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Corporate Growth and Environmental Conservation: Evidence from Shizuoka Prefecture in Japan

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ABSTRACT

This study explores how publicly traded corporations in Shizuoka Prefecture in Japan achieve corporate growth and environmental conservation. Data on financial performance and environmental impacts before, during, and after the COVID-19 pandemic of 22 entities from 2019 to 2022 were used for the analysis. This study is structured around three major points. First, the regression analyses identify a clear range of turning points (between JPY 0.818 and 0.922) that the 22 corporations should target in terms of scope 1 carbon dioxide emissions per employee and total shareholders return per employee (TSR/EMP) based on the Environmental Kuznets Curve (EKC) hypothesis. Second, the EKC hypothesis is established based on the deciding factors that result from the interaction of (1) enforcement of stricter emissions regulations, including penalties; (2) business and environmental organizations' guidelines, ratings, and initiatives; (3) investors' emphasis on the environment, social, and governance (ESG) concept; and (4) intrinsic or endogenous efforts of the corporations. These four points have been recently encouraged and prioritized in Japan. Third, an approach that focuses on ESG and TSR can contribute not only to the achievement of financial growth and environmental conservation but also to the expansion of the academic literature.

Keywords: EKC Hypothesis, Environment, Society, and Governance, Total Shareholders Return
JEL Classifications: L21, Q56, R11

1. INTRODUCTION

This study explores how publicly traded corporations in Shizuoka Prefecture in Japan achieve corporate growth and environmental conservation. Data on financial performance and environmental impacts before, during, and after the COVID-19 pandemic of 22 entities from 2019 to 2022 were used for the analysis.

This study primarily aims to offer findings and implications for the advancement of academic research, corporate strategic planning, and policy-making, focusing on corporate financial growth and environmental conservation.

This section presents the advantages of focusing on listed companies in Shizuoka and unexplored research frontiers to provide context for the primary objective. First, Shizuoka Prefecture (where the author belongs to Tokoha University) is unique and thus worthy of consideration. Despite its remote location compared with the two major metropolitan areas of Tokyo and Osaka, Shizuoka ranks third among Japan's 47 prefectures in terms of industrial shipments.

Moreover, it is home to the headquarters of several Japanese global companies, including two automotive companies, namely, Suzuki Motor Corporation and Yamaha Motor Co., and two musical instrument manufacturers, namely, Yamaha Corporation and Kawai Musical Instruments Manufacturing Co. Furthermore, Shizuoka Prefecture is the place of origin of Honda Motor's founder Mr. Soichiro Honda and where he started his company. Furthermore, the Prefecture has an industrial cluster of subsidiaries and suppliers that provide mechanical parts and various services to these prominent Japanese firms.

Accordingly, this study analyzed 22 Tokyo Stock Exchange (TSE)-listed corporations in Shizuoka that have disclosed environmental and financial data. Their combined sales volume totaled USD 62 billion. The findings and implications of this study will provide useful perspectives for research on countries, cities, and company clusters with size and/or characteristics.

Second, research on balancing the two major issues of business competition and environmental conservation is expected to expand in the future. Two Nobel Prizes in Economics have expanded academic frontiers: (1) market power and regulation analysis in the field of industrial organization theory and (2) climate change integration into long-term macroeconomic analyses in the field of environmental economics. These two recognitions were awarded to Dr. Jean Tirole in 2014 and Dr. William D. Nordhaus in 2018, respectively. Their findings have demonstrated the possibility of exploring academic frontiers in competition and conservation.

This chapter concludes with a discussion of the research's originality. The author applies the Environmental Kuznets Curve (EKC) hypothesis to corporate analysis, focusing on listed companies in Shizuoka. Furthermore, the author employs the total shareholder return (TSR) as one of the explanatory variables in the regression analysis.

This study applies the EKC hypothesis and its advanced theory of an inverted N-shaped curve, discussed in Chapter 2, to analyze companies, rather than the traditional approach of analyzing countries and regions.

Moreover, the study uses the TSR as one of the explanatory variables in the regression analysis. The TSR is calculated by dividing the sum of dividends, capital gains, and other relevant financial elements by the initial investment amount. TSR disclosure is a relatively recent phenomenon that started in 2019 with the amendment of the Cabinet Office Order on Disclosure of Corporate Affairs in Japan. Therefore, prior research has not employed the TSR for environmental data analysis.

The application of the TSR analysis can extend the research scope not only in Japan but also in other countries. The author endorses the recommendation of the Boston Consulting Group (BCG) of Japan. In 2021, BCG recommended the TSR to be positioned as a medium–long-term goal to increase corporate value, rather than as a short-term objective that focuses on share price appreciation. The TSE also employs the TSR as an indicator for TSE executive compensation due to its significance in enhancing shareholder value (Tokyo Stock Exchange, 2024).

The author comprehensively examined domestic and international academic journals and found that the only prior study that integrated the EKC hypothesis with the TSR is the one by the author (Tsujimoto, 2023). However, the study was conducted on Japanese major public utilities, such as the aviation, electric power, and gas sectors. Therefore, no prior study has applied the EKC hypothesis to analyze listed companies in Shizuoka, using the TSR as one of the explanatory variables in the regression.

As a result, the author offers findings and implications that contribute to the advancement of academic research, corporate strategic planning, and policy-making for corporations to achieve financial growth and environmental conservation.

2. DEFINITIONS AND LIMITATION OF PRIOR STUDIES AND CHALLENGES

2.1. Definitions

"Financial growth" refers to an increase in sales, net income, and other important reported financial items.

"Environmental conservation" is defined by the Article 2 of the Act (No. 91 of 1995) on Basic Environment in Japan. It means preventive measures against global warming, ozone layer depletion, marine pollution, decrease in wildlife species, or situations affecting the whole or part of the world caused by human activities, which contributes to the welfare of humankind as well as wholesome and cultured living.

This study employs the EKC hypothesis to undertake a corporate analysis. The EKC hypothesis is an economic theory that clarifies the interrelationship between growth and environmental impacts. It was formulated based on the application of Dr. Simon Kuznets's theory of economic growth and income inequality to the environmental domain. Dr. Simon Kuznets is a Nobel Prize laureate in economics.

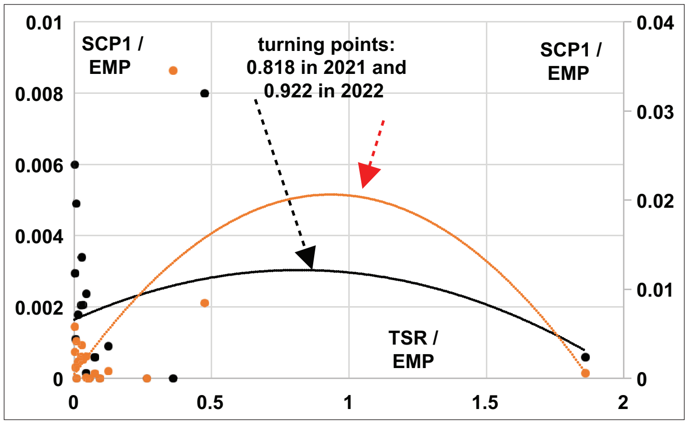
The EKC hypothesis has been the subject of academic research since the 1990s. The earliest studies were conducted by Grossman and Krueger (1991) and the World Bank (1992). This research has been broadened to cover various environmental issues, including air and water pollution and deforestation. The following sources were consulted: Csereklyei et al., 2017; Galeotti et al., 2009; Gopakumar et al., 2022; Markandya et al., 2006; Panayotou, 1997; Perman and Stern, 1999; Selden and Song, 1999; Sorgea and Neumann, 2020; Stern and Common, 2001; Tsujimoto 2022; 2023; 2024).

The ECK hypothesis proposes that economic growth and environmental impact are inversely related, whereby the impact increases up to a certain threshold of economic growth and then begins to decrease. This relationship is characterized by an inverted U-shaped curve at the turning point. The hypothesis is valid when the linear (positive: $\beta > 0$) and squared terms (negative: $\beta < 0$) are statistically significant (for further details, please refer to Figure 1 in Section 3.2).

Furthermore, this study also assesses the efficacy of a cubic curve as an extension of the EKC hypothesis. An inverted N-shaped curve should be illustrated when investigating the relationship between growth and environmental impacts. This approach is valid when environmental impacts increase (positive: $\beta > 0$) at the first turning point (bottom) and then decrease (negative: $\beta < 0$) at the second turning point (top) (Figure 2 in Section 3.2).

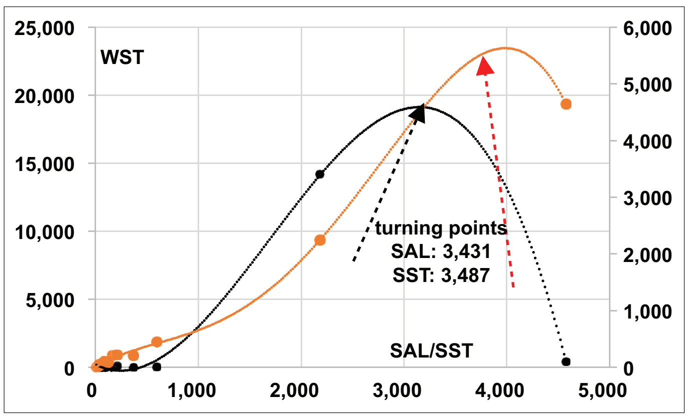
This study examines the relationship between corporate financial performance and the environmental impacts from carbon dioxide

Figure 1: Scope 1 CO_2 per employee–TSR per employee (SCP1/EMP-TSR/EMP) in 2021 and 2022



Sources: author's calculation

Figure 2: Industrial waste generation –net sales (WST-SAL) and industrial waste generation –total assets (WST-SST) in 2022



Sources: author's calculation

(CO_2) emissions, electricity consumption, water consumption, and waste generation to identify a turning point and/or range of turning points that can simultaneously facilitate growth and conservation. Table 1 in Chapter 3 presents a comprehensive list of the companies examined.

