How to estimate the model of sustainable profit and corporate social responsibility

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ABSTRACT

This paper proposes an empirical method to estimate the model of sustainable profit and corporate social responsibility originated by Sudtasan and Suriya (2013). It suggests analysts to use data from official financial statements of companies which may be reported to the Stock Exchange in a particular country. These data can construct a time series data of a company if the number of years is long enough. Otherwise, the pooled cross-section and time series data from companies in the same industry may allow the construction of a panel data set. Then analysts can apply panel data analysis with fixed effects model and random effects model to estimate the data. These methods aim at locating the position of a company or a group of companies onto a phase diagram and calculate the steