Magnificent 7 : High Cap - High Risk

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Contents

1 Introduction

1.1 Purpose of the project

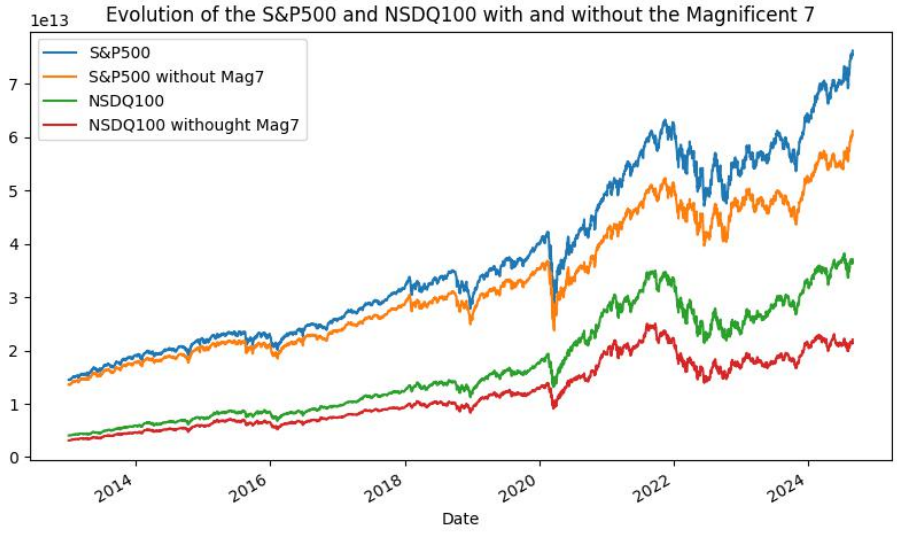
This project is an application of the risk analysis tools I learned through my studies and various MOOCs. This historic analysis will focus primarily on quantitative data and will be made using Python. Macroeconomic factors will be used to understand some of the results.

1.2 Presentation of the project

The Magnificient Seven (Amazon, Apple, Google, Meta, Microsoft, Nvidia and Tesla) share prices have grown exponentially over the last decade. They are frequently featured in the news and play a major role in technological changes, such as ecological transition, artificial intelligence and the application of data science in medicine. Moreover, their weight in the two main American indices continues to grow, as illustrated in the graph below.

In August 2024, the market capitalization of 5 of the Magnificent was over $2 trillion and they accounted for 16.5% of the S&P500 and 28.9% of the NASDAQ100. Therefore, it is crucial to understand the risks associated with these 7 companies to protect portfolios containing such indices from potential downfalls.

We will analyze the period 2013-2023. This choice is justified by Meta's late integration into the markets in May 2012. Also, the impact of the subprime mortgage crisis had already subsided by 2013 and will have little effect on the results. The crisis related to COVID-19 propelled those 7 stocks to historic highs, establishing the current situation.



2 Market-risk exposure

In this first part of the analysis, we want to understand how the Magnificent 7 evolved over the last decade by comparing them to the market. This will outline the existence or absence of systematic risk for the 7 companies.

Systematic risk is the risk related to the market or sector, in opposition to idiosyncratic risk affecting only a company (due to a management issue for example).

The metrics calculated in this section are computed using the compounded returns over the period 2013-jan to 2024-aug[1]. Compounding returns show the evolution of a dollar invested in each asset at the beginning of the period.

