

NATIONAL INSTITUTE OF SECURITIES MARKETS

Portfolio Construction for Socially Responsible Investors

A thesis submitted in partial satisfaction of the requirements
for the Financial Analytics and Data Science

in

PGCM (Financial Markets) course

by

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THESIS APPROVAL

The thesis of **Portfolio Construction for Socially Responsible Investors** is approved, and it is acceptable in quality and form for publication on microfilm and electronically.

National Institute of Securities Markets (NiSM)

2022

DEDICATION

This thesis is dedicated to my parents who have always encouraged me to acquire knowledge throughout my life.

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LIST OF ABBREVIATIONS

API	Application Programming Interface
AUM	Assets under Management
BRR	Business Responsibility Report
BRSR	Business Responsibility and Sustainability Report
ESG	Environmental, Social, Governance
GSIA	Global Sustainable Investment Alliance
SDG	Sustainable Development Growth
SEBI	Securities and Exchange Board of India
SRI	Socially Responsible Investment

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ABSTRACT OF THE THESIS

Traditionally, most investors are focused on the stocks that provide them best performances in terms of monetary returns even if the companies floating those stocks are not socially responsible companies. Such companies not only are hazardous for the humanity, environment but also potentially pose a huge risk (monetary loss) in the long-term investments.

Socially responsible investing (SRI) is an investing strategy that aims to generate both social change and financial returns for an investor. Such SRI can include companies making a positive sustainable social impact and may exclude those making a negative impact based on evaluation of ESG (Environmental, Social and Governance) risks.

Global Sustainable Investment Review 2020 report provided by Global Sustainable Investment Alliance has shown that the sustainable investment together in the 5 main regions across the United States, Canada, Japan, Australasia, and Europe has reached USD35.3 trillion in assets under management (AUM), having grown by 15% in two years.

This project attempts to bring a completely new perspective to the traditional investors and Fund Managers or Portfolio Managers community to prove that it is always not necessary that the traditional investments only bring the better performance. Instead, the investments done using the ESG aspects/risks of the stocks would be more sustainable investments in the long run.

In the project, a thoughtful analysis is done using the ESG (Environmental, Social and Governance) ratings / scores and controversy scores provided by "Sustainalytics" (A Morningstar company) for Nifty50 stocks.

The project compares 4 cases of screening the stocks and demonstrates, how a portfolio manager can construct a portfolio which will reduce the ESG risks and get better returns. The concepts of ESG investments, sustainable investments, responsible investment, or ethical investments are the same and explained in the introduction section below.

The portfolio optimization has been done based on MV-optimization concept, which was laid down by Markowitz. Optimization is done to arrive at the optimized weights.

The empirical analysis of this work got encouraging results which are given below in brief:

INTRODUCTION

Traditional investing delivers value by translating investor capital into investment opportunities that carry risks commensurate with expected returns. Sustainable investing balances traditional investing with environmental, social, and governance related (ESG) insights to improve long-term outcomes.

Environmental, Social and Governance (ESG) performance is now an essential metric for capital markets. Investors are increasingly focused on climate and ESG-related disclosures and investments. Companies with strong ESG performance can have higher returns on their investments, lower risks, and better resiliency during a crisis.

Examples of ESG data include the quantification of a company's carbon emissions, water consumption or customer privacy breaches. Institutional investors, stock exchanges and boards increasingly use sustainability and social responsibility disclosure information to explore the relationship between a company's management of ESG risk factors and its business performance.

Trends in Sustainable Investment:

Globally, over the last decade, ESG has gone from fringe to mainstream. Investors and Corporations have seen increased regulation, demands for transparency and a quest for standards. They recognize that ESG Ratings are tools that help provide valuable information for their decision making. **Most of the countries' governments are also committed for improving ESG factors (to reduce risks) and setting regulations**

towards this. Also, many new research studies are being carried out. Due to this, the Sustainable investment industry is still evolving and no complete standardization is set.

