ECO475 Term Paper Proposal

Research Question: An Empirical Analysis of the Efficient Market Hypothesis and the Quantifiable Impact of Financial Metrics on Abnormal Returns

Relevance: The Efficient Market Hypothesis (EMH) is the notion that all publicly available information is reflected in the price of the stock leading to returns not greater than the market. This theory has been the foundation of multiple doubts regarding the financial market. The efficiency of the financial market is a crucial property since it establishes the approach investors should take when investing in equity markets. For instance, believers of the EMH often invest in index funds aiming to replicate the returns of major stock indices such as, S&P 500, DJIA, and NASDAQ. Furthermore, the EMH is essential to evaluate the funds allocated to information gathering. Investment intermediaries, such as mutual and hedge funds, assign millions of dollars to information gathering, thereby raising queries on whether these funds are being utilized efficiently, since this information should already be priced in. This paper adds to the existing literature by quantifying the impact of increments in financial metrics, relative to the consensus, on abnormal returns, as well as conducting analysis on the most The secondary portion of the paper is vital to assessing the influence of the independent variables for investors looking to generate positive alphas, since it highlights the importance that must be given to each financial metric when considering investment strategy.

Regression: There are three forms of the EMH, however this paper will only be analyzing the initial two forms. The weak form of the EMH articulates there exists no serial correlation between past and future price movements. To assess the accuracy of the weak form, I shall be conducting the regression given by Equation 1.1.

$$P_t = \beta_0 + \beta_1 P_{t-1} + \epsilon \qquad \text{(Equation 1.1)}$$

P_t and P_{t-1} correspond to value of the S&P 500 index in time period t and $t-1$ respectively. The S&P 500 is the index often used by participants in financial markets to gauge market performance and incorporates the performance of the 500 largest firms by market capitalization. I will be conducting a runs test and two unit root tests, the Augmented Dicky-Fuller test (ADF) test and Philips-Perron (PP) test, to assess the randomness of the returns. The weak form of the EMH dictates that the returns resemble a random walk and thus be nonstationary.

The semi-strong form of the EMH states that all publicly available information except corporate insider information is reflected in the price of the stock. I shall be first conducting the regression given by Equation 1.2 to estimate the beta of stock i, β, to estimate stock i's expected return using the Capital Asset Pricing Model (CAPM).

$$R_{it} = \alpha_0 + \beta_i M_t + \varphi \quad \text{(Equation 1.2)}$$

R_{it} corresponds to the returns of stock i above the risk-free rate at time period t whereas M_t corresponds to the market return above the risk-free rate at time period t. To determine the strength of this form, I shall be calculating the abnormal returns, at time t, given by Equation 1.3 and conducting the regression given by Equation 1.4.

$$r_{a_{it}} = r_{it} - [r_{f_t} + \beta_i \left(m_t - r_{f_t}\right)] \quad \text{(Equation 1.3)}$$

$$r_{a_{it}} = \theta_0 + \theta_1 \widehat{V_{it}} + \omega \quad \text{(Equation 1.4)}$$

$r_{a_{it}}$ corresponds to the abnormal return of stock i at time t. r_{it} and m_t correspond to realized returns of stock i and the market at time t. r_{f_t} corresponds to the risk free rate at time t. $\widehat{V_{it}}$, constrained to be greater than 0.5, corresponds to the standardized trading volume of stock i at time t. By using standardized trading volume, I am consolidating the publicly available information into a single element. Upon entry of new information, trading volume, and thus, standardized trading volume tends to increase. For instance, upon an earnings release, standardized trading volume surges, reflecting an infusion of new information. For the semi strong form to hold true, a *t-test* on θ_1 should reject the null hypothesis at the 5% significance level for $\theta_1 < 0$ signifying the entry of new information reducing the ability to attain abnormal returns and representing a negative linear relationship.

To complete the secondary part of this paper, I shall run a regression given by Equation 1.6.

$$r_{a_{it}} = \pi_{0i} + \pi_{1i} EPS + \pi_{2i} Div + \pi_{3i} Curr + \pi_{4i} DeEq + \tau \quad \text{(Equation 1.6)}$$

EPS and Div correspond to the surprise gains relative to the consensus. $Curr$ corresponds to the current ratio of the firm which is the current assets of a firm divided by the current liabilities. Finally, $DeEq$ corresponds to the debt to equity ratio which measures how leveraged a firm is. This regression will be quantifying the impact of financial metrics on abnormal returns to gauge the efficiency of the market.

