PORTFOLIO PROJECT

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Contents

[Macro Economy and Investment Strategy 2](#_Toc486003145)

[Industry and Company Analysis 3](#_Toc486003146)

[i. Apple (AAPL) 4](#_Toc486003147)

[ii. Johnson and Johnson (JNJ) 4](#_Toc486003148)

[iii. Wal-Mart (WMT) 4](#_Toc486003149)

[iv. Citigroup (C) 5](#_Toc486003150)

[v. Proctor and Gamble (PG) 5](#_Toc486003151)

[vi. United Technologies (UTX) 5](#_Toc486003152)

[Stock Performance Analysis 6](#_Toc486003153)

[i. Daily Stock Statistics 6](#_Toc486003154)

[ii. Capital Asset Pricing Model (CAPM) 6](#_Toc486003155)

[iii. Fama-French 3 Factor Model 6](#_Toc486003156)

[iv. Safety First Ratio (SFRatio) 7](#_Toc486003157)

[v. Sharpe Ratio 7](#_Toc486003158)

[vi. Rank 7](#_Toc486003159)

[Portfolio Optimization 8](#_Toc486003160)

[i. Methodology 8](#_Toc486003161)

[ii. Global Minimum Variance 9](#_Toc486003162)

[iii. Tangent Portfolio 9](#_Toc486003163)

[iv. Efficient Frontier 9](#_Toc486003164)

[Reflection 10](#_Toc486003165)

[Appendix 11](#_Toc486003166)

[Portfolio Performance 11](#_Toc486003167)

[References 11](#_Toc486003168)

# Macro Economy and Investment Strategy

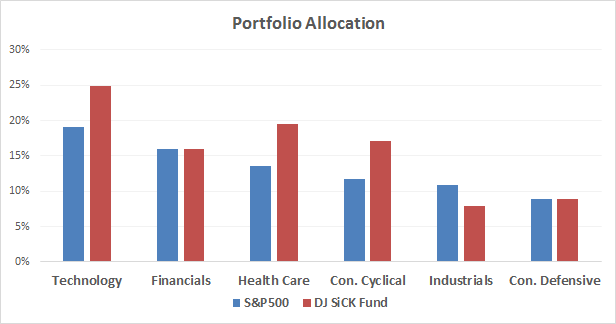
Looking ahead in 2017 and 2018, the bull market is poised to continue its run based on the three drivers of the market. Economic, political, and sentiment drivers. When we look at the economy we want to focus on forward looking economic indicators, and one of the most accurate indicators is the “The Conference Board Leading Economic Indicator” (LEI). The LEI is a collection of forward looking indicators such as Interest Rate Spread (the difference between 10-yr Treasury Bonds and Fed Funds rate), Average consumer expectations for business conditions, and building permits. In the history of this gauge, there has never been a recession when the LEI is high and rising. In its latest release (May 18, 2017) the gauge hit an all-time high improving by 0.3%. From a political scope, there is still gridlock in Congress despite the Republican majority in both the House and the Senate. Establishment Republicans are not on the same page as Trump giving rise to more inter-party gridlock, which is bullish. Gridlock is favored by investors because markets fear aggressive legislative change, as that creates a heightened probability of big unforeseen negatives that can knock bull markets off course. Lastly, sentiment seems to be tamed. We went through a period of heightened fear but the market likes to climb the wall of worries, which is created by falling uncertainty. This has been the most hated bull market in history, which is very bullish.

Our investment strategy is based on a top down philosophy. The most important decision we made was determining the sectors, and size we want to invest in relative to the S&P 500. Given that we are in the back half of this current bull market, history shows us that mega cap stocks tend to outperform the market. A mega cap company is any company with a market capitalization larger than the average market capitalization of the relative benchmark, which in our case is $85.5 billion. That is the first parameter of the portfolio. Secondly, we want to make sure we are properly diversified, and given that we can only hold 6 total stocks, we want to spread the money amongst the top 6 sectors to reduce the relative risk. That means we are looking for companies in Technology, Financials, Health Care, Consumer Cyclical, Industrials, and Consumer Defensive covering about 80% of the US market, meaning we are taking an opportunity risk on the other 20% of the market. The breakdown of the top 6 sectors of the S&P 500 when we first started our investments are as follows:

|  |  |
| --- | --- |
| **Sector** | **Weight** |
| Technology | 19.07% |
| Financials | 15.99% |
| Health Care | 13.62% |
| Consumer Cyclical | 11.79% |
| Industrials | 10.87% |
| Consumer Defensive | 8.89% |

