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A Two-Phase Optimal Portfolio Selection Using Sharpe Index Model Applied to the Athens Stock Exchange

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Abstract

Although in literature numerous multivariate models have been applied for optimal portfolio selection based on either market or accounting stock characteristics, whereby plenty of technical and/or fundamental criteria have been proposed, the problem is yet to be solved. This paper enhances a two-phased analysis that combines both fundamental and technical criteria, to overcome the aforementioned shortcomings. Initially, the fundamental characteristics of 25 stocks from 11 industries/sectors with the largest market capitalization, are compared to the performance of the Athens Stock Exchange FTSE/XA Large CAP Index, and hence two scoring tables are formed using different benchmarks, where the best performing stocks are selected. Subsequently, for these stocks, based on weekly data covering a 3-year period, the Sharpe Index Model is applied, and the best performing portfolio is selected. The estimated Sharpe Index Model (SIM) reveals that there are several opportunities to optimize return and diversify risk in an efficient manner, outperforming the FTSE Large Cap Index.

JEL Classifications: D53, G11, G12, G17, G23

Key words: Risk & Return, Technical Analysis, Fundamental Analysis, Sharpe Index Model

1. Introduction

Numerous studies in the literature have focused on portfolio optimization decisions, applying either fundamental analysis or technical analysis. At a company level, the fundamental analysis may include the study of financial figures, accounting statements, sales and assets, etc. In contrast, Technical Analysis does not deal with the fundamentals of a company or a market but studies the price changes from the past analyzing stock (or index) charts. The present paper aims into introducing an approach that combining the above two methods, leads to a more effective portfolio selection.

The paper is structured as follows: At the beginning, a brief literature review is presented. Then the analysis carried out in presented in 2 Phases, one for each Analysis type. In Phase I, using Fundamental Criteria, 2 different benchmarks were assumed, and 2 corresponding scoring tables were calculated according to which the initial selection process, based on Fundamental Criteria was completed. Then, the Sharpe Index Model was applied and according to Cut Off Rate Methodology of Elton & Gruber the optimal Portfolio was estimated, concluding the seconding selection process using Technical Analysis. The Optimal portfolio's profitability and risk were analyzed, and its predictability was also tested. Finally, the main conclusions are summarized and suggestion for further research are presented.

2. Literature Review

The modern portfolio theory was founded by Markowitz (1952) focusing on the estimation of the optimal return portfolio for the investor. Markowitz's portfolio theory provides a mathematical method for analyzing the performance of a portfolio based exclusively on the average value of the assets and the variance of the returns on the assets included in the portfolio.

Samanez (2006) stated that the Markowitz (1952) model requires estimates of the correlations of each pair resulting in the formation of a portfolio. This process requires the analyst to have a certain level of understanding in the construction and interpretation of the covariance matrix, increasing the number of assets, all while increasing the complexity level.

Elton and Gruber (1995) argued that the Sharpe Index Model (Sharpe, 1963) main advantage is its model construction ease. This model is the best way to present the formation of the covariance between the rates of return on assets. To establish the optimal portfolio while taking into account the Elton et al (2011) model, it is necessary to accept the Single-Index Model and the constant correlation model as the source of the covariance structure between various assets. They also stated that its Traynor Ratio is used to determine the assets that will be chosen for the optimal portfolio, so as to achieve results comparable to those obtained by quadratic programming.

Even though historical data is widely used to create optimal portfolios, many studies investigate the link between fundamental characteristics (corporate or sectoral financial data) and security prices. More specifically:

- As stated by McNamara and Cheng (2000), the Price/Earnings (P/E) valuation method is one of the most popular valuation methods used in the investment community, its usefulness relying on the fact that it compares the stock price of the company with its respective profits.
- Chan & Chen (1991) showed that the Price/Book Value ratio (P/BV) relates to efficiency as well as risk and growth. They also suggested that the P/BV ratio affects the company's production performance.
- Finally, Nukala & Rao (2021) revealed that the Debt/Equity Ratio (D/E) compares a company's Liabilities to its Equity and can also be used to estimate its leverage. Higher leverage rates may reasonably lead to higher risk for investors.

The comparison of the company's ratios with other industry or stock exchanges indices is suggested as a method for further enhancing optimal valuation analysis as well as detecting undervalued and/or overvalued stocks. Koller et al (2005) reported that traditional valuation methods along with the use of a Benchmark can assess more efficiently the existence or not of investment opportunities.

Pinho & Melo (2018) applied the Elton & Gruber Model in the PSI-20 Index of the Portuguese Stock Exchange, to analyze stocks offering a high Traynor Ratio for the period 2008-2016. They constructed an optimal portfolio composing of 4 stocks and analyzed its profitability and risk.

Marisetty (2012) applied the Cut-Off Rate Methodology using the Sharpe Index Model, to construct an optimal Portfolio for the Indian Stock Exchange for the year 2010. His optimal portfolio composed of 5 stocks its portfolio's profitability and risk were compared with NSE NIFTY Index.

Kyritsis & Kiohos (2001) showed that the Cut Off Rate Methodology is amongst the most popular methods used in the Investment Community and he applied it the Athens stock Exchange for the period 1997-1999. The Optimal Portfolio he constructed composed of 5 companies and his profitability and risk were compared to the Athens Stock Exchange FTSE Large Cap Index.

