Hedging financial and environmental risk in portfolios: constructing and evaluating eco-funds

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Abstract: Reducing their environmental load has recently become a key concern to firms. Many financial products that invest in companies with a strong environmental consciousness, such as the Nikko Eco-fund, have been released. However, choosing an ecological fund based on an interview or questionnaire is a qualitative process, as an ecological fund does not reflect a firm’s environmental performance, nor reduces environmental risk. This study calculates an environmental beta value (environmental risk) using emissions data on environmental load material, applying eco performance and economic screening. We, then, decide on investment brands and ratios using the environmental beta value and efficient frontier. Finally, we propose an environmental portfolio that reduces environmental and financial risks. This methodology enables to assess environmental risk in a quantitative manner. Two brands of company that simultaneously reduce environmental and financial risks are identified.

Keywords: environmental risks; beta-value; portfolio management; eco-funds; economic screening; eco performance screening.


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1 Introduction

Growth potential and profitability are the conventional measures used in corporate valuation and to build a corporate image. Due to recent scandals and corporate crimes, and following the diffusion of socially responsible investment (SRI), especially in Europe, corporate social responsibility (CSR) (Tanimoto, 2003) is increasingly gaining attention as a corporate valuation factor.

As a form of corporate self-regulation instrument integrated into a business model, CSR policy functions as a self-regulatory mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards, and international norms. In some models, a firm’s CSR implementation goes beyond compliance and engages in actions that appear to further some social good, beyond the interests of the firm and that which is required by law. Thus, CSR aims to embrace corporate responsibility and foster positive impacts on the environment and stakeholders, including consumers, employees, investors, and communities. Environmental concerns have become prominent, and more companies are now focusing on ‘environmental management’, through which business is conducted in harmony with the global environment to foster sustainable development. In this process, reducing the environmental load is an important task (Kokubu et al., 2002).

Recently, many financial products that invest in companies with a strong environmental consciousness, such as the Nikko Eco-fund, have been released (Hanada, 2004). Nikko Eco-fund is an open-ended investment trust fund, which has pursued capital gains specifically investing in stocks of:

1. companies whose environmental activities are superior and that are expected to keep growing
2. companies that conduct businesses related to environmental issues and are expected to keep growing.

However, choosing an ecological fund based on an interview or questionnaire is a qualitative process. The disclosure of such information can cause conflicts of interests with corporate managers, particularly when it can affect their remuneration. Schaltegger and Burritt (2003) argue that external stakeholders must provide corporate managers with incentives to disclose this type of information in a transparent fashion. As a matter of fact, a conventional ecological fund does not necessarily reflect a firm’s environmental performance, nor reduces environmental risk.
Many studies exist about the relationship between the natural environment and investment (Pava and Krausz, 1995; Feldman et al., 1996; Cohen et al., 1997; Kurtz, 1998; Innovest Strategic Value Advisors, 2004). Some researches consider the environment as one of the risks to account for (Shimazaki, 2008).

An investment cannot be said to reduce environmental risk unless firms’ environmental performance can be quantitatively evaluated using information on the emissions data concerning the environmental load material. In addition, in investment decision, stocks that have movement conflicts in the market are usually not combined, as they may not hedge efficiently the risks of a fund. However, to the best of our knowledge, no research has quantified yet environmental risks.

This study builds a new investment method by introducing a new index to measure environmental risks. The proposed indicator of environmental risk allows us to extend the potential range of investment. In addition, the methodology proposed in this study allows investors to minimise the financial and environmental risks by using the efficient frontier.

Quantitative environmental performance is measured by a single score indicator (Bare and Gloria, 2006). The Japanese Ministry of the Environment (2002) recommends the calculation of a single-score environmental indicator in the environmental guidelines. This indicator is not only useful for environmental management within a company, but also for effective communication with the stakeholders through environmental reporting.

