Stock Market Timing versus Buy-and-Hold

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December 31, 2017

Introduction

Successful stock market timing, predicting the lows and highs of the market in order to invest at the low points and divest at the high points, can result in maximum returns. While many academics say that successful market timing is not possible, at least not consistently, many active investment managers claim otherwise. Who is right? And whose advice should a normal investor, one who typically earns a regular paycheck and primarily invests for retirement, follow?

This project attempts to address the above two questions by analyzing and comparing returns from a simple buy-and-hold strategy with seven different market-timing strategies utilizing 147 years of monthly market data. While the first question is addressed by comparing returns over all 147 years of the market data, the second question is addressed by comparing returns based on a normal person's typical investment horizon of 40 years.

The rest of this report discusses the project methodology, the seven market-timing rules, the design of the Python program that was developed for calculating and comparing returns resulting from those rules, and finally, the findings of the project.

Project Methodology

The project involved three major steps:

1) Collection and preparation of as much historical market data as possible. Fortunately, the data was readily available at http://www.multpl.com for years 1871-2017. All that was required was the extraction of the necessary data - monthly S&P Composite Index values, dividends, earnings, and the 10-year US Treasury bill (GS10) rates – from the site and the creation of a CSV file with the data.

2) Development of a Python program to compute and present investment returns over a given time period using a simple buy-and-hold stock strategy as well as the seven market-timing strategies that are outlined in the next section. In addition to computing and presenting results for each of the investment strategies over any period between 1871 and 2017, the program computes and presents results for every interval of a specified investment horizon (such as 40 years, which is the typical horizon for a salaried employee). For all computations, the program assumes that dividends are reinvested and that there are no transaction costs.

3) Documenting the project and summarizing the findings, the purpose of this report.

The Seven Market-Timing Rules

The method behind all of the market-timing strategies is the same. If the market is overvalued at the end of a month as per a defined rule, invest in GS10. Otherwise, invest in S&P Composite Index. The seven rules used for this project are:

1) P/E Rule: If the S&P Composite Index Price/Earnings (P/E) ratio at the end of the month is greater than the median P/E ratio for the entire 147 years, invest in GS10. Otherwise, invest in S&P Composite Index.

2) Yield Rule: If the S&P Composite Index Dividend/Price (Dividend Yield) at the end of the month is less than the median Dividend Yield for the entire 147 years, invest in GS10. Otherwise, invest in S&P Composite Index.

3) Yield & GS10 Rule: If the Dividend Yield at the end of the month is less than the median Dividend Yield AND the GS10 rate is higher than the Dividend Yield at the end of the month, invest in GS10. Otherwise, invest in S&P Composite Index.

4) P/E & Yield Rule: If the P/E ratio at the end of the month is greater than the median P/E ratio AND the Dividend Yield at the end of the month is less than the median Dividend Yield, invest in GS10. Otherwise, invest in S&P Composite Index.

5) P/E | Yield Rule: If the P/E ratio at the end of the month is greater than the median P/E ratio OR the Dividend Yield at the end of the month is less than the median Dividend Yield, invest in GS10. Otherwise, invest in S&P Composite Index.

6) P/E & Yield & GS10 Rule: If the P/E ratio at the end of the month is greater than the median P/E ratio AND the Dividend Yield at the end of the month is less than the median Dividend Yield AND the GS10 rate is higher than the Dividend Yield at the end of the month, invest in GS10. Otherwise, invest in S&P Composite Index.

7) Fed Rule: If the S&P Composite Earnings/Price (Earnings Yield) at the end of the month is less than the GS10 rate at the end of the month, invest in GS10. Otherwise, invest in S&P Composite Index.

Program Design

Python programming language was selected for implementing the project because of prior experience with it, as well as the availability of libraries for reading CSV files, performing complex mathematical operations, and creating charts and graphs.

The program is organized into five modules:

1) formulas.py uses the math package to define methods that convert each member of a list to a percentage, from yearly to monthly data, divide each member of one list by another, and derive monthly returns and the compound annual growth rate (CAGR).

2) rules.py contains methods for computing a list of the end balances of each rule after each month for the specified time period. If a rule's condition is met, then it uses the GS10 rate to compute the balance for the next month. Otherwise, it uses S&P Composite Index return to compute the balance for the next month.

3) time_plot_xaxis.py contains a method for creating an evenly spaced and accurate x-axis for the time plot.

4) typical_investor.py contains a method that computes the end balances for a typical investment horizon for every possible interval between 1871 and 2017. The function uses the numpy package to create an array of every end balance for each interval. It then compares each row of the array, finds and outputs the largest one, and totals the number of times each rule generated the largest end balance.