3 Methodology

The sample used in the present analysis consists of weekly closures of the 25 stocks (that belong to 11 sectors of economic activity), presented in Table 1 that follows, listed on the Athens Stock Exchange, that comprise the FTSE Large Cap Index for a period of 3 years, from 01/01/2016 to 31/12/2018. The weekly closures of the Athens Stock Exchange FTSE Large Cap Index for the aforementioned period were used as well. ADMIE was the only company with incomplete data for this period, as it went public at the end of June 2017 and although relative figures are presented, this stock was excluded from the study.

Two different Benchmarking options were considered as follows:

a) Using the sample companies' financial statements, we calculated the ***Sectoral Weight (X_i)*** of each stock as the percentage of participation of each company's capitalization in 2018 to the respective sector's capitalization in the same year (defining as sector: the sum of sample companies belonging in the same sector of economic activity) as presented in Table 1:

$$Xi = \frac{\boldsymbol{Capitalization}}{\sum \boldsymbol{Capitalization}}$$

b) We used each stock's weight in the ***Athens FTSE Large Cap Index (W_i)*** as presented in the final column of Table 1.

Table 1

The Greek Stock Exchange FTSE Large Cap Index Stocks and their relevant X_i and W_i weights

No	SECTOR	STOCK	A. SECTORAL WEIGHTS (Xi) %	B. FTSE WEIGHTS (Wi) %
1	BANKS	PIRAEUS BANK	44,90	2,04
2		ALPHA BANK	32,10	8,16
3		NATIONAL BANK	12,10	4,33
4		EUROBANK	10,90	5,30
5	INDUSTRIAL PRODUCTS	MYTILYNAIOS	50,40	4,11
6		VIOHALCO	33,10	0,90
7		PIRAEUS PORT	16,50	0,51
8	FOOD & BEVERAGE	COCA COLA	100,00	25,30
9	DOMESTIC PRODUCTS	JUMBO	72,90	6,54
10		SARANTIS	17,70	1,03
11		FOURLIS	9,40	0,90
12	FINANCIAL SERVICES	LAMDA	19,70	0,80
13		EXAE	80,30	1,10
14	REAL ESTATE	GRIVALIA	100,00	2,23
15	PUBLIC UTILITY SERVICES	TERNA	49,10	1,20
16		ADMIE	26,80	0,83
17		PUBLIC POWER CORP	24,10	0,82
18	TRAVELLING & ENTERTAINMENT	OPAP	83,20	7,97
19		AEGEAN	16,80	1,02
20	MANUFACTURING	TITAN	65,10	3,31
21		GEK	22,30	1,77
22		ELLAKTOR	12,60	0,74
23	OIL & GAS	HELLENIC PETROLEUM	53,30	2,10
24		MOTOR OIL	46,70	4,98
25	COMMUNICATIONS	OTE	100,00	11,95

1st Phase (Fundamental Analysis)

The following Ratios were considered:

- **P/E Ratio:** Price to Earnings ratio is the ratio for valuing a company that measures its current share price relative to its per-share earnings (EPS). A stock with a P/E ratio lower than other companies of the same sector is considered by investors that has higher risk or lower growth or both than the sector.

- **P/BV Ratio**: Price to Book Value ratio, is calculated by dividing the price of a share of stock by the book value per share. It expresses how analogous the stock price of the share is to its real value as it results from the equity, i.e the asset of the company. If the P/BV ratio of a stock is less than 1, it indicates that the market value of the stock is inferior to its book (internal) value.
- **D/E Ratio**: Debt to Equity Ratio indicates the amount of financing by debt via lenders, versus to the funding through equity via shareholders. Therefore D/E ratio is used to determine whether or not there is over-indebtedness in a business, indicating the security that the company offers to its lenders.

For each stock, using the relevant financial statements we calculated the annual P/E, P/BV and D/E ratios (for 2016, 2017 and 2018) and also their corresponding 3-year average ratios.

Two different weighting options were applied as to benchmarking P/E and P/BV ratios (as presented in the following Tables 2 and 3 respectively):

a) For each stock we compared its 3-year Average ratio to the relevant Stock Sectoral Ratio (using X_i from Table 1) calculated as follows:

$$Average\ Ratio = \frac{\sum_1^n\ Ratio}{n}$$

$$Benchmark\ 1: Stock\ Sectoral\ Ratio = \sum Xi * Average\ Ratio$$

b) For each stock we compared its 3-year Average ratio to the relevant Athens Stock Exchange FTSE Large Cap Ratio calculated (using W_i from Table 1) calculated as follows:

$$Average\ Ratio = \frac{\sum_1^{\mathrm{n}}\ Ratio}{n}$$

$$Benchmark\ 2: FTSE\ Large\ Cap\ Ratio = \sum Wi * Average\ Ratio$$

Coca-cola was excluded form calculations in order to correct for its extraneous high weight.

Table 2

Price/Earnings Ratio

No	SECTOR	STOCK	Price to Earnings Ratio					
			2016	2017	2018	AVERAGE P/E	Benchmark 1 Stock Sectoral Ratio	Benchmark 2 FTSE Index Ratio
1	BANKS	PIRAEUS BANK	0,00	0,00	0,00	0,00	0,00	0,00
2		ALPHA BANK	0,00	0,00	0,00	0,00		0,00
3		NATIONAL BANK	0,00	0,00	0,00	0,00		0,00
4		EUROBANK	0,00	0,00	0,00	0,00		0,00
5	INDUSTRIAL PRODUCTS	MYTILYNAIOS	9,07	38,24	8,93	18,71	18,43	0,77
6		VIOHALCO	0,00	10,77	11,49	7,42		0,67
7		PIRAEUS PORT	41,03	38,81	37,29	39,04		0,20
8	FOOD & BEVERAGE	COCA COLA	323,30	27,14	23,62	124,69	124,69	-
9	DOMESTIC PRODUCTS	JUMBO	16,90	16,72	15,47	16,36	17,53	1,07
10		SARANTIS	19,40	18,45	17,18	18,34		0,19
11		FOURLIS	0,00	49,03	26,06	25,03		0,24
12	FINANCIAL SERVICES	LAMDA	0,00	0,00	0,00	0,00	4,75	0,00
13		EXAE	66,90	0,00	0,00	22,30		0,25
14	REAL ESTATE	GRIVALIA	0,00	0,00	0,00	0,00	0,00	0,00
15	PUBLIC UTILITY SERVICES	TERNA	14,10	14,40	14,20	14,23	0,00	0,17
16		ADMIE	0,00	0,00	0,00	0,00		0,00
17		PUBLIC POWER CORP	0,00	0,00	0,00	0,00		0,00
18	TRAVELLING & ENTERTAINMENT	OPAP	15,27	24,04	22,30	20,68	18,68	0,09
19		AEGEAN	6,60	9,82	9,78	8,73		1,01
20	MANUFACTURING	TITAN	42,70	13,82	34,78	30,43	21,42	1,01
21		GEK	6,60	7,82	7,29	7,24		0,13
22		ELLAKTOR	0,00	0,00	0,00	0,00		0,00
23	OIL & GAS	HELLENIC PETROLEUM	4,10	5,71	7,08	5,63	5,87	0,12
24		MOTOR OIL	4,90	6,26	7,28	6,15		0,31
25	COMMUNICATIONS	OTE	31,20	76,88	0,00	36,03	36,03	4,31
								10,55

Table 3

Price/Book Value Ratio

No	SECTOR	STOCK	Price to Book Value Ratio					
			2016	2017	2018	AVERAGE P/BV	Benchmark 1 Stock Sectoral Ratio	Benchmark 2 FTSE Index Ratio
1	BANKS	PIRAEUS BANK	0,18	0,08	0,08	0,11	0,19	0,00
2		ALPHA BANK	0,26	0,25	0,26	0,26		0,02
3		NATIONAL BANK	0,24	0,26	0,27	0,26		0,01
4		EUROBANK	0,22	0,29	0,29	0,27		0,01
5	INDUSTRIAL PRODUCTS	MYTILYNAIOS	0,56	0,89	0,90	0,78	0,96	0,03
6		VIOHALCO	0,28	0,64	0,65	0,52		0,00
7		PIRAEUS PORT	2,65	2,33	2,13	2,37		0,01
8	FOOD & BEVERAGE	COCA COLA	6,00	3,80	3,80	4,53	4,53	-
9	DOMESTIC PRODUCTS	JUMBO	2,22	1,85	1,90	1,99	2,06	0,13
10		SARANTIS	2,58	2,52	2,54	2,55		0,03
11		FOURLIS	1,81	1,77	1,63	1,74		0,02
12	FINANCIAL SERVICES	LAMDA	0,97	1,25	1,48	1,23	0,97	0,01
13		EXAE	2,11	2,30	2,39	2,27		0,02
14	REAL ESTATE	GRIVALIA	2,20	2,25	2,23	2,23	2,23	0,05
15	PUBLIC UTILITY SERVICES	TERNA	1,00	1,40	1,20	1,20	1,01	0,01
16		ADMIE	0,81	0,80	0,85	0,82		0,01
17		PUBLIC POWER CORP	0,85	0,80	0,83	0,83		0,01
18	TRAVELLING & ENTERTAINMENT	OPAP	4,19	4,24	4,11	4,18	3,96	0,33
19		AEGEAN	3,09	3,02	2,46	2,86		0,03
20	MANUFACTURING	TITAN	1,57	1,50	1,19	1,42	1,14	0,05
21		GEK	0,52	1,12	1,03	0,89		0,02
22		ELLAKTOR	0,00	0,00	0,48	0,16		0,00
23	OIL & GAS	HELLENIC PETROLEUM	0,66	0,91	1,07	0,88	1,43	0,02
24		MOTOR OIL	1,70	1,95	2,29	1,98		0,10
25	COMMUNICATIONS	OTE	2,15	2,20	0,23	2,22	2,22	0,26
								1,19

Finally, for Debt/Equity the ratio for each year and for each company is calculated, then their average calculated, and each company's D/E ratio is compared to the average, as presented in Table 4 that follows. This methodology for calculating D/E ratio was applied for constructing both the scoring tables that follow.

