An Investing Method That Combined ESG Factor and Modern Portfolio Theory

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Abstract. Investors use diverse portfolio theories to guide their decisions. These days, many businesses and investors prioritise sustainable growth and profitability. To compute a portfolio and obtain the highest Sharpe Ratio, the author employed the MPT and Sharpe Ratio theories during the study process. This essay introduces the clear ESG criteria and standards in the first part, then proves that ESG is essential nowadays. Secondly, this essay presents the portfolio theory and methodology used during the research process, along with formulas and explanations. A sample and a detailed introduction to the ESG companies are also provided. Then, this essay presents the financial performance of each stock and portfolio. The specific calculating process of the portfolio is demonstrated, and the return and risk are exhibited. The findings of this study will give investors precise instructions on how to construct portfolios that maximise return per risk while satisfying ESG requirements.

Keywords: ESG; Modern Portfolio Theory; Investing Method; Risk-averse.

1. Introduction

Investors make decisions according to different portfolio theories. Investors need to face risk when making investment decisions, and most investors are risk-averse, which means they want to avoid high risk. Thus, investors need to have a method to balance risk and return. Nowadays, many investors and companies focus on sustainable development and return. Environment, social, and governance (ESG) have close relationships with sustainability. Many investors have already considered ESG performance and are likely to invest in companies meeting the ESG criteria. However, there are a few methods for investors to invest in ESG companies using the portfolio theory. Based on this reality, the author will combine the ESG concept with Modern Portfolio Theory (MPT) to meet the needs of risk-averse investors. The author will find the top 10 returns of NASDAQ stock and build a portfolio of three. Finally, the author will calculate the Sharpe Ratio of this portfolio. This research will provide a clear guideline for investors to build portfolios that meet ESG criteria and maximise the return per risk.

2. ESG Concept

2.1. ESG Introduction

The Environmental, Social, and Governance (ESG) concept serves as a tool to help stakeholders comprehend how a company manages opportunities and risks associated with these criteria, which are also referred to as ESG factors [1]. The most important thing is distinguishing whether a company is an ESG organization.

2.2. ESG Standard

ESG investing has three distinct elements: environmental, social, and governance [2]. To be classified as an ESG investment, a company must fulfil at least half of the requirements listed in these three categories [3]. Here are some examples of environmental, social and governance criteria. (Table1)

Table 1. ESG Criteria.

Environmental	Social	Governance
Climate Change	Human rights	Bribery and Corruption
Resource Depletion	Modern Salary	Executive Pay
Pollution	Child Labor	Trade Association
Deforestation	Working Conditions	Tax Strategy

Additionally, looking at the ESG scores is also considered to know which companies meet the ESG standards [4]. Although there is no single, widely accepted method for grading ESG businesses, many resources that assign a number to businesses according to how well they perform to ESG standards are still available. Investing in ESG funds is another option for investors to ensure the companies they are funding meet ESG standards. ESG funds typically avoid investing in stocks linked to actions considered immoral or unethical, such as weapons, gambling, and alcohol.

3. Portfolio Theory

3.1. Modern Portfolio Theory

Modern Portfolio Theory (hereafter MPT) was introduced by Economist Harry Markowitz, also known as mean-variance analysis [5]. It is a mathematical framework that maximises the expected return for a given risk. Suppose all the investors are risk-averse, and the expected rate of return expresses the variance that presents the expected return and the risk [6].

The formula of MPT is present in Equation (1). Where E_r Is the expected return, i is the rate of return on asset, and P_i is the possibility.

$$E_r = \sum_{i=1}^{n} P_i r_i \tag{1}$$

The formula of variance is present in Equation (2). Where σ^2 is the variance of the return of an asset?

$$\sigma^2 = \sum_{i=1}^{n} Pi[ri - E(r)]^2 \tag{2}$$

The formula of expected return is present in Equation (3). Where R_P is the return on the portfolio, R_i is the return on asset i and W_i is the weighting of component asset i.

$$E(R_P) = \sum_i w_i E(R_i) \tag{3}$$

The formula of variance is present in Equation (4). Where σ_i is the sample standard deviation of the return of an asset i, andP_{ij} is the correlation coefficient between the returns on assets i and j.

$$\sigma_P{}^2 = \sum_i w_i{}^2 \sigma^2 + \sum_i \sum_i \sum_{j \neq i} w_i w_j \sigma_i \sigma_j \rho_{ij} \tag{4}$$

The formula of standard deviation is present in Equation (5). Where x is the sample's mean and n is the sample size. The standard deviation is half the power of variance.

$$\sigma = \sqrt{\frac{\sum(x - \bar{x})^2}{(n-1)}} \tag{5}$$

The formula of covariance is present in Equation (6). Where $\bar{x}$the sample is means array 1 and $\bar{y}$ is the array 2, and n is the sample size. Array 1 is the return of NVDA, array 2 is the return of COST, and array 3 is the return of ASML.

$$cov(x,y) = \frac{\sum(x-\overline{x})(y-\overline{y})}{n} \tag{6}$$

The correlation formula is present in Equation (7). Where $\overline{x}$the sample is means array 1 and $\overline{y}$ is the array 2. Array 1 is the return of NVDA, array 2 is the return of COST, and array 3 is the return of ASML.

$$correlation\ (x,y) = \frac{\sum(x-\overline{x})(y-\overline{y})}{\sqrt{\sum(x-\overline{x})^2}\sum(y-\overline{y})^2} \tag{7}$$

3.2. Sharpe Ratio

As a byproduct of work on the Capital Asset Pricing Model (CAPM), economist William F [7]. Sharpe presented the Sharpe ratio in 1966 under the reward-to-variability ratio. The Sharpe ratio evaluates an investment's risk and return [8]. It is a mathematical representation of the realization that excess returns over time could indicate increased risk and volatility.

