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Measuring Portfolio Risk & Performance

Abstract

The goal of this project was to understand the calculations of a zero-cost portfolio and how this information can influence investors behavior. It is important to understand the effects and possible benefit of risk as it pertains to future portfolios. When understanding risk within a portfolio, there is a higher probability for future investment decisions to be made rationally. Analyzing straightforward quantitative data allows investors have the resources and potential to make coherent daily and future investment choices.

Measuring Portfolio Risk & Performance:

In order to create a zero-cost portfolio, calculations of twelve different firms were gathered. The twelve companies consist of the following: Apple Inc. (AAPL), General Motors (GM), Walmart Inc. (WMT), Target Corporation (TGT), Microsoft Corporation (MSFT), Delta Airlines (DAL), GNC Holdings, Inc. (GNC), Vanguard Information Technology Index Funds Admiral Shares (VITAX), Nike Inc. (NKE), Comcast Corporation (CMCSA), L'Oréal (OR.PA), and Nordstrom Inc. (JWN). The monthly adjusted close for each firm was gathered from Yahoo Finance over a five-year period beginning March 2015 and ending March 2020.

The goal of this analysis was to develop the best trading strategy through observation of historical data with consideration of risk. After comparing the Sharpe ratio of the twelve firms, the four firms with the largest Sharpe ratio would establish the long portfolio whereas the four firms with the smallest Sharpe ratio would create the short portfolio. The combination of the long-short portfolio results in a zero-cost portfolio for an ideal and rational trading decision.

I. Fama French Model:

Historical values from Fama French Model in addition to firm value data and formulas can be found in the "WK1AssgnAslanianM." Excel file. Selected data from the evaluation will be explained in detail. The first piece of data gathered includes data from the Fama French three factor file. From March 2015 through March 2020, the risk-free rate as well as the deviation between the market and risk-free rate were collected. Three other factors that were gathered included small minus big (SMB), high minus low (HML), and momentum (MOM). This data was converted into decimals to assist in other avenues of the analysis. The addition of one was added to the market return to assist in obtaining the geometric average. The total return of the market was calculated as well (French, 2020).

II. Description of Firm's Calculations:

After gathering sixty months' worth of data, the monthly return was calculated from the adjusted close price. This formula consisted of the adjusted close price of month two minus the adjusted close price of month one price divided by the adjusted close price of month one. Excess monthly returns were gathered by subtracting the calculated monthly returns by the risk-free rate. The market excess returns were gathered by subtracting the market by the risk-free rate. This monthly return value was used on a continual basis throughout the analysis. For each firm, the difference between the monthly return and the risk-free rate was calculated. The four Fama French factors were also copied to the raw stock data in order to compare the values accurately.

The summary statistics sheet for the twelve firms is displayed in Exhibit One. This allowed for a comparison of the following: mean monthly arithmetic return, mean monthly geometric return, standard deviation of return, beta relative to the market, idiosyncratic volatility using CAPM, Sharpe ratio, Jensen's Alpha, beta of market, beta of SMB, beta of HML, beta of MOM, and the four-factor monthly alpha.

III. Exhibit One: Risk and Performance Measures for all Firms

In order to obtain the mean monthly arithmetic return, the average of the individual

