratio of 10 or less performed 50% better than companies with a P/E ratio of more than 22 during the 3-year time period. This percentage was even higher in the 6-year and 10-year time periods with an outperformance of 69% and 66% respectively. The results of these studies show that the P/E ratio is definitely an important financial ratio to consider when measuring stock performance.

2.3 Basu's test of the efficient market hypothesis

There are more academic papers that provide evidence that companies with low P/E ratios perform better than companies with high P/E ratios. Basu (1975) made a portfolio with low P/E ratio companies to see if the efficient markets hypothesis would hold.
Grossman and Stiglitz (1980) argued that it would not be possible for the market to be completely efficient. Since this would mean that specialists are not motivated to unearth the information that is so swiftly reflected in market prices.
Basu included in his study over 1,400 firms that were traded on the New York Stock Exchange. Basu created 5 different portfolios based on the P/E ratio. The results showed that after 12 months, the portfolio with the lowest P/E ratios earned 3.5% more than analysts would expect this portfolio to earn. The prior expectation of the analysts was based on the level of risk of the portfolio. The portfolios with the highest P/E ratios earned about 1.6% to 2.2% less than their level of risk would imply.

Basu researched the stock returns of different P/E ratios even more in another paper two years later. Basu (1977) looked at the relationship between P/E ratios and the investment performance of common stocks. This study consisted again of 5 different portfolios called A, B, C, D and E. Portfolio A consisted of stocks with the highest P/E ratios and portfolio E consisted of stocks with the lowest P/E ratios. The portfolios were observed for a much

longer time period than in Basu's previous research. The time period during this research was from the 31st of March 1957 to the 31st of March 1971. Every portfolio was purchased on the 1st of April and the stocks were held for a year. After the year ends, the proceeds of disposition were reinvested in the same P/E ratio portfolio. Portfolio D and E, hence the portfolios with the lowest P/E ratios, had on average a stock return of 13.5% and 16.3% respectively per year over the 14-year time period. This return was way higher than the stock return of the portfolios A and B, which received a return of around 9.4% per year. In addition, portfolio D and E also outperformed their expectation based on the level of risk that was involved. Portfolio D and E earned 2.0% and 4.5% respectively more than their level of risk would expect. However, the high P/E ratio portfolios A and B performed around 2.7% less than their risk levels expected. All these differences were statistically significant at the 5% level.

2.4 Behavioural biases in investment decisions

Behavioural biases can influence the investment decisions of individual investors a lot (Odean, 1998 and 1999). Therefore, there might be other reasons why stocks with low P/E ratios outperform stocks with high P/E ratios. Lakonishok, Shleifer, and Vishny (1994) show that value stocks outperformed growth stocks between April 1968 and April 1990. A reason for this was the fact that investors overestimated the growth rates of growth stocks relative to value stocks. Investors are focused too much on past growth rates and think that this will continue in the future, which is in most cases highly unlikely. Therefore, instead of acting rational, individual investors suffer from extrapolation bias. This type of behavioural bias is reoccurring a lot in the stock market. However not only individual investors suffer from extrapolation bias in their investment decisions. Lakonishok, Shleifer, and Vishny (1992) show that institutions also prefer growth stocks over value stocks. The reason for institutions to prefer growth stocks over value stocks is the same as the reason for individual investors. Institutions also base their investment decision on past events. Since growth value stocks have been performing well in the past, it is easier for institutions to justify the purchase of a growth stock.

The result of these behavioural biases is that the demand for growth stocks is way higher than for value stocks. It is for this reason that growth stocks become overvalued and value stocks undervalued. Contrarian investment strategies make use of this behavioural bias in

investors and invest more heavily in stocks that are underpriced. De Bondt and Thaler (1985) show that because of this strategy the contrarian investor outperforms the market. Since growth stocks have high P/E ratios and value stocks low P/E ratios, the extrapolation bias can be a possible reason for the overperformance of low P/E ratio stocks.

3. Data and methodology

3.1 Data source

The data that is being used in this research is retrieved from the Wharton Research Data Services (WRDS) platform. The stock returns of U.S. companies from 31st of December 1999 to the 31st of December 2019 are collected from the Center for Research in Security Prices (CRSP). CRSP is a vendor of historical time series data on securities. In this research Compustat provided all the financial data of the U.S. companies. Compustat is a comprehensive database of fundamental financial and market information on companies. Company financials like the earnings per share are needed in order to calculate the P/E ratio for each company.