5) main.py is the main program. It reads in the historical market data (dates, S&P Comp Index, dividends, earnings, and GS10 rates) from a CSV file, calls the methods in the formulas.py file to convert the data into a usable form and to calculate the monthly returns, and then asks for inputs (the beginning and end year and month, the initial investment amount, the additional monthly investment amount, and the investment horizon) and converts those inputs in to usable form. The program then calls each rule in the rules.py file to compute the monthly end balances for each rule, and the method from typical_investor.py to compute results for a normal investor with a typical investment horizon (such as 40 years). Finally, the program outputs the results – the total amount invested, the end balance and the compound annual growth rate (CAGR) for each rule, a bar graph composed of the end balance of each rule, and a time plot composed of each rule's balance over time followed by a summary of how often each of the rules wins for the typical investment horizon

The program and instructions on how to use it are available for public use at https://github.com/RohanChilukuri/stockmarketresearch.

Project Findings

Program outputs below show the results from an initial investment of $1 followed by a monthly recurring investment of $1 thereafter for the entire 147 year period.

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Total investment: $1,754
Buy-and-Hold S&P Comp - End Balance: $58,688,098 / CAGR: 7.2%
Buy-and-Hold GS10 - End Balance: $240,925 / CAGR: 3.36%
P/E Rule - End Balance: $6,658,624 / CAGR: 5.64%
Yield Rule - End Balance: $5,131,543 / CAGR: 5.52%
Yield & GS10 Rule - End Balance: $23,040,012 / CAGR: 6.48%
P/E & Yield Rule - End Balance: $7,605,567 / CAGR: 5.76%
P/E or Yield Rule - End Balance: $4,488,327 / CAGR: 5.4%
P/E & Yield & GS10 Rule - End Balance: $22,724,509 / CAGR: 6.48%
Fed Rule - End Balance: $29,312,075 / CAGR: 6.72%
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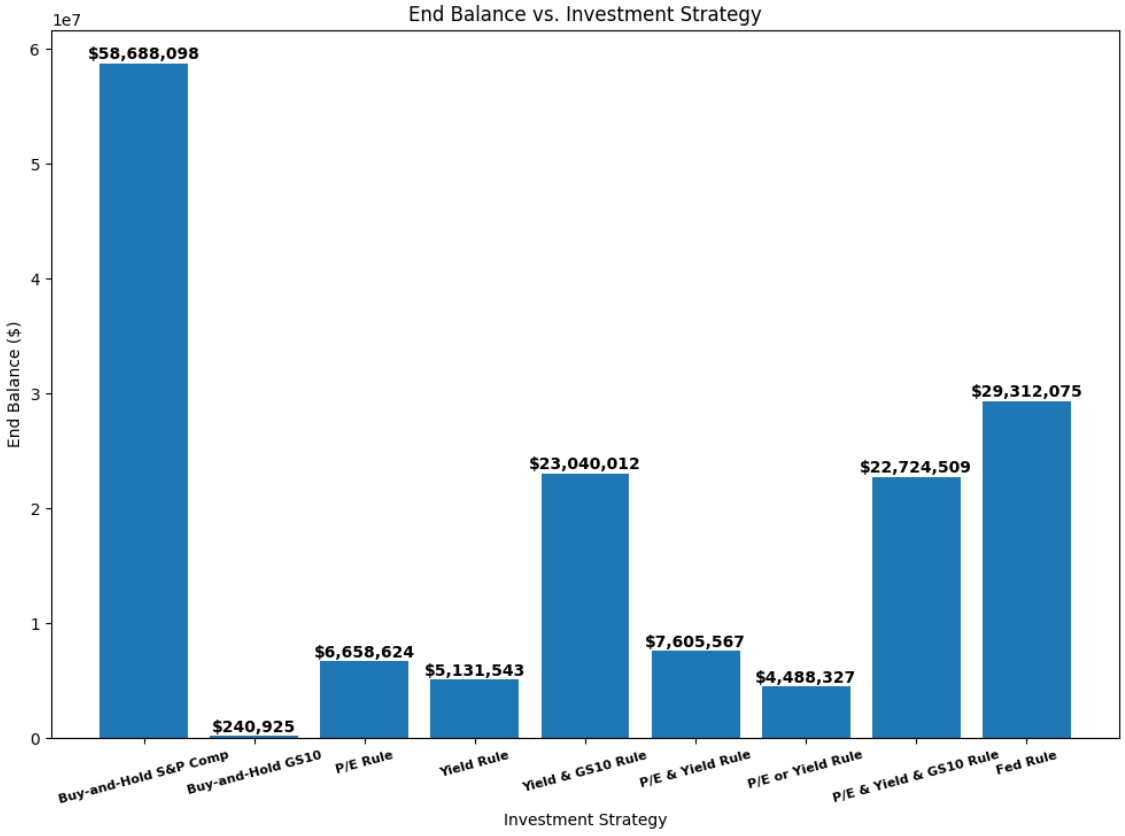