We plan to go overweight to Tech, Health Care, and Con. Cyclical. Stay neutral to Financials and Con. Defensive and underweight to Industrials. Our portfolio breakdown is as follows:

|  |  |  |
| --- | --- | --- |
| **Sector** | **Weight** | **Vs. S&P 500** |
| Technology | 24.88% | ~5.81% |
| Health Care | 19.45% | ~5.83% |
| Consumer Cyclical | 17.03% | ~5.24% |
| Financials | 15.93% | ~0% |
| Consumer Defensive | 8.96% | ~0% |
| Industrials | 7.91% | ~-0.98% |

****

# Industry and Company Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Stock** | **# Shares Purchased** | **Purchased Price Per Share ($)** | **Purchased Amount ($)** | **%** |
|  |  |  |  | **Weight** |
| Apple (AAPL) | 176 | 141.39 | 24,884.64 | 24.88% |
| Johnson and Johnson (JNJ) | 159 | 122.30 | 19,445.70 | 19.45% |
| Wal Mart (WMT) | 231 | 73.75 | 17,036.25 | 17.03% |
| Citi (C) | 271 | 58.77 | 15,926.67 | 15.93% |
| Proctor and Gamble (PG) | 99 | 90.49 | 8,958.51 | 8.96% |
| United Technologies (UTX) | 70 | 113.00 | 7,910.00 | 7.91% |

1. Apple (AAPL):Apple Inc. designs, manufactures, and markets mobile communication and media devices, personal computers, and portable digital music players to consumers, small and mid-sized businesses, and education, enterprise, and government customers worldwide. It offers iPhone, a line of smartphones; iPad, a line of multi-purpose tablets; and Mac, a line of desktop and portable personal computers. The company sells and delivers digital content and applications through the iTunes Store, App Store, Mac App Store, TV App Store, iBooks Store, and Apple Music. Apple Inc. was founded in 1977 and is headquartered in Cupertino, California.

APPL = SIC Code 3663 – Radio & TV Broadcasting & Communications Equipment

|  |  |  |  |
| --- | --- | --- | --- |
| **Fiscal Year 2016** | **ROA %** | **LT Debt to Assets %** | **EBITDA Margin %** |
| Mean (Industry) | -0.38% | 17.29% | 7.03% |
| Median (Industry) | 2.29% | 11.76% | 11.86% |
| Standard Deviation (Industry) | 16.52% | 20.20% | 32.49% |
|  |  |  |  |
| APPL | 14.20% | 23.44% | 32.21% |

Data source: for example COMPUSTAT or Annual reports

1. Johnson and Johnson (JNJ)**:** Johnson & Johnson, together with its subsidiaries, researches and develops, manufactures, and sells various products in the health care field worldwide. It operates through three segments: Consumer, Pharmaceutical, and Medical Devices. Johnson & Johnson has various brands. Few of the brands are : Johnson’s, Listerine, Aveeno, Clean & Clear, Dabao, Le Petite Marseillas, Neutrogena, RoC, OGX, Tylenol, Sudafed, Zyrtec, and other brands. Johnson & Johnson was founded in 1885 and is based in New Brunswick, New Jersey. JNJ = SIC Code 2834 – Pharmaceutical Preparations

|  |  |  |  |
| --- | --- | --- | --- |
| **Fiscal Year 2016** | **ROA %** | **LT Debt to Assets %** | **EBITDA Margin %** |
| Mean (Industry) | -54.66% | 42.30% | -7787.38% |
| Median (Industry) | -8.77% | 17.01% | 12.15% |
| Standard Deviation (Industry) | 165.51% | 120.91% | 49765.17% |
|  |  |  |  |
| JNJ | 11.71% | 15.89% | 34.73% |

1. Wal-Mart (WMT):Wal-Mart Stores, Inc. operates retail stores in various formats worldwide. It operates through three segments: Walmart U.S., Walmart International, and Sam’s Club. It operates 11,695 stores under 59 banners in 28 countries and e-commerce Websites in 11 countries. Wal-Mart Stores, Inc. was founded in 1945 and is headquartered in Bentonville, Arkansas. WMT = SIC Code 5331 – Variety Stores

|  |  |  |  |
| --- | --- | --- | --- |
| **Fiscal Year 2016** | **ROA %** | **LT Debt to Assets %** | **EBITDA Margin %** |
| Mean (Industry) | 7.70% | 0.18% | 9.15% |
| Median (Industry) | 7.31% | 0.20% | 10.40% |
| Standard Deviation (Industry) | 3.70% | 13.10% | 3.66% |
|  |  |  |  |
| WMT | 6.86% | 2.11% | 6.14% |