2.1 Correlation Matrix

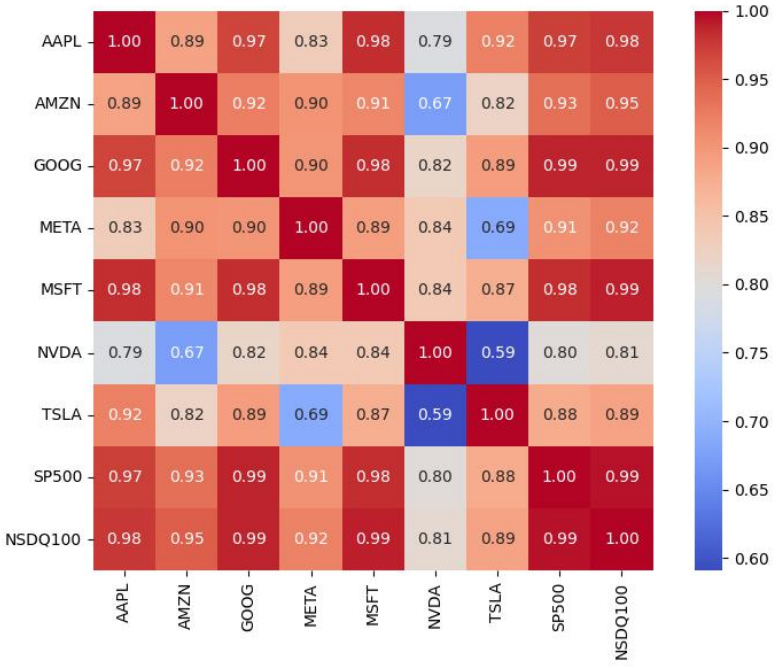


Figure 1: Correlation Matrix of Compounded returns 2013-2024

The Pearson correlation matrix highlights a strong correlation among the Magnificent 7 and between them and the market. The dowwnfall of one of these companies could drag the others and hence the whole market and lead to a recession. The year 2022 revealed the possibility of such a plunge happening.

[1]Period used for the whole project.

Nasdaq100 index fell by 33% after 2 years of growth in the tech industry due to Covid crisis

Only Nvidia and Tesla seem to act as outsiders, we can explain this with multiple reasons. Especially, they are working on innovative technologies (AI and electric cars), adding speculation to their market price. However, they reacted differently after the 2022 stock market drop.

Tesla share price rose quickly in 2020 and 2021. But it didn't bounce back from the 2022 crisis. But it was the opposite for Nvidia which started rising quickly in 2023 thanks to the big interest sparked by Artificial Intelligence.

The stock market is not immune to the possibility of Nvidia reacting the same way as Tesla in the near future, if expectations over AI were to shrink.

2.2 Share price Volatility

The high risk brought by the Magnificent 7 to the overall market can be highlighted by the high variance of the stock prices. Especially for the 2 most volatile ones, Nvidia and Tesla. The S&P500 variance is low but is clearly influenced by the high volatility of the tech sector which weight.

Note that a log-scale was applied in the graph below, and that the volatility of Nvidia and Tesla are 10 times higher than the volatility of rest of the Magnificent 7.

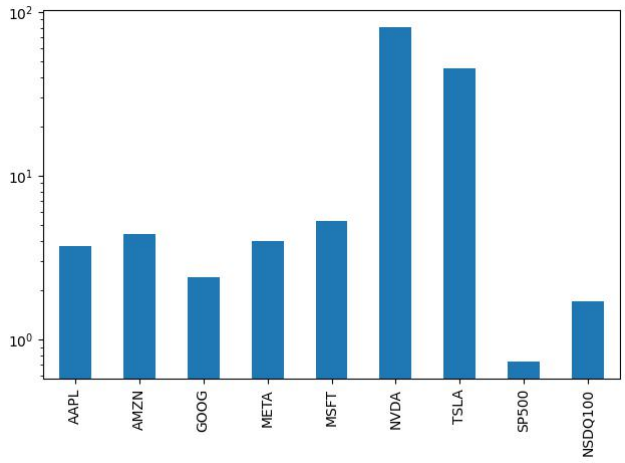


Figure 2: Standard deviation of Magnificent 7, S&P500 and NSDQ100

2.3 CAPM

2.3.1 Presentation of the model

The Capital Asset Pricing Model helps to measure the market risk affecting a stock. It is a linear regression where the market risk premium[2] of an asset explains its expected return. It can be represented by an equation:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

where:
R_i : returns of asset i
R_f : risk-free rate
β_i : measure of market risk
R_m : market returns

Beta measures how much a stock is affected by systematic risk. An investment with a $\beta > 1$ indicates a greater opportunity of growth when the general market is going up, but can lead to significant loses in case of market plunge.

The opposite is also true, when $\beta < 1$, the investment is not as much correlated with the market and can be considered safer. Especially, a negative Beta investment can be used as hedging. For example, gold has a low Beta, sometimes negative, and it is considered a safe haven.