ESG risk measurement is essential, as the already-apparent effects of climate change dominate investment concerns. From public equities to private debt, the transition to a net -zero economy (lowest carbon emissions) has the potential to impact every financial asset. Therefore, **Sustainable investment has become an industry** and has become a major trend in the investors' community. The following table depicts the growth in sustainable investment assets under management (AUM) in 5 major regions/markets.

Snapshot of global sustainable investing assets, 2016-2018-2020 (USD billions)

REGION	2016	2018	2020
Europe*	12,040	14,075	12,017
United States	8,723	11,995	17,081
Canada	1,086	1,699	2,423
Australasia*	516	734	906
Japan	474	2,180	2,874
Total (USD billions)	22,839	30,683	35,301



In India, as per **Economic Survey 21-22**, there has been an increasing recognition that ESG issues can put the performance of companies at risk. In this regard, SEBI has been one of the early adopters of sustainability reporting for listed entities and requires mandatory ESG related disclosures as part of the Business Responsibility Report (BRR), for the top 100 listed entities (by market capitalization) since 2012. This requirement of filing BRR was progressively extended to the top 500 entities (from financial year 2016-17) and later to the top 1000 listed entities (from the financial year 2019-20).

- SEBI in February 2017 had encouraged the top 500 listed entities to adopt the framework of Integrated ESG integration and Reporting.
- In May 2021, SEBI issued new sustainability reporting requirements as per the Business Responsibility and Sustainability Report (BRSR) which shall replace the existing BRR to bring in greater transparency through disclosure of ESG-related information and by enabling market participants to identify and assess sustainability-related risks and opportunities.

The BRSR is more outcome oriented and is focused on having granular and quantifiable metrics, seeking disclosures from listed entities on their performance.

ESG RATING AGENCIES AND RATING SCALES

The ESG ratings industry is highly fragmented with dozens of ratings agencies and data providers in existence. The backgrounds of these firms are not uniform, with many having entered the ESG ratings business from different areas of historical expertise.

Most rating companies are considering 3 main pillars (E, S, G) for their assessment and ratings. The assessment and the evaluation are done based on the material risk in multiple industries, sectors, sub-sectors. The rating scale is different for different companies. There is no standardization yet set.

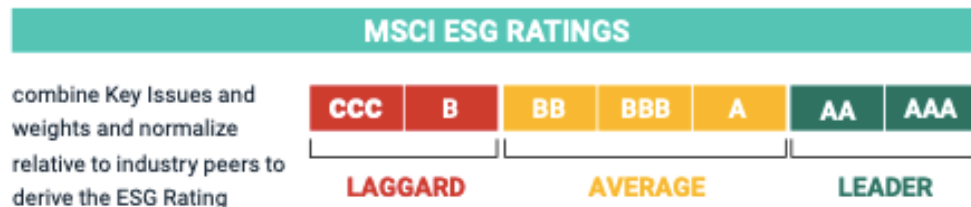
In addition to the E, S, G ratings, some companies are also giving a score based on controversies in which the companies are involved in. **Controversies, if not resolved by the managements, they can prove to be very detrimental for the company reputation and so also for the business and the stock prices.**

Common factors in ESG Pillar:



1. MSCI is one of the leaders which is providing institutional investors with a robust integration mechanism to support ESG risk mitigation and long-term value creation.

MSCI does research and rates companies on a scale of 'AAA' to 'CCC' according to their ESG risks and ability to manage the risks.



For more details visit: [MSCI ESG Ratings mechanism](#)

2. Sustainalytics' ESG Risk Ratings measure a company's exposure to industry-specific material ESG risks and how well a company is managing those risks. This multi-dimensional way of measuring ESG risk combines the concepts of management and exposure to arrive at an absolute assessment of ESG risk. They identify five categories of ESG risk severity that could impact a company's enterprise value.

Negligible	Low	Medium	High	Severe
0 - 10	10 - 20	20 - 30	30 - 40	40+

Note: In other companies, higher score could mean better ESG performance. In the case of Sustainalytics, higher score implies higher or sever risk.