Eco-indicator (Goedkoop and Spriensma, 2000) and LIME (Itsubo et al., 2004) are life cycle impact assessment (LCIA) methodologies. Japan Environmental Policy Priorities Index (JEPIX) (Miyazaki et al., 2004; Kumagai, 2012) is an integrative technique that converts emission data of multiple substances to a single-score indicator. This indicator integrates the environmental impact of various harmful substances with different physical and chemical properties in order to make environmental reporting for external stakeholders clearer.

Generally, larger companies produce more emissions and have a considerably larger impact on the environment. Environmentally, harmful emissions are larger in the manufacturing industry than in the service industry. When selecting a company for investment, the difference in industry specific emissions should be taken into account to evaluate companies fairly, and the growth potential and profitability of companies should be considered as well.

There has been a wide range of studies focusing on environmental risk assessment. However, to the best of our knowledge, no study evaluates both quantitative environmental performance and growth profitability. In other words, no eco fund hedges both financial and environmental risks.

This study aims to provide a method to construct a portfolio to hedge the financial and environmental risk of companies. The proposed procedure for selecting brands to be included in the portfolio is as follows:

- Select investment brands using eco performance screening through a performance evaluation of environmental load emissions.
- Calculate an environmental beta-value using the sales and environmental load emissions of each brand and, then, propose an environmental portfolio that reduces environmental risks.
• Propose a portfolio that excels both environmentally and financially.
• Evaluate the profitability of each fund.

2 Method

Two screening methods are used in this study: eco performance and economic screening. Decisions about investment brands and ratios are, then, taken on the basis of the environmental beta and efficient frontier (Tanimoto, 2003; Negishi, 2006).

Using both eco performance and economic screening allows us to overcome two issues affecting eco-funds: opaque screening in brand selection and the exclusive use of qualitative data.

Figure 1 Process of portfolio construction (see online version for colours)

2.1 Eco performance screening

First, we consider the total environmental load emissions and sales of each brand to calculate its total per-sales environmental load emissions. Then, we calculate their annual change rate.

Finally, investment brands are screened according to their average change rates. We select companies with change rate lower than 100% or showing a decreasing trend (i.e., companies that can increase their environmental efficiency).

We consider the fact that larger companies produce more emissions in order to screen firms fairly.
Figure 2 shows that per-sales emissions are almost the same across the industry.

Eco performance was calculated in the following manner:

\[ f \] brand name

\[ t \] year

\[ G_f \] the total environmental load emissions of brand \( f \)

\[ S_f \] sales of brand \( f \)

\[ P_f \] per-sales total environmental load emissions of brand \( f \)

\[ Q_f \] the average emission change rate of brand \( f \)

\[ G_{ft} \] the total environmental load emissions of brand \( f \) in year \( t \)

\[ S_{ft} \] sales of stock \( f \) in year \( t \)

\[ Q_{ft} \] change rate of the total per-sales environmental load emissions of brand \( f \) from year \( (t - 1) \) to year \( t \)

\[ S_f \] the average change rate of brand \( f \)

\[ P_{ft} \] total per-sales environmental load emissions of brand \( f \) in year \( t \):

\[ P_{f,t} = \frac{G_{f,t}}{S_{f,t}} \] (1)

\[ Q_{ft} \] (\%) per-sales change rate of the total environmental load emissions of brand \( f \) year from \( (t - 1) \) to year \( t \):

\[ Q_{f,t} = \left( \frac{P_{f,t}}{P_{f,t-1}} \right) \times 100 \] (2)

\[ S_f \] the average change rate of brand \( f \)

\[ S_f = AVERAGE(Q_{f,2009} + \cdots + Q_{f,2013}) \] (3)
2.2 Economic screening

The economic screening evaluates the profitability of each brand by using return on equity (ROE) as an indicator. In general, companies with a ROE at or above 10% are considered blue chip companies. Therefore, we select companies with an ROE at or above 10% for this screening.

**Figure 3** Investment brand coverage using the two screening methods (see online version for colours)

2.3 Calculation of environmental beta value

Calculating the environmental beta value allows us to determine and quantify environmental risks.