1. Citigroup (C)**:** Citigroup Inc., a diversified financial services holding company, provides various financial products and services for consumers, corporations, governments, and institutions worldwide. The company operates through two segments, Citicorp and Citi Holdings. As of December 31, 2016, it operated 2,649 branches in 19 countries. The Citi Holdings segment provides consumer loans; and portfolio of securities, loans, and other assets. Citigroup Inc. was founded in 1812 and is based in New York, New York. C = SIC Code 6199 – Finance Services

|  |  |  |  |
| --- | --- | --- | --- |
| **Fiscal Year 2016** | **ROA %** | **LT Debt to Assets %** | **EBITDA Margin %** |
| Mean (Industry) | 0.99% | 9.50% | 30.75% |
| Median (Industry) | 0.99% | 5.89% | 30.75% |
| Standard Deviation (Industry) | 0.22% | 4.15% | 13.19% |
|  |  |  |  |
| C | 0.83% | 9.50% | 40.10% |

1. Proctor and Gamble (PG)**:** Proctor & Gamble (PG) is an American consumer goods corporation located in Cincinnati, OH. The company primarily specializes in a variety of cleaning agents, personal care, and hygienic products. Some of their most notable brands include Bounty (paper towels), Pampers (disposable diapers), Gillette (personal care products), Crest (toothpaste and oral care), Tide (laundry detergent), Swiffer (household cleaning supplies), and many others. PG’s portfolio previously included food and snacks; the company developed the snack “Pringles” in 1967, which was sold to Kellogg’s in 2012. PG = SIC Code 2840 – Soap, Detergents, Cleaning Preparations, Perfumes, Cosmetics

|  |  |  |  |
| --- | --- | --- | --- |
| **Fiscal Year 2016** | **ROA %** | **LT Debt to Assets %** | **EBITDA Margin %** |
| Mean (Industry) | 6.20% | 17.77% | 16.74% |
| Median (Industry) | 7.31% | 17.42% | 17.93% |
| Standard Deviation (Industry) | 4.69% | 2.70% | 10.42% |
|  |  |  |  |
| PG | 8.27% | 14.90% | 26.71% |

1. United Technologies (UTX)**:** United Technologies Corp (UTX) is an American corporation that is located in Farmington, CN. The company researches, develops, and manufactures high-technology products in many areas, including aircraft engines, HVAC, elevators, and escalators. It is also one of the biggest defense contractors for the U.S government. Its products and brands consist of Carrier, Interlogix, Chubb, and others. UTX = SIC Code 3724 - Aircraft Engines and Engine Parts

|  |  |  |  |
| --- | --- | --- | --- |
| **Fiscal Year 2016** | **ROA %** | **LT Debt to Assets %** | **EBITDA Margin %** |
| Mean (Industry) | 1.53% | 17.49% | 14.61% |
| Median (Industry) | 5.63% | 22.44% | 16.92% |
| Standard Deviation (Industry) | 8.91% | 10.12% | 10.81% |
|  |  |  |  |
| UTX | 7.66% | 22.45% | 16.92% |

# Stock Performance Analysis

### Daily Stock Statistics

Below you can find the daily average return and standard deviation of our stock picks for the year 2016:

|  |  |  |
| --- | --- | --- |
| **Company** | **Mean Daily Return** | **Standard Deviation** |
| AAPL | 0.000575 | 0.014701 |
| C | 0.000787 | 0.020026 |
| JNJ | 0.000602 | 0.008496 |
| PG | 0.000396 | 0.008969 |
| UTX | 0.000686 | 0.010928 |
| WMT | 0.000663 | 0.012132 |

Based on the data, it appears that Citigroup was the most volatile stock (high relative Standard Deviation) in our portfolio during that period while also possessing the highest average daily return.

### Capital Asset Pricing Model (CAPM)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Company | alpha | alpha  P-Value | Beta | Beta  P-Value |
| AAPL | 0.00009 | 0.90668 | 0.94 | 0.00000 |
| UTX | 0.00024 | 0.63371 | 0.86 | 0.00000 |
| PG | 0.00013 | 0.79098 | 0.51 | 0.00000 |
| JNJ | 0.00034 | 0.46512 | 0.51 | 0.00000 |
| WMT | 0.00044 | 0.55166 | 0.44 | 0.00000 |
| C | -0.00016 | 0.83991 | 1.86 | 0.00000 |

The CAPM model confirms that none of our stocks had a significant alpha, which shows no arbitrage opportunities in our portfolio. All of our stocks had a significant beta with a beta p-value <0.01. The most volatile stock is Citigroup with a beta of 1.86 and the least volatile is Walmart with a beta of 0.44.