Sources for frameworks: More detailed information can be found in the links given below.

MSCI Key Issue Framework (as of July 2022), available
at: <https://www.msci.com/our-solutions/esg-investing/esg-ratings/esg-ratings-key-issue-framework>

FTSE ESG Ratings Model (as of June 2021), available
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S&P Global ESG Ratings (as of July 2022), available
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Sustainalytics ESG Risk Ratings (as of January 2021), available for download
at: <https://www.sustainalytics.com/esg-data>

LITERATURE REVIEW

Nhi N.Y.Vo, Xuezhong He, Shaowu Liu, Guandong Xu
Deep Learning for Decision Making and the Optimization of Socially Responsible
Investments and Portfolio
<https://doi.org/10.1016/j.dss.2019.113097>

OBJECTIVES AND SCOPE

The main objectives of this project are:

1. To provide investors a different perspective on screening the stocks based on ESG scores supported by experimental evidence.
2. To provide easy to use methodology to investors using which the Portfolio could be constructed returns could be calculated using new ESG weights.
3. To provide further inputs and recommendations to investors and researchers to carry analysis in a new direction.
4. To bring and promote awareness of Socially Responsible Investments in the investors' community.

Scope:

1. The scope of this project is limited to the Indian Equity Market only.
However, can be extended to any financial market.
2. The portfolios are constructed using only stocks within Nifty50. The same method can be applied to other stocks too.
3. The ESG and Controversy ratings from Sustainalytics only are considered for calculations.
4. Stock prices and ESG and controversy scores are collected from Yahoo Finance only.

DATA SOURCES

Data source: There are several websites which provide ESG ratings for different stocks, however most of them charge a subscription fee. Yahoo finance made ESG Risk Scores and Controversy scores from Sustainalytics (A Morningstar company) available publicly on their website.

Data on Stock prices: Yahoo Finance API has been used as the data source and stocks listed in NIFTY50 index are selected for the project. For this project, the adjusted closed prices, ESG risk scores and controversy scores of all the stocks listed in NIFTY50 are downloaded.

To ensure enough data points, the monthly adjusted closed prices were taken for 10 years which resulted in 121 data points.

Data on ESG ratings: Yahoo Finance provides E, S, G scores and the Controversy scores for listed companies. The scores are provided by Sustainalytics. Although the historical data available for stock (adjusted close prices, historical data is not freely provided for ESG and controversy scores.

What are Controversy Scores? Sustainalytics assesses companies for their level of involvement in controversies that have an impact on the environment or society and the associated business risks companies face from such involvement. Each controversy is categorized from Category 1 (low ESG impact) to Category 5 (severe ESG impact).

Refer to [Methodology of Sustainalytics scores](#)

Table-1: Sample Data:

	STOCK	ESG RISK RATING	CONTROVERSY	ESG+CONT
0	HEROMOTOCO.NS	12.00	1	13.00
1	TECHM.NS	12.00	1	13.00
2	WIPRO.NS	13.00	2	15.00
3	EICHERMOT.NS	13.00	2	15.00
4	HCLTECH.NS	13.00	2	15.00
5	ADANIPORTS.NS	12.00	4	16.00
6	TCS.NS	14.00	2	16.00
7	TITAN.NS	15.00	2	17.00
8	INFY.NS	15.00	2	17.00

ESG Risk is assumed to be ESG+CONT from the above table.

i.e., ESG Risk = ESG RISK RATING (column 2) + CONTROVERSY (column 3)

EXPERIMENT AND METHODOLOGY

Empirical Experiment: The experiment is essentially carried out on Nifty50 Index stocks to provide the empirical evidence using the **4 different cases for comparisons**. The comparisons are done within each case.

In each of the cases, stocks are screened and selected with certain criteria based on the current ESG scores and/or controversy scores. The weights for calculation of portfolio return and portfolio standard deviation are constructed using ESG parameters.