2.3.2 Measuring Beta

For a stock i, we compute the Beta with:

$$\beta = \frac{\text{Cov}(R_i, R_m)}{\text{Var}(R_m)}$$

We want to measure the Beta of the Magnificent 7 stocks using both indexes as the market. The risk-free rate required to calculate the excess returns will be following the interest rate of US 3-month government bonds[3].

The calculation of β (plot below) over the 7 stocks confirms previous results: systematic risk is very high. If we take Nvidia and Tesla aside, the Beta relatives to the S&P500 is around 5, meaning that a 2% drop of the S&P500 could lead to a 10% drop on average for these 5 stocks. As well if Google has a low beta compared to the others, it is still very high.

Nvidia and Tesla are still highlighted as the most risky assets. But it shows the limit of the CAPM. Nvidia rose faster than the market in the beginning of 2024 and it made the Beta grow, without having necessarily an increase in risk.

[2] A premium is the excess return an investor is willing to get back from the risk he takes.
[3] This risk-free rate will be adopted for the whole project.

Therefore, computing the Beta of the Capital Asset Pricing Model is rarely enough to quantify the risk of a company in a portfolio. This model can be ameliorated by adding more factors (like in the Fama-French model). We won't study it here but we could add factors such as company size, book value or stock momentum.

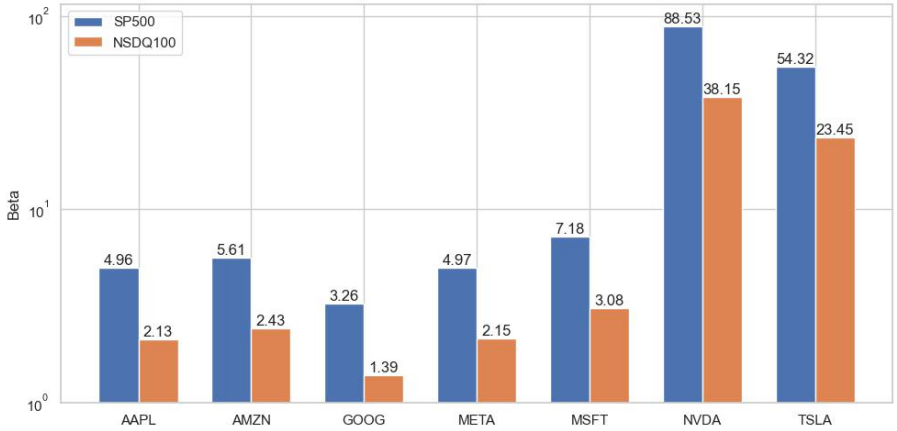


Figure 3: Beta of the Magnificent 7

Analyzing the market-risk exposure underlined a high risk among the 7 stocks. Yet, we identified a bias coming from the performing growth of these companies share price. Additional tools, especially the ones focusing on down-side returns will permit a clearer identification of the risks involved.

We will continue the analysis by measuring Risk-Adjusted Returns with Sharpe-Ratio and some of its variations.

3 Risk-Adjusted Returns

Risk-adjusted metrics are ratios used to determine if the excess returns of an investment is fair considering the risk taken over an historic period. We will explore 3 models, to compare returns with different measures of risk.

In order to understand the risk of the Magnificent 7 over the S&P500 and NSDQ100, we are going to analyze them as if they were assets in a market-cap weighted portfolio.

3.1 Sharpe Ratio

Sharpe Ratio compares the excess returns of an investment over its total volatility. For an asset i, it is calculated using:

$$SharpeRatio_i = \frac{R_i - R_f}{\sigma_i}$$

3.2 Sortino Ratio

Sortino Ratio compares the excess returns of an investment over its negative deviations to emphasize on downside risk. For an asset i, it is calculated using:

$$SortinoRatio_i = \frac{R_i - R_f}{\sigma_{d,i}}$$

3.3 Treynor Ratio

Treynor Ratio compares the excess returns of an investment over its Beta from the CAPM model to emphasize on systematic risk. For an asset i, it is calculated using:

$$TreynorRatio_i = \frac{R_i - R_f}{\beta_i}$$

4 Normality of returns

5 Expected Shortfall

5.1 Value at Risk

5.2 Conditional Value at Risk

6 Drawdowns