All observations that showed a negative P/E ratio within the 20-year time period have been removed from the sample. The reason for this is that the reliability of the P/E ratio with a net loss is limited (R Gottwald, 2012). As a result, not every company has an observation for every quarter within the 20-year time period.

At the end, the final sample consists of 9,320 different U.S. companies and 133,778 different observations. For each observation the corresponding beta has been retrieved from WRDS. The beta of a stock is needed to calculate the Fama-French adjusted alphas.

3.2 Research method

In this research, equally weighted decile portfolios have been made based on the P/E ratio of the companies. These decile portfolios range from 1 (consisting of stocks from companies with the lowest P/E ratios) to 10 (consisting of stocks from companies with the highest P/E ratios). The decile portfolios need to be rebalanced at the end of every quarter, because new companies' earnings are reported every quarter. The rebalancing of the decile portfolios makes sure that the companies with the lowest P/E ratios stay in portfolio 1.

Since the decile portfolios are rebalanced every three months, the returns of the portfolios are based on the past 3 months.

In order to account for inaccuracies in the stock returns, an adjustment factor has been used to adjust for any stock splits during the 20-year time period.

In this research, the performance of the decile portfolios is being compared with each other and to a market portfolio.

The market portfolio is based on the value weighted average return of all U.S. stocks. In order to make a fair comparison, the market portfolio return is also based on the past 3 months.

In order to calculate the excess returns and Sharpe ratios of the portfolios, a risk-free rate of return is needed.

The risk-free rate that is being used in this research is the 3 Month Treasury Bill Rate. The 3 Month Treasury Bill Rate is the return received for investing in a government issued treasury security that has a maturity of 3 months. This 3 Month Treasury Bill Rate is often used as the risk-free rate for U.S. investors.

The excess return of the portfolios is being calculated as follows:

$$Excess\ Return = R_i - R_f. \quad (1)$$

Where Ri is the 3-month return of the portfolio and Rf is the risk-free rate.

The Sharpe ratio is calculated with the following formula:

$$Sharpe\ Ratio = (R_i - R_f) / \sigma_i \quad (2)$$

Where Ri is the 3-month return of the decile portfolio. Rf is the risk-free rate and σ_i is the standard deviation of the decile portfolio.

In order to compare the return of the decile portfolios to the market portfolio, the alpha of the decile portfolios has to be found.

The Fama-French adjusted alphas are calculated with the following equation:

$$R_i = \alpha_i + \beta_i R_M \quad (3)$$

Ri indicates the 3-month return of the decile portfolio. Rm stands for the 3-month return of the market portfolio. The α_i is the Fama-French adjusted alpha and β_i is the beta of the decile portfolio.

The statistical significance of the alphas is obtained from a regression with Newey-West

standard errors. Newey-West standard errors are used to correct for autocorrelation and heteroscedasticity in the error terms of the alphas.

4. Results

Table 1 contains an overview of the main results of this research. Portfolio D1 contains stocks with the lowest P/E ratios and portfolio D10 contains stocks with the highest P/E ratios. The 12th column of Table 1 shows the difference between portfolio D1 and D10. The results of the market portfolio can be found in the 13th column of Table 1.
The excess return of portfolio D1 is 12.9%, which is way higher than any other decile portfolio excess return and the market portfolio excess return. Portfolio D10 is performing the worst based on the excess return, with an excess return of 1.3% over the past 3 months.

Table 1

Main results of the decile portfolios based on their P/E ratios

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D1-10**	**Market**
Excess Return	12.9%	7.9%	5.7%	4.6%	3.3%	3.0%	2.3%	1.7%	1.9%	1.3%	11.6%	1.3%
Standard deviation	40.8%	25.6%	21.2%	19.9%	19.7%	19.3%	22.8%	21.2%	24.3%	25.2%	15.6%	7.9%
Sharpe ratio	0.32	0.31	0.27	0.23	0.17	0.15	0.10	0.08	0.08	0.05		0.17
Beta	0.94	0.93	0.94	0.94	0.95	0.93	0.93	0.94	0.93	0.94	0.00	1.00
Alpha	11.4%	6.8%	4.6%	3.6%	2.4%	2.1%	1.3%	0.7%	0.6%	0.0%	11.4%	
(t-value)	34.4*	33.4*	27.6*	23.2*	15.3*	13.6*	7.5*	4.1*	2.9*	0.2		