	Mean Monthly Arith. Return	Mean Monthly Geom. Return	STD. Deviation of Return	Beta Relative to the Market	Idiosyncratic Volatility using CAPM	Sharpe Ratio	Jensen's Alpha	Beta MKT	Beta SMB	Beta HML	Beta Mom	Four-Factor Monthly Alpha
MSFT	0.027715439	0.026066453	0.059012286	0.867787434	0.002258196	0.46965541	0.023541661	1.1026914	-0.864231	-0.268198	-0.012805	0.017259948
AAPL	0.017456124	0.015278032	0.07841138	1.103547455	0.00416852	0.22262233	0.012148417	1.2891193	-0.211038	-0.520189	0.0659563	0.006981906
NKE	0.011992196	0.010291233	0.058869642	0.781710722	0.002472206	0.20370765	0.00823242	0.7846706	0.0584299	0.1918873	0.1461765	0.008259837
WMT	0.01022821	0.008843461	0.052751025	0.245018409	0.002685072	0.19389595	0.009049751	0.4102548	-0.55355	-0.066316	0.0884581	0.004984292
OR.PA	0.008248574	0.007346303	0.042971863	0.398491666	0.001588424	0.19195291	0.006331958	0.4836123	-0.06394	-0.155021	0.0945809	0.003518541
TGT	0.010883486	0.007936756	0.078356755	0.598442397	0.005557558	0.13889659	0.008005171	0.6602134	0.2359025	0.232345	0.4115669	0.007576168
CMCSA	0.007044433	0.005136782	0.061687088	0.949065821	0.002340972	0.11419623	0.002479732	0.9736399	-0.470828	0.0444562	-0.161649	0.000977432
GM	-0.002080967	-0.005768153	0.084697365	1.509928759	0.003467198	-0.0245694	-0.009343237	1.2894534	0.2716062	0.7908556	0.0297654	-0.003261441
DAL	-0.00521398	-0.010027357	0.094123696	1.533100342	0.005038192	-0.055395	-0.012587698	1.591915	-0.480083	0.9699936	0.4401103	-0.010043917
JWN	-0.011720408	-0.020940548	0.124068102	1.333593763	0.012501603	-0.0944675	-0.018134564	0.858173	0.8471229	1.5119523	0.0937001	-0.004621072
VITAX	-0.011720408	-0.020940548	0.124068102	1.333593763	0.012501603	-0.0944675	-0.018134564	0.858173	0.8471229	1.5119523	0.0937001	-0.004621072
GNC	-0.049200389	-0.069863208	0.181607627	2.029315089	0.026286436	-0.2709159	-0.05896074	1.8241181	1.0785301	1.0112689	0.6187228	-0.051244643
Market-Rf	0.004809677	0.004122429	0.040320172	1	0	0.11928712	0					

Risk Free Rate	0.0033	
5 Year T-Bond		

firms' excess returns was used. This translates into the calculated monthly return subtracted by the risk-free rate. The value of one was added to each excess monthly return to calculate the geometric return. This value was used in the excel function, GEOMEAN, followed by the subtraction of one to accurately calculate the mean monthly geometric return. Of course, the

excel function, STDEV, was used to gather the standard deviation of each firm's excess monthly return.

When calculating the beta relative to the market, the excel function, SLOPE, was used. The y variable for the slope consisted of the firm's excess monthly returns while the x variable contained the return of the market. For the idiosyncratic volatility, the variance of the stock was subtracted by the beta relative to the market squared multiplied by the standard deviation of the market squared. This allows for the total risk of firm to be subtracted by systematic risk to display the portion of risk unexplained by the market. To test whether a firm is correctly priced, Jensen's alpha, similar to CAPM alpha, was gathered. This calculation was derived by subtracting the firm's mean monthly arithmetic return by firm's beta relative to the market multiplied by the mean monthly arithmetic return of the market excess. One can also gather this information from a regression analysis. Similarly, the four factors, beta of the market, beta of SMB, beta of HML, and four-factor monthly alpha was collected through a four-factor regression analysis.

IV. The Sharpe Ratio:

The Sharpe ratio is one of the most important calculations for achieving the short-long portfolio. The ratio allows one to measure risk-adjusted returns by dividing the mean monthly arithmetic return by the firm's standard deviation of return. When the Sharpe ratio is high, it means that the returns are better compared to the firm's risk. Out of the twelve firms, Microsoft Corporation (MSFT), Apple Inc. (AAPL), Nike, Inc. (NKE), and Walmart Inc (WMT) fell within the top one-third based on the Sharpe ratio values. This means that these stocks have a greater potential to perform well in the future. MSFT has the highest Sharpe ratio with AAPL and NKE following closely behind. These four firms are represented in the long portfolio. The

four stocks that fall within the lower Sharpe ratio are Delta Airlines (DAL), Nordstrom, Inc. (JWN), Vanguard Information Technology Index Funds Admiral Shares (VITAX), and GNC Holdings, Inc (GNC). JWN and VITAX have the same Sharpe ratio with GNC being the lowest value. The lower four firms make up the short portfolio.