Metrics for comparison: For all the cases the comparisons are done using 3 metrics.

1. Portfolio returns,
2. Portfolio Standard Deviation and
3. Sharpe's ratio.


Note: The experiment uses minimize function from `scipy.optimize` to optimize Sharpe's ratio.

In each case, Portfolio Returns and Portfolio Standard Deviations and Sharpe's ratio are calculated multiple times using different weights.

Types of Weights used for calculation of the metrics: The weights applied for calculations of Portfolio Returns and Portfolio Standard Deviation are different case by case basis. The following are definitions for types of weights.

- **Equal Weights:** All weights are equal in the selected stocks for the portfolio
 - Here, sum of all Equal weights is 1
- **ESG Weights:** These are constructed in all cases based on ESG scores. The ratings given by Yahoo Finance (Sustainalytics) are representing the ESG risks, so higher the ESG score higher is the ESG risk.
 - The calculation for ESG Weights from ESG risk is done in the following way.
 - First ESG Multiplier is calculated.
 - $\text{ESG Multiplier} = \text{Reciprocal of ESG risk}$
 - Thereafter, ESG Weight is calculated as
 - $\text{ESG Weight} = \text{ESG Multiplier} / \text{Sum (ESG Multiplier)}$
 - Here, sum of all ESG weights = 1
- **Assigned Weights:** These are used mainly when the portfolio is logically split in 2 parts based on Low ESG risk and High ESG risk.
 - Higher (0.7) weightage is considered for Low ESG risk group of stocks.
 - Lower (0.3) weightage is considered for High ESG risk group of stocks.
 - Here, Sum of all weights is 1.
 - The weightage is decided manually.

Table-2: Example of calculated ESG Weights (ESG_Wts):

	Rtn	SD	Wts	ESG_risk	ESG_Multiplier	ESG_Wts	
STOCK							
HEROMOTOCO.NS	0.040602	0.279736	0.020833	13.00	0.0769	0.041227	
TECHM.NS	0.215725	0.299147	0.020833	13.00	0.0769	0.041227	
WIPRO.NS	0.130310	0.269551	0.020833	15.00	0.0667	0.035758	
EICHERMOT.NS	0.257336	0.316147	0.020833	15.00	0.0667	0.035758	
HCLTECH.NS	0.230843	0.264621	0.020833	15.00	0.0667	0.035758	
ADANIPTS.NS	0.195392	0.323341	0.020833	16.00	0.0625	0.033507	
TCS.NS	0.193025	0.228208	0.020833	16.00	0.0625	0.033507	
TITAN.NS	0.242022	0.323185	0.020833	17.00	0.0588	0.031523	
INFY.NS	0.185789	0.267107	0.020833	17.00	0.0588	0.031523	

The Cases:

- **Case1:** (*Base Case*)
 - Select entire Nifty50 portfolio and
 - Compare the metrics calculated with ESG weights, Equal weights, and optimized weights given by Optimizer.

Case2: (*Dropping Controversial stocks*)

- Select the Nifty50 stocks after dropping the stocks which have Controversy ratings ≥ 4 and
- Compare the metrics calculated with ESG weights, Equal weights, and Optimized weights given by Optimizer. Controversial Stocks are assumed to be high risk stocks.

Case3: (*Differentiating the Low ESG risk and High ESG risk stocks and assigning different weights to Low and High ESG Risk stocks*)

- Select all Nifty50 stocks and divide them in 2 parts based on Low ESG risk score (≤ 25) and High ESG score (> 25).
- After such segregation, assign higher but equal weights within all Low ESG risk stocks and assign lower equal weights within all Higher ESG risk stocks. Here, the ratio could be 70% weightage to all Low ESG risk stocks and 30% for higher ESG risk stocks. This means the total weight for Low ESG stocks would be 0.7 and that of Higher ESG stocks would be 0.3.
- A different weight ratio such as 60%: 40% could also be taken.
- Compare the metrics calculated with ESG weights, assigned weights, and Optimized weights given by Optimizer. (No equal weights in this case)

Case4: (*This is a combination of Case 2 and Case3*)

- Select the Nifty50 stocks after dropping the stocks which have Controversy ratings ≥ 4 as done in Case2.
- With the remaining stocks carry out the steps as mentioned in Case3.