**significant at 1% level*

However, the results can be better interpreted with a risk-adjusted performance instead of looking only at the excess return. Therefore, the Sharpe ratios of all portfolios are calculated and shown as a bar chart in Figure 1. Since the standard deviation is very important in Sharpe ratios, portfolio D1 becomes less attractive than before because of its high standard deviation. Despite this high standard deviation, portfolio D1 still outperforms any other decile portfolio and the market portfolio. However, portfolio D2 is performing almost as good as portfolio D1. The Sharpe ratios of portfolio D1 and D2 differ only with 0.01, since their Sharpe ratios are 0.32 and 0.31 respectively. The market portfolio has a Sharpe ratio of 0.17, which outperforms portfolio D6 till D10, but underperforms portfolio D1 till D4. This indicates that the low P/E ratio portfolios have the best risk-adjusted performances and

outperform the high P/E ratio portfolios and market portfolio. Thus, there is a negative relationship between the P/E ratio and its risk-adjusted performance. The Sharpe ratios are decreasing consistently for the consecutive decile portfolios except from portfolio D8 and D9 that have the same Sharpe ratio.

Table 1 also contains the beta and alpha of the portfolios. The betas of the decile portfolios are all between 0.93 and 0.95. This suggests that there is no relationship between the P/E ratio and beta.

Table 2 shows the summary statistics of alpha with Newey-West standard errors. All alphas, except from the alpha of portfolio D10, are statistically different from zero at the 1% significance level. The alpha of portfolio D10 is not statistically different from zero with a t-value of 0.18.

Figure 2 presents a graph of the Fama-French adjusted alphas for each decile portfolio. The figure shows that the alphas are decreasing monotonically for the consecutive decile portfolios, which suggests a negative relationship between the P/E ratio and alpha. All decile portfolios except from portfolio D10 show a positive alpha and outperformed the market portfolio. The best performing portfolio is again portfolio D1 with an alpha of 11.4%. Portfolio D1 is outperforming the other decile portfolio by a huge margin, since the second largest alpha is 6.8% from portfolio D2. The combined alpha spread for the low P/E ratio minus the high P/E ratio portfolio amounts to 11.4%.

Table 2

Summary statistics of alpha with Newey-West standard errors

	Number of obs	Mean	Newey-West Std. Err.	t	P>|t|	99% Confidence Interval	
D1	12,234	.1143424	.0033181	34.46	0.000	.1057943	.1228905
D2	13,682	.0675978	.002023	33.42	0.000	.0623862	.0728093
D3	14,188	.0463588	.0016789	27.61	0.000	.0420336	.0506841
D4	14,271	.0364785	.0015726	23.20	0.000	.0324273	.0405297
D5	14,250	.0235553	.0015387	15.31	0.000	.0195914	.0275192
D6	14,174	.0207792	.0015245	13.63	0.000	.0168517	.0247066
D7	13,851	.0130229	.0017458	7.46	0.000	.0085255	.0175203
D8	13,331	.0070134	.0017253	4.07	0.000	.0025687	.011458

D9	12,582	.0055949	.0019568	2.86	0.004	.0005537	.0106362
D10	11,189	.0004158	.0022771	0.18	0.855	-.0054507	.0062823

5. Conclusion

This research aimed to find out if it is possible to outperform the market portfolio by creating a portfolio based on P/E ratios. The results show that this is possible and the 4 decile portfolios with the lowest P/E ratios outperformed the market portfolio based on the Sharpe ratio. The hypothesis of this research is true and the decile portfolios with low P/E ratios outperformed the decile portfolios with high P/E ratios. Moreover, there is a negative relationship between the P/E ratio and the Sharpe ratio. The Sharpe ratios are decreasing consistently for the consecutive decile portfolios except from portfolio D8 and D9 that have the same Sharpe ratio.

Additionally, positive Fama-French adjusted alphas for portfolios D1 till D9 are found and these alphas are all statistically different from zero at the 1% significant level. The alpha of portfolio D10 is not significantly different from zero. The results show that the alphas are consistently decreasing for the consecutive decile portfolios, indicating a negative relationship between the P/E ratio and alpha.

