Comparison of Cross-sectional Momentum Strategy and Time-Series Momentum Strategy

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Abstract. There are all kinds of quantitative portfolios used in the stock investing such as momentum, mean reversion, liquidity and so on. Cross-sectional momentum and Time-series momentum are the two main method of momentum strategies. They are also the basic methods that were used to construct the portfolio of investing. The essay analyses the difference of the theoretical definition and compares the two methods' return, sharp ratio, maximum drawdown and some other indicators in a relative stable and prosperous environment which is simulated by well performed stocks in the 10 years' period without considering the transaction cost. The result finds that the time-series momentum and cross-sectional momentum both generate positive return in the environment that is simulated. Moreover, the time-series momentum even performs better than cross-sectional momentum strategies in the stable and prosperous environment. The essay also points out the limitation of the experiment and presents some useful advice for the investors who want to invest in the stock market.

Keywords: Quantitative portfolio, Cross-sectional momentum; Time-series momentum; stable and prosperous investing environment; sharp ratio; return.

1. Introduction

In the world of financial investing, momentum strategy is a method of selecting investment targets based on historical price or yield trends. The core idea of this strategy is that "the winners continue to win, and the losers continue to lose" such as investing in assets that have performed better in the recent past and avoiding assets that have performed less recently. It depends on short run autocorrelation in returns [1]. The momentum strategy has shown its effectiveness across multiple markets and multiple time periods, attracting a lot of attention from academics and investors. It is acknowledged that in academia momentum strategies generate robust and significant profits across different asset classification. And the profits are robust to standard risk-factor adjustments and can be improved through different methods of construction [2]. Cross-sectional momentum strategy and Time-series momentum strategy are the two main branches of momentum investing.

The cross-sectional momentum strategy focuses on the comparison of the relative performance of different assets at the same point in time, and selects the assets with the strongest relative performance to invest in. In contrast, a time series momentum strategy focuses on evaluating the past performance of a single asset to determine its current investment value, making a buy or sell decision based on the asset's past price trend. Although both strategies rely on historical data and trend analysis, they are fundamentally different in terms of target selection, portfolio formation, and risk management. These differences not only affect the efficiency of the implementation of the strategy, but also have a significant impact on the risk-return characteristics of the strategy. Therefore, by comparing the cross-sectional momentum strategy and the time series momentum strategy, we can deeply understand the performance of the momentum effect under different conditions, and provide investors with a more refined basis for investment decisions.

This paper aims to explore the differences and connections between cross-sectional momentum strategies and time series momentum strategies in terms of theoretical basis, experimental performance, and risk management. Through the analysis of historical data, this paper attempts to reveal the adaptability and effectiveness of the two strategies in different market environments, and

provides a reference for investors to choose the appropriate momentum strategy under volatile market conditions.

The rest of the arrangement in this article is as follows: The second part Data collection introduce how the data were collected to use this experiment and explain the reason why the data were chosen like that. The third part Method illustrates the definition of two strategies separately and how the two momentum strategies were constructed. The fourth part of the essay gives results of the experiment and do a comparison between the results with explicit figures and indicators of the strategy. The final part of the essay concludes the whole experiment and gives useful advice for investors according to the study of the essay.

2. Data collection

In this study, the monthly spot prices of S&P 500 stocks from 2010 to 2021 were collected, excluding stocks that had no price over the 10-year period, and retaining stocks that had a price for the 10-year period. Then, time-series momentum and cross-sectional momentum strategies were respectively applied to the data collected to see the difference between them. In terms of time of the selected data, there were no serious economic mistakes during the period 2010-2020, for which the economic environment is relative stable, and in terms of stock selection, the stocks of companies that have been with S&P500 for ten years tend to have strong robustness, and there will be no huge volatility deviations, and their fluctuations tend to be more like the daily fluctuations of stocks. Therefore, the selected data can be used to compare the two strategies' empirical performance and risk management in a stable and prosperous market environment. The data were collected like the Table 1 below:

Table 1. Monthly Spot Price of Selected Stock.