We calculate the environmental beta value of each brand by using the covariance of each brand’s total per-sales environmental load emissions, the total per-sales environmental load emissions of the entire market, and the variance in the total per-sales environmental load emissions of the entire market.

The larger the absolute value of the environmental beta, the greater the reactivity against the total per-sales environmental load emissions of the entire market. Thus, the larger the absolute value of the environmental beta, the higher the brand’s environmental risk; conversely, the smaller the absolute value of the environmental beta, the lower the brand’s environmental risk.

The environmental beta value is calculated in the following manner:

\[
\beta_f = \frac{\text{Cov}(P_f, P_m)}{\sigma^2(P_m)}
\]

- \(f\) = brand name
- \(\beta_f\) = environmental beta value
- \(P_m\) = total per-sales environmental load emissions of the entire market
- \(\sigma^2(P_m)\) = variance in total per-sales environmental load emissions of the entire market
- \(\text{Cov}(P_f, P_m)\) = covariance of total per-sales environmental load emissions of brand \(f\) and total per-sales environmental load emissions of the entire market
\[ \beta_f = \frac{\text{Cov}(P_f, P_m)}{\sigma^2(P_m)} \]  

(4)

Table 1  
Ten brands characterised by a small absolute beta value

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Environmental beta value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hakuto</td>
<td>-0.001306486</td>
</tr>
<tr>
<td>Marubeni</td>
<td>-0.00068451</td>
</tr>
<tr>
<td>R-lease</td>
<td>-0.000681504</td>
</tr>
<tr>
<td>Mitsubishi Motors</td>
<td>-0.000590619</td>
</tr>
<tr>
<td>Mitsubishi Corporation</td>
<td>-2.00902E-05</td>
</tr>
<tr>
<td>Japan Pulp&amp;Paper</td>
<td>0.000207923</td>
</tr>
<tr>
<td>Itochu Corporation</td>
<td>0.000397545</td>
</tr>
<tr>
<td>Ryoden</td>
<td>0.000460474</td>
</tr>
<tr>
<td>Sojitz</td>
<td>0.000941074</td>
</tr>
<tr>
<td>Horiba</td>
<td>0.000966577</td>
</tr>
</tbody>
</table>

2.4 Suggesting an environmental portfolio

One of the premises of an environmental portfolio is that the environmental loads of a market vary according to factors such as the economy and legal regulations. Environmental loads will likely continue to decrease over the long term because Japan has ratified agreements on global environmental load reduction, such as the Kyoto Protocol and the Cancun Agreement [adopted by the Conference of the Parties (COP)16 in 2010]. As the country is gradually being subjected to a policy of reducing environmental loads, companies that fail to comply with this policy requirements will be weeded out. Therefore, such companies represent a risk for investors.

We select investment brands taking this risk into account. We choose brands that carry little environmental risk (whose absolute environmental beta values are small). We can further minimise environmental risks by combining stocks that have movement conflicts in the market (i.e., by combining stocks with positive and negative environmental beta values).

Next, we take decisions about investment ratios. We use modern portfolio theory to determine the ratio defined by the maximum return for a certain risk (i.e., the ratio of the effective frontier).

First, we identify the ratio group that hedges financial risk by using the efficient frontier concept. Then, we identify the ratio group that hedges environmental risk using the same concept. Applying both the environmental and financial efficient frontiers produces an investment portfolio that hedges environmental and financial risk simultaneously.

The two efficient frontiers are used in the investment ratio determination of the two brands. Then, the ratio in which the relationship between risk and return is efficient is selected.

In Figure 4, the red dots in the upper half of the graph indicate the ratio of the financial efficient frontier. In Figure 5, the red dots in the lower half of the graph indicate the ratio of the environmental efficient frontier. The red points of the environmental
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Efficient frontier are located in the lower part of the figure because we assume a reduction in the return of the total environmental load. Therefore, the return is negative.