The alpha difference between the lowest and highest P/E ratio portfolio is 11.4%. The results of this paper are consistent with Basu (1975, 1977) and Nicholson (1960) since they concluded that stocks with low P/E ratios have superior returns compared to stocks with high P/E ratios. The outperformance of low P/E ratio stocks may be a result of the extrapolation bias from which investors suffer.

Furthermore, there was no relationship found between the beta of the stocks and its P/E ratio. All the different decile portfolios showed a beta between 0.93 and 0.95.

A possible limitation of this research is that multiple observations could not be used. The reason for this is that these observations showed negative earnings which resulted in negative P/E ratios. Also, there might be other effects related to the overperformance of low P/E ratio stocks. Further research could investigate how the outperformance of low P/E ratio stocks compares to other effects such as the value effect, size effect and momentum effect. In addition, the effect of the P/E ratio on the stock performance of stocks from different industries can be researched.

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Appendix

Figure 1

Sharpe ratios of the portfolios

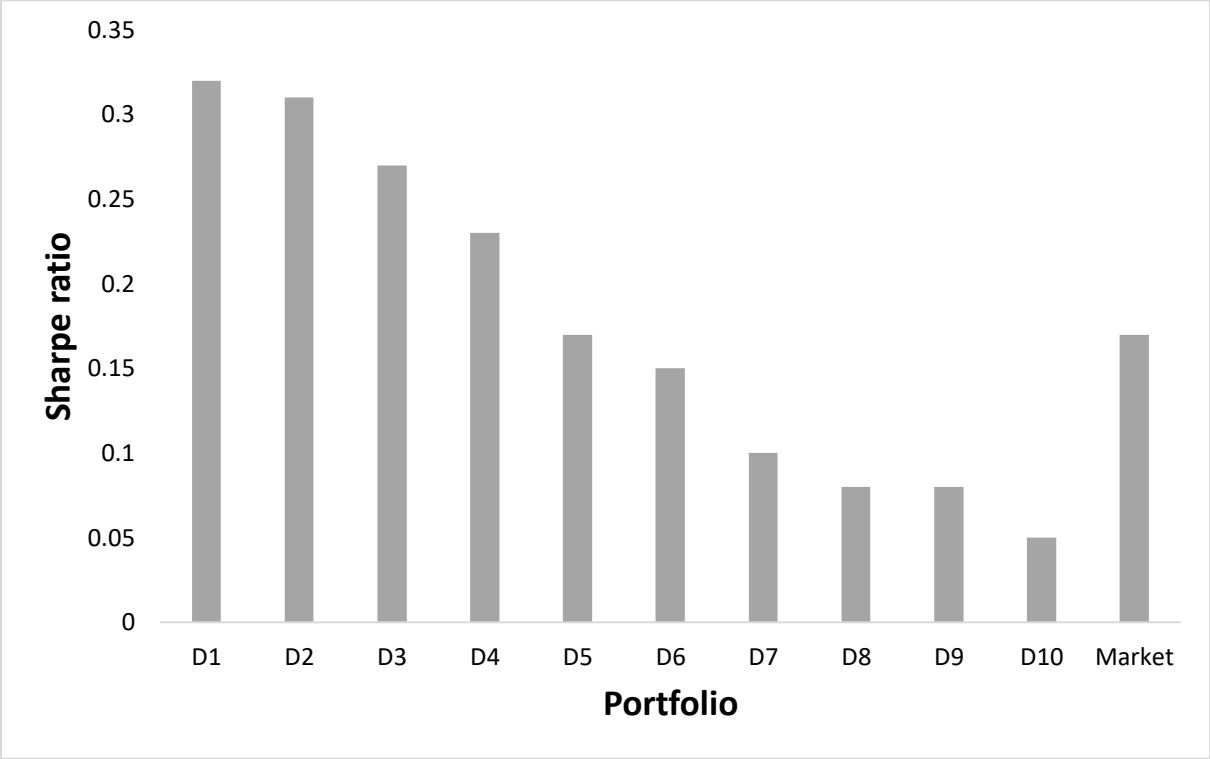

Figure 2

Fama-French adjusted alphas of the decile portfolios