Stock	2010/1/1	2010/2/1	2010/4/1	……	2020/10/1	2020/11/1	2020/12/1
A	18.04927	20.25794	22.14465	……	99.80543	114.4901	116.0473
AAL	5.005959	6.910295	6.929151	……	11.28	14.13	15.77
……	……	……	……	……	……	……	……
ZBRA	26.1	28.57	29.6	……	283.64	378.42	384.33
ZION	14.92429	14.58599	17.19176	……	28.61183	34.21539	38.8493

3. Method

3.1. Time-series momentum

The time-series momentum is a kind of trading strategy that looks for 'trends' in the time series of asset returns. This strategy is based on assumption that once an asset exhibits a certain price trend, whether rising or falling, that trend will continue in the short term. According to the time-series momentum perspective, an asset's past performance predicts its future performance [3], traders go long when a market has experienced positive excess returns over this horizon and short otherwise.

In this study, the rate of change [4] is selected as time-series momentum indicator in a three-month cycle, and the rate of change is sorted in each cycle. The top 50 stocks are selected to establish a long position, and the bottom 50 stocks are selected to establish a short position, Adjustments are made to long and short positions each period to meet the above conditions. the growth of total investment was calculated each month as our rate of return.

3.2. Cross-sectional momentum

Cross-sectional momentum strategy, on the other hand, involves comparing the performance of multiple assets against each other over the same period choosing stocks on basis of their relative performance over some prior period [5]. Traders rank assets based on their past returns and then take long positions in those that have performed relatively better and short positions in those that have

performed relatively worse, regardless of whether the absolute returns are positive or negative. This strategy relies on the relative outperformance or underperformance among a group of assets.

For cross-sectional momentum, the average return [6] was used to calculate the return rate for each cycle, and then ranked them according to the average return rate. To compare it with the momentum, the top 50 stocks are still selected to establish a long position, and the bottom 50 stocks are still selected to establish a short position, his growth of total investment was still calculated each month as our rate of return.

4. Results

4.1. Time-series momentum

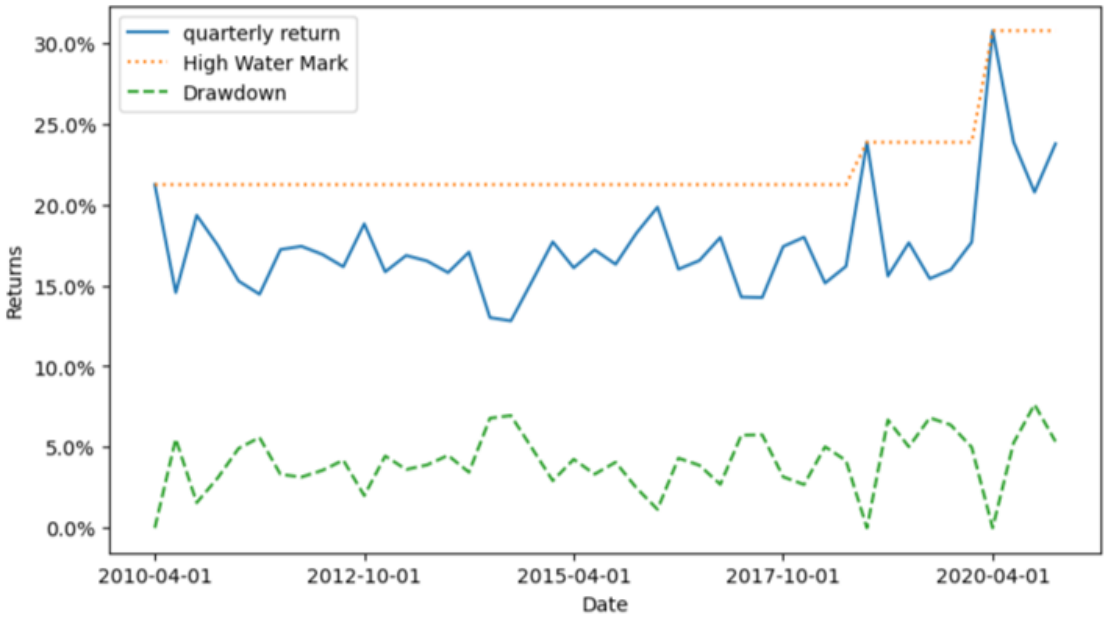

Figure 1. Performance of time-series momentum.

