

A Note on ESG CAPM and Carbon Reduction Index Funds*

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1. Introduction

Global efforts to achieve net-zero carbon emissions by 2050 and mitigate climate change are being driven intensively by the functions of capital markets, including ESG investing. In this context, stock prices are expected to reflect carbon emissions.

Bolton and Kacperczyk (2021a) show that there is a significant carbon risk premium in the U.S. stock market, meaning that companies with higher carbon emissions have higher stock returns. Bolton and Kacperczyk (2021b) also conducted an empirical analysis showing that the carbon risk premium exists not only in the U.S. stock market but also in the stock markets of many other countries, including China. On the other hand, Ishijima et al. (2021b) showed that in the Japanese stock market, firms with high carbon emissions have lower stock returns - there is a significant negative carbon risk premium in the Japanese stock market. The existence of a negative carbon risk premium in the Japanese stock market was demonstrated by Oshika et al. (2009) and Saka and Oshika (2011) more than a decade before Bolton and Kacperczyk (2021a,b). The results of these earlier studies suggest that firms that reduce carbon emissions have higher stock returns in the Japanese stock market. In other words, firms can achieve a “double bottom line” by reducing carbon emissions and increasing their stock price at the same time.

Therefore, in this study, we measure the percentage increase in the stock price of a company listed on the Japanese stock market if it reduces its carbon dioxide emissions by 1%. This index can also be interpreted as the return of the Carbon Reduction Index Fund (CRIF), an investment fund for companies that reduce carbon emissions. We show that this fund outperforms the market index fund. In other words,

* This paper was presented at the 2023 RIMS Workshop on Financial Modeling and Analysis, supported by the Research Institute for Mathematical Sciences, an International Joint Usage/Research Center at Kyoto University. We thank Professor Motoh Tsujimura, Professor Makoto Goto (organizers), and the participants for their comments. We remark that we are planning to submit the extended version in which some parts of this paper might be included.

this study shows that investing in companies that are committed to reducing carbon dioxide emissions in the Japanese stock market produces very good investment performance.

The rest of this paper is organized as follows: Section 2 elaborates on how we create the carbon reduction index fund and demonstrates its investment performance. Section 3 concludes.

2. CRIF - Carbon Reduction Index Fund

We elaborate on how to quantify the return on investment of CRIFs. We assume that n assets are traded at discrete points in time t ($= 0, \dots, T$). We conduct a cross-sectional regression with respect to the stock return observed in the market, $R_{i,t}$ ($i = 1, \dots, n; t = 1, \dots, T$):

$$R_{i,t} = \alpha_t \cdot CO2_{i,t} + \mathbf{c}'_t \mathbf{CTRL}_{i,t} + \tau \cdot \mathbf{1}_{\{TIME\ t\}} + \gamma \cdot \mathbf{1}_{\{SECTOR\ j\}} + \eta \cdot \mathbf{1}_{\{FIRM\ i\}} + \varepsilon_{i,t} \quad (1)$$

The explanatory variable of interest is $CO2_{i,t}$, the rate of reduction of the firm's carbon dioxide emissions over the period. The regression coefficient, α_t , represents the percentage increase in the stock price of a company listed on the Japanese stock market if it reduces its carbon dioxide emissions by 1%. This regression coefficient can also be interpreted as the return on investment of CRIF, a fund that invests in companies that reduce carbon dioxide emissions. Note that it is still significant even when we control for known explanatory variables, $\mathbf{CTRL}_{i,t}$, explaining stock prices, time dummies $\mathbf{1}_{\{TIME\ t\}}$, industry dummies $\mathbf{1}_{\{SECTOR\ j\}}$, and firm dummies $\mathbf{1}_{\{FIRM\ i\}}$.

Theoretically, we derive the regression model (1) based on ESG CAPM developed by Ishijima and Maeda (2018). In ESG CAPM, they defined the double-return $R_{i,t}$ for ESG investing which is a sum of cashflow return $\mathbf{c}'_t \mathbf{CTRL}_{i,t}$ and ESG yields $\alpha_t \cdot CO2_{i,t}$.

According to Ishijima et al. (2021a,b), two types of carbon dioxide emission data are reported by Japanese companies: ONTAI and SCOPE3. ONTAI is reported under the Act on Promotion of Global Warming Countermeasures. It is the sum of direct and indirect emissions and can be considered the sum of Scope 1 and 2 of the Greenhouse Gas Protocol (GHG Protocol). SCOPE3 is reported according to the GHG Protocol. SCOPE3 emissions are the so-called supply chain emissions reported under the GHG Protocol. This data was obtained from the Toyo Keizai Shinposha CSR Database, Environment section. However, as this database contains anomalous values, we applied the correction described in Ishijima et al. (2021a,b). Then, the reduction rate from the previous year to the current year was obtained for each of the two types of carbon dioxide emission data over the 72-month period from October 2014 to September 2020. Equation (1) is estimated monthly for each of the two types of CRIFs to obtain a

monthly time series of the investment returns of the two types of CRIFs. In the following, the two types of CRIFs are referred to as ONTAI-CRIF and SCOPE3-CRIF, respectively.

We analyzed the investment performance of ONTAI/SCOPE3-CRIF in terms of risk and return. During this period, the market index fund, which has benefited from Abenomics since December 2012, provided good returns (7.14%) with acceptable risk (15.6%). On the other hand, the ONTAI/SCOPE3-CRIFs offered better returns (7.79%, 10.65%) with lower risk (11.13%, 12.32%). This can be interpreted to mean that the Japanese stock market values companies that are highly committed to reducing carbon emissions and that investing in such companies offers a better risk premium than the market as a whole.

3. Conclusion

We have quantified the percentage increase in the share price of a company listed on the Japanese stock market if it reduces its carbon dioxide emissions by 1%. This index can also be interpreted as the return of the Carbon Reduction Index Fund (CRIF), an investment fund for companies that reduce carbon emissions. We showed that the CRIF outperformed the market index funds. In other words, this study showed evidence of a double bottom line effect in the Japanese stock market, meaning that investing in companies that are committed to reducing carbon dioxide emissions produces very good investment performance.

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