2.2. Limitations of Prior Studies

As mentioned previously, no study, thus far, has explored the relationship between corporate financial growth and environmental conservation using a comprehensive set of listed companies headquartered in Shizuoka Prefecture and employing the EKC hypothesis. Accordingly, the author broadens his perspective and, after mentioning the limitations of his work (2023), directs attention to the shortcomings of previous studies on corporate ESG activities.

Tsujimoto (2023) analyzed the turning points of the EKC hypothesis and the factors that led to its establishment by selecting 43 TSE-listed Japanese corporations. These corporations were public utilities including electric power, gas, transportation, telecommunications, and postal services, for which raw environmental impact data were available. The data comprised CO_2 emissions, electricity consumption, water consumption, and industrial waste generation.

The study was the first to rely on primary raw data disclosed by the corporations. However, the analysis focused on the leading companies in each industry headquartered in large cities, such as Tokyo and Osaka. Conversely, the analysis of the relationship between corporate growth and environmental conservation of local firms was insufficient.

The shortcomings of the methods used by academic researchers to analyze corporate ESG activities must be identified. Secondary ESG scores (e.g., A, AA, and 80 points) provided by rating agencies and organizations are commonly used in research. These ESG scores may be subject to arbitrariness. Only a few studies have utilized raw data due to insufficient environmental information disclosure and the absence of consistent disclosure standards among companies and rating agencies during the transition period to global standard setting.

The disclosure process requires time and resources, including data certification by auditing firms. It may also include confidential corporate information disclosure. Furthermore, the lack of consensus among regulatory authorities, industry associations, legal and accounting firms, financial institutions, and media organizations has resulted in a lack of uniformity in disclosure extent across companies. The consequence is asymmetric whereby corporations that have undergone rigorous legal and financial reviews, disclosing systematic and comprehensive financial data at the time of listing, do not promptly disclose environmental data that can be verified through academic research.

Certain companies present environmental bar graphs and approximate values only, failing to provide the exact figures necessary for research. Several listed companies in Shizuoka refused to disclose environmental data requested by the author in performing this study.

The recently implemented system for "the Greenhouse Gas Emissions Reporting and Publication Scheme" as overseen by the Ministry of the Environment of Japan, enables companies to estimate the CO_2 emissions of their respective sites. However, it cannot feasibly integrate company-wide emission data due to information unavailability concerning the CO_2 emissions of offices and other facilities not encompassed by the aforementioned scheme.

Moreover, sustainability-related information disclosure requirement by TSE-listed companies is expected by 2027. However, as of writing (November 2024), the extent of the research contribution of such disclosure remains unclear.

Another reason for the absence of prior research utilizing ESG raw data is the lack of consistency in its disclosure. Furthermore, the ESG data-gathering process often necessitates considerable time and effort. In contrast to financial disclosure, ESG data disclosure via Excel or CSV is not commonly practiced. Thus, this study manually investigated relevant sections of environmental and/or ESG reports of over 50-100 pages or company websites, inputting the data into Excel sheets and reconfirming each figure.

Accordingly, the calculations in this study employ primary data disclosed by firms to eliminate the inherent biases and

Table 1: Corporations' participation (☑) and ratings

Corporate Names	Kei-Danren	Toyo Keizai	TCFD	CDP
Daytona	-	-	N	-
Emvipro	☑	-	☑	A-
Enshu	-	-	N	F
FCC	-	-	N	B
Hagoromo Foods	-	-	N	-
Hamamatsu Photonics	☑	AAA	☑	B
Kawai Musical Instruments Manufacturing	☑	-	N	-
Kyowa Leather Cloth	-	-	N	-
Midac	☑	A	☑	B
Murakami	-	-	N	-
Nihon Plast	-	-	N	-
Roland	-	-	N	C
Roland DG	-	C	N	B+
Shizuoka Gas	☑	-	☑	F
Star Micronics	-	A	☑	D
Suzuki Motor	☑	AA	☑	B
Tokushu Tokai	☑	-	☑	F
Univance	-	-	N	-
Yaizu Suisan	-	-	N	-
Yamaha	☑	AAA	☑	A
Yamaha Motor	☑	AAA	☑	A
Yutaka Gigen	-	-	N	-

Sources: each website as of September 2024, Corporation, Group, Holdings, etc. are omitted for simplicity

arbitrariness. This method differs from those employed by previous studies. Although it requires considerable time and effort, the methodology employed in this study offers a valuable contribution to knowledge advancement.

2.3. Impacts and Challenges

To conclude Chapter 2, this section examines the economic and environmental impacts of Shizuoka Prefecture as a whole and the 22 targeted companies to facilitate readers' understanding.

The Ministry of Internal Affairs and Communications of Japan (MIC) (2024) reports that Shizuoka Prefecture has a population of 3.6 million as of 2021, ranking 10th among the 47 prefectures in Japan, whereas the Tokyo Metropolitan has the largest population at 14 million.

However, the Ministry of Economy, Trade and Industry of Japan (2024) published Shizuoka as a prominent manufacturing center, ranking third in terms of manufacturing shipment value, after Aichi and Osaka Prefectures. In 2021, the gross domestic product (GDP) of Shizuoka Prefecture was estimated at USD 128 billion. This figure is comparable to that of the State of Mississippi's USD 128 billion (US Bureau of Economic Statistics, 2024) and Kuwait's USD 137 billion (International Monetary Fund, 2024).

The aggregated sales of the 22 companies in Shizuoka amounted to USD 62 billion in 2022. This figure is comparable to the GDP of Slovenia (USD 62 billion) and Lithuania (USD 67 billion).

The latest available data by the Ministry of Environment of Japan (2024) indicate that Japan's CO_2 emissions in 2021 were 1.06 billion tons, whereas those of Shizuoka Prefecture were 24.24 million tons. Furthermore, Shizuoka Prefecture's CO_2 emissions in 2021 are 23.4% below the 2013 level, aligning with the Japanese government's commitment to reduce CO_2 emissions sustainably to 46% below the 2013 level.

The combined scopes 1 and 2 CO_2 emissions of the 22 target corporations are estimated at 2.37 million metric tons in 2022, equivalent to Ford Motors' 2.38 million metric tons in the same year (Ford Motors, 2024). Moreover, the collective workforce of the 22 companies totals 188,519 employees, which is comparable to the size of Alphabet (Google), with 190,234 employees (Alphabet, 2023) as of the end of 2022. Thus, considering the size and influence described above, the group of corporations in this paper is worth academic research.

3. VERIFICATION

3.1. Methods

This section examines the relationship between financial performance and environmental impact data by employing linear, quadratic, and cubic regressions. The methodology is detailed below.

3.1.1. Target companies

This study selected 22 TSE-listed corporations headquartered in Shizuoka Prefecture. Thirty companies are listed in Shizuoka, but those engaged in nonmanufacturing activities, such as banking and logistics, and without emission data disclosure were excluded.

The 22 companies represent a diverse range of entities, including industry leaders in the sales, development, and export of cutting-edge technologies, suppliers of parts to such companies, and recycling and resource recovery companies. Notwithstanding the diversity in size and name recognition, these 22 companies altogether offer economic and social development contributions to Shizuoka, Japan, and internationally. This goal is achieved through numerous channels, including employment opportunities, shareholder value generation, tax payments, and the provision of a sense of life purpose (Table 4 for a list of company names).

3.1.2.Target year of data

The cross-sectional data analysis covers 2019-2022. Certain available data on environmental impacts before 2018 are insufficient and inconsistent, making time series analysis impossible. Furthermore, regression analysis requires a minimum of 3 or 4 years of data within the difference equation to prevent the occurrence of spurious regressions.

Despite the data limitation, the study illustrates the circumstances before, during, and after the COVID-19 pandemic, with findings and implications for the relationship between growth and conservation. This study inductively examines performance based on certain criteria and rules from the disclosed information.

3.1.3. Variables

Table 2 presents the dependent and explanatory variables. This study endeavors to provide an accurate analysis of financial performance and environmental impacts by focusing on individual employees.

- Six dependent variables are employed in this study. In addition to the basic variables (1)-(6), advanced variables (7)-(12) are also set by dividing by the number of employee (EMP). As a result, 12 basic and advanced dependent variables were set.
- Five explanatory variables are introduced. In addition to the basic variables (1)-(5), advanced variables (6)-(10) are also set by dividing by the number of employee (EMP). Thus, 10 basic and advanced explanatory variables were set.
- The total number of regression equations is 1,440. The breakdown is as follows:
    - -The number of equations is 360 for 2019, 360 for 2020, 360 for 2021, and 360 for 2022, respectively.
    - -The 360 equations are broken down as follows: 360 equations = 120 (linear) + 120 (quadratic) + 120 (cubic).
    - -The smallest breakdown of 120 linear equations = 12 (dependent variables) × 10 (explanatory variables).
    - -The smallest breakdown of 120 quadratic and 120 cubic equations is the same as that of the 120 linear equations.

Definitions of scope 1 and 2 (US Environment Agency, 2021) are as follows.