This figure 1 shows that returns fluctuated significantly, but were generally on an upward trend. The high-water mark shows the highest value of observing period. Every time the portfolio reaches a new high, the high-water mark rises. It can be shown that in the last quarter, the portfolio reached a new high-water mark, meaning that the value of the portfolio hit a new all-time high point. The drawdown shows the largest decline in asset value compared with the high-water mark. This is an important risk indicator that shows the maximum potential loss of portfolio value at any point in time. This chart shows that drawdowns were relatively small throughout the period, suggesting that while there was a fluctuation in returns, there was no significant short-term significant decline in asset value.

To be specific, the sharp ratio, maximum drawdown, skewness [7], kurtosis are calculated shown as the Table 2 below:

Table 2. Indicator of Time-series Momentum.

Sharp ratio	Maximum drawdown	Skewness	Kurtosis
5.36	7.64%	2.0	8.73

The Sharp ratio is 5.36 which indicates a very high risk-adjusted return. The Maximum drawdown is 7.64% which is maximum loss of the portfolio from the highest point to the lowest point during the observation period. In this case, the maximum drawdown is relatively small, indicating a low level of risk. The Skewness [7] is 2.0 indicating that the tail on the right side of the distribution is longer, which means that larger positive returns are more likely to occur than larger negative returns. The kurtosis is 8.73 meaning that the distribution is thicker than the tail of the normal distribution, indicating a higher probability of extreme returns occurring.

4.2. Cross-sectional momentum

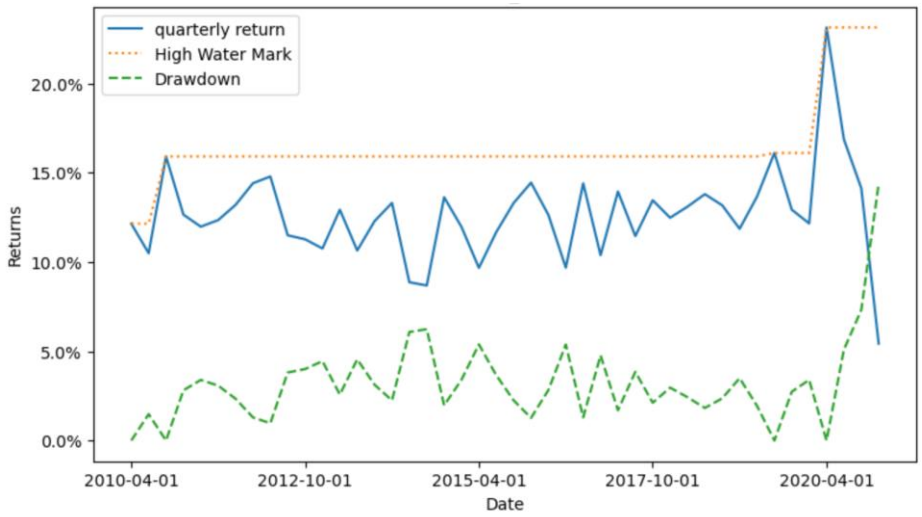

Figure 2. Performance of cross-sectional momentum.

This figure 2 shows that quarterly returns of cross-sectional momentum fluctuated between 10% and 20%, showing that this strategy has generated positive returns in most quarters. The high-water mark is almost keeping upward trend which means that the strategy generally up. The drawdown in the chart shows that the value of the strategy has decreased to varying degrees at different points in time, with the largest drawdown appearing at the end of the chart.

To be specific, the sharp ratio, maximum drawdown, skewness [7], kurtosis are calculated shown as the Table 3 below:

Table 3. Indicator of Cross-sectional Momentum.

