

CARIMA - A capital market-based approach to quantify transition risks to investment portfolios

Carbon Risk Management (CARIMA) was a research project funded by the German Federal Ministry of Education and Research (BMBF) and was completed in 2019. CARIMA aims to quantify the existing risks and opportunities for the values of financial assets and respective portfolios in light of climate change and the transition towards a green economy. Compared to other approaches, the advantage of CARIMA was that only the (freely available) return time series of the Carbon Risk Factor BMG (Brown-Minus-Green) is required for the analysis. There is therefore no need for detailed fundamental climate change-relevant information (e.g., financial statements and emissions data) about firms, which is often difficult and expensive to obtain or may not even be available.

The methodology

The CARIMA concept presents a capital market-based approach with which the risks and opportunities of the economy's transition process towards a Green Economy can be quantified comparatively easy, as carbon risks are simply "extracted" from the historical returns of global stock prices using a Carbon Risk Factor BMG in a factor model. CARIMA involves four modules:

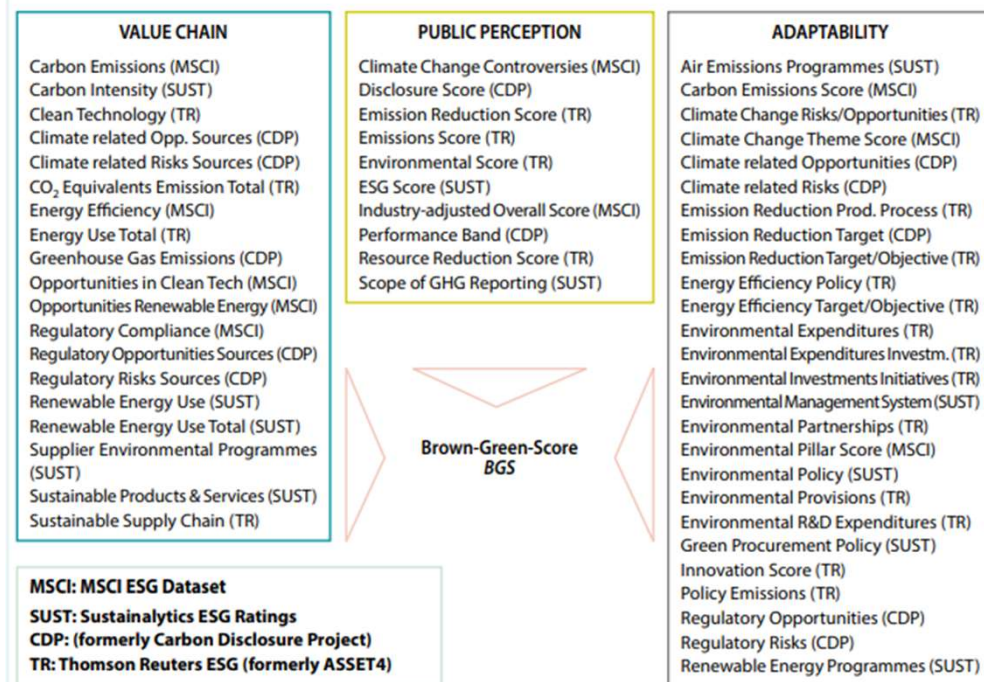
Module A: Master Dataset

The starting point for developing and practically implementing the CARIMA concept is a comprehensive master dataset. It is crucial that the data allow a sufficiently accurate assessment of a firm's change in value in the event of unexpected changes in the transition process of the economy. Data from different databases, namely Thomson Reuters ESG, MSCI ESG-Stats and IVA-Ratings, Sustainalytics ESG Ratings, and CDP is used. The master dataset generated comprises a large number of ESG and capital market variables for around 40,000 listed firms worldwide.

Module B: Scoring Concept

Module B describes 55 Carbon Risk Proxy Variables, which are selected to support a fundamental assessment of whether the value of firms (and thus their stock prices) are influenced positively or negatively by unexpected changes in the transition process towards a green economy. Information from these 55 variables is condensed into the three group indicators via a scoring concept in order to calculate a so-called Brown-Green-Score (BGS) for each firm. The BGS represented a fundamental assessment of the direction and strength of the changes in – or in other words risks to firms' values that may occur as a result of unexpected changes in the transition process of the economy towards a Green Economy.

Figure 5. Assignment of the 55 carbon risk proxy variables to group indicators



Module C: Carbon Risk Factor BMG

In the next step, suitable firms for the factor construction are selected. Only firms that are represented in all four databases and for which data is available for at least five Carbon Risk Proxy Variables are used for factor construction. These conditions are necessary to minimize distortions in the database-specific data collection methodology. Based on their average BGS, 1,108 firms (624 "brown" and 484 "green" firms) are assigned to one of two mimicking stock portfolios: the first portfolio consists of stocks of "brown" firms and the other of stocks of "green" firms.

Subsequently, the Carbon Risk Factor BMG can be formed from the historical returns of the four corner portfolios described, each of which is value-weighted by market capitalization, according to the following Formula:

$$BMG_t = 0.5 (SH_t + BH_t) - 0.5 (SL_t + BL_t) \dots\dots\dots [1]$$

The Carbon Risk Factor BMG thus reflects a hypothetical portfolio that is invested long in "brown" and short in "green" stocks. .../...

Module D: Factor Model

Since stock market prices at any time reflect the speed of the transition process that market participants currently assume is occurring and thus which transition path is expected by society, the return time series of the Carbon Risk Factor BMG, constructed as a mimicking portfolio for carbon risk, contains such information in a condensed form. For a concrete assessment of the carbon risk, a simple regression analysis is applied. Only the historical returns of the financial assets or portfolios, for which the users seek to quantify the carbon risk, are necessary as the dependent variable. The return time series of the explaining variables, such as the Carbon Risk Factor BMG and the remaining factors, are available free of charge on the project website and further websites, respectively. The Carbon Beta as a measure of carbon risk is the result of a regression analysis. The Carbon Beta reflects the capital market's assessment of the carbon risk of the respective financial asset or portfolio.

The Carbon Beta estimates the impacts or effects on firms, and their values or stock prices, of possible changes in expectations that may occur as the present economy moves towards a Green Economy. It is thus the central measure for quantifying risks. Sudden changes in expectations regarding the transition process of the economy are reflected in the Carbon Beta. The higher the absolute Carbon Beta value, the greater the impact (either upward or downward) on the stock price.

Applications

A variety of potential applications for the Carbon Beta is included in Module E. The Carbon Beta can be determined for different asset classes such as stocks, corporate bonds, loans, portfolios, and funds. Furthermore, various country and sector aggregations and corresponding analyses are possible. Scenarios for stress testing the values of financial assets and portfolios can be generated based on the Carbon Beta. In portfolio management, the Carbon Beta can be integrated into investment strategies, such as Factor Investing and Best-in-class approaches, and can be used for hedging carbon risks.

Source: Chapter 34 of NGFS Occasional Paper on Case Studies of ERA Methodologies.