- Scope 1: direct emissions by the business itself
- Scope 2: indirect emissions from the use of electricity, heat, and steam supplied by other companies
- Scope 3 is not considered in this study because some companies do not disclose it.
- Financial data are presented in the following manner: Japan's annual securities reports (Yuka Shouken Hokokusho, abbreviated as Yuho in Japanese) are equivalent to Form 10-K in the United States. Statutory audits submitted to the Finance Bureau of the Ministry of Finance of Japan guarantee the reliability of the Yuho. Particularly, explanatory variables 1-4 are listed at the beginning of the Yuho in a standard format, forming the basis of the financial results. The sources referenced for the environmental impact data were manually gathered from each environmental, ESG, and/or sustainability report. This study employs a consolidated data approach because nonconsolidated financial and environmental data are not disclosed comprehensively. This means that the financial data for the 22 companies comes from their annual securities reports, while the environmental impact data comes from their ESG and/or sustainability reports. For example, the companies are listed in order from A to Z: Daytona (2024ab); Enshu (2024ab); Envipro (2024ab); FCC (2024ab); Hagoromo Foods (2024ab); Hamamatsu Photonics (2024ab); Kawai Musical Instruments Manufacturing (2024ab); Kyowa Leather (2024ab); Midac (2024ab); Murakami (2024ab); Nihon Plast (2024ab); Roland (2024ab); Roland DG (2024ab); Shizuoka Gas (2024ab); Star Micronics (2024ab); Suzuki Motor (2024ab); Tokushu Tokai Paper (2024ab); Univance (2024ab); Yaizu Suisankagaku (2024ab); Yamaha (2024ab); Yamaha Motor (2024ab); and Yutaka Giken (2024ab). For details, see the reference list at the end of this report.

The linear regression model is presented below, where the environmental impact of scope 1 CO_2 emissions (SCP1) is the dependent variable, and each variable from (1) SAL to (5) TSR is set as the explanatory variable.

$$Y\ (SCP1) = \alpha + \beta\ (SAL) + \varepsilon,$$

$$Y\ (SCP1) = \alpha + \beta\ (INC) + \varepsilon,$$

Table 2: Dependent and explanatory variables (abbreviation)

Dependent variables: 6 - basic	Explanatory variables: 5 - basic
(1) Scope 1 CO_2 emissions (SCP1) (2) Scope 2 CO_2 emissions (SCP2) (3) Scope 1+2 CO_2 emissions (SCP1+2) (Unit: CO_2, thousand metric tons) (4) Electricity consumption (ELC, MWh) (5) Water consumption (AQU, m³) (6) Industrial waste generation (WST, tons)	(1) Net sales (SAL) (2) Net income (INC) (3) Earnings per share (EPS) (4) Total assets (SST) (5) Total shareholders return (TSR) (1, 2, 4, 5): Million JPY, (3): JPY
Dependent variables: 6 - advanced	**Explanatory variables: 5 - advanced**
(7) SCP1/per-employee (SCP1/EMP) (8) (SCP2/EMP) (9) (SCP1+2/EMP) (thousand metric tons/EMP) (10) (ELC/EMP, MWh/EMP) (11) (AQU/EMP, m³/EMP) (12) (WST/EMP, tons/EMP)	(6) SAL / per-employee (SAL/EMP) (7) (INC/EMP) (8) (EPS/EMP) (9) (SST/EMP) (10) (TSR/EMP) (6, 7, 9, 10): million JPY/EMP, (8): JPY/EMP

$Y (SCP1) = \alpha + \beta (EPS) + \varepsilon,$

$Y (SCP1) = \alpha + \beta (SST) + \varepsilon,$

$Y (SCP1) = \alpha + \beta (TSR) + \varepsilon.$

The P-value significance level is set at 5% ($P < 0.05$). In principle, insignificant results are omitted in the text for brevity. α and ε indicate constant and error terms, respectively. The significance of the constant term is not considered. The data are presented with three digits after the decimal point to ensure rigor. If zero continues after the third digit (e.g., 0.0000916371), it is not presented as 0.000 but as an exponent, i.e., 9.164E-05.

The combinations of the dependent and explanatory variables are computed in order. To avoid unnecessary complexity, the author omits the details, showing only certain combinations.

Next, examples of the formulas for scope 2 CO_2 emissions (SCP2) are:

$Y (SCP2) = \alpha + \beta (SAL) + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP2) = \alpha + \beta (TSR) + \varepsilon.$

Moreover, the examples of the formulas for scope 1+2 CO_2 emissions (SCP1+2) are:

$Y (SCP1+2) = \alpha + \beta (SAL) + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP1+2) = \alpha + \beta (TSR) + \varepsilon.$

Furthermore, the formulas for scope 1, 2, and 1+2 CO_2 emissions per-employee (SCP1/EMP, SCP2/EMP, and SCP1+2/EMP) are:

$Y (SCP1/EMP) = \alpha + \beta (SAL/EMP) + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP2/EMP) = \alpha + \beta (SAL/EMP) + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP1+2/EMP) = \alpha + \beta (SAL/EMP) + \varepsilon,$

- - - - - *omitted* - - - - -.

The second is to examine the EKC hypothesis. The examples of the formulas of scope 1, 2, and 1+2 CO_2 emissions are:

$Y (SCP1) = \alpha + \beta (SAL) + \beta (SAL)^2 + \varepsilon,$

$Y (SCP1) = \alpha + \beta (INC) + \beta (INC)^2 + \varepsilon,$

$Y (SCP1) = \alpha + \beta (EPS) + \beta (EPS)^2 + \varepsilon,$

$Y (SCP1) = \alpha + \beta (SST) + \beta (SST)^2 + \varepsilon,$

$Y (SCP1) = \alpha + \beta (TSR) + \beta (TSR)^2 + \varepsilon.$

- - - - - *omitted* - - - - -

$Y (SCP2) = \alpha + \beta (SAL) + \beta (SAL)^2 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP1+2) = \alpha + \beta (TSR) + \beta (TSR)^2 + \varepsilon,$

- - - - - *omitted* - - - - -.

Moreover, the formulas for scope 1, 2, and 1+2 CO_2 emissions per-employee (SCP1/EMP, SCP2/EMP, and SCP1+2/EMP) are:

$Y (SCP1/EMP) = \alpha + \beta (SAL/EMP) + \beta (SAL/EMP)^2 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP2/EMP) = \alpha + \beta (SAL/EMP) + \beta (SAL/EMP)^2 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP1+2/EMP) = \alpha + \beta (SAL/EMP) + \beta (SAL/EMP)^2 + \varepsilon,$

- - - - - *omitted* - - - - -.

The third is to verify whether or not an inverted N-shaped curve is established. The examples of the formulas of scope 1, 2, and 1+2 CO_2 emissions are:

$Y (SCP1) = \alpha + \beta (SAL) + \beta (SAL)^2 + \beta (SAL)^3 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP2) = \alpha + \beta (SAL) + \beta (SAL)^2 + \beta (SAL)^3 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP1+2) = \alpha + \beta (SAL) + \beta (SAL)^2 + \beta (SAL)^3 + \varepsilon,$

- - - - - *omitted* - - - - -.

Furthermore, the formulas for scope 1, 2, and 1+2 CO_2 emissions per-employee (SCP1/EMP, SCP2/EMP, and SCP1+2/EMP) are:

$Y (SCP1/EMP) = \alpha + \beta (SAL/EMP) + \beta (SAL/EMP)^2 + \beta (SAL/EMP)^3 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP2/EMP) = \alpha + \beta (SAL/EMP) + \beta (SAL/EMP)^2 + \beta (SAL/EMP)^3 + \varepsilon,$

- - - - - *omitted* - - - - -

$Y (SCP1+2/EMP) = \alpha + \beta (SAL/EMP) + \beta (SAL/EMP)^2 + \beta (SAL/EMP)^3 + \varepsilon$,

- - - - - *omitted* - - - - -.

3.2. Results

The findings of this study are as follows. Of the 120 cases tested for linear regression analysis in each year, 24 (20.0%), 21 (17.5%), 16 (13.3%), and 15 cases (12.5%) in 2019, 2020, 2021, and 2022, respectively, revealed significant monotonic relationships. Table 3 and Appendix Table 1 present these results. The findings indicate a trend in which environmental impacts increase as financial performance expands.

The regression analyses significantly provide empirical support for the EKC hypothesis in 2019-2022 (the years before, during, and after the COVID-19 pandemic). The quadratic regression analysis of the EKC hypothesis validates the findings in two cases (1.7%), three cases (2.5%), four cases (3.3%), and four cases (3.3%) in 2019, 2020, 2021, and 2022, respectively.

Moreover, the cubic regression analyses of the inverted N-shaped curve confirm the validity of five cases (4.2%), four cases (3.3%), four cases (3.3%), and five cases (4.2%) in 2019, 2020, 2021, and 2022, respectively.

The overall number of EKCs and inverted N-shaped curves has increased cannot be ascertained. However, a discernible downward trend in the number of monotonically increasing curves was observed. An asterisk (*) in Appendix Table A1 indicates that the EKC hypothesis, or the inverted N-shaped curve, has been confirmed.

Next, this study explores the combination of the dependent and explanatory variables to achieve financial growth and environmental conservation and identifies a turning point and/or a range of turning points that should be targeted. Although the combinations where the hypotheses hold for more years must be explored, turning points that are extremely high to reach cannot be targeted.

Table 3: Number of significant cases and percentage

Years	1 linear (%)	2 EKC (%)	3 inverted N-shaped (%)
2019	24 (20.0)	2 (1.7)	5 (4.2)
2020	21 (17.5)	3 (2.5)	4 (3.3)
2021	16 (13.3)	4 (3.3)	4 (3.3)
2022	15 (12.5)	4 (3.3)	5 (4.2)

Source: Author's calculations

Table 4: Number of significant cases of the eKC hypothesis and inverted N-shaped curve

Items	SAL	INC	SST	EPS	TSR
EKC	4	0	4	0	5
Inverted N	5	3	3	3	5
Total	9	3	7	3	10

Source: Author's calculations

Table 4 presents the number of cases confirming the EKC hypothesis and the inverted N-shaped curve, classified by the explanatory variable. The most frequently occurring explanatory variables were TSR, SAL, and SST in 10, nine, and seven cases, respectively.