Sharp ratio	Maximum drawdown	Skewness	Kurtosis
4.81	14.38%	0.97	8.66

The Sharp ratio is 4.81 which also indicates a very high risk-adjusted return. The Maximum drawdown is 14.38% showing that the strategy experiences high downside risk in certain period. The Skewness [7] is 0.97 indicating that the return distribution is slightly tilted to the right, but close to zero, indicating that the distribution is relatively symmetrical. The return distribution has a thick tail of spikes, that is, the frequency of extreme values is higher than the normal distribution.

4.3. Comparison

In summary, the time-series momentum strategy appears to offer a higher Sharpe ratio and lower maximum drawdown over the period under simulated environment which is stable and prosperous suggesting that it may perform better on a risk-adjusted basis which means that a better return can be acquired taking the same risk. The cross-sectional momentum strategy, while also showing significant returns, is accompanied by higher drawdowns and volatility, which means that it has high potential to generate higher return than time-series momentum. This may appeal to investors who are willing to take higher risks in exchange for potentially higher yields. Skewness and kurtosis indicate the potential for positive return and the potential for extreme returns in both strategies. Investors should consider their own risk appetite and investment objectives when choosing a strategy.

5. Conclusion

5.1. Experimental Summary

To sum up all the above, the essay compares the time-series momentum strategy and cross-sectional momentum strategy in an ideal environment which has no transaction cost, no extreme risk

with normal volatility. And the experiment shows both strategies generate positive returns which is consistent with the research that both time-series momentum and cross-sectional momentum strategies can get positive returns in most case [8]. According to Ron Bird et al, the average performance of stock across the 24 markets under time-series momentum outperforms performance of stock under cross-sectional momentum [8]. This point also agrees on this essay's experimental result that the time-series momentum perform better than the cross-sectional momentum in the stable and prosperous environment.

5.2. Advice and limitation

First, according to the research by Bryan Foltice and Thomas Langer, increasing trading frequency will increase trading cost, which will lead to an optimal condition to risk-adjusted returns of trading strategies [9]. The experiment of this essay ignores the cost of trading strategies just comparing the return of the strategies themselves. Therefore, it is necessary for the investors who wants to invest in a stable environment to consider the trading frequency so that they can achieve a relative well return.

Second, although the experiment points out that the time-series momentum strategies have better performance than cross-sectional strategies, the investors also need to take their risk appetite into consideration so that they can choose the strategies which suit them best.

Finally, with the multiple risk appetite of the investor the market become more volatile, the market become efficient when investors apply diversified trading strategies [10]. Therefore, regardless of your risk appetite, diversifying your portfolio is always an important strategy to reduce risk. You may consider combining momentum and cross-sectional momentum strategies to adjust their weighting to your portfolio based on market conditions and personal preferences.

References

[1] Mark Hon, Ian Tonks. Momentum in the UK Stock Market. Department of Economics, University of Bristol, 2001.

[2] Wiest, T. Momentum: what do we know 30 years after Jegadeesh and Titman's seminal paper?. Financ Mark Portf Manag 37, 2023.

[3] Athina Georgopoulou, Jiaguo (George) Wang, the Trend Is Your Friend: Time-Series Momentum Strategies across Equity and Commodity Markets, Review of Finance, 2017, 21(40):1557–1592.

[4] Elearnmarkets. Top 5 Momentum Indicators that Analyses Trend Strength, 2024

[5] Narasimhan Jegadeesh, Sheridan Titman. Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, The journal of finance, 1993, 48(1):65-91.

[6] Joëlle Miffre, Georgios Rallis. Momentum strategies in commodity futures markets. Journal of Banking & Finance, 2007, 31(6): 1863-1886.

[7] Martin, Richard. Design and analysis of momentum trading strategies. ResearchGate, 2021.

[8] Bird, R., GAO, X., & Yeung, D. Time-series and cross-sectional momentum strategies under alternative implementation strategies. Australian Journal of Management, 2017, 42(2): 230-251.

[9] Leseur, M. Analysis of the causes of the momentum effect and their implications for the efficient market hypothesis, 2016.

[10] Shi-Nan Cao, Jing Deng, Honggang Li. Momentum strategies under alternative implementation strategies. Australian Journal of Management. Journal of Economic Interaction and Coordination, 2010, 5(2): 249.