PUBLIC UTILITIES' CORPORATE GROWTH AND ENVIRONMENTAL CONSERVATION: EVIDENCE FROM JAPAN

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Overview

This presentation explores how public utilities in Japan have achieved both growth and environmental conservation by using financial performance and environmental impact data from publicly traded companies of power, gas, transport, telecommunication, and postal services. First, the regression analyses confirm the Environmental Kuznets Curve (EKC) hypothesis and an inverted N-shaped curve. Second, the growing trend of Environment, Society, and Governance (ESG)-oriented investment and management are deciding factors; they have acted as competitive pressure on the public utilities for fundraising, especially in spurring them to disclose information before and during the COVID-19 pandemic. Third, further consideration based on ESG and total shareholders return (TSR) could contribute not only to environmental conservation but also to academic frontier expansion.

Methods

This presentation verifies the relationship between the financial performance and environmental impact data of 43 stock-listed public utilities in Japan, employing linear, quadratic, and cubic regressions. This approach differs from previous studies in that the EKC and its advanced theory of the inverted N-shaped curve are applied to companies through accounting, rather than the conventional and traditional approach applied to countries. Sources include both ESG reports and annual securities reports in Japanese, which are equivalent to US Form 10-Ks.

▪ Of the 3,869 companies listed on the Tokyo Stock Exchange as of December 31, 2022, 43 were chosen from the electricity, gas, transportation, telecommunications, and postal services for which environmental data are available.

Table 1 dependent and explanatory variables (abbreviation)

dependent variables: 8	explanatory variables: 7
(1) total CO_2 emissions (CO_2) (2) Scope 1 CO_2 emissions (SCP1) (3) Scope 2 CO_2 emissions (SCP2) (4) Scope 1+2 CO_2 emissions (SCP1+2) (5) Scope 3 CO_2 emissions (SCP3) (6) electricity consumption (ELC, MWh) (7) water consumption (AQU, m^3) (8) industrial waste generation (WST, tons)	(1) net sales (SAL) (2) net income (INC) (3) earnings per share (EPS) (4) total assets (SST) (5) property, plant, and equipment (PEQ) (6) treasury stocks (RES) (7) total shareholders return (TSR) (1, 2, 4, 5, 6): million JPY, (3): JPY

▪ Dependent variables: 16 = 8 x 2 [both cases are divided and not divided by persons (per staff member)].

There are both patterns in which it is calculated on a per staff member basis and not; 8 patterns for the former and 8 patterns for the latter, for a total of 16 patterns.

▪ Explanatory variables: 14 = 7 x 2 (both cases are divided and not divided by persons).

As in the dependent variables, both cases are a per staff member basis and otherwise; that is, there are 7 patterns for the former and 7 patterns for the latter, for a total of 14.

▪ The total number of regression formulas is 1,008. The breakdown is as follows; the number of linear equations is 112 = 8 (dependent variables) x 7 (explanatory variables) x 2 (both cases divided by persons and not) in 2019. The number of quadratic equations is 112 and that of cubic is 112 in 2019. The number of equations for 2019 is 336 = 112 (linear) + 112 (quadratic) +112 (cubic). The number of formulas is 336 in 2020 and 336 in 2021, respectively, the same as in 2019. So, (112 x 3) x 3 (2019, 2020 and 2021) = 1,008.

The significance level of the p-value is set at 5% ($p < 0.05$). Then, the regression models are as follows.

First, where CO_2 emission is the dependent variable and each variable from (1) SAL to (7) TSR is placed as the explanatory variable.

$$Y\ (CO_2) = \alpha + \beta_1\ (SAL) + \varepsilon, \qquad (1\text{-}1\text{-}1)$$

$$Y\ (CO_2) / persons = \alpha + \beta_1\ (SAL) / persons + \varepsilon, \qquad (1\text{-}1\text{-}1P)$$

The order of the explanatory variables is the same as above, only replacing the dependent variable, while equations (2)–(8) are omitted.

Second, the Environment Kuznets Curve (EKC) hypothesis is examined. The hypothesis is valid when the linear term (positive: $\beta > 0$) and the squared term (negative: $\beta < 0$) are significant ($p < 0.05$).

$$Y\ (CO_2) = \alpha + \beta_{11}\ (SAL) + \beta_{12}\ (SAL)^2 + \varepsilon, \qquad (1\text{-}1\text{-}2)$$

$$Y\ (CO_2) / persons = \alpha + \beta_{11}\ (SAL) / persons + \beta_{12}\ (SAL) / persons^2 + \varepsilon, \quad (1\text{-}1\text{-}2P)$$

Third, the success or failure of a cubic curve is tested. It is desirable to illustrate an inverted N-shaped curve in investigating the relationship between growth and environmental impact. The inverted N-shape is valid in cases wherein the environmental impact increases (positive: $\beta > 0$) at the first turning point (bottom), it decreases (negative: $\beta < 0$) at the second turning point (top).