Table 4

Debt/Equity Ratio

STOCK	2016	2017	2018	AVERAGE D/E
PIRAEUS BANK	7,30	6,12	6,12	6,52
ALPHA BANK	6,14	5,34	5,34	5,61
NATIONAL BANK	11,37	8,57	11,37	10,44
EUROBANK	8,50	7,40	10,50	8,80
MYTILINAIOS	1,42	1,25	1,14	1,27
VIOHALCO	2,16	0,00	0,03	0,73
PIRAEUS PORT	1,03	0,37	0,34	0,58
COCA COLA	0,43	3,90	4,15	2,83
JUMBO	0,16	0,17	0,29	0,20
SARANTIS	0,59	0,53	0,60	0,57
FOURLIS	0,03	1,51	1,44	0,99
LAMDA	2,60	2,80	2,60	2,67
EXAE	1,32	1,44	1,49	1,42
GRIVALIA	0,05	0,13	0,21	0,13
TERNA	7,07	3,34	3,33	4,58
ADMIE	0,00	0,00	0,00	0,00
PUBLIC POWER	2,11	1,74	2,57	2,14
OPAP	0,36	1,30	1,30	0,99
AEGEAN	-	1,75	2,83	2,29
TITAN	0,53	0,63	0,55	0,57
GEK	1,48	6,21	7,05	4,91
ELLAKTOR	3,35	3,47	3,71	3,51
HELLENIC PETROLEUM	2,60	2,50	2,70	2,60
MOTOR OIL	1,44	0,98	1,56	1,32
OTE	0,80	0,79	2,22	1,27
				2,58

Accordingly, the two Scoring Tables (presented in Table 5 that follows) are constructed, applying the following Selection Process:

- If a stock's 3year average P/E and P/BV ratios are greater than the relevant Benchmark ratio, the stock received the value 1 (Otherwise 0)

- If a stock's 3year average D/E ratio is lower than each Benchmark's ratio, the share received the value 1 (Otherwise 0)

From Table 5 it is evident that the stocks with the higher scores (i.e., 3 and 2) are mostly common in both Scoring Tables. The stocks that scored at least 2 in one of the two Scoring Tables were selected (marked with Bold letters and grey lines in Table 5) in this selection phase, 13 in total, namely: Mytilinaios, Piraeus Port, Coca Cola, Jumbo, Sarantis, Fourlis, EXAE, Grivalia, Opap, Aegean, Titan, Motoroil and OTE.

Table 5

Scoring Tables

	SCORING TABLE 1:				SCORING TABLE 2:			
	STOCK SECTORAL WEIGHTS				ATHENS FTSE LARGE CAP INDEX WEIGHTS			
STOCK	**PE**	**PBV**	**D/E**	**SCORING**	**P/E**	**P/BV**	**D/E**	**SCORING**
PIRAEUS BANK	0	0	0	0	0	0	0	0
ALPHA BANK	0	0	0	0	0	0	0	0
NATIONAL BANK	0	1	0	1	0	0	0	0
EUROBANK	0	1	0	1	0	0	0	0
MYTILINAIOS	1	0	1	2	1	0	1	2
VIOHALCO	0	0	1	1	0	0	1	1
PIRAEUS PORT	1	1	1	3	1	1	1	3
COCA COLA	1	1	0	2	1	1	0	2
JUMBO	0	0	1	1	1	1	1	3
SARANTIS	1	1	1	3	1	1	1	3
FOURLIS	1	0	1	2	1	1	1	3
LAMDA	0	1	0	1	0	1	0	1
EXAE	1	1	1	3	1	1	1	3
GRIVALIA	0	0	1	1	0	1	1	2
TERNA	0	0	0	0	1	0	0	1
ADMIE	0	0	1	1	0	0	1	1
PUBLIC POWER	0	0	1	1	0	0	1	1
OPAP	1	1	1	3	1	1	1	3
AEGEAN	0	0	1	1	0	1	1	2
TITAN	1	1	1	3	1	1	1	3
GEK	0	0	0	0	0	0	0	0
ELLAKTOR	0	0	0	0	0	0	0	0
HELLENIC PETROLEUM	1	0	0	1	0	0	0	0
MOTOR OIL	1	1	1	3	0	1	1	2
OTE	1	1	1	2	1	1	1	3

Comparing the two Benchmarking results and taking into consideration the nature of industry and the companies of the sample, the Stock Sectoral Weights was considered more appropriate and hence was used throughout the rest of this paper.

Then, a correlation table was created on the returns of the stocks of our initial sample, as presented in Table 6 that follows. According to the Modern Portfolio Theory (Markowitz, 1952), correlation coefficient values between 0 and 0.4 are considered ideal. Therefore, only stocks that had at least 10 coefficient values at the aforementioned range were chosen, 19 stocks in total (marked with bold letters in Table 6) , namely : Alpha Bank, National Bank of Greece, Eurobank, Mytilinaios, Piraeus Port, Coca Cola, Jumbo, Sarantis, Fourlis, Lamda, Grivalia, Terna, Admie, Public Power Corporation, Opap, Aegean, Titan, Ellaktor and Motor Oil.

Table 6

Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	No of Correlations
1.PIRAEUS BANK	1,0	0,7	0,8	0,8	0,4	0,5	0,5	0,2	0,3	0,2	0,4	0,4	0,5	0,2	0,5	0,3	0,5	0,5	0,4	0,4	0,4	0,5	0,5	0,4	0,5	8
2.ALPHA BANK	0,7	1,0	0,8	0,7	0,4	0,5	0,5	0,1	0,3	0,1	0,3	0,3	0,6	0,3	0,4	0,3	0,4	0,5	0,3	0,3	0,3	0,4	0,4	0,3	0,5	14
3.NATIONAL BANK	0,8	0,8	1,0	0,8	0,4	0,5	0,5	0,2	0,3	0,1	0,4	0,4	0,6	0,2	0,5	0,3	0,5	0,5	0,5	0,4	0,3	0,5	0,5	0,3	0,5	10
4.EUROBANK	0,8	0,7	0,8	1,0	0,4	0,5	0,5	0,2	0,4	0,1	0,4	0,3	0,5	0,3	0,6	0,2	0,4	0,5	0,4	0,4	0,3	0,4	0,5	0,4	0,5	10
5.MYTILINAIOS	0,4	0,4	0,4	0,4	1,0	0,5	0,5	0,2	0,3	0,2	0,4	0,4	0,5	0,3	0,5	0,3	0,3	0,3	0,4	0,4	0,3	0,4	0,5	0,4	0,4	16
6.VIOHALCO	0,5	0,5	0,5	0,5	0,5	1,0	0,6	0,4	0,2	0,2	0,5	0,4	0,5	0,4	0,5	0,3	0,5	0,4	0,4	0,4	0,4	0,2	0,5	0,4	0,4	5
7.PIRAEUS PORT	0,5	0,5	0,5	0,5	0,5	0,6	1,0	0,3	0,3	0,3	0,4	0,4	0,5	0,2	0,5	0,2	0,3	0,6	0,4	0,4	0,3	0,4	0,5	0,5	0,4	10
8.COCA COLA	0,2	0,1	0,2	0,2	0,2	0,4	0,3	1,0	0,2	0,0	0,3	0,1	0,1	0,1	0,2	0,2	0,1	0,3	0,1	0,2	0,1	0,1	0,3	0,1	0,2	23
9.JUMBO	0,3	0,3	0,3	0,4	0,3	0,2	0,3	0,2	1,0	0,1	0,3	0,2	0,4	0,4	0,3	0,3	0,3	0,3	0,4	0,4	0,1	0,2	0,4	0,2	0,5	23
10.SARANTIS	0,2	0,1	0,1	0,1	0,2	0,2	0,3	0,0	0,1	1,0	0,3	0,2	0,2	0,1	0,2	0,3	0,2	0,2	0,2	0,3	0,3	0,2	0,2	0,2	0,2	24
11.FOURLIS	0,4	0,3	0,4	0,4	0,4	0,5	0,4	0,3	0,3	0,3	1,0	0,3	0,4	0,2	0,5	0,1	0,3	0,4	0,4	0,4	0,2	0,4	0,4	0,3	0,4	18
12.LAMDA	0,4	0,3	0,4	0,3	0,4	0,4	0,4	0,1	0,2	0,2	0,3	1,0	0,4	0,3	0,4	0,3	0,3	0,4	0,2	0,4	0,3	0,4	0,4	0,2	0,4	19
13.EXAE	0,5	0,6	0,6	0,5	0,5	0,5	0,5	0,1	0,4	0,2	0,4	0,4	1,0	0,3	0,5	0,4	0,4	0,5	0,4	0,4	0,3	0,5	0,6	0,3	0,6	9
14.GRIVALIA	0,2	0,3	0,2	0,3	0,3	0,4	0,2	0,1	0,4	0,1	0,2	0,3	0,3	1,0	0,2	0,2	0,2	0,2	0,2	0,3	0,0	0,1	0,2	0,1	0,3	22
15.TERNA	0,5	0,4	0,5	0,6	0,5	0,5	0,5	0,2	0,3	0,2	0,5	0,4	0,5	0,2	1,0	0,3	0,4	0,5	0,4	0,4	0,4	0,4	0,5	0,4	0,4	22
16.ADMIE	0,3	0,3	0,3	0,2	0,3	0,3	0,2	0,2	0,3	0,3	0,1	0,3	0,4	0,2	0,3	1,0	0,3	0,3	0,3	0,3	0,2	0,3	0,3	0,1	0,3	24
17.PUBLIC POWER CORP	0,5	0,4	0,5	0,4	0,3	0,5	0,3	0,1	0,3	0,2	0,3	0,3	0,4	0,2	0,4	0,3	1,0	0,4	0,3	0,3	0,2	0,4	0,5	0,2	0,3	15
18.OPAP	0,5	0,5	0,5	0,5	0,3	0,4	0,6	0,3	0,3	0,2	0,4	0,4	0,5	0,2	0,5	0,3	0,4	1,0	0,4	0,4	0,2	0,3	0,5	0,3	0,6	10
19.AEGEAN	0,4	0,3	0,5	0,4	0,4	0,4	0,4	0,1	0,4	0,2	0,4	0,2	0,4	0,2	0,4	0,3	0,3	0,4	1,0	0,4	0,3	0,4	0,4	0,3	0,5	15
20.TITAN	0,4	0,3	0,4	0,4	0,4	0,4	0,4	0,2	0,4	0,3	0,4	0,4	0,4	0,3	0,4	0,3	0,3	0,4	0,4	1,0	0,2	0,4	0,5	0,3	0,5	17
21.GEK	0,4	0,3	0,3	0,3	0,3	0,4	0,3	0,1	0,1	0,3	0,2	0,3	0,3	0,0	0,4	0,2	0,2	0,2	0,3	0,2	1,0	0,4	0,3	0,2	0,3	7
22.ELLAKTOR	0,5	0,4	0,5	0,4	0,4	0,2	0,4	0,1	0,2	0,2	0,4	0,4	0,5	0,1	0,4	0,3	0,4	0,3	0,4	0,4	0,4	1,0	0,5	0,3	0,5	13
23.HELLENIC PETROLEUM	0,5	0,4	0,5	0,5	0,5	0,5	0,5	0,3	0,4	0,2	0,4	0,4	0,6	0,2	0,5	0,3	0,5	0,5	0,4	0,5	0,3	0,5	1,0	0,4	0,5	8
24.MOTOR OIL	0,4	0,3	0,3	0,4	0,4	0,4	0,5	0,1	0,2	0,2	0,3	0,2	0,3	0,1	0,4	0,1	0,2	0,3	0,3	0,3	0,2	0,3	0,4	1,0	0,3	21
25.OTE	0,5	0,5	0,5	0,5	0,4	0,4	0,4	0,2	0,5	0,2	0,4	0,4	0,6	0,3	0,4	0,3	0,3	0,6	0,5	0,5	0,3	0,5	0,5	0,3	1,0	9