SAL, SST, and TSR do not significantly differ. However, the turning points of SAL and SST tend to be at the theoretical value for the measurement, i.e., a virtually unattainable height. For example, the turning points of the combinations for (WST-SAL) or (WST-SST) are approximately JPY 3.4 trillion (USD 23.2 billion) in 2022. Only one company, namely, Suzuki, reached this turning point. This value is an unrealistic goal for other companies with net sales or total assets of JPY 30-40 billion (USD 210-280 million).

The establishment of the EKC hypothesis was confirmed by the combination of SCP1 per employee and TSR per employee (SCP1/EMP-TSR/EMP) in 2021 and in 2022. The turning points are 0.818 in 2021 and 0.922 in 2022, which are reached by two of the 22 companies, namely, Daytona Corporation and Midac Holdings. Daytona engages in the planning, development, and sales of motorcycle parts and accessories, whereas Midac operates chains of waste collection, transport, and treatment businesses. Among the 22 corporations, these two companies are ranked 20th and 22nd in terms of sales, respectively. Medium- and low-ranked firms in terms of sales can manage their business to reach a range of turning points where others can also achieve financial growth and conservation.

Figure 1 illustrates the explanatory (TSR/EMP) and dependent variables (SCP1/EMP) on the x-axis and y-axis, respectively. The figure reveals an inverted U-shaped curve relationship, with turning points of JPY 0.818 in 2021 and JPY 0.922 in 2022.

The two cases in which the EKC hypothesis was established with TSR/EMP in 2021 and 2022 are listed below.

<2022>

$Y (SCP1/EMP) = \alpha + \beta (TSR/EMP) + \beta (TSR/EMP)^2 + \varepsilon$,

$= -4.263E\text{-}04 + 0.089 (TSR/EMP) - 5.466E\text{-}02 (TSR/EMP)^2$

$(p = 0.818)\ (5.037E\text{-}04)\ (0.048) + 0.005$

$Adj.\text{-}R^2 = 0.593,\ F = 11.205\ (p = 0.002)$,

Turning point (JPY/EMP): 0.818.

2022

$Y (SCP1/EMP) = \alpha + \beta (TSR/EMP) + \beta (TSR/EMP)^2 + \varepsilon$,

$= 0.001 + 0.047 (TSR/EMP) - 0.025 (TSR/EMP)^2$

$(p = 0.336)\ (0.053^*)\ (0.048) + 0.004$.

Adj.-R^2 = 0.183, F = 2.565 (p = 0.118),

Turning point (JPY/EMP): 0.922.

Sources: Author's calculation. *The value is deemed to meet the required significance level.

Figure 2 presents examples of the establishment of inverted N-shaped curves for which the cubic curves can be drawn relatively. The figure illustrates the explanatory (SAL or SST) and dependent variables (WST) on the x-axis and y-axis, respectively, revealing an inverted N-shaped curve relationship with two turning points.

However, these combinations present theoretical values of JPY 3,431 billion for SAL and JPY 3,487 billion for SST in 2022, which are extremely high and will take many years to achieve.

<2022>

$Y(WST) = \alpha + \beta(SAL) + \beta(SAL)^2 + \beta(SAL)^3 + \varepsilon$

$= 310.647 - 0.003(SAL) + 7.577E\text{-}09(SAL)^2$

(p = 0.003) (7.867E-05) (5.283E-09)

$- 1.472E\text{-}15(SAL)^3 + 118.329$

(5.252E-10)

Adj.-R^2 = 0.999, F = 4,344.710 (p = 3.483E-13),

Turning points (JPY millions): 226,411.546 and 3,431,364.801.

<2022>

$Y(WST) = \alpha + \beta(SST) + \beta(SST)^2 + \beta(SST)^3 + \varepsilon$

$= 484.471 - 0.005(SST) + 8.953E\text{-}09(SST)^2$

(p = 0.003) (7.359E-05) (4.222E-08)

$- 1.712E\text{-}15(SST)^3 + 202.577$

(6.070E-09)

Adj.-R^2 = 0.998, F = 1,480.623 (p = 2.569E-11),

Turning points (JPY millions): 286,267.484 and 3,486,597.836

Sources: author's calculation

Net sales are an important factor in financial growth and environmental conservation. However, increased sales do not necessarily lead to environmental conservation.

Figure 3 indicates an N-shaped curve demonstrating that the environmental impact per unit, i.e., SCP2, increases after the second turning point (JPY 4,435 billion) in the (SCP2–SAL) relationship.

$Y(SCP2) = \alpha + \beta(SAL) + \beta(SAL)^2 + \beta(SAL)^3 + \varepsilon$

$= - 11.179 + 3.979E\text{-}04(SAL) - 1.713E\text{-}10(SAL)^2$

(p = 0.392) (0.002) (0.013)

$+ 2.574\text{-}E17(SAL)^3 + 22.534$

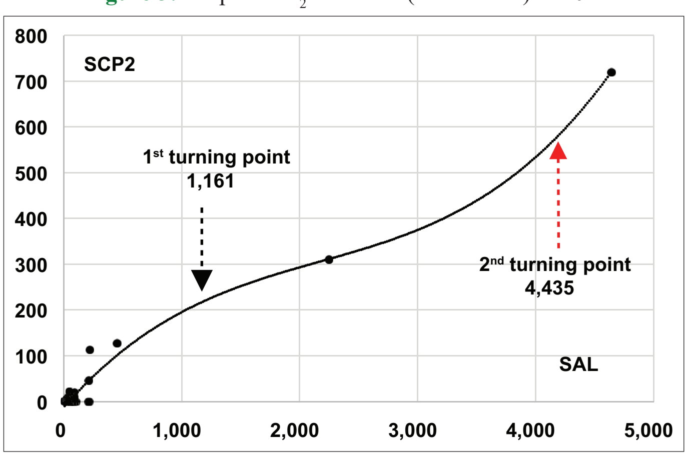
(0.011)

Adj.-R^2 = 0.989, F = 308.289 (p = 8.528E-08),

turning points (JPY millions): 1,161,606.881 and 4,435,485.915.

Sources: author's calculation

Figure 3: Scope 2 CO_2–net sales (SCP2-SAL) in 2022



Sources: author's calculation

As mentioned previously, Midac and Daytona's TSR/EMP was above the JPY 0.818-0.922 range in 2021 and 2022. Consequently, a TSR/EMP range of JPY 0.818-0.922 could be an achievable target for other small and midsized firms. Therefore, the enhancement of the (SCP1/EMP-TSR/EMP) combination to the thresholds (i.e., JPY 0.818-0.922) in the EKC could serve as a target or key indicator in establishing the EKC hypothesis and achieving a balance between corporate growth and environmental conservation. This enhancement could also be a benchmark for decoupling corporate financial growth and environmental impacts.

3.3. Discussion

This section examines the determinants that contribute to the significance of the analyzed results. The linear regression results indicate that environmental impacts increase along with financial scales. For example, the results demonstrate that scope 1 CO_2 emissions (SCP1) increased as net sales (SAL), net income (INC), and total assets (*SST*) increased in 2019-2022. The results also indicate that as (SAL) and (SST) increased, electricity consumption (ELC) increased in 2019-2022. Therefore, CO_2 emissions and electricity consumption tend to increase along with financial growth.

Increases in CO_2 emission and electricity consumption include external factors that cannot be addressed solely by companies' independent actions. The reason is that emissions and consumption cover numerous activities, from upstream to downstream, as well as market expansion in response to growing demands.

However, the determinants that contribute to the establishment of the EKC hypothesis are derived from the interaction of the following four points:
1. Stricter emission regulations, including penalties
2. Business and environmental organizations' guidelines, ratings, and initiatives
3. Investors' ESG emphasis; and
4. The intrinsic or endogenous efforts of corporations. These factors have been increasingly encouraged and prioritized in Japan recently.

Regarding the first factor of the enforcement of stricter emission regulations, including penalties, the Japanese government declared in 2021 that the Japanese economy's goal to reduce its greenhouse gas emissions by 46% in 2030 from the 2013 level. This goal has been set following the goals of the Paris Agreement adopted in 2015, setting a target that is consistent with the long-term goal of achieving net-zero emissions by 2050. In line with target strengthening, the 2021 Revised Act (No. 117 of 1998) on Promotion of Global Warming Countermeasures has strengthened its text from "controlling" to "reducing" greenhouse gas emissions.

For example, Article 5 of the 2021 Revised Act emphasizes that "enterprises shall endeavor to take measures to reduce greenhouse gas emissions and cooperate with measures taken by national and local governments to reduce emissions." Specifically, Article 26 of the 2021 Revised Act provides that "specified emitters", which are designated by the Cabinet Order shall report matters relating to the calculated amount of greenhouse gas emissions. These emitters are those emitting significant amounts of greenhouse gases in connection with their business activities.

In addition, Article 75 of the 2021 Revised Act states that any company that fails to submit a report shall be subject to a civil fine of not more than JPY 200,000 (approximately USD 1,360). The amount may be small, but the incentive to disclose and report works by avoiding point deductions for non-compliance when applying for public tenders or any potential negative consequences for the business in the future, such as a loss of reputation. Accordingly, Article 5 of the Cabinet Order No. 272 of 2023 for the Enforcement of the 2021 Revised Act stipulates that specified emitters are companies whose total energy consumption in crude oil equivalent is 1,500 kiloliters or more. Twenty-one of the 22 companies in this report are subject to Cabinet Order No. 272.

Moreover, emission trading is scheduled to progress in Japan. The trading is currently implemented between Tokyo and Saitama. The J-Credit scheme was initiated on a trial basis on the TSE in 2023 on a nationwide scale, with the objective of a full-scale introduction by 2026. The introduction of the new trading system will require companies to further address emission reduction and is expected to create a new market.

In addition to the existing emission regulations, directives, and emission trading system in the European Union, Japanese automakers and parts suppliers in Shizuoka Prefecture must also comply with the introduction of stringent emission reduction scheme for heavy-duty vehicles (trucks, buses, and trailers). This requirement was agreed upon by the European Commission in February 2024 (European Commission 2024a, b and c).

The second factor is business and environmental organizations' guidelines, ratings, and initiatives. Corporations in developed countries have been forced to compete intensely on nonfinancial performance within their industry and across industry segments, particularly in terms of environmental ratings.

The author begins by examining influential guidelines, ratings, and initiatives from a domestic Japanese perspective, focusing on Keidanren (Japan Business Federation), the Weekly Toyo Keizai, and RE Action. Then, this examination is extended to an analysis of international organizations, including the Task Force on Climate-related Financial Disclosures (TCFD) and CDP (formerly known as Carbon Disclosure Project).

The Keidanren's ESG-oriented guidelines should be mentioned. Keidanren is one of the most influential economic organizations in Japan. As of April 01, 2024, Japan has 1,728 listed companies, such as Toyota Motor Corporation. Keidanren often recommends economic and environmental policies, sometimes directly to the Prime Minister through its Chairman. It also provides binding corporate guidelines, including the expulsion clause for members.

Although only nine of the 22 corporations covered in this report are Keidanren members, the regulations have binding power on nonmembers. It requires member companies to emphasize sustainable raw material procurement and the creation of a recycling-oriented society. For example, Univance Corporation in Shizuoka is a nonmember company that manufactures transmissions for automobiles. It supplies automotive parts to leading Japanese automakers of Keidanren member companies such as Suzuki Motor and Nissan Motor. Therefore, Univance is indirectly bound by Keidanren regulations.

In 2017, Keidanren revised its Charter of Corporate Behavior for the Achievement of the Sustainable Development Goals (SDGs) (Keidanren, 2017). The Charter states, "As a good corporate citizen, we (member companies) will actively participate in society and contribute to its development." "We promote initiatives for social responsibility through ESG-conscious management." "We will act toward the achievement of a sustainable society." Keidanren has also continued to share best ESG practices through conferences and websites. In this way, members and nonmembers have shared ESG-related knowledge with competitors while competing.

The Keidanren Charter is grounded in the widely shared Japanese view that "a company belongs not so much to its shareholders as to everyone involved with it, including investors, executives, employees, employees' families, customers, business partners, and local communities," and that even although they are private, they should behave as respectful public entities or members of society.

Subsequently, the author addresses the corporate ratings published by the Weekly Toyo Keizai, one of Japan's most widely circulated economic periodicals. After Yamaha's AAA and Suzuki's

AA, Midac, which has crossed the turning point of the EKC hypothesis, is rated as A in the "environment" category for the newly published edition of Toyo Keizai (2024). Table 1 above presents this information.

The results indicate that competition occurs not only in financial scores but also in nonfinancial environmental scores. As previously stated in Section 2.2, ESG/SDG scores may be arbitrary. Thus, an academic analysis relying solely on them may be misguided. However, a favorable score enhances a company's external image, providing a competitive advantage in qualified personnel recruitment. Conversely, poor image and ratings resulting from non-compliance can hinder the company's ability to attract suitable candidates.

For instance, Disco Corporation, one of the most influential Japanese recruiting firms, conducted yearly surveys to understand job seekers' perceptions and attitudes. The 2022 survey (Disco, 2022) was conducted in January among third-year students who will graduate in March 2025. They were instructed to select one of the 30 items that most closely matched their career preferences. "Social contributions" was the fourth most important factor (8.1%) after "salary," "future prospects," and "workplace atmosphere." The survey had 1,033 respondents; the response rate was unknown. "Social contributions" also include environmental conservation activities. In certain instances, students were unaware of the actual situation of a company. Thus, they will make career choices based on their personal preferences and abilities, as well as information such as ESG/SDG ratings. It is also a win-win situation for investors: Hiring the best people helps improve firm performance.

An initiative of RE Action also influences, e.g., knowledge sharing. Of the 22 entities, only Daytona and Midac are RE Action signatories. The initiative aims to promote the use of 100% renewable energy in society. In contrast to RE100, which has a global membership, RE Action members are exclusively domestic. Nevertheless, they represent a considerable workforce of 240,000 employees across 386 companies and public institutions who exchange information and share knowledge. Through the activities of RE Action, Daytona and Midac have disclosed that 100% and 98.2% of their respective electricity consumption is derived from renewable energy sources.

Subsequently, the author outlines the global guidelines and ratings established by the TCFD and CDP.

The TCFD task force examines and recommends climate-related information disclosure and targets (TCFD, 2023). The TCFD's supporters have increased, reaching 4,141 (1,681) in 2022 and then 4,855 (1,831) in 2023, compared with only 952 (including 485 financial institutions) in 2019. The total market capitalization of these companies is estimated at USD 29.5 trillion, with combined assets under management of USD 222.2 trillion by 1,831 financial institutions, representing a significant growth trajectory. In Japan, 1,470 companies and institutions have expressed their support as of October 2023. Of the 22 companies in this paper, Midac, which has crossed the range of turning points, has signed the TCDF. Eight other companies that have not crossed the threshold (e.g., Yamaha, Yamaha Motor, and Suzuki) have also signed the TCFD.

The CDP advocates information disclosure pertaining to climate change mitigation, water security, and forests while maintaining consistency with the TCFD. In 2023, over 23,000 corporations worldwide, including 1,900 Japanese companies, disclosed environmental information using CDP questionnaires (CDP, 2023).

Of the 22 companies, the following corporations improved by one rank in the "climate change" section of the CDP rating: Envipro's rating improved to A− in 2023, FCC to B in 2023, Hamamatsu Photonics to B in 2022, Roland DG to B+ in 2023, Suzuki to B in 2022, Yamaha to A in 2023, and Yamaha Motor to A in 2023. All companies have endeavored to improve their respective rating.

Regarding the third factor of increased investor focus on ESG, the growing investor sentiment drives the advancement of environmental activities, particularly through financing requirements such as loans and security and bond underwriting. Conversely, raising funds becomes a challenge due to inadequate ESG activities, particularly ESG-related disclosures. In addition, the disclosures require the formulation and implementation of disclosure-ready corporate strategies and the promotion of ESG activities, such as participation in and commitment to global ESG initiatives. Furthermore, the websites of the sponsoring organizations should disclose whether or not the companies are signatory and their associated ratings. As a result, companies are driven to compete with their competitors in terms of disclosure.

The TCFD signatories have significant shareholdings in companies based in Shizuoka Prefecture. Shizuoka Bank is positioned in the 10th place in Midac, whereas Mitsubishi UFJ Bank and Suruga Bank are ranked 7th and 10th in Daytona, respectively (Midac, 2024; Daytona, 2024). Therefore, these financial institutions have a notable impact on ESG management.

Listed corporations headquartered in Shizuoka Prefecture may be less influenced by requests of institutional investors in their management, compared with the group of leading Japanese utilities analyzed in the author's previous studies (Tsujimoto, 2023; 2024). The reason is that the major shareholders of certain Shizuoka companies are founders, as is typical of leading local companies.

Nevertheless, as corporations in Shizuoka attract great interest from investors in the future, they are likely to be subject to significant influence from global investors, ratings, and initiatives. They include the UN Principles for Responsible Investment (PRI), Renewable Electricity 100 (RE100) and the Morgan Stanley Capital International (MSCI) ESG Ratings (PRI, 2024; RE 100, 2024; MSCI, 2024).

First, PRI's signatory investors are bound by the associated Six Principles. Principle 1: "We [signatory investors] will incorporate ESG issues into investment analysis and decision-making processes." Principle 3: "We will seek appropriate disclosure on ESG issues by the entities in which we invest." Consequently, the Principles require signatory investors, including life and nonlife

Table 5: Company names, major PRI shareholders, and percentages of major shareholdings as of March 2024

Names	Mejor shareholders	Percentages
Kawai Musical Instruments Manufacturing	Meiji Yasuda Life Insurance	3.47
Murakami	Meiji Yasuda Life Insurance	2.86
Nihon Plast	Daiichi Life Insurance	1.59
Star Micronics	Nippon Life Insurance	1.34
Suzuki Motor	Sompo Holdings	1.60
Tokushu Tokai	Daiichi Life Insurance	1.97
Yamaha	Sumitomo Life Insurance	4.28
Yutaka Gigen	Meiji Yasuda Life Insurance	1.35

Sources: Annual security reports of each company

insurance companies, asset managers, and pension funds to make ESG-conscious investment and holding decisions, disclose information to investors, and even obligate disclosures from the investors themselves. Table 5 presents the major PRI signatory shareholders in the 22 corporations analyzed in this study. The top 10 shareholders are disclosed for each company.

Moreover, RE100 is an initiative that aims to achieve 100% renewable energy for electricity in business operations. As of September 2024, 433 companies worldwide, including 88 Japanese enterprises, are engaged in the RE100 initiative (RE100, 2024). MSCI ESG Ratings is a global research index affiliated with Morgan Stanley covering approximately 2,900 companies (MSCI, 2023).

However, out of the 22 companies in this paper, only two, Envipro and Hamamatsu Photonics, signed the RE100, whereas only three, Yamama Motor (AAA Leader), Hamamatsu Photonics (BBB Average), and Suzuki (BBB Average), currently have MSCI ratings.