Key Articles: Malkiel, Burton G. "Is the Stock Market Efficient?" *Science* 243, no. 4896 (1989): 1313-318. Accessed January 23, 2020. www.jstor.org/stable/1703677.

This article provides much of the background financial literary knowledge required to understand the EMH. It provides the key definitions of the two forms of the EMH my paper shall be analyzing. Nevertheless, it dives into the history of the EMH clarifying the initial research conducted on this topic. Although not handling any data itself, the paper debates the empirical analysis conducted by others, thereby laying the foundation of few of the arguments presented in my research paper. The article expounds historical findings exploring the weak form, providing arguments which reason with and against the evidence. Finally, the paper offers its own perspective on the anomalies observed when testing the weak form, attempting to explain the logic behind the existence of these anomalies.

Khan Masood Ahmad, Shahid Ashraf, and Shahid Ahmed. "Testing Weak Form Efficiency for Indian Stock Markets." *Economic and Political Weekly* 41, no. 1 (2006): 49-56. Accessed January 23, 2020. www.jstor.org/stable/4417642.

This article explores the weak form in the Indian stock market. It conducts statistical analysis of its own through multiple unit root tests, out of which only two will be utilized in the writing of my research paper, the ADF-GLS and PP. Thus, this paper proves to be of great importance since it follows the similar procedure applied to the US market. The article explores the importance of each test providing a detailed explanation of methodology along with a clear interpretation of the results. Furthermore, it also conducts a non-parametric test, a runs test, which I shall also be incorporating in my research paper.

Wooldridge, Jeffrey M. *Introductory Econometrics: A Modern Approach*. Boston, MA: Cengage, 2016.

This book provides extremely critical foundation for unit root tests, providing an introduction into the Dicky-Fuller test, the bedrock of ADF. I shall be using Chapters 11 and 18 mostly to test for serial correlation in my time series analysis of the weak form. The mathematical notation in this text is limited relative to articles addressing similar topics, thereby making it easier to understand. The serial correlation is focussed on autoregressive models of order one, which my research paper focusses on. Chapter 11 introduces the subject of weakly dependent time series and basic statistical

terms along with some mathematical background surrounding the material. It further explores random walks, both with and without drift. Finally, Chapter 18 focusses much more on the tests to identify unit roots and will be providing me with the framework to identify them in my S&P 500 time series.

Data: My data has been taken from Yahoo Finance and US Department of the Treasury. The frequency of my data is daily and is from 1st January 2015 to 31st December 2019 to evaluate the EMH for the most recent data set for uniqueness. To assess the weak form, I shall be using a time series of the S&P 500 over the specified period whereas to assess the semi-strong form, a panel data would be used of the top 10 firms in S&P 500 ranked by market capitalization (S&P 500 Companies). The risk-free rate is taken from the US Department of the Treasury as the daily Treasury yields. For the secondary part, since earnings report are released quarterly, the frequency of my data will be quarterly over the specified time frame and the data will be collected from Macrotrends.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	154.3658	43.96196	90.34	291.52
VOL	1,257	3.59e+07	1.79e+07	1.14e+07	1.62e+08
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0780842	1.569293	-10.49244	6.805254
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0675449	1.569349	-10.50371	6.79331
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0417105	1.052491	-5.193905	6.002121
ARET_n	1,256	.0363737	1.164068	-7.379697	7.186976
STDVOL	1,257	9.38e-17	1	-1.372147	7.060058

Figure 1 – Summary Statistics for Apple (AAPL)

"Apple Inc. (AAPL) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020.

