

FIN 502 Project: Evaluating a Stock Return

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This report aims to evaluate the stock return of Microsoft (MSFT) by analyzing its data from December 2001 to December 2022 and comparing them with an appropriate benchmark fund. Furthermore, the whole report is divided into three parts to analyze the return performance and risk of MSFT, the correlation with the overall benchmark market, and the volatility comparison.

Basic statistical data description and analysis

In terms of risk premium, the performance of MSFT is better than that of S&P500. The justifications are that the mean, variance and Sharpe ratio of MSFT is 1.20%, 6.71%, -1.19% respectively, and the mean, variance and Sharpe ratio of S&P500 is 0.58%, 4.37%, -16.02% respectively, which indicate that for 1 unit of risk of MSFT, the return is slightly lower than risk-free asset, while the return of S&P500 is much lower for 1 unit of risk.

For skew, there is an increasing trend of MSFT's return. The skew of S&P500 is -0.58, and MSFT is 0.14, showing skew left and right respectively. So, there are more extreme values above the average for MSFT's monthly return.

The basic risk is evaluated from the perspective of kurtosis and normal distribution. Firstly, the excess kurtosis of S&P500 is -1.83 and MSFT is -2.31, indicating that the distributions are more smooth than normal. So, most returns of S&P500 and MSFT are relatively stable and concentrated around one specific value, which means the risks for these two assets are low. Secondly, under the normal distribution model to estimate, the extreme downside risk of MSFT's returns is relatively higher. When assuming a normal distribution, it showed that MSFT has a higher downside time threshold for 1% probability (16.81% > 10.75%), indicating that is relatively safer than S&P500. However, after finding that their returns did not follow a normal distribution and compared the actual monthly return in sample distribution, the conclusion is that the normal distribution model underestimated the downside risk of MSFT stock.

Hypothesis tests of correlation and volatility comparison between MSFT and S&P500 returns

MSFT's returns are affected in part by the overall performance of the S&P500 index. There are following methods to give evidence and relative recommendations:

- Based on the "Scatterplot of Returns of S&P500 and MSFT" and calculating the correlation to be around 0.65, concluded there is a moderately strong positive linear correlation between the returns of the S&P500 and MSFT.
- In hypothesis tests, " $p\text{-value} < \alpha$ " and " $|t| > |t^*|$ " are double-checked to prove that there is a correlation between their returns. It means that when the returns of S&P500 rise, MSFT's returns tend to rise as well, and investors can make relevant judgments by S&P500's returns.

However, it cannot confidently say that MSFT's returns are significantly higher. In hypothesis test, " $|t| > \text{critical } t$ " prove that MSFT's returns are not significantly different from the S&P500 at a 5% confidence level, which suggests that MSFT's performance is in line with the overall market (S&P500). It could also mean that MSFT's returns are influenced by market conditions in a way that does not significantly deviate from the market average.

Moreover, MSFT's return volatility is different from the S&P500 due to that in t-test, the p-value is much smaller than 2.5%. So, we reject the null hypothesis at a 5% confidence level.

External Fed target rate impact and regression

Regardless of whether in a Fed target rate up cycle or a down cycle, MSFT and S&P500's mean returns are not significantly different, but their volatilities are significantly different. It is proved by selecting two up and down cycles between December 2001 and December 2022, and the results in hypothesis test. In addition, they are influenced by many factors except Fed target rate. The market may respond to the change of Fed target rate differently. Stock markets and external environment are complex.

According to the regression results, Alpha is significantly positive by comparing the value t-stat of alpha 1.93 is smaller than 1.96 (the value of upper threshold points at 5% confidence level), which indicates MSFT can give positive excess return and provide better returns than what its risk profile alone would predict. Meanwhile, Beta is significantly different from 1 at 5% confidence level, which can be explained by the p-value 8.502E-36 is smaller than 2.5% and can reject the null hypothesis. MSFT's returns behave better than the market.

In summary, MSFT's overall returns are positively affected by the overall S&P500 benchmark market and have an increasing trend in returns and lower overall risk. Its volatility differs from the S&P500, and it has a higher extreme downside risk. After adding the Fed rate analysis, its average return and volatility remain the same as S&P500. At the same time, MSFT's returns behave better than the market to obtain excess returns.