Therefore, based on the TCFD discussion above, the impact of the RE100 and MSCI on the 22 companies may be small at present but may become more significant as the corporations grow in Shizuoka.

The last factor is the intrinsic or endogenous effort of the corporations. This factor stems from the desire to contribute to environmental conservation as society members, regardless of their position. All corporations, irrespective of whether they are state-owned or private, can be considered a collective of citizens. As citizens increasingly gain interest in environmental conservation and social contributions, discussions on ESG-oriented issues within corporations will increase. Consequently, the management and employees will pursue strategies and actions that are ESG-oriented. For example, Japanese elementary school students are sometimes required to submit a report on the business activities of their parents' companies, including environmental conservation, as homework. Such homework assignments can be an opportunity for the children and parents to cultivate an awareness of environmental conservation.

To conclude this section, the author focuses on Daytona and Midac, which have reached a range of turning points. Although the precise econometric reasons for the crossing of the turning points are not immediately apparent, two common factors may be identified on a circumstantial basis.

First, the TSR/EMP of both companies is higher than the average of the 22 companies included in the sample, at JPY 3.653 for Daytona and JPY 1.860 for Midac, compared with the average of JPY 0.318.

Moreover, individual reasons for each company are discussed in detail. Daytona has operated as a "fabless company" without production facilities. It has adopted a strategy of in-house planning and design, complemented by outsourcing manufacturing to partner companies that possess particular strengths in specific fields. Thus, its status as a fabless company is one of the reasons for TSR/EMP's crossing over the threshold. The option of not having production facilities by outsourcing production to environmentally and technologically advanced companies will be a feasible alternative for other companies seeking to achieve future growth and environmental conservation.

Regarding Midac, it participates in various organizations and initiatives, such as Keidanren and the TCFD, to provide information and share knowledge. Midac also established Green Circular Factory Co. as a joint venture with Yamada Denki Co., one of Japan's largest electronics retailers by sales. The objective is to combine Yamada's nationwide networks of waste appliance collection with Midac's advanced waste treatment facilities. The above activities have contributed to attaining a range of turning points JPY 0.818-0.922 in the combination of (SCP1/EMP–TSR/EMP).

4. CONCLUSIONS AND IMPLICATIONS

The quadratic regression analysis of the EKC hypothesis validates the findings in two cases (1.7%), three cases (2.5%), four cases (3.3%), and four cases (3.3%) in 2019, 2020, 2021, and 2022, respectively.

Moreover, the cubic regression analyses of the inverted N-shaped curve confirm the validity of five cases (4.2%), four cases (3.3%), four cases (3.3%), and five cases (4.2%) in 2019, 2020, 2021, and 2022, respectively.

Moreover, the determinants that contribute to the establishment of the EKC hypothesis are derived from the interaction of the following four points: (1) enforcement of stricter emissions regulations, including penalties; (2) business and environmental organizations' guidelines, ratings, and initiatives; (3) investors' emphasis on the ESG concept; and (4) intrinsic or endogenous efforts of the corporations. These four points have been recently encouraged and prioritized in Japan.

Certain points of this research still require further consideration in the fields of academic research, policy-making, and corporate strategic planning. For instance, in the context of academic research, a more detailed examination must be conducted on the reasons behind the distinction between significant cases under the EKC hypothesis and inverted N-shaped test and those that are not. Long-term verification is also required as environmental statistics are subject to fluctuations and modifications. Moreover, research must also focus on the corporate pretense of ESG or green washing. Furthermore, statistical significance was also confirmed for electricity and water consumption and industrial waste generation. However, target values could not be identified due to the high turning points. Therefore, the search for turning points for these environmental impacts is also a future challenge.

The 22 companies addressed in this study are expected to enhance corporate governance, safeguard personal information, promote environmental conservation and sustainable business practices as well as contribute to regional development through job creation and tax payments. These actions must adhere to the goals and expectations set forth by the Japanese government, Shizuoka Prefecture, and local municipalities.

However, the emergence of the turning points in Figure 1 indicates an achievement of corporate growth and environmental conservation, namely, the decoupling of financial growth and environmental impacts. Therefore, the enhancement of the combination of scope 1 CO_2 emissions per employee and TSR per employee (SCP1/EMP-TSR/EMP) to the thresholds (i.e., JPY 0.818-0.922) can serve as a key indicator in establishing the EKC hypothesis and achieving a balance between corporate growth and environmental conservation, i.e., a benchmark for decoupling corporate financial growth and environmental impacts. As discussed in Chapter 1 and 2, the aggregated sales and emissions of the companies analyzed in this study correspond to single countries or global companies. Thus, ESG-oriented management and efforts to increase TSR/EMP to the aforementioned thresholds can contribute to domestic and global environmental conservation.

Furthermore, an approach emphasizing ESG and TSR, as illustrated in this study, contributes to the expansion of the research frontier in environmental economics and industrial organization theory.

Therefore, the academic community must continue to explore the relationship between corporate growth and environmental conservation from various perspectives.

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APPENDIX

Appendix Table 1: Significant combinations of dependent and explanatory variables (*Marks indicate the eKC hypothesis, or the inverted N-shaped curve)

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
2019														
SCP1-SAL	−0.459	0.853	9.183 E-05	2.831 E-08					6.619	0.980	438.775	2.831 E-08		
SCP1-INC	5.294	0.185	0.001	1.193 E-06					10.550	0.949	167.854	1.193 E-06		
SCP1-SST	−2.287	0.556	9.822 E-05	7.990 E-07					10.037	0.954	186.307	7.990 E-07		
SCP1/ EMP-SAL/ EMP	−0.008	0.192	3.840 E-04	0.020					0.008	0.449	8.334	0.020		
SCP1/ EMP-SST/ EMP	−0.008	0.047	3.491 E-04	0.001					0.005	0.729	25.210	0.001		
SCP1/ EMP-TSR/ EMP	1.801 E-04	0.898	0.084	3.419 E-05					0.004	0.882	68.485	3.419 E-05		
SCP2-SAL	10.929	0.131	2.277 E-04	2.114 E-06					13.538	0.990	600.018	2.114 E-06		
SCP2-INC	29.204	0.226	0.004	0.001					49.698	0.866	39.899	0.001		
SCP2-SST	3.031	0.530	2.486 E-04	4.124 E-07					9.766	0.995	1,157.720	4.124 E-07		
SCP2/ EMP-SAL/ EMP	0.004	0.132	1.746 E-04	0.024					0.003	0.607	10.275	0.024		
SCP2/ EMP-TSR/ EMP	0.008	0.002	0.049	0.029					0.003	0.579	9.247	0.029		
SCP1+2-SAL	3.752	0.407	3.243 E-04	8.279 E-10					11.103	0.996	1,929.321	8.279 E-10		
SCP1+2-INC	24.821	0.248	0.005	5.340 E-05					53.763	0.903	75.581	5.340 E-05		
SCP1+2-SST	−3.273	0.548	3.502 E-04	2.907 E-09					13.284	0.994	1,345.722	2.907 E-09		
ELC-SAL	−31,765.656	0.398	0.845	0.010					60,449.169	0.804	21.497	0.010		
ELC-SST	−20,893.069	0.514	0.736	0.007					55,511.691	0.835	26.235	0.007		
AQU-SAL	17.527	0.890	0.002	1.713 E-08					352.825	0.982	498.490	1.713 E-08		
AQU-INC	50.899	0.674	0.063	1.196 E-08					337.362	0.984	545.982	1.196 E-08		
AQU-SST	−25.986	0.849	0.003	3.013 E-08					378.590	0.980	431.897	3.013 E-08		
AQU- EPS	−1,827.690	0.156	24.099	0.017					1,929.577	0.469	8.934	0.017		
AQU/ EMP-SST/ EMP	−0.163	0.360	0.008	0.040					0.273	0.358	6.016	0.040		
WST-SAL	−7.255	0.737	8.630 E-05	0.001					56.577	0.735	25.993	0.001		
WST-INC	2.966	0.916	0.002	0.010					75.144	0.533	11.270	0.010		
WST-SST	−7.529	0.722	9.110 E-05	0.001					55.462	0.746	27.374	0.001		
SCP1/ EMP-SST/ EMP	0.009	0.014	−4.666 E-04	0.008	7.043 E-06	2.947 E-04			0.002	0.958	102.388	6.566 E-06	33.125	

(Contd...)