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

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	1114.464	531.7384	286.95	2039.51
VOL	1,257	4191475	2251226	881300	2.39e+07
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.1424739	1.826339	-8.142352	13.21779
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.1319346	1.826353	-8.155328	13.20815
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.043692	1.119398	-5.524822	6.382907
ARET_n	1,256	.0987818	1.443067	-11.13925	14.57766
STDVOL_n	1,256	.0004981	1.000242	-1.470388	8.735073

Figure 2 – Summary Statistics for Amazon (AMZN)

"Amazon.com, Inc. (AMZN) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020. https://ca.finance.yahoo.com/quote/AMZN/history?p=AMZN&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	174.109	29.85878	124.13	227.05
VOL	1,257	3808007	1489099	961100	1.49e+07
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0329925	1.046282	-6.072023	5.13353
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0224532	1.046299	-6.083808	5.121784
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0353377	.8373089	-4.129629	4.77746
ARET_n	1,256	-.0023452	.6273799	-3.175678	4.920368
STDVOL	1,257	-1.38e-16	1	-1.911832	7.453967

Figure 3 – Summary Statistics for Berkshire Hathaway Class B (BRK-B)

"Berkshire Hathaway Inc. New (BRK-B) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020. https://ca.finance.yahoo.com/quote/BRK-B/history?p=BRK-B&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	143.0239	38.06147	74.05	217.5
VOL	1,257	2.26e+07	1.40e+07	5913100	1.70e+08
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0762473	1.788918	-21.02387	14.4286
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.065708	1.788932	-21.03609	14.41856
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0403896	1.007888	-4.973299	5.748269
ARET_n	1,256	.0358578	1.477965	-20.66077	13.77548
STDVOL	1,257	1.36e-16	1	-1.193659	10.50912

Figure 4 – Summary Statistics for Facebook (FB)

"Facebook, Inc. (FB) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020.

https://ca.finance.yahoo.com/quote/FB/history?p=FB&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	926.7542	225.7551	497.06	1362.47
VOL	1,257	1863761	942706.9	520600	1.29e+07
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0738997	1.488639	-7.798239	15.06453
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0633605	1.488653	-7.809509	15.05315
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0402996	1.004852	-4.958283	5.730991
ARET_n	1,256	.0336001	1.098317	-7.908798	14.93568
STDVOL	1,257	9.68e-17	1	-1.424792	11.66252

Figure 5 – Summary Statistics for Google (GOOGL)

"Alphabet Inc. (GOOGL) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020.

https://ca.finance.yahoo.com/quote/GOOGL/history?p=GOOGL&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	122.1841	14.98424	90.73	148.14
VOL	1,257	7284336	3259963	2353800	5.81e+07
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0262279	1.036144	-10.57815	4.839489
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0156886	1.036157	-10.59041	4.829449
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0278257	.5836585	-2.875091	3.333867
ARET_n	1,256	-.0015978	.8561129	-9.256111	3.870043
STDVOL	1,257	-1.21e-16	1	-1.512452	15.60014

Figure 6 – Summary Statistics for Johnson and Johnson (JNJ)

"Johnson & Johnson (JNJ) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020.

https://ca.finance.yahoo.com/quote/JNJ/history?p=JNJ&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	89.13779	22.43721	53.07	139.14
VOL	1,257	1.48e+07	5873175	3324300	5.62e+07
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0634396	1.324694	-7.200853	7.999926
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0529004	1.324716	-7.209266	7.990838
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0400798	.9974291	-4.921571	5.688747
ARET_n	1,256	.0233598	.8717487	-3.349511	5.728859
STDVOL	1,257	-8.20e-17	1	-1.948722	7.052883

Figure 7 – Summary Statistics for JP Morgan (JPM)

"JP Morgan Chase & Co. (JPM) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020. https://ca.finance.yahoo.com/quote/JPM/history?p=JPM&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	81.00512	31.98594	40.29	158.96
VOL	1,257	2.91e+07	1.40e+07	7425600	1.69e+08
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0967332	1.467684	-9.709859	9.941299
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0861939	1.467685	-9.718629	9.931656
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.043612	1.116696	-5.511458	6.367529
ARET_n	1,256	.0531212	.9523763	-7.932939	9.648146
STDVOL	1,257	7.54e-17	1	-1.55427	10.028

Figure 8 – Summary Statistics for Microsoft (MSFT)

"Microsoft Corporation (MSFT) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020. https://ca.finance.yahoo.com/quote/MSFT/history?p=MSFT&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	89.22811	13.01195	68.06	126.09
VOL	1,257	9044083	6910089	2022100	1.24e+08
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0254282	.9958752	-4.244842	8.432838
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0148889	.9958695	-4.256985	8.419584
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0248224	.482252	-2.373541	2.756735
ARET_n	1,256	.0006058	.8712982	-4.166021	8.447654
STDVOL	1,257	4.45e-17	1	-1.016193	16.59771

Figure 9 – Summary Statistics for Proctor and Gamble (PG)

"Procter & Gamble Company (The) (PG) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020. https://ca.finance.yahoo.com/quote/PG/history?p=PG&.tsrc=fin-srch.