Technical aspects:

Python programming language is used for data collection from Yahoo Finance API / files, data screening, filtering, and calculations.

For each of the cases mentioned in the previous chapter, a separate python code is written for better understanding and execution. The code can be easily changed by the user should she/he thinks so for any modification. (A single program could have been written for all cases without repeating many steps of the 4 programs, the author, however, found this more convenient for the smaller experiment). The code is commented for all steps for readability.

In general, the steps carried out in each program are:

1. Install yfinance (! pip install).
2. Import the required python libraries (pandas, numpy, matplotlib, requests, io).
3. Read ESG scores from csv (stored in github).
4. Drop stocks with higher controversy ratings for Case 2 and Case 4.
5. Read prices data from yfinace (Yahoo Finance).
6. Keep only adjusted close prices.
7. Check for NaN/Nulls and drop stocks if NaNs are in multiple rows.
8. Synch all Data Frames for stocks to be used.
9. Calculate annualized monthly log returns, annualized standard deviation, covariance matrix.
10. Create ESG weights - The calculation for ESG weights is explained earlier.
11. Create Equal weights, assigned weights depending on cases.
12. Create portfolio returns, portfolio standard deviations, Sharpe's ratios using different weights depending on cases.
13. Print the results. The calculation for ESG.

EMPIRICAL FINDINGS AND DISCUSSION

Following are the findings from the experiment for all 4 cases. A brief narration is given below each case for discussion to draw inference.

Result of Case1 - All Nifty Stocks

```
-----  
Nifty Portfolio Rtn using Opt wts    = 19.1263%  
Nifty Portfolio SD using Opt wts     = 15.3027%  
Sharpe ratio from optimized wts      = 0.8656  
This is the optimum portfolio
```

```
  
Nifty Portfolio Rtn using ESG Wts    = 17.4442%  
Nifty Portfolio SD using ESG Wts     = 18.3627%  
Sharpe ratio from ESG wts           = 0.6298
```

```
  
Nifty Portfolio Rtn using Equal Wts  = 16.8193%  
Nifty Portfolio SD using Equal Wts   = 17.6650%  
Sharpe ratio from Equal wts          = 0.6193  
-----
```

Inference1: The first case is a base case where no new method is introduced for screening the stocks. So, all stocks are considered. The only change is the concept of ESG Weights. It is also quite obvious that no portfolio manager would generally use the equal weights. However, the experiment shows that the portfolio returns are better than those of equal weights.

Another obvious fact is optimizer will always get the best results and provide the optimized weights, however, such a solver will drop many stocks if the standard deviation is high unless there is significantly high returns.

The first case shows that using the ESG weights one can achieve slightly better or similar results as those of equal weights. There is no drop in the portfolio returns.

Result of Case2 - Dropping Controversial Stocks

Nifty Portfolio Rtn using Opt wts	=	15.8403%
Nifty Portfolio SD using Opt wts	=	14.9070%
Sharpe ratio from optimized wts	=	0.6682

This is the optimum portfolio

Nifty Portfolio Rtn using ESG Wts	=	17.1647%
Nifty Portfolio SD using ESG Wts	=	17.2945%
Sharpe ratio from ESG wts	=	0.6525

Nifty Portfolio Rtn using Equal Wts	=	16.5425%
Nifty Portfolio SD using Equal Wts	=	17.0095%
Sharpe ratio from Equal wts	=	0.6269

Inference2: Case 2 results are very encouraging. **It is evident that when the stocks with higher controversy ratings are dropped, The returns are even higher than those given by optimiser.**

One can also infer that controversial stocks were giving high returns, however, in the long run it would pose a significant potential risk.