Appendix Table 1: ***(Continued)***

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
*SCP2-SAL	−0.915	0.807	3.436 E-04	1.339 E-04	−6.744 E-11	0.008			5.683	0.998	1,714.730	1.357 E-06	2.547 E+06	
SCP1+2/ EMP-INC / EMP	0.009	1.871 E-04	−0.002	0.028	0.001	0.003			0.002	5.499 E-06	12.352	0.007	0.998	
AQU- EPS	1,819.409	0.104	−44.444	0.021	0.230	0.002			999.535	0.857	28.055	4.545 E-04	96.739	
*AQU/ EMP-TSR/ EMP	−0.019	0.786	4.177	0.001	−3.781	0.001			0.165	0.767	15.819	0.003	0.552	
WST-INC	33.510	0.048	−0.007	0.004	6.703 E-08	0.001			35.446	0.896	39.802	1.501 E-04	49,723.488	
*SCP1/ EMP-SAL/ EMP	0.113	0.023	−0.009	0.016	2.419 E-04	0.011	−1.781 E-06	0.010	0.005	0.782	11.736	0.006	19.442	90.528
AQU- EPS	−1,152.516	0.116	59.817	0.017	−0.626	0.005	0.002	0.001	403.965	0.977	126.790	8.144 E-06	47.775	222.927
*AQU-SAL	1.568	0.068	−0.125	0.046	0.003	0.023	−1.868 E-05	0.016	0.197	0.666	6.985	0.022	21.034	106.241
AQU/ EMP-SST/ EMP	−0.590	0.100	0.060	0.046	−0.001	0.029	9.588 E-06	0.016	0.126	0.863	19.928	0.002	21.359	97.834
*AQU/ EMP- EPS/ EMP	0.377	0.055	−34.664	0.021	666.819	0.009	−2,810.280	0.008	0.193	0.681	7.390	0.019	0.026	0.158
*AQU/ EMP-TSR/ EMP	0.107	0.007	−2.409	0.032	20.506	0.001	−17.234	2.182 E-04	0.053	0.976	123.863	8.725 E-06	0.059	0.793
*WST- EPS	634.398	0.018	−12.991	0.012	0.075	0.008	−1.174 E-04	6.277 E-03	61.993	0.682	7.437	0.019	86.706	425.437
2020														
SCP1-SAL	−5.413	0.326	1.157 E-04	2.054 E-09					15.156	0.982	559.708	2.054 E-09		
SCP1-INC	−0.485	0.982	0.002	5.445 E-04					59.978	0.725	27.315	5.445 E-04		
SCP1-SST	−5.528	0.221	9.298 E-05	2.964 E-10					12.226	0.989	865.029	2.964 E-10		
SCP1/ EMP-SAL/ EMP	−0.015	0.006	0.001	5.175 E-04					0.005	0.728	27.717	5.175 E-04		
SCP1/ EMP-SST/ EMP	−0.010	0.018	3.701 E-04	6.870 E-04					0.005	0.710	25.538	6.870 E-04		
SCP1/ EMP-TSR/ EMP	−1.157 E-04	0.928	0.085	1.391 E-05					0.003	0.876	71.844	1.391 E-05		
SCP2-SAL	12.018	0.094	2.100 E-04	1.006 E-08					14.414	0.996	1,880.830	1.006 E-08		
SCP2-INC	13.401	0.804	0.004	0.003					119.102	0.747	21.637	0.003		
SCP2-SST	10.716	0.130	1.686 E-04	1.075 E-08					14.575	0.996	1,839.547	1.075 E-08		

(Contd...)

Appendix Table 1: ***(Continued)***

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
SCP1+2-SAL	18.562	0.307	3.212 E-04	9.366 E-09					50.158	0.975	397.194	9.366 E-09		
SCP1+2-INC	23.733	0.683	0.006	3.753 E-04					161.134	0.746	30.359	3.753 E-04		
SCP1+2-SST	16.587	0.313	2.583 E-04	3.772 E-09					45.346	0.980	487.977	3.772 E-09		
SCP1+2/ EMP-SAL/ EMP	−0.040	0.092	0.002	0.015					0.024	0.446	9.055	0.015		
SCP1+2/ EMP-SST/ EMP	−0.022	0.216	0.001	0.019					0.024	0.415	8.086	0.019		
SCP1+2/ EMP- EPS/ EMP	0.005	0.513	0.261	0.005					0.021	0.558	13.625	0.005		
ELC-SAL	−24,203.390	0.259	0.969	2.373 E-10					53,880.783	0.997	2,759.777	2.373 E-10		
ELC-INC	2.621 E-04	0.001	−18.002	9.560 E-06					86,536.733	0.993	533.304	1.750 E-07		
ELC-SST	−26,575.678	0.218	0.762	2.316 E-10					53,695.713	0.997	2,778.882	2.316 E-10		
ELC- EPS	5.694	0.548	197.937	0.035					22.665	0.377	6.453	0.035		
AQU- EPS	−5,139.644	0.346	88.350	0.011					13,091.540	0.446	9.859	0.011		
AQU/ EMP- EPS/ EMP	−4.531	105.014	0.234	0.008					8.439	0.510	11.394	0.008		
SCP1-SAL	2.559	0.105	5.685 E-05	2.947 E-06	1.951 E-11	1.816 E-06			3.613	0.999	5,000.745	4.080 E-13	−1.457 E+06	
SCP1-SST	0.358	0.901	6.068 E-05	4.937 E-05	8.330 E-12	0.003			7.113	0.996	1,287.201	9.210 E-11	−3.642 E+06	
SCP1/ EMP-SAL/ EMP	0.024	0.004	−0.002	0.002	2.672 E-05	1.430 E-04			0.002	0.954	105.639	1.772 E-06	29.098	
SCP1/ EMP-SST/ EMP	0.014	1.766 E-04	−0.001	6.052 E-05	8.827 E-06	2.094 E-06			0.001	0.983	289.377	3.456 E-08	38.599	
*SCP2-SST	2.904	0.452	2.035 E-04	2.068 E-06	−8.855 E-12	0.007			7.312	0.999	3,664.073	1.214 E-08	1.149 E+07	
SCP2/ EMP-SST/ EMP	0.051	0.056	−0.003	0.030	4.095 E-05	0.007			0.016	0.748	15.862	0.002	35.528	
SCP1+2/ EMP- EPS/ EMP	0.009	0.039	−0.291	0.029	2.367	0.001			0.011	0.891	41.679	5.880 E-05	0.061	
AQU/ EMP-EPS/ EMP	2.806	0.258	−154.729	0.019	1,024.537	0.001			4.306	0.872	35.165	1.088 E-04	0.076	
*WST-SAL	−1,585.227	0.021	0.014	8.008 E-05	-4.231 E-09	1.242 E-04			1,350.663	0.842	27.595	2.569 E-04	1.669 E+06	
*WST-SST	−1,438.800	0.057	0.011	2.905 E-04	−2.583 E-09	4.081 E-04			1,591.240	0.780	18.764	0.001	2.113 E+06	

(Contd...)

Appendix Table 1: *(Continued)*

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
SCP1-INC	0.317	0.979	0.006	0.012	−1.221 E-07	0.010	6.845 E-13	0.005	29.094	0.935	49.111	4.544 E-05	23,684.638	118,875.270
SCP1/ EMP-SAL/ EMP	−0.019	0.062	0.002	0.019	−7.773 E-05	0.006	8.661 E-07	0.001	0.001	0.989	313.217	8.071 E-08	14.603	59.834
SCP2-SAL	−2.400	0.434	3.840 E-04	7.668 E-05	−1.693 E-10	0.002	3.651 E-17	0.002	4.464	1.000	6,556.128	7.751 E-08	1.134 E+06	3.091 E+06
*SCP2/ EMP-INC/ EMP	0.007	5.247 E-05	−0.003	0.002	0.003	0.001	−0.001	0.002	0.001	0.912	25.295	0.005	0.515	3.516
SCP1+2-INC	5.769	0.880	0.020	0.008	−3.887 E-07	0.010	2.059 E-12	0.006	91.226	0.919	38.599	1.007 E-04	25,666.339	125,859.239
SCP1+2/ EMP-SAL/ EMP	−0.326	0.043	0.040	0.031	−0.002	0.025	1.732 E-05	0.019	0.015	0.776	12.553	0.003	13.446	57.922
SCP1+2/ EMP-SST/ EMP	−0.045	0.088	0.005	0.019	−1.520 E-04	0.006	1.331 E-06	0.002	0.008	0.937	50.400	4.169 E-05	17.254	76.127
* ELC-TSR	2.004 E+07	0.038	−295,827.913	0.053	1,194.680	0.069	−0.860	0.073	7.701 E+05	0.502	3.688	0.097	123.811	926.637
*WST-SAL	404.884	0.005	−0.006	2.434 E-04	1.494 E-08	2.383 E-07	−4.150 E-15	4.136 E-08	151.734	0.998	1,666.677	2.377 E-10	186,933.864	2.400 E+06
WST-INC	−1,279.903	0.116	0.674	0.001	−1.231 E-05	0.001	5.315 E-11	0.002	1,711.303	0.746	10.788	0.005	27,370.308	154,458.921
*WST-SST	588.022	0.006	−0.007	2.807 E-04	1.245 E-08	1.350 E-06	−2.678 E-15	3.630 E-07	243.665	0.995	644.867	6.542 E-09	269,099.258	3.100 E+06
2021														
SCP1-SAL	−3.550	0.426	1.071 E-04	1.456 E-12					15.091	0.979	668.552	1.456 E-12		
SCP1-INC	0.216	0.991	0.001	2.663 E-04					64.351	0.627	24.484	2.663 E-04		
SCP1-SST	−3.951	0.281	9.442 E-05	9.664 E-14					12.252	0.986	1,021.027	9.664 E-14		
SCP1/ EMP-SST/ EMP	−0.009	0.012	3.213 E-04	2.396 E-04					0.005	0.632	25.078	2.396 E-04		
SCP2-SAL	20.208	0.166	1.924 E-04	3.041 E-08					39.026	0.968	303.863	3.041 E-08		
SCP2-INC	18.622	0.681	0.003	9.866 E-04					122.123	0.687	22.950	9.866 E-04		
SCP2-SST	19.033	0.184	1.694 E-04	2.633 E-08					38.408	0.969	314.016	2.633 E-08		
SCP1+2-SAL	24.755	0.117	2.968 E-04	9.117 E-12					53.702	0.965	409.857	9.117 E-12		
SCP1+2-INC	33.090	0.481	0.004	5.793 E-05					162.768	0.675	32.139	5.793 E-05		
SCP1+2-SST	23.336	0.113	2.616 E-04	3.318 E-12					49.969	0.969	475.565	3.318 E-12		

(Contd...)