It is noticeable that EXAE and OTE are the only stocks selected in the aforementioned Scoring Table process, not qualifying in the correlation selection process and therefore were not included in the sample we proceeded with to the 2nd Phase of Technical Analysis. Furthermore, Furthermore, the necessary data for technical analysis of TITAN were incomplete observations for the period studied. Therefore, TITAN stock was also excluded from the Second Phase despite the fact that its Fundamental Criteria were promising. Hence, we proceeded to the 2nd Phase, analyzing the following 10 stocks: Mytilinaios, Piraeus Port, Coca Cola, Jumbo, Sarantis, Fourlis, Grivalia, Opap, Aegean, Motoroil.

2nd Phase (Technical Analysis)

Sharpe's (1963) simplified model focuses on the fact that the return on each investment can be correlated with changes in the market as a whole. So instead of calculating all the fluctuations and co-fluctuations of market assets, we can study the relationship between a security and the Market Index, where as a market index we can use a stock index (e.g., the Athens Stock Exchange FTSE Large Cap Index).

The single Index model is described by the following linear regression equation:

$$R_i t = a_i + \beta i R_M + E_l t$$

where:

$R_i t$: the yield of the security in the time period t.

R_M : the return on the market index of the time period t.

a_i : a stable return on securities independent of R_M .

βi : the regression coefficient that measures the sensitivity of the performance of the security to changes in the performance of the market index.

$E_l t$: a random error equal to the difference between the actual return on the security and the expected return when the market index return is known.

The slope of the Securities Characteristic Line is called the beta coefficient and is a measure of a stock's systemic risk. Systemic risk is the market risk that cannot be eliminated by portfolio diversification. The mathematical formula for calculating the beta coefficient is as follows:

$$\beta i = \frac{\mathrm{cov}(r_i, r_m)}{\mathrm{var}(r_m)}$$

The higher the coefficient β is, the more extreme the relationship between the stock' performance and market's performance. If βi =1, the stock's performance is expected to be in accordance to the market index performance (since by definition $\beta_M = 1$). When $\beta i > 1$, the stock is expected to be more aggressive than the market. According to the simple index model, the expected return and risk of the portfolio calculated as:

$$E(R_p) = a_\rho + \beta_\rho E(R_m)$$

$$\sigma_\rho^2 = \beta_\rho^2 \sigma^2(Rm) + \sigma^2(E\rho)$$

Are presented in Table 7 that follows, using, weekly closing prices (160 observations for each stock) for the period 2016-2018 for the stocks selected in the Fundamental Analysis.

Table 7

Estimated Sample Portfolio Risk and Return

STOCK	EXPECTED RETURN $E(R_i)$	SYSTEMATIC RISK $b_i^2 \sigma_m^2$	PORTFOLIO RISK $\sigma_{\epsilon_i}^2$
SARANTIS	1,500%	0,007%	0,118%
MOTOR OIL	0,890%	0,036%	0,137%
COCA COLA	0,590%	0,017%	0,089%
MYTILINAIOS	0,790%	0,056%	0,125%
JUMBO	0,340%	0,042%	0,119%
FOURLIS	0,380%	0,054%	0,141%
GRIVALIA	0,100%	0,016%	0,105%
OPAP	0,150%	0,061%	0,065%
PIRAEUS PORT	0,060%	0,044%	0,062%
AEGEAN	0,050%	0,039%	0,099%

The stocks classification presented in Table 8 is based on the excessive return of their beta rates. This measure calculates the risk premium of the examined portfolio, per unit of systemic risk. According to Fernandez al (2018), the average annual risk-free interest rate for Greece, which is used in the following calculations, equals to 4,8%.

$$\boldsymbol{Traynor\ Ratio} = \frac{(\boldsymbol{R_i} - \boldsymbol{Rf})}{\boldsymbol{\beta_i}}$$

Table 8

Ranking on Traynor ratio

STOCK	RISK FREE R_f	EXPECTED RETURN $E(R_i)$	TRAYNOR RATIO	RANKING
SARANTIS	0,09%	1,50%	0,0627	1
MOTOR OIL	0,09%	0,89%	0,016	2
COCA COLA	0,09%	0,59%	0,0152	3
MYTILINAIOS	0,09%	0,79%	0,0113	4
JUMBO	0,09%	0,34%	0,0056	5
FOURLIS	0,09%	0,38%	0,0055	6
GRIVALIA	0,09%	0,10%	0,0024	7
OPAP	0,09%	0,15%	0,002	8
PIRAEUS PORT	0,09%	0,06%	0,0008	9
AEGEAN	0,09%	0,05%	0,0006	10