The formula of the Sharpe Ratio is present in Equation (8). R_p Is the return on portfolio, R_f the risk-free rate and σ_p is the standard deviation of the portfolio's return.

$$Sharpe\ ratio = \frac{R_p - R_f}{\sigma_p} \tag{8}$$

4. Sample

To apply the MPT model and ESG concept into reality, the author browses the TOP 10 of the NASDAQ Price Increase Leaderboard (Table 2) and introduces them. The author finds that all the companies met the ESG standard and analyzed the TOP3 stocks (NVDA, COST, and ASML) because of high returns.

Table 2. Top 10 of NASDAQ Price Increase Leaderboard.

NVDA	NVIDIA Crop
COST	Costco Wholesale Corp
ASML	ASML Holding NV
CEG	Constellation Energy Corp
DASH	DoorDash Inc
QCOM	Qualcomm Inc
AVGO	Broadcom Inc
SNPS	Synopsys Inc
AMD	Advanced Micro Devices Inc
ISRG	Intuitive Surgical Inc

4.1. NVIDIA

Nvidia ranked first in this graph as an ESG company. NVIDIA's survey shows that its employees recommend it as a great workplace. NVIDIA has a good reputation among the workers; also, they cooperate with the government—the white house. They also emphasise human rights, governance and society. For instance, they work on cybersecurity and data privacy; they consider employees' health and safety and take consumer services seriously. NVIDIA conducts Greenhouse Gas Emissions Management, Energy Management System, and Water Consumption. Consequently, NVIDIA is a standard ESG company.

4.2. Costco

Costco focused on governance and education since 2022, and they began reporting ESG and conducting the Sustainability Accounting Standards Board (SASB). Also, they focus on oversight of

climate-related risks and opportunities, involving Strategy & Oversight and Implementation, Reporting & Compliance in their governance structure. Costco brings many environmental benefits since it limits gas emissions and has a climate change plan.

4.3. ASML

"To be a sustainability leader, we must drive progress toward a sustainable society." is their mission statement. ASML focus on an ESG sustainability strategy. They are using computing power with minimal waste, energy and emissions, and they also provide an attractive workplace to create a supply chain and to give innovation to the ecosystem. They also react actively with the government, posting transparent reporting to stakeholders.

4.4. CEG

CEG aims to promote building a carbon-free future and bring advantages to their customers, communities, and shareholders. For almost ten years, Constellation has led the way in creating clean energy. The shift to a carbon-free economy is currently being accelerated, and in order to support businesses, governments, communities, and individuals in achieving their decarbonisation and sustainability objectives, low- or zero-carbon power is being delivered more quickly.

4.5. DASH

DoorDash establishes an international marketplace for local trade that offers goods and services to help people find gainful employment, shoppers discover the best local businesses, and merchants expand their enterprises. They act globally to prevent, minimise, and eliminate emissions from our operations and business plan. They also cooperate with the government and have an all-rounded approach to ethics and compliance.

4.6. QCOM

Qualcomm has also joined the Climate Declaration, a commitment jointly signed by several cross-industry companies to reach the Paris Agreement goal 10 years ahead of zero net emissions by 2040. Qualcomm aims to promote Diversity and inclusiveness, meaningful innovation, STEM (Science, Technology, Engineering and Mathematics) education, supply chain management, greenhouse gas emission reductions, and product energy efficiency. They are 2022 Enterprise ESG Outstanding Cases in China.

4.7. AVGO

Avago Technologies aims to uphold morality, social responsibility, and environmental sustainability. They strive to operate and produce our products in an environmentally responsible way, as stated in our environment and sustainability policy. All management and staff at Avago Technologies are expected to support the implementation of this policy in line with their respective positions within the company.

4.8. SNPS

They generate value for their key stakeholders, including customers, employees, business partners, and local communities. Synopsys make progress on environmental and social issues within the ecosystem, such as climate action, inclusion and diversity in our workforce, and social impact in communities. They adhere to ethical business practices and corporate governance guidelines.

4.9. AMD

For nearly thirty years, their approach to corporate responsibility has stayed essentially the same: They listen to their stakeholders and recognise the importance of corporate responsibility to their operations, supply chain, engagement, and products. AMD has a good ESG performance.

4.10. ISRG

They want to improve patient care while being responsible for the environment, our communities, and our governance ideals. Initiative's ESG team directs, oversees, and documents advancements in climate mitigation, decarburization tactics, environmental regulatory trends, and resource efficiency.