V. The Capital Asset Pricing Model (CAPM):   **V. Part One: CAPM Expected Return Formula**

The Capital Asset Pricing Model (CAPM) is appropriate to use in this type of analysis to assist in determining the appropriate required rate of return. The CAPM can also assist in decision making for a more diversified portfolio. The basic formula can be seen in Part One.

$$ER_i = R_f + \beta_i(ER_m - R_f)$$
where:
ER_i = expected return of investment
R_f = risk-free rate
β_i = beta of the investment
$(ER_m - R_f)$ = market risk premium

CAPM was used in this analysis for the regression as well as when calculating Jensen's alpha. The regression performed closely examined the relationship between expected risk and returns for each firm. This regression was also performed for the long portfolio, the short portfolio, and the short-long portfolio. The model allows for a greater idea of the required return for the portfolio in addition to the beta coefficient, or risk, that the asset has taken on in the past.

In addition to the regression analysis, Jensen's alpha was calculated in order to determine a prediction of abnormal return. A positive alpha value often means the stock will outperform the benchmark whereas a negative alpha shows the stock will underperform. Of course, a beta of less than one also means the firm will be less prone to change than the market.
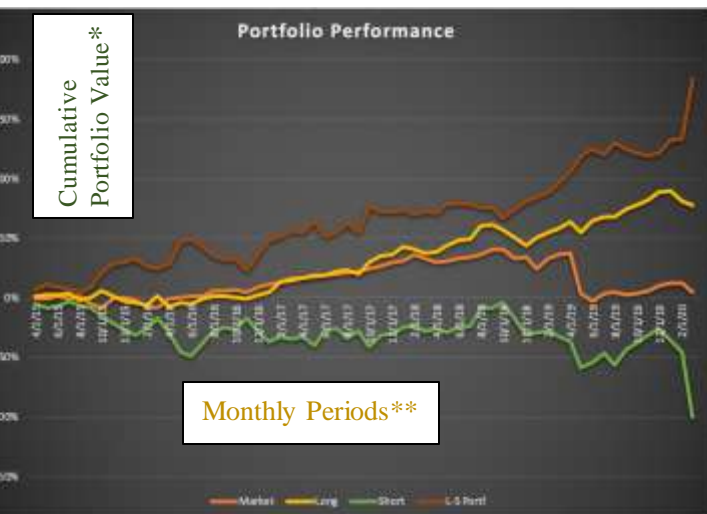
For the long portfolio and the short portfolio, the excess return was calculated by multiplying each firm's excess return by its portfolio weight. All four portfolio weights in the short and long portfolio add up to one. When constructing the long-short portfolio, otherwise named the zero-cost portfolio, the excess returns were gathered by subtracting the short portfolio

excess returns by the long portfolio excess returns. Summary statistics for the long portfolio, the short portfolio, and the long-short portfolio are included in Exhibit Two.

VI. Exhibit Two: Annual Returns

	Mean Monthly Arith.Return	Mean Monthly Geom.Return	STD. Deviation of Return	Beta Relative to the Market	Idiosyncratic Volatility using CAPM	Sharpe Ratio	Jensen's Alpha	Beta MKT	Beta SMB	Beta HML	Beta Mom	Four-Factor Monthly Alpha
Long Portfolio	0.01393523	0.01293424	0.04518128	0.80458573	0.00098893	0.3084294	0.01006544	0.943902	-0.30672	-0.190076	0.0829691	0.00869607
Short Portfolio	-0.016674	-0.0236367	0.10549677	1.44873818	0.00771745	-0.1580523	-0.0238742	0.943902	-0.30672	-0.190076	0.0829691	0.00669607
L-S Portfolio	0.030609239	0.026858263	0.093279214	-0.644152446	0.008029133	0.3281464	0.033707405	-0.166587	-0.9024	-1.532566	-0.132753	0.018791387

