The Logarithmic Method of Ranking Stocks

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Abstract

An new matrix ranking system – the Logaithmic Method – is created to determine the best bank and tech stock based on their P/E, PEG, P/B, DPR, and implied volatility. The Logarithmic Method compares stocks based on each metric by a ratio and applies the natural log to each ratio to weigh the metric differences between stock fairly.

Introduction

Stocks (also commonly known as shares or equity) are securities issued by stock corporation that represent ownership in the stock corporation, as well as proprietorship in the company's assets and earnings. Some critical matrics that are used to evaluate the performance of stocks are P/E (price/earnings ratio), PEG (price/earnings to growth ratio), P/B (price/book ratio), DPR (dividend pay ratio), and implied volatility.

To clarify, P/E indicates the dollar amount that's needed to invest in a company in order to receive one dollar of that companys earnings. PEG indicates how the share price compares to the company's anticipated earnings. P/B reflects the value of a company's equity in the market relative to its book value of equity. DPR is the ratio of the total amount of dividends paid out to shareholders relative to the company's net income. Implied volatility is the estimated volatility of share price derrived from its option pricing.

In this project, bank stocks and tech stocks are ranked separately using two variations of the Logarithmic Method

Data Source

The selection of bank stocks is JPM, DB, BAC, WFC, HSBC, C, MS, GS; The selection of tech stocks is MSFT, GOOGL, FB, AMZN, INTC, ORCL, ADBE, NVDA.

We collected the P/E, PEG, P/B, DPR, and implied volatility of each bank and tech stock from *Yahoo! Finance*. When a company's earnings or growth is negative, its P/E and PEG are unavailable. They are replaced with values that will be explained in the Methodology section.

Ranking Methodology

The motivation behind the Logarithmic Method is to rank stocks by comparing each stock's metric one at a time and prevent a stock from ranking too high by dominating in just one metric.

1. Pick a metric to evaluate the stocks, i.e. P/E, PEG, P/B, Dividend Payout Ratio, or implied volatility. Let stocks $s_1, s_2, \ldots, s_n$ have metric $r_1, r_2, \ldots, r_n$ respectively.

2. Taking the outer product of the reciprocal metric vector and the metric vector to form an $n \times n$ matrix where each entry of column i represent the match outcome of s_i vs. s_j, including the trivial match of s_i against itself.

$$\mathcal{M} = \begin{bmatrix} \frac{1}{r_1} \\ \frac{1}{r_2} \\ \vdots \\ \frac{1}{r_n} \end{bmatrix} \begin{bmatrix} r_1 & r_2 & \ldots r_n \end{bmatrix} = \begin{bmatrix} 1 & \frac{r_2}{r_1} & \cdots & \frac{r_n}{r_1} \\ \frac{r_1}{r_2} & 1 & & \vdots \\ \vdots & & \ddots & \frac{r_n}{r_{n-1}} \\ \frac{r_1}{r_n} & \cdots & \frac{r_{n-1}}{r_n} & 1 \end{bmatrix}$$

3. Computing the natural log of the matrix entry-wise gives the score of each match between s_i and s_j. This is reasonable because

$$\ln\left(\frac{r_i}{r_j}\right) = \begin{cases} \text{positive} & \text{if } r_i > r_j \\ \text{negative} & \text{if } r_i < r_j \\ 0 & \text{if } r_i = r_j \end{cases}$$

Furthermore

$$\ln\left(\frac{r_j}{r_i}\right) = -\ln\left(\frac{r_i}{r_j}\right)$$

This means that the outcome of any match is one stock gaining some points while the other losing that same amount. In addition, property of the natural log reduces the weight of the difference between r_i and r_j exponentially as that difference increases, hence diminishing the affect that a overwhelmingly dominant or disadvantaged metric has on a stock's place in the final ranking.

4. For all $i \in [n]$, the points earned or lost in each match by s_i corresponds to each entry of column i. Thus adding up all entries in column i gives a rating of s_i based on r_i.

$$\text{Rank Score}_r = \begin{bmatrix} 1 & 1 & \ldots & 1 \end{bmatrix} \cdot \ln[\mathcal{M}]$$

5. Repeat steps 1 to 4 to obtain the ranking vector for each metric. Add up all ranking vectors for the final ranking, where the higher a stock's ranking score, the higher it ranks.

For both bank and tech stocks, we consider P/E, PEG, and P/B that have the lower value to be better because we are paying less for the company's earnings, growth, and book value respectively. However, we interpret DPR and implied volatility differently for bank and tech stocks.

A good bank stock should be fit for long-term investment; it should consistently pay high dividend and have low volatility. In contrast, a good tech stock should grow rapidly; it should pay less dividend, since companies need to reinvest in themselves for innovation, and large implied volatility brings more call/put opportunities.

To compare stock metrics that are best when large, simply take the original vector and use the Logarithmic Method. However, to compare stock metrics that are best when small, we take the norm of the vector, then subtract the vector from the norm vector (where every entry is the norm) to form the complement of the original vector. Then the vector can be used directly in the Logarithmic Method.

Complication arises when the EPS or Growth per Share of a stock is negative. In this case, the P/E or PEG becomes negative, and hence incomparable. As a rule of thumb, any stock that has negative earnings for growth is undesirable regardless of other factors. Therefore, to ensure that those stock will have low ranking, we take the norm of the vector pretending those negative entries are 0. Then we replace those negative values with the calculated norm. This way, the P/E or PEG for tha stock will be as large as possible, and thus rank last.

Results

Table 1 shows the two highest and lowest ranked bank stocks. Table 2 shows the two highest and lowest ranked tech stocks.

Stock	Rank	Rank Score
MS	1st	47.8652
BAC	2nd	47.3727
C	7th	-112.4682
DB	8th	-116.5257

Table 1: Bank Stocks

Stock	Rank	Rank Score
NVDA	1st	7.1202
FB	2nd	6.3628
MSFT	7th	-7.7658
AMZN	8th	-10.7575

Table 2: Tech Stocks

MS stock ranks as the highest bank stock and NVDA stock ranks as the highest tech stock. The second highest bank stock, BAC, is lower than MS by less than 0.5, although BAC's volatility is 10% lower than that of MS. This is due to BAC having higher P/E, PEG, and P/B than MS, although only slightly. Hence the Logarithmic Method, which accounts for a well-balanced evaluation, placed BAC slighly lower. The second highest tech stock, FB, is lower than NVDA by because its implied volatility is half of that of NVDA and it has fairly similar P/E, PEG, and P/B as NVDA. In particular, FB's P/E is 1.37 more than NVDA's P/E, FB's PEG is 0.18 less than NVDA's PEG, FB's P/B is 4.31 less than NVDA's P/B, and most importantly, FB's implied volatility is 31.15% less than NVDA's implied volitility, which is the primary reason why NVDA ranked higher than FB.

Conclusions

- MS stock is ranked the highest bank stock due to its low P/E, low PEG, moderate P/B, DPR, implied volatility.
- Interestingly, NVDA stock is similarly ranked the highest tech stock due to its remarkably low P/E, low PEG, moderate P/B, DPR, implied volatility
- The Logarithmic Method is distinctive in that it compares each stocks metric one by one and prevents a stock from ranking too high by dominantly in just one metric
- The Logarithmic Method can be improved if weighting coefficients are added to adjust the individual rank score according to the importance of each metric.

References

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