Appendix Table 1: ***(Continued)***

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
SCP1+2/ EMP-SST/ EMP	−0.007	0.584	0.001	0.031					0.024	0.239	5.716	0.031		
ELC-SAL	−1,466.255	0.958	0.914	2.134 E-10					77,536.140	0.994	1,506.471	2.134 E-10		
ELC-INC	−103,427.795	0.360	19.338	8.989 E-06					292,420.568	0.915	98.476	8.989 E-06		
ELC-SST	−12,694.577	0.701	0.785	8.279 E-10					91,847.729	0.992	1,071.276	8.279 E-10		
ELC/ EMP-SAL/ EMP	−66.718	0.223	2.610	0.018					81.897	0.464	8.792	0.018		
WST-INC	−489.213	0.642	0.045	0.006					2,898.562	0.536	12.545	0.006		
SCP1-SAL	3.208	0.190	5.200 E-05	5.245 E-05	1.657 E-11	2.331 E-05			7.249	0.995	1,470.859	4.496 E-15	−1.569E-06	
SCP1-SST	0.777	0.789	6.368 E-05	9.376 E-06	7.859 E-12	0.003			8.795	0.993	997.479	4.569 E-14	−4.051 E-06	
SCP1/ EMP-SST/ EMP	0.013	2.081 E-04	−0.001	5.160 E-05	7.946 E-06	5.710 E-07			0.002	0.954	145.864	3.803 E-09	38.630	
*SCP1/ EMP-TSR/ EMP	−4.263 E-04	0.818	0.089	0.001	−0.055	0.001			0.005	0.593	11.205	0.002	0.818	
* ELC/ EMP-TSR/ EMP	−6.277	0.793	821.805	0.001	−160.574	0.001			55.670	0.752	14.671	0.003	2.559	
*WST-SAL	−1,995.859	0.017	0.016	6.081 E-05	−4.179 E-09	1.016 E-04			1,625.014	0.854	30.274	1.855 E-04	1.875 E+06	
WST-INC	511.881	0.488	−0.101	0.035	7.664 E-07	0.006			1,856.708	0.810	22.254	0.001	65,639.001	
*WST-SST	−1,852.278	0.049	0.013	2.597 E-04	−2.987 E-09	3.869 E-04			1,961.042	0.788	19.535	0.001	2.181 E+06	
SCP1-INC	21.038	0.017	−0.004	0.001	9.580 E-08	1.769 E-06	−3.623 E-13	5.831 E-07	20.121	0.963	124.133	9.179 E-09	19,572.813	176,299.261
*SCP1-/ EMP-TSR/ EMP	0.004	1.793 E-04	−0.085	0.001	0.553	1.902 E-06	−0.310	7.342 E-07	0.002	0.956	102.561	2.531 E-08	0.077	1.191
ELC/ EMP-SAL/ EMP	−352.363	0.074	24.671	0.041	−0.472	0.027	0.003	0.017	46.788	0.825	15.149	0.003	26.159	116.477
ELC/ EMP-INC/ EMP	−659.499	0.079	706.527	0.047	−221.834	0.030	21.544	0.019	50.984	0.792	12.443	0.005	1.592	6.865
WST-SAL	432.673	0.003	−0.005	1.176 E-04	1.297 E-08	6.393 E-08	−3.213 E-15	8.905 E-09	146.625	0.999	2,804.204	3.857 E-11	207,057.455	2.690 E+06
WST-INC	−115.284	0.515	0.072	3.602 E-03	−1.880 E-06	6.418 E-05	9.088 E-12	5.802 E-06	421.843	0.990	336.736	6.277 E-08	19,220.183	137,898.856
WST-SST	668.980	0.004	−0.007	1.713 E-04	1.288 E-08	5.793 E-07	−2.684 E-15	1.341 E-07	260.544	0.996	886.512	2.156 E-09	2.809 E+05	3.198 E+06
2022														
SCP1-SAL	−3.238	0.451	8.714 E-05	5.112 E-13					14.599	0.983	787.469	5.112 E-13		

(Contd...)

Appendix Table 1: ***(Continued)***

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
SCP1-INC	−3.075	0.855	0.001	2.407 E-05					56.342	0.739	40.741	2.407 E-05		
SCP1-SST	−4.733	0.325	8.856 E-05	1.886 E-12					16.139	0.979	641.961	1.886 E-12		
SCP1/ EMP-SAL/ EMP	−0.002	0.273	1.239 E-04	0.006					0.003	0.404	10.497	0.006		
SCP1/ EMP-SST/ EMP	−0.002	0.288	1.327 E-04	0.014					0.003	0.336	8.090	0.014		
SCP2-SAL	15.195	0.213	1.490 E-04	7.055 E-09					33.076	0.977	423.539	7.055 E-09		
SCP2-INC	6.121	0.873	0.002	2.285 E-04					103.900	0.772	34.834	2.285 E-04		
SCP2-SST	10.759	0.333	1.524 E-04	3.360 E-09					30.463	0.980	500.902	3.360 E-09		
SCP1+2-SAL	22.042	0.160	2.333 E-04	8.247 E-12					54.092	0.965	415.965	8.247 E-12		
SCP1+2-INC	21.098	0.609	0.003	7.614 E-06					143.287	0.755	47.276	7.614 E-06		
SCP1+2-SST	17.691	0.243	2.379 E-04	5.383 E-12					52.472	0.967	442.926	5.383 E-12		
ELC-SAL	−15,970.298	0.611	0.746	1.472 E-11					97,465.903	0.990	1,099.163	1.472 E-11		
ELC-INC	−70,162.990	0.372	15.057	9.788 E-08					234,608.805	0.943	181.431	9.788 E-08		
ELC-SST	−33,599.759	0.313	0.758	2.030 E-11					100,651.799	0.989	1,030.058	2.030 E-11		
WST-INC	−240.819	0.820	0.033	0.014					3,117.477	0.415	8.790	0.014		
SCP1-SAL	2.921	0.298	4.783 E-05	5.026 E-05	9.041 E-12	2.275 E-04			8.441	0.994	1,191.059	1.586 E-14	−2.645 E+06	
SCP1-SST	2.315	0.469	4.678 E-05	1.580 E-04	9.748 E-12	3.213 E-04			9.596	0.992	920.365	7.383 E-14	−2.399 E+06	
SCP1/ EMP-SAL/ EMP	0.011	0.004	−4.127 E-04	0.004	4.570 E-06	5.728 E-04			0.002	0.769	24.279	6.054 E-05	45.151	
SCP1/ EMP-INC/ EMP	0.006	7.535 E-05	−0.003	0.002	2.703 E-04	0.015			0.003	0.523	8.685	0.005	4.694	
SCP1/ EMP-EPS/ EMP	0.005	5.051 E-05	−0.029	0.001	0.009	0.001			0.003	0.554	9.685	0.003	1.589	
SCP1/ EMP-SST/ EMP	0.016	4.886 E-04	−0.001	4.381 E-04	8.082 E-06	8.921 E-05			0.002	0.809	30.712	1.906 E-05	44.142	
*SCP1/ EMP-TSR/ EMP	0.001	0.336	0.047	0.053	−0.025	0.048			0.004	0.183	2.565	0.118	0.922	
** ELC/ EMP-TSR/ EMP	−9.576	0.776	833.398	0.029	−225.926	0.028			76.704	0.305	3.413	0.079	1.844	

(Contd...)

Appendix Table 1: ***(Continued)***

Combinations	Constant	(p)	x	(p)	x^2	(p)	x^3	(p)	Standard errors	Adj.-R_2	F	(p)	1st turning points	2nd turning points
*WST-SAL	−1,755.422	0.008	0.012	6.899 E-06	−2.520 E-09	1.212 E-05			1,371.578	0.887	44.035	2.250 E-05	2.424 E+06	
*WST-SST	−1,681.548	0.030	0.012	5.647 E-05	−2.443 E-09	9.752 E-05			1,729.755	0.820	26.016	1.816 E-04	2.399 E+06	
*SCP1/ EMP-INC/ EMP	0.005	4.440 E-04	−0.003	1.608 E-04	0.001	0.003	−8.744 E-05	0.016	0.002	0.700	11.893	0.001	1.615	7.719
*SCP1/ EMP- EPS/ EMP	0.004	2.352 E-05	−0.037	7.023 E-06	0.110	0.001	−0.032	0.001	0.002	0.824	22.799	5.038 E-05	0.166	2.257
*SCP1-/ EMP-TSR/ EMP^3	0.005	0.001	−0.140	0.004	1.235	3.817 E-04	−0.6241	3.241 E-04	0.002	0.738	14.131	4.320 E-04	0.057	1.319
SCP2-SAL	−11.179	0.392	3.979 E-04	0.002	−1.713 E-10	0.013	2.574 E-17	0.011	22.534	0.989	308.289	8.528 E-08	1.162 E+06	4.435 E+06
* ELC/ EMP-TSR/ EMP	56.463	0.087	−1,491.019	0.066	9,669.649	0.009	−2,535.930	0.008	51.286	0.689	9.134	0.006	0.077	2.542
*WST-SAL	310.647	0.003	−0.003	7.867 E-05	7.577 E-09	5.283 E-09	−1.472 E-15	5.252 E-10	118.329	0.999	4,344.710	3.483 E-13	226,411.546	3.431 E+06
*WST-SST	484.471	0.003	−0.005	7.359 E-05	8.953 E-09	4.222 E-08	−1.712 E-15	6.070 E-09	202.577	0.998	1,480.630	2.569 E-11	286,267.484	3.487 E+06

Sources: Author's calculation based on the environmental reports/eSG data of each company. The data is presented to three digits after the decimal point to ensure rigor. If zero continues after the third digit (e.g., 0.0000152678), it is not presented as 0.000, but as an exponent, 1.527e-05. The amount exceeding one million yen, i.e., seven digits, is also indicated as an exponent. **The value is deemed to meet the requisite level of significance