**Figure 4** Financial risk and return (AuBEX, Ltd. and Mitsubishi heavy industries, Ltd.)
(see online version for colours)

![Graph showing financial risk and return](image)

**Figure 5** Environmental risk and return (AuBEX, Ltd. and Mitsubishi heavy industries, Ltd.)
(see online version for colours)

![Graph showing environmental risk and return](image)

3 Discussion


Eco performance screening was carried out first, leading to the selection of 357 target investment brands, chosen from about 1,200 candidates.
Then, screening for economic performance was performed on those 357 brands; 42 brands were selected as investment targets.

We determined the investment brands and investment ratios using the calculation results for the environmental beta and efficient frontier. We, then, built an efficient environmental portfolio. In addition, we built an environmentally-oriented portfolio and financially-oriented portfolio. This portfolio emphasised on the performance of per-sales greenhouse gas emissions and ROE, respectively.

We use the Nikko Eco Fund, Daiwa Eco Fund, and Nikkei Stock Average as benchmarks to verify the soundness of the proposed environmental portfolio.

In addition, the environmental portfolio proposed in this study was compared to the environmentally-oriented portfolio and financially-oriented portfolio.

With respect to the Japanese economic situation (2011~2014), the market was beginning to recover from the collapse of Lehman Brothers.

**Figure 6** Stock investment ratio of the environmental portfolio, Nikko Eco Fund, Nikkei Stock Average, and Daiwa Eco Fund (between November 2011 and December 2014) (see online version for colours)

Comparing the three-year price movements (between November 2011 and December 2014), Figure 6 shows that the environmental portfolio outperformed the benchmarks in most periods. Therefore, the validity of the proposed methodology is confirmed.

Figure 7 shows that the environmentally-oriented portfolio outperformed the Nikko Eco Fund. However, it does not show significant differences with respect to the Nikkei Stock Average. The financially-oriented portfolio seems to almost co-move with the environmental portfolio, and it largely outperforms the Nikkei Eco Fund and Nikko Eco Fund. The financially-oriented portfolio is very close to the environmental portfolio in terms of financial performance. A potential reason is that two brands of the financially-oriented portfolio have also been selected through the eco performance screening and economic screening, meaning that the two brands in question excel both
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environmentally and financially, such as the brands of the proposed environmental portfolio.

Figure 7  Stock investment ratio of every kind of portfolio, Nikko Eco Fund, and Nikkei Stock Average (between November 2011 and December 2014) (see online version for colours)

However, the environmental beta value of the brands that constitute the financially-oriented portfolio are all negative. Therefore, this portfolio is not fully hedging environmental risk (Table 1 and Table 2).

Finally, we can conclude that the environmental portfolio outperforms both the environmentally-oriented portfolio and the financially-oriented portfolio, as it can efficiently hedge both the environmental and financial risk.

Table 2  Key information on the brands constituting the environmental portfolio

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Environmental beta value</th>
<th>ROE</th>
<th>Investment ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>AuBEX</td>
<td>0.007660195</td>
<td>13.481</td>
<td>29.9%</td>
</tr>
<tr>
<td>Mitsubishi Heavy Industries</td>
<td>−0.007230</td>
<td>14.082</td>
<td>70.1%</td>
</tr>
</tbody>
</table>

Table 3  Key information on the brands constituting the financially-oriented portfolio

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Environmental beta value</th>
<th>ROE</th>
<th>Investment ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seiko Epson</td>
<td>−0.402597188</td>
<td>35.934</td>
<td>63.3%</td>
</tr>
<tr>
<td>Mitsubishi Motors</td>
<td>−0.000590619</td>
<td>39.621</td>
<td>36.7%</td>
</tr>
</tbody>
</table>
4 Conclusions

In this study, we quantified the environmental risks faced by companies through the environmental beta value. The quantification of environmental risks allows us identify investments that can actually reduce environmental risk. Many investors seem to value the reduction of environmental risks as much as the containment of financial risks. The proposed environmental portfolio enables investors to simultaneously reduce both financial and environmental risk.

In this study, only two company brands are considered in the environmental portfolio. Therefore, this environmental portfolio cannot obtain the effect that the risk is reduced in proportion to the number of brands. The construction of a method to build a portfolio consisting of n brands is a topic for future research.

References