In order to determine the annual returns for the market and the three portfolios, the cumulative returns were calculated. These calculations were provided by adding the percentage of excess returns to each additional return value of the year prior. This process was repeated for the short portfolio, the long portfolio, and the short-long portfolio. After completing these calculations, a graph comparing the market and the three portfolios was created. This can be seen in Exhibit Three.

*Cumulative Portfolio Values based on a one-hundred-dollar investment
**Numbers of monthly periods over five years

VII. Exhibit Three: Graph Containing Cumulative Annual Returns

After calculating the portfolio performance, I was surprised to see a significant decline in the short portfolio. The historical decline occurs around December making me wonder if these companies are negatively affected by the ending holiday season. The short-long portfolio displays the best results with the long portfolio following close behind. This trading strategy will lead to a positive alpha supporting the long-term risk and return effects of this decision. I definitely predict that MSFT will continue to perform well because of society's need for connectivity even in an economic hardship. Based on the data, it is best to sell the short portfolio. Comparing the risk with this data allows for rational investment decisions influencing more informative financial decision choices.

Reference

Apple Inc. (AAPL) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020, from

    https://finance.yahoo.com/quote/AAPL/history?p=AAPL

Comcast Corporation (CMCSA) Stock historical prices & data. (2020, May 9). Retrieved May 9,

    2020, from https://finance.yahoo.com/quote/cmcsa/history?p=

Delta Air Lines, Inc. (DAL) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020,

    from https://finance.yahoo.com/quote/dal/history?p=

French, K. R. (2020, March 1). Fama/French 3 factors. Retrieved May 9, 2020, from

    http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Developed

General Motors Company (GM) Stock historical prices & data. (2020, May 9). Retrieved May 9,

    2020, from https://finance.yahoo.com/quote/gm/history?p=AAPL

GNC Holdings, Inc. (GNC) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020,

    from https://finance.yahoo.com/quote/gnc/history

L'OREAL (OR.PA) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020, from

    https://finance.yahoo.com/quote/OR.PA?p=OR.PA&.tsrc=fin-srch

Microsoft Corporation (MSFT) Stock historical prices & data. (2020, May 9). Retrieved May 9,

    2020, from https://finance.yahoo.com/quote/MSFT/history?p=MSFT

Nickolas, S. (2020, March 13). What is the formula for calculating capm in excel? Retrieved May 9,

    2020, from https://www.investopedia.com/ask/answers/071415/what-formula-calculating-

    capital-asset-pricing-model-capm-excel.asp

Nike, Inc. (NKE) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020, from

    https://finance.yahoo.com/quote/nke/history

Nordstrom, Inc. (JWN) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020, from

    https://finance.yahoo.com/quote/jwn/history

Sharpe Ratio - How to calculate risk adjusted return, formula. (2020, March 4). Retrieved May 9,

    2020, from https://corporatefinanceinstitute.com/resources/knowledge/finance/sharpe-ratio-

    definition-formula/

Target Corporation (TGT) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020,

    from https://finance.yahoo.com/quote/TGT/history?p=TGT

U.S. Department of the Treasury. (2020, May 8). Retrieved May 9, 2020, from

    https://www.treasury.gov/resource-center/data-chart-center/interest-

    rates/pages/textview.aspx?data=yield

Vanguard Information Technology (VITAX) Stock historical prices & data. (2020, May 9).

    Retrieved May 9, 2020, from https://finance.yahoo.com/quote/vitax/history

Walmart Inc. (WMT) Stock historical prices & data. (2020, May 9). Retrieved May 9, 2020, from

    https://finance.yahoo.com/quote/wmt/history