Master SMT

Sustainable and Entrepreneurial Finance

Assignment 2
Due date: April 18, 2023 at 11:59 pm

Objectives

The objectives of this homework are the following:

- Evaluate the (weighted average) carbon intensity of a business-as-usual (BAU) portfolio
- Build a decarbonized portfolios of stocks based on the mean-variance criterion (efficient frontier)
- Evaluate the relative performance of BAU and decarbonized portfolios

Instructions

- Assignments should be done in groups of 4 students.
- You should work with the same group through the entire course.
- Submit on Moodle only one copy of solutions per group with the code.
- For each homework you can get a maximum of 100 points.
- All assignments turned in late will not be graded (zero points).

Each group will pick firms to analyze for Homework 1 and Homework 3 as follows:

1. **Group 1**: U.S. firms with available **environmental** scores (MSCI)
2. **Group 2**: U.S. firms with available **social** scores (MSCI)
3. **Group 3**: U.S. firms with available **governance** scores (MSCI)
4. **Group 4**: U.S. firms with available scope 1 to 3 emissions (Trucost)
5. **Group 5**: European firms with available scope 1 to 3 emissions (Trucost)
6. **Group 6**: Firms from Emerging countries with available scope 1 to 3 emissions (Trucost)
7. **Group 7**: Utilities firms with available scope 1 to 3 emissions (Trucost)

8. **Group 8**: Energy firms with available scope 1 to 3 emissions (Trucost)
9. **Group 9**: European firms with available **environmental** scores (MSCI)
10. **Group 10**: European firms with available **social** scores (MSCI)
11. **Group 11**: Firms from Emerging countries with available **environmental** scores (MSCI)

Take the same data from Homework 1 and answer the following questions:

? What will be the impact of implementing ESG constraint on our portfolio ?

Portfolio allocation with ESG/GHG emissions constraints

Idea: Could we plot a histogram for periods: 2005-2010, 2010-2015 2015-202

1. Report summary statistics (mean, median, min, max, standard deviation) on the cross-sectional distribution of your group's variable of interest (i.e. environmental score for groups 1, 9 and 11; social score for groups 2 and 10; governance score for group 3; carbon intensity for groups 4 to 8). Draw the histogram of the cross-sectional distribution of the variable of interest and comment on the summary statistics and the histogram. (10 points)

Carbon Intensity != Carbon emission
Have to calculate this. ton/mill$

2. In Question 4 of Homework 1, you calculated efficient portfolios with various target returns. Take these portfolios, calculate and report the weighted-average E/S/G score or weighted-average carbon intensity of these portfolios (you can take the average score/carbon intensity for each firm over time). Comment on the E/S/G score or carbon intensity of the portfolios. Which firms (e.g. top 10; report firm names along with ISIN) are driving the E/S/G score down or driving the carbon intensity up? Plot on the volatility-E/S/G score (carbon intensity) space the various portfolios (i.e., make a plot similar to the efficient frontier except that E/S/G score or carbon intensity replaces the return on the y-axis). (15 points)

Each month optimal weights multiply by carbon intensity

3. This question is a follow-up of Question 7 of Homework 1. First, take the same 100 selected firms. Then, create a minimum variance portfolio with monthly rebalancing with an additional constraint: you exclude the worst firms in terms of E/S/G score/most polluting (high carbon intensity) firms. Specifically, exclude the **bottom** tercile of the distribution in month $t-1$ for ESG scores or exclude the **top** tercile of the distribution in month $t-1$ for the carbon intensity. Report summary statistics on the performance (return, risk, Sharpe ratio) of this portfolio as well as its E/S/G score or carbon intensity. How do the performance measures (return, risk, Sharpe ratio) compare with the minimum variance portfolio from Question 3 of Homework 1. (20 points)

Exclude 1/3 of the worst co2eq intensity scored company.

Company A can be in your portfolio in month j, not in g, and then back again in month c.

4. For each month, sort firms based on your group's variable of interest (E/S/G scores or carbon intensity) into quintiles. Create equally-weighted and value-weighted portfolios for each time period and each score or carbon intensity quintile. Report the average returns for each quintile portfolio as well as a portfolio that goes long in the highest

Quintiles:

End up with 5 portfolios

1: Q1 portfolio: 20 assets with the companies with the lowest ESG scores
2: Q2: 20 assets based on the ESG scores that are higher/worse

do this until Q5.

For each quintile portfolios: create one portfolio that goes long in the Q1 and short in Q5 (for each month).

When commenting the results:

is there a difference between Q1 and Q5?

In the long / short, subtract the short from the long.

quintile and short the lowest quintile. Comment on your results. What can explain the relationship between the return of your portfolios and firms' ESG score or carbon emissions? (25 points)

5. Take the minimum variance portfolio from Question 3 of Homework 1 and calculate its E/S/G score or carbon intensity. Reallocate its composition in order to improve the E/S/G score by 20%/reduce carbon intensity by 50% (see optimization problem below). Comment on the changes it took in order to improve the ESG score/carbon intensity (e.g., how many and which firms (firm names) had to be removed in the most recent year of your sample in order to achieve these objectives). (30 points)

$$\begin{aligned} \min_{\alpha} \quad & \alpha'\Sigma\alpha \\ \text{s.t.} \quad & \alpha' e = 1 \\ & \alpha' ESGscore \geq 1.2 \times (\alpha' ESGscore)_{Q3-Homework1} \end{aligned} \tag{1}$$

or

Question:

IDEA to include:
Whats is the correlation between previous months co2eq intensity and next months

Improve the intensity for the previous months for the next months portfolio.

$$\begin{aligned} \min_{\alpha} \quad & \alpha'\Sigma\alpha \\ \text{s.t.} \quad & \alpha' e = 1 \\ & \alpha' CI \leq 0.5 \times (\alpha' CI)_{Q3-Homework1} \end{aligned} \tag{2}$$

6. Prepare approx. 10 slides in order to present the key results from this homework with an emphasis on your area of focus (sectoral or geographical). Each group has 15 minutes to present. Presentations will count as separate points.

Overall note: GWP100 years are not very accurate for Methane, can we find another scoring system that uses another co2Eq calcualtion?