5. Financial performance

5.1. NVIDIA

The share price of NVIDIA is around $850 from Feb to Mar 2024. The most recent financial reports from NVIDIA show that the company has $65.72 billion in total assets and revenue is $60.92 billion. Also, the market cap is $2.234 trillion, and the P/E ratio as of Mar 2024 is 214.

5.2. Costco

According to the latest financial reports of Costco, the share price is around 732. The revenue is $245.65 billion, and the total assets is $73.72 billion. The market cap is $324.72 billion, and the P/E ratio is 58.1 as of March 2024.

5.3. ASML

The share price of ASML is around $950.According to its financial report, the revenue is $29.90 billion, and the total asset is $44.17 billion. The market cap is $375.61 billion, and the P/E ratio is 45.8 as of March 2024.

6. Portfolio construction

First, the author collects these three stocks' share prices from 2013 to 2023 from NASDAQ. (Table 3) The author uses Excel to calculate all the data.

Table 3. Historical stock price of NVDA, COST, and ASML.

Date	NVDA	COST	ASML
2013/11/13	4.04	5.04	6.04
2014/11/13	4.89	138.71	101.92
2015/11/13	7.45	153.67	91.40
2016/11/14	20.91	152.00	99.20
2017/11/13	53.16	172.28	178.85
2018/11/13	49.83	228.74	170.89
2019/11/13	52.14	302.90	269.92
2020/11/13	132.97	378.84	419.59
2021/11/12	303.90	517.17	851.63
2022/11/14	162.95	509.68	577.82
2023/11/13	486.20	578.23	654.60

Secondly, the author calculates the yearly return of these three stocks.(Table 4) The result can be calculated using the difference between the next year and the base year, then divided by the base year, $(Year_n\text{-}Year_{n-1})/Year_n$ and n is the sample.

Table 4. Yearly return of NVDA, COST and ASML.

Date	NVDA	COST	ASML
2014/11/13	52.35%	10.79%	-10.32%
2015/11/13	180.67%	-1.09%	8.53%
2016/11/14	154.23%	13.34%	80.29%
2017/11/13	-6.26%	32.77%	-4.45%
2018/11/13	4.64%	32.42%	57.95%
2019/11/13	155.02%	25.07%	55.45%
2020/11/13	128.55%	36.51%	102.97%
2021/11/12	-46.38%	-1.45%	-32.15%
2022/11/14	198.37%	13.45%	13.29%

After that, the author calculates the expected return (Table 5), which is the average of each stock's yearly return between 2014 and 2022. Also, the author gets the standard deviation result of these three samples (Table 6) using the return data.

Table 5. Expected Return of NVDA, COST, and ASML.

	NVDA	COST	ASML
E(r)	91.24%	17.98%	30.17%

Table 6. Standard Deviation of NVDA, COST, and ASML.

STD	NVDA	COST	ASML
	0.859	0.136	0.431

Then, the author calculates the covariance of NVDA, COST and ASML. (Table 7).

Table 7. Covariance of NVDA, COST, and ASML

Covariance	NVDA	COST	ASML
NVDA	0.737	-0.012	0.165
COST	-0.012	0.018	0.035
ASML	0.165	0.035	0.186

The author counts the samples' correlation function (Table 8) and weight (Table 9).

Table 8. Correlation of NVDA, COST, and ASML

Correlation	NVDA	COST	ASML
NVDA		-0.103	0.447
COST			0.604
ASML			

Table 9. Weight of NVDA, COST, and ASML.

	NVDA	COST	ASML
Weight	11.74%	78.30%	9.97%

According to the expected return of Table 4 and Table 5, the author counts the expected return of this portfolio as 27.77%. The portfolio expected return is the sum of an asset's expected rate of return and its weight in the portfolio. The risk-free rate of this portfolio is 4.25%.

Then, the author calculates this portfolio's variance, standard deviation, and sharp ratio. (Table 10)

Table 10. Variance, Standard Deviation, and Sharp Ratio of this Portfolio

variance	0.024773271
Standard deviation	0.157395269
sharp ratio	1.495826822

7. Conclusion

Investors base their selections on beliefs about diverse portfolios. Profitability and sustainable growth are now top priorities for many companies and investors. The author used the MPT and Sharpe Ratio theories throughout the research process to compute a portfolio and get the highest Sharpe Ratio. This essay first explains the precise ESG standards and criteria before demonstrating why ESG is still significant and necessary in the modern world. Second, this essay describes and provides formulas for the portfolio theory and technique employed in the study process. A sample and a thorough overview of the ESG businesses are also given. The financial performance of each stock and portfolio is then presented in this essay. The portfolio's particular calculation procedure is shown. Risk-averse investors can barely invest in ESG companies while using portfolio theory. The author provided a clear solution and guideline to investors in this essay, and they can use it to maximise return and avoid high risk. The author combined the ESG criteria when building the portfolio. During the research process, the author used MPT and Sharpe Ratio theories to calculate a portfolio and get the highest Sharpe Ratio. Also, the author combined the ESG criteria when building the portfolio.

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