We then proceeded to the calculation of the Cut Off Rate Ci. Equation (1) is mathematically equal to Equation (2) where:

$$c_i = \frac{\sigma_m^2 \sum_{i=1}^{i} \frac{(R_i - Rf)\,\beta i}{\sigma_e^2}}{1 + \sigma_m^2 \sum_{i=1}^{i} \frac{\beta_i^2}{\sigma_{ei}^2}} \quad (1)$$

$$c_i = \frac{\beta_{ip}(r_p - r_F)}{\beta_i} \quad (2)$$

where:

β_{ip} : is the expected change in the return rate on stock associated with a 1% change in the return on the optimal portfolio

r_p : is the expected return on the optimal

Stock selection depends on the Cut Off Rate where all stocks with a ratio $\frac{Ri - R_f}{\beta i}$ higher than this can be included in the portfolio, while stocks with a ratio lower than this will not be preferred.

$$\frac{Ri - R_f}{\beta i} > c_i \overset{(2)}{\Rightarrow} (r_i - r_F) > \beta_{ip}(r_p - r_F)$$

The right-hand side is the expected excess return on a particular stock that is based exclusively on the expected performance of the optimum portfolio. The term on the left-hand side is the security analyst's estimate of the expected excess return on the individual stock.

Therefore, if the analysis of a particular stock leads the portfolio manager to estimate that it will perform better than expected based on its relationship to the optimal portfolio, then it should be added to the portfolio. As stocks are ranked according to Traynor Ratio, the last stock which is greater than relevant Ci value is the cut-off point C*. Stocks ranking above C* have higher excess return to beta than the Ci, while stocks below C* have lower excess returns to beta so they are excluded. Table 9 that follows, summarizes the Cut-Off rate calculations performed by using the aforementioned methodology.

Table 9

Cut-Off Rate Calculation

STOCK	Traynor Ratio	$\frac{(Ri - R_f)b_i}{\sigma_{ei}^2}$	$\frac{b_i^2}{\sigma_{ei}^2}$	C_i
SARANTIS	0,0627	12,8119	48,2015	0,0043
MOTOR OIL	0,0160	7,7334	219,2322	0,0050
COCA COLA	0,0152	2,4615	162,4228	0,0025
MYTILINAIOS	0,0113	18,9433	376,7844	0,0048
JUMBO	0,0056	14,6749	298,2441	0,0041
FOURLIS	0,0055	4,2224	318,6273	**0,0032***
GRIVALIA	0,0025	19,2538	125,2227	0,0047
OPAP	0,0020	9,7898	780,3679	0,0034
PIRAEUS PORT	0,0008	8,2230	597,1907	0,0039
AEGEAN	0,0006	13,0180	332,0972	0,0040

We observed that the Cut-Off Rate is at C^* = **0,0032***. Therefore, stocks with Traynor Ratio > c_i are selected, namely (marked in bold in Table 9)

The amount to be invested in each security, or otherwise its weight in the suggested portfolio, is given by the following formula:

$$Xi = \frac{Zi}{\Sigma j \in K zi} \times 100 \ , \forall \ Zi \ > \ 0$$

where K is the total number of securities that make up the portfolio, while

$$Z_i = \frac{\beta_i^2}{\sigma_{ei}^2} \left\{ \frac{R_j - Rf}{\beta i} - C^* \right\}$$

Table 10 that follows, summarizes the optimal portfolio weights estimated by using the aforementioned methodology. We observed that the average return of our portfolio for the period 2016-2018 was 0,91% while the analogous average return of the Athens Stock Exchange FTSE Large Cap Index was equal to 0,04%. We noticed that our portfolio presented much higher expected returns as compared to the FTSE Index one. We also found that for our sample period, the optimal portfolio estimated had a standard deviation equal to only 0.008% while the FTSE index's one was 3.45%. Therefore, it was evident that the optimal portfolio constructed outperformed the FTSE Large Cap Index both in terms of performance and risk.

Table 10

Optimal Portfolio Weights

STOCK	Traynor Ratio	C_i	Z_i	Y_i	Beta	$Y_i * Beta$
SARANTIS	0,0627	0,0043	2,8135	25,76%	0,2382	0,061346
MOTOR OIL	0,016	0,005	2,4054	22,02%	0,5482	0,120718
COCA COLA	0,0152	0,0025	2,06	18,86%	0,3812	0,071891
MYTILINAIOS	0,0113	0,0048	2,469	22,60%	0,6856	0,154974
JUMBO	0,0056	0,0041	0,4377	4,01%	0,5945	0,023823
FOURLIS	0,0055	0,0032	0,7373	6,75%	0,6708	0,045282

The Optimal portfolio is less volatile than market which is expected due to diversification. The Beta of Optimal Portfolio = 0,478

$$\boldsymbol{bp} = \sum (\boldsymbol{Yi} * \mathbf{Beta}) = 0{,}478$$

Finally, we tested the predictability performance of the Optimal Portfolio estimated in order to further secure the Model. We used daily closures of the Optimal Portfolio stocks covering the 3d quarter of 2019 and we observed that our portfolio continued to outperform the Athens Stock Exchange FTSE Large Cap Index both in terms of risk and return. We selected the specific period, after the publication of all stocks' annual financial statements, to increase our estimation reliability. The fit of the Optimal Portfolio estimated for the 3-year period 2016-2018and of the predictions for the 3nd quarter of 2019 versus the relevant Athens FTSE large Caps Index, are presented in Tables 11 and 12 that follow.