Result of Case3 - Assigning 0.7:0.3 Weights to Low and High ESG risk Stocks

Nifty Portfolio Rtn using Opt wts	=	19.1281%
Nifty Portfolio SD using Opt wts	=	15.3036%
Sharpe ratio from optimized wts	=	0.8657

This is the optimum portfolio

Nifty Portfolio Rtn using ESG Wts	=	17.4442%
Nifty Portfolio SD using ESG Wts	=	18.3627%
Sharpe ratio from ESG wts	=	0.6298

Nifty Portfolio Rtn using Assigned Wts	=	18.2528%
Nifty Portfolio SD using Assigned Wts	=	17.9335%
Sharpe ratio from Assigned Wts	=	0.6899

Inference3: The experiment used higher weights for Low ESG stocks and lower weights for High ESG stocks. This result is also encouraging. **It is evident that with such new scheme of assigned weights the portfolio returns have improved significantly.** Even (60:40) ratio would work.

Result of Case4 - Drop Controversial and Assigning 0.7:0.3 Weights to Low and High ESG risk Stocks

Nifty Portfolio Rtn using Opt wts = 15.8403%
Nifty Portfolio SD using Opt wts = 14.9071%
Sharpe ratio from optimized wts = 0.6682
This is the optimum portfolio

Nifty Portfolio Rtn using ESG Wts = 17.1647%
Nifty Portfolio SD using ESG Wts = 17.2945%
Sharpe ratio from ESG wts = 0.6525

Nifty Portfolio Rtn using Assigned Wts = 18.0866%
Nifty Portfolio SD using Assigned Wts = 17.0489%
Sharpe ratio from Assigned Wts = 0.7160

Inference4: This case in the experiment is a combination of Case 2 and Case3 where stocks with higher controversies are excluded first and then the remaining stocks are divided in 2 groups for Low ESG and Higher ESG risks. Then the new scheme of assigned weights is used. (70:30)

This Case 4 in the experiment has not shown improvement, however, the results are close to those of Case 3. There is very little drop 0.17%) in portfolio returns.

CONCLUSION AND RECOMMENDATION

Conclusion: The experiment has provoked a food for thought by giving the encouraging results. The detailed discussion has been shown in the previous section and inferences have been drawn.

It can be concluded that that the screening of the stocks must be done with respect to the Environmental, Social and Governance factors and especially with respect to controversy ratings too.

Dropping controversial stocks is anyway better to reduce risk as they pose much higher risk for future. Such stocks can tumble down if the controversies are not resolved by the management.

Similarly, if the segregation is done based on ESG ratings/scores, it would prove to be beneficial.

The new ESG weightage scheme can be altered or expanded to suit the need of the investors. The basis is though provided here.

Recommendation: The author would like to recommend here that this experiment can be researched further with historical data of ESG ratings which was not available for this experiment. With the growing trends in the Responsible Investment industry. the future trends can be forecasted for ESG scores along with the stock prices using a deep learning model. This will be a great study and much useful for the investors' community, students, and researchers.

REFERENCES

[Economic Survey 21-22](#)

[Wiki - ESG](#)

[Investopedia - ESG criteria](#)

[Global Sustainable Investment Review 2020](#)

[MSCI - ESG ratings](#)

[MSCI - ESG Industry Materiality Map](#)

[MSCI ESG Ratings mechanism](#)

[Harvard Law School of corp governance](#)

Links to ESG rating frameworks of main 5 companies.

MSCI Key Issue Framework (as of July 2022), available at: <https://www.msci.com/our-solutions/esg-investing/esg-ratings/esg-ratings-key-issue-framework>

FTSE ESG Ratings Model (as of June 2021), available at: https://research.ftserussell.com/products/downloads/Guide_to_FTSE_Sustainable_Investment_Data_used_in_FTSE_Russell_Indices.pdf

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Sustainalytics ESG Risk Ratings (as of January 2021), available for download at: <https://www.sustainalytics.com/esg-data>