Variable	Obs	Mean	Std. Dev.	Min	Max
CLOSE	1,257	109.0905	37.1487	61.59	189.39
VOL	1,257	8441344	3745157	2188800	5.07e+07
MARKET	1,257	2452.024	356.9189	1829.08	3240.02
RET_n	1,256	.0829639	1.283966	-5.413717	7.178712
MRKTRET_n	1,256	.0356648	.8483534	-4.184254	4.840318
RISKFREE	1,257	.0105387	.0013627	.0073016	.0135317
RISKP_n	1,256	.0724246	1.283962	-5.422805	7.168871
MRKTRISKP_n	1,256	.0251255	.8483839	-4.19604	4.828373
PRET_n	1,256	.0393406	.9724702	-4.798127	5.546699
ARET_n	1,256	.0436233	.8383318	-4.949672	5.398131
STDVOL	1,257	1.87e-17	1	-1.669501	11.27233

Figure 10 – Summary Statistics for Visa (V)

"Visa Inc. (V) Stock Historical Prices & Data." Yahoo! Finance. Yahoo!, January 23, 2020.

https://ca.finance.yahoo.com/quote/V/history?p=V&.tsrc=fin-srch.

*All variables of the form VARIABLE_n is due to the conversion of string to numerical values within Stata

*Summary statistics of P_t and P_{t-1} are provided with the summary statistics of individual stocks with the variable name MARKET representing the closing prices of the S&P 500 index after every trading day

*Summary statistics of EPS, Div, $Curr$, and $DeEq$ are not presented in the proposal as the provided summary statistics are of greater importance

*All data has been initially standardized using Excel and then imported into Stata to conduct statistical tests

Variable Name	Variable Description
CLOSE	The closing price of the respective individual stock at the end of each trading day
VOL	The trading volume of the respective individual stock at the end of each trading day
MARKET	The closing price of the S&P 500 index at the end of each trading day
RET_n	The daily return of the respective individual stock at the end of each trading day computed by taking the natural logarithm of CLOSE at time t divided by CLOSE at time t-1
MRKTRET_n	The daily return of the S&P 500 at the end of each trading day computed by taking the natural logarithm of MARKET at time t divided by MARKET at time t-1
RISKFREE	The daily risk-free rate computed by dividing the risk-free rate obtained from the US Department of the Treasury by 252 (there are 252 trading days on average each year)
RISKP_n	The risk premium of the respective individual stock at the end of each trading day calculated by subtracting RET_n at time t by RISKFREE at time t
MRKTRISKP_n	The risk premium of the S&P 500 index at the end of each trading day calculated by subtracting MRKTRET_n at time t by RISKFREE at time t
PRET_n	The predicted return of the respective individual stock at the end of each trading day calculated by the CAPM
ARET_n	The abnormal return of the respective individual stock at the end of each trading day computed by subtracting RET_n at time t by PRET_n at time t
STDVOL	The standardized trading volume at the end of each trading day calculated by subtracting the average of the trading volumes over the specified time period from the realized trading volume at time t and dividing the difference by the standard deviation of the trading volumes over the specified time frame

*The table above lists the description of the variables stated in the summary statistics

Additional References (Not Included Above)

S&P 500 Companies - S&P 500 Index Components by Market Cap. Accessed January 23, 2020. https://www.slickcharts.com/sp500.

"S&P 500 (^GSPC) Historical Data." Yahoo! Finance. Yahoo!, January 23, 2020. https://ca.finance.yahoo.com/quote/^GSPC/history?p=^GSPC&.tsrc=fin-srch. (All market-based data has been taken from this source)

"U.S. Department of the Treasury." Daily Treasury Yield Curve Rates, January 23, 2020. https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield. (All data regarding the risk free has been taken from this source)