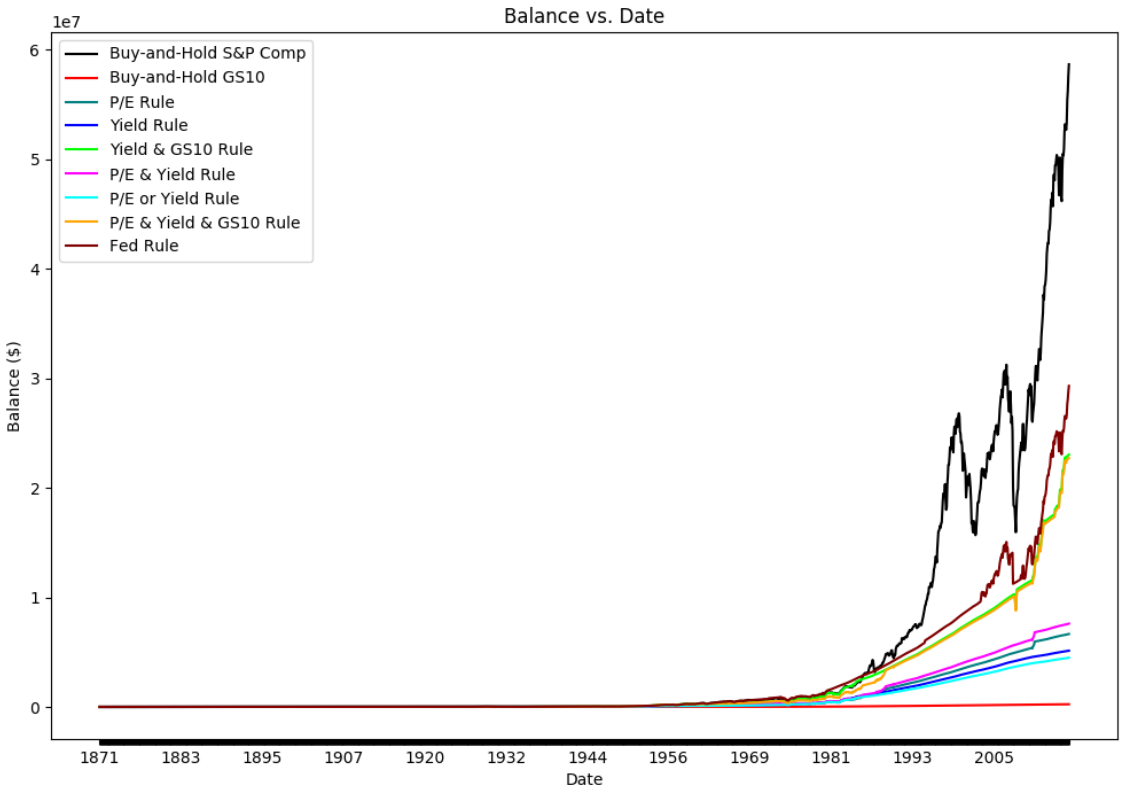

As is clearly evident from the program output, simply buying-and-holding the S&P Composite Index would have returned a far greater amount than any of the market-timing strategies. It is also clear from the time plot that sometimes some of the market-timing strategies have a higher balance, and even lose less during market crashes, but the buy-and-hold strategy results in the highest returns over the full 147 years.

From the output below, which shows the results for the typical investment horizon of 40 years, it is still clear that buying-and-holding the overall stock market would have resulted in the greatest returns more often than any of the market-timing strategies (38.98% of the time). Though some of the strategies do beat the buy-and-hold strategy in some time periods, they were quite random and thus, unpredictable.

```
Buy-and-Hold S&P Comp wins: 497 (38.98%)
Buy-and-Hold GS10 wins: 0 (0.0%)
P/E Rule wins: 240 (18.82%)
Yield Rule wins: 0 (0.0%)
Yield & GS10 Rule wins: 291 (22.82%)
P/E & Yield Rule wins: 0 (0.0%)
P/E or Yield Rule wins: 42 (3.29%)
P/E & Yield & GS10 Rule wins: 0 (0.0%)
Fed Rule wins: 204 (16.0%)
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Another interesting observation, not reflected above but shown in the program output, is that a strategy that has been successful in a particular period never re-emerges in later periods, indicating that past data cannot be used to predict the future success of various market-timing strategies.

Conclusion

From the findings discussed above, it is clear that a simple buy-and-hold strategy results in the highest returns in the long term. Even in the short term, the buy-and-hold strategy seems to win more often than any market-timing strategy. Furthermore, when a market-timing strategy won, it wasn't the same strategy that won again in the future. This randomness makes it impossible to stick to a specific market-timing strategy.

All of the above points to the futility of market-timing. Perhaps a professional quantitative analyst, who constantly analyzes the market, can find new opportunities for market-timing, but for a normal investor who earns a regular paycheck and invests primarily for retirement, a simple buy-and-hold strategy is probably the best investment strategy.