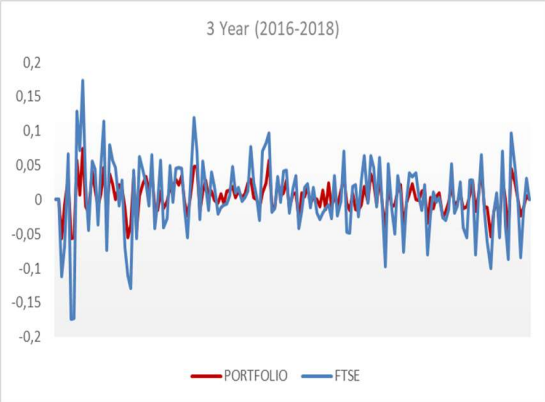
Table 11

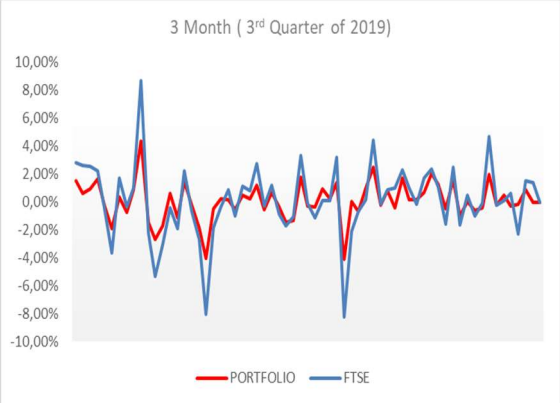
Expected Risk and Return

	3-year Average Estimates		3 Month Average Prediction	
	Risk	Return	Risk	Return
Optimal Portfolio	0,01%	0,91%	1,40%	0,08%
Athens Stock Exchange FTSE Index	3,45%	0,04%	1,40%	0,03%

Table 12

Optimal Portfolio vs Athens FTSE Large Cap Index





4 Conclusions

For this study, a combination of Fundamental and Technical Analysis was used to estimate an optimal portfolio. Our research followed 2 Phases, one for each Analysis. In Phase I, using Fundamental Criteria and assuming 2 different benchmarks, 2 different Scoring Tables were created, and Stocks with the best score were selected. In Phase II, the Sharpe Index Model was applied and according to Cut Off Rate Methodology of Elton & Gruber the optimal Portfolio was estimated. The Optimal portfolio's profitability and risk were analyzed and was proved that the Optimal Portfolio's performance outperformed the Athens Stock Exchange FTSE Large Cap Index for the Research Period of 2016-2018. The selection process is presented in Table 13 that follows.

Table 13

Selection Process

No	SECTOR	STOCK	1st Phase FUNDAMENTAL ANALYSIS			2nd Phase TECHNICAL ANALYSIS
			1.1 SCORING TABLES	1.2 CORRELATION MATRIX	RESULT	TRAYNOR RATIO & CUT-OFF RATE
1	BANKS	PIRAEUS BANK				
2		ALPHA BANK				
3		NATIONAL BANK				
4		EUROBANK		×		
5	INDUSTRIAL PRODUCTS	MYTILYNAIOS	×	×	×	×
6		VIOHALCO				
7		PIRAEUS PORT	×	×	×	
8	FOOD & BEVERAGE	COCA COLA	×	×	×	×
9	DOMESTIC PRODUCTS	JUMBO	×	×	×	×
10		SARANTIS	×	×	×	×
11		FOURLIS	×	×	×	×
12	FINANCIAL SERVICES	LAMDA		×		
13		EXAE	×			
14	REAL ESTATE	GRIVALIA	×	×	×	
15	PUBLIC UTILITY SERVICES	TERNA		×		
16		ADMIE		×		
17		PUBLIC POWER CORP		×		
18	TRAVELLING & ENTERTAINMENT	OPAP	×	×	×	
19		AEGEAN	×	×	×	
20	MANUFACTURING	TITAN	×	×	(×)	
21		GEK				
22		ELLAKTOR		×		
23	OIL & GAS	HELLENIC PETROLEUM				
24		MOTOR OIL	×	×	×	×
25	COMMUNICATIONS	OTE	×			

(x) Excluded from Phase 2 due to lack of full scale data

The optimal portfolio was composed of the following companies: Sarantis (25,76%), Mytilinaios (22,6%), Motor Oil (22,02%), Coca Cola (18,86%), Fourlis (6,75%) and Jumbo (4,01%). The Optimal Portfolio's predictive power was tested using data covering the third trimester of 2019, and again the Optimal Portfolio outperformed the FTSE Index. Hence this study showed that the Combination of Fundamental and Technical Analysis for creating optimal portfolios seems a more eligible way for maximizing returns and minimizing risk.

Although this study is limited by the fact that:

- we assumed as valid the Sharpe's Model assumption that security prices move together only because of common co-movement with the Market. Although this assumption was proper for the selected period studied, further research could test a broader sample period.
- transaction costs inclusion and dynamic portfolio management were not included due to model's complexity.

further research, could endorse the combined use of Fundamental and technical Analysis for Optimal Portfolio selection.

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