### Fama-French 3 Factor Model

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Company | alpha | alpha  P-Value | Beta | Beta P-Value | SMB | SMB P-Value | HML | HML P-Value |
| AAPL | 0.00060 | 0.42768 | 1.03 | 0.00000 | -0.19930 | 0.18007 | -0.64384 | 0.00000 |
| UTX | 0.00010 | 0.83992 | 0.86 | 0.00000 | -0.02858 | 0.77740 | 0.19303 | 0.03152 |
| PG | 0.00031 | 0.51878 | 0.62 | 0.00000 | -0.50441 | 0.00000 | -0.14561 | 0.08013 |
| JNJ | 0.00052 | 0.25915 | 0.57 | 0.00000 | -0.25140 | 0.00577 | -0.19607 | 0.01468 |
| WMT | 0.00072 | 0.32092 | 0.54 | 0.00000 | -0.39532 | 0.00596 | -0.31027 | 0.01445 |
| C | -0.00100 | 0.13223 | 1.79 | 0.00000 | -0.04856 | 0.70987 | 1.13903 | 0.00000 |

The 3 factor model is the standard CAPM plus two additional factors; SMB (Small vs. Big) and HML (High book-to-market ratio vs. Low book-to-market ratio). The addition of the new independent variables did alter the beta for all of our stocks but did not change the significance of the alpha.

### Safety First Ratio (SFRatio)

We conducted a Safety-First ratio (2016 data) for each individual stock in our portfolio with a 3% threshold and attained the following results:

|  |  |  |
| --- | --- | --- |
| **Company** | **SF Ratio** | **Probability Stock Return < 3%** |
| Apple Inc | 0.64 | 26.09% |
| United Tech Corp | 1.06 | 14.56% |
| Procter & Gamble | 0.67 | 25.19% |
| Johnson & Johnson | 1.17 | 12.12% |
| Walmart Stores | 0.91 | 18.02% |
| Citigroup | 0.67 | 25.07% |

### Sharpe Ratio

|  |  |
| --- | --- |
| **Company** | **Sharpe Ratio for 2016** |
| AAPL | 0.69 |
| C | 0.71 |
| JNJ | 1.25 |
| PG | 0.75 |
| UTX | 1.12 |
| WMT | 0.97 |

Based on both the SFRatio and the Sharpe Ratio, it appears that our best risk adjusted stock in our portfolio is Johnson and Johnson and on the other end of the spectrum it is Apple. The primary difference between the SFRatio and Sharpe Ratio is the value the expected return is subtracted from in the numerator. For SFRatio it is a threshold return and Sharpe Ratio is the Risk Free Rate.

### Rank

Our performance on a per-stock basis is below, ranked from best to last:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Company** | **Rank** | **No. of Shares** | **Price Bought** | **Price Sold** | **Return** |
| C | 1 | 271 | $58.77 | $64.66 | 10.02% |
| AAPL | 2 | 176 | $141.39 | $154.78 | 9.47% |
| WMT | 3 | 231 | $73.75 | $79.23 | 7.43% |
| JNJ | 4 | 159 | $122.30 | $130.92 | 7.05% |
| UTX | 5 | 70 | $113.00 | $120.59 | 6.72% |
| **S&P 500** | **NA** | **NA** | **NA** | **NA** | **3.52%** |
| PG | 6 | 99 | $90.49 | $87.73 | -3.05% |

Most of our stock picks worked out in our favor, as 5 of our 6 stocks outperformed the S&P 500. Our overweights (AAPL, WMT, and JNJ) all outperformed the market making that the right decision. Our neutral weights (C, and PG) were split on performance, C was our best performer but PG was our worst performer. The right decision here would have been to go overweight on C and underweight on PG. And lastly, our only underweight (UTX) also outperformed the market and we would have been in a better position had we gone overweight to that stock. The best decision we made in the portfolio was to buy mega cap stocks, which outperformed the market and benefited our stock selection.

# Portfolio Optimization

### Methodology

We utilized 2016 daily return data to compile the average daily return of our six stocks (AAPL, UTX, PG, JNJ, WMT, and C). We used that data along with the 2016 daily Risk Free Rate of 0.01% to help us identify the proper weights of our stocks based on the optimal portfolio standard deviation and optimal Sharpe ratio. We targeted daily returns of 0.014%, 0.029%, 0.043%, 0.057%, 0.071%, and 0.107%. Based on the risky assets, the most conservative and the most aggressive portfolios would contain the following weights:

|  |  |  |
| --- | --- | --- |
| **Company** | **Conservative** | **Aggressive** |
| AAPL | 14.15% | 1.72% |
| UTX | 20.87% | 29.66% |
| PG | 61.23% | -59.78% |
| JNJ | 14.40% | 76.26% |
| WMT | -10.65% | 52.13% |
| C | -43.23% | 36.87% |
|  |  |  |
| Daily Portfolio Standard Deviation | 0.86% | 1.43% |
| Daily Return | 0.014% | 0.107% |

In the conservative portfolio, the mode shorts WMT and C and go long AAPL, UTX, PG, and JNJ. We would have an **expected annual return of 5.21%** and a **standard deviation of 16.46%.** Alternatively, in our aggressive portfolio the model would have us take a large short position in PG, and go long in AAPL, UTX, JNJ, WMT, and C. In this model we would have an **expected annual return of 39.11%** and a **standard deviation of 27.29%.**

### Global Minimum Variance

Our Global Minimum Variance model provided the following weights, daily standard deviation, and daily average return:

|  |  |
| --- | --- |
| **Company** | **Weight** |
| AAPL | 7.69% |
| UTX | 16.56% |
| PG | 27.21% |
| JNJ | 39.50% |
| WMT | 13.89% |
| C | -4.84% |
|  |  |
| Daily Portfolio Standard Deviation | 0.68% |
| Daily Return | 0.056% |

Based on the optimal minimum variance model, we would short C and go long AAPL, UTX, PG, JNJ, and WMT. Would this portfolio allocation, we would have an **expected annual return of 20.33%** with a **standard deviation of 12.94%.**

### Tangent Portfolio

To achieve the optimal Sharpe ratio, we used the data mentioned under “methodology” and achieved the following weights:

|  |  |
| --- | --- |
| **Company** | **Weight** |
| AAPL | 6.66% |
| UTX | 25.39% |
| PG | 0.00% |
| JNJ | 45.44% |
| WMT | 22.52% |
| C | 0.00% |
|  |  |
| Daily Portfolio Standard Deviation | 0.72% |
| Daily Return | 0.064% |
| Sharpe Ratio | 7.67% |

In this model, we would invest in everything but C. Through this allocation, we would achieve an **expected annual return of 23.18%** and a **standard deviation of 13.77%**. This portfolio has an optimized **Sharpe Ratio of 7.67%**.

### Efficient Frontier

We have provided the Efficient Frontier below:

# Reflection

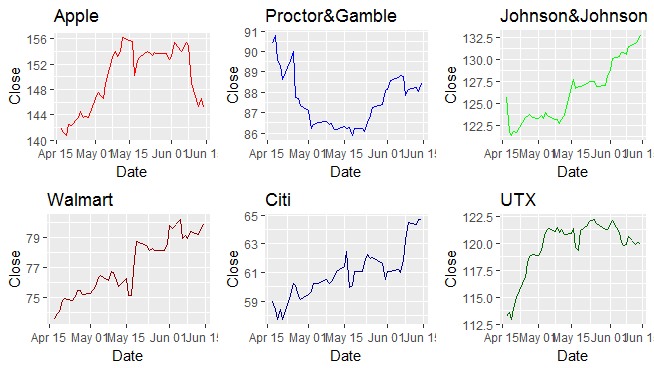
Overall, our investment strategy was a success and we beat S&P returns by over 3%. The CAPM model correctly predicted that Citigroup would be the riskiest asset in our portfolio which generated the highest returns at 10%. However, the CAPM model predicts that Apple’s returns should be relatively close to the market based on a Beta of 0.94, but Apple still outperformed the market and generated our second largest returns of 9.47%. In summary, the CAPM could offer some guidance for longer term strategies, but was not accurate in the short term for our portfolio.

Based on the tangency of the efficiency, our optimal portfolio allocation should not have included any allocation for Proctor&Gamble and Citigroup. While Proctor&Gamble was the only stock in our portfolio that generated negative returns, it would not have worked in our favor to follow this strategy. As we mentioned above, Citigroup generated the largest returns.

While our portfolio could have been further diversified by adding assets from other industries in the market including Energy, Utilities, Real Estate, and Telecom, our top down sub-asset allocation approach allowed us to outperform the market by being selective in the sectors we invested in.

# Appendix

### Portfolio Performance

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