A Predictive Model for Stock Prices in the Russell 1000 Index Using Cross-Sectional Momentum

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***Abstract*—Using the adjusted closing prices of tickers in the Russell 1000 Index, a predictive model considering the cross-sectional momentum was developed. The model achieved a Sharpe ratio of 0.75, a turnover ratio of 8.5%, and a bias of 43.85 basis points. These metrics indicate reasonable model performance.**

I. Introduction

THE modern trading portfolio frequently includes thousands of stocks within certain asset classes, making it essential to integrate cross-sectional momentum to improve model performance [1]. A prototype predictive model was developed using stock prices from the Russell 1000 Index, and its performance was assessed through various financial metrics. The limitations of the prototype, including inherent look-ahead bias, were discussed, and recommendations for enhancing the model, such as incorporating volatility considerations, were suggested to better refine its performance.

II. Theory

The Sharpe ratio measures the risk-adjusted return of an investment. It indicates how much excess return you receive for the extra volatility (risk) you endure for holding a riskier asset. It can be calculated as:

$$\text{Sharpe Ratio} = \frac{\mu_{\text{PnL}}}{\sigma_{\text{PnL}}} \times \sqrt{252}, \tag{1}$$

where μ_{PnL} represents the mean of the portfolio returns and σ_{PnL} refers to the standard deviation of the portfolio returns.

The turnover ratio is a measure of how frequently assets within a fund or portfolio are bought and sold by the managers. It is obtained by dividing the total amount of trading activity from position change by the total Gross Market Value (GMV) over the period.

The bias in basis points represents the average profit per unit of turnover, scaled to basis points, indicating the efficiency of trading in terms of profit relative to trading activity.

III. Methodology

The stock prices of the Russell 1000 Index were obtained from the Wikipedia page [2] using the *yfinance* package. Minor adjustments were made to the ticker labels, and tickers without valid data were removed. Data for the remaining tickers, covering the period from 1 January 2015 to 31 December 2023, was then downloaded.

Adjusted Closing Prices (Adj Close) were extracted from the dataframe, resulting in a dataset with Adj Close values for all tickers. The percentage change in Adj Close was calculated to derive the returns. Columns with entirely NaN values were removed, ensuring that only columns with valid returns were retained.

The rolling mean of the returns, calculated over an 11-month window, was used to determine the cross-sectional momentum. The resulting signal data was then shifted forward by 21 periods, introducing a lag that reflects a medium-term strategy.

Subsequently, the signal was standardised by calculating its z-score to determine holding positions. To ensure comparability of the model and its metrics, the signal was scaled to unit Gross Market Value (GMV).

The portfolio returns for each ticker were computed as the product of the signal and returns. Summing these portfolio returns across all tickers provided the total portfolio returns for each time period.

IV. Results and Discussion

The Sharpe ratio was 0.75, suggesting that the portfolio has a moderate risk-adjusted return. A turnover ratio of 0.085 indicates that, on average, 8.46% of the portfolio's positions were traded (bought or sold) during each period. This reflects a relatively low turnover. A low turnover ratio implies lower transaction costs and potentially reduced tax liabilities, which can enhance net returns.

The bias of approximately 43.85 basis points (bps) indicates that the portfolio generates about 0.44% return per unit of turnover, on average. This demonstrates a positive and reasonably high efficiency in trading activities.

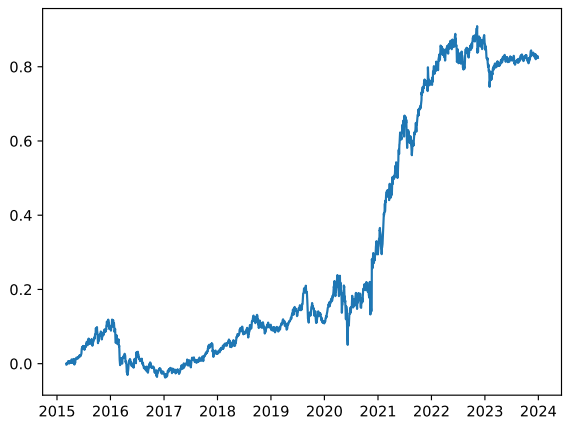

Fig. 1. The cumulative sum of the total portfolio returns over time.

V. Conclusion

The predictive model prototype using cross-sectional momentum demonstrated reasonable performance, with a Sharpe ratio of 0.75, a turnover ratio of 8.5%, and a bias of 43.85 basis points. However, the methodology may be fundamentally flawed due to the presence of look-ahead bias. Given the dynamic nature of the Russell 1000 Index, the portfolio should not rely solely on the current composition of the index. Instead, it should be tested against a broader pool of tickers to accommodate the inherent fluidity.

Additionally, while the current signal was scaled to the gross market value (GMV), modern trading practices increasingly involve dividing the signal by volatility. This approach not only accounts for returns but also incorporates the risk level of the investment, leading to a more robust investment strategy.

References

[1] Two Sigma. (n.d.) Momentum and Trend Following. Available at: https://www.venn.twosigma.com/insights/momentum-and-trend-following (Accessed: 10 July 2024).

[2] Wikipedia. (2024) Russell 1000 Index. Available at: https://en.wikipedia.org/wiki/Russell_1000_Index (Accessed: 10 July 2024).