$$Y\ (CO_2) = \alpha + \beta_{11}\ (SAL) + \beta_{12}\ (SAL)^2 + \beta_{13}\ (SAL)^3 + \varepsilon. \quad (1\text{-}1\text{-}3)$$

$$Y\ (CO_2) / persons = \alpha + \beta_{11}\ (SAL) / persons + \beta_{12}\ (SAL) / persons^2 + \beta_{13}\ (SAL) /persons^3 + \varepsilon. \quad (1\text{-}1\text{-}\ 3P)$$

Results

This study's findings are as follows. First, linear regression analysis reveals significant monotonic relationships in 18, 27 and 34 cases out of the 112 cases tested in 2019, 2020 and 2021, respectively. The results illustrate a trend in which when financial performance expands, environmental impact increases. Second, quadratic regression analysis of the EKC hypothesis confirms the validity of 14 cases in 2019, 13 in 2020 and 14 in 2021. Third, cubic regression analysis of the inverted N-shaped curve confirmed the validity of 4 cases in 2019 and 2 cases in 2020 and 2021.

Table 2 Significant cases' number and percentage (%)

	1	2	3
2019	18 (16.1%)	14 (12.5%)	4 (3.6%)
2020	27 (24.1%)	13 (11.6%)	2 (1.8%)
2021	34 (30.4%)	14 (12.5%)	2 (1.8%)

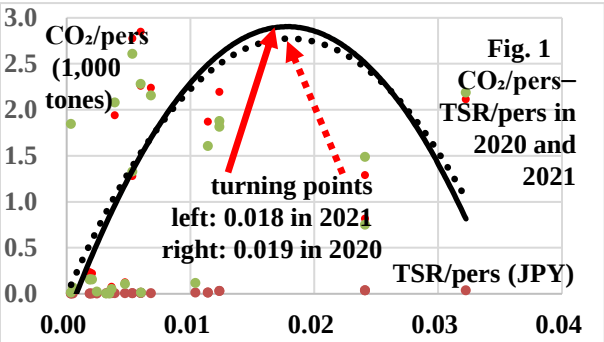

Fig. 1 CO_2/pers– TSR/pers in 2020 and 2021

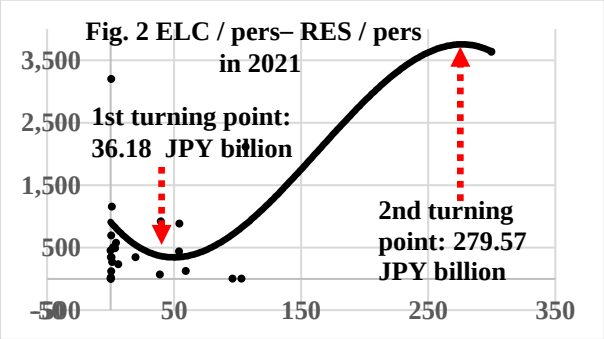

Fig. 1 illustrates the explanatory variables (TSR / persons) on the X-axis, while the dependent variables (CO_2 total / persons) in 2020 and 2021 are on the Y-axis, revealing that the relationship depicts an inverted U-shaped curve with the turning point. And Fig.2 also illustrates the explanatory variable (RES) on the X-axis, while the dependent variable (ELC) is on the Y-axis, depicting an inverted N-shaped curve with the turning points.

Detailed results and further discussion of their underlying factors will be provided in the 2023 presentation; as for the significant cases confirmed in the EKC and the inverted N-shaped curve, ESG-oriented investment and management should be noted. Investors' emphasis on ESG has been functioning as the compelling or driving force to advance the implementation of environmental conservation.

Especially, total shareholders return (TSR) is important. TSR is calculated based on dividends, capital gains, etc. divided by the amount invested. Moreover, firms above the 0.018-0.019 level are not necessarily among the top-ranked firms in terms of net sales, but rather among the middle or low-ranked firms. Therefore, TSR can be the key to establishing the EKC hypotheses, that is, realizing environmental conservation. The emergence of the turning points in Figures 1 and 2 indicates the birth of the growth and environmental impact decoupling. The increasing TSR to thresholds, that is, JPY 0.018-0.019 in the EKC, could serve as guidelines or benchmarks for decoupling.

Finally, the disclosure of TSR has just begun with the 2019 amendment of the Cabinet Office Order on Disclosure of Corporate Affairs in Japan. Previous studies have almost never used TSR to analyze environmental data; a TSR analysis in this presentation could contribute to expanding the research frontier not only in Japan but also in other countries.

Conclusions

A TSR- and ESG-focused approach demonstrated in this presentation could contribute toward expanding the frontiers of environmental economics and industrial organization theory, and environmental conservation. Therefore, it is recommended that the academic community keep exploring the relationship between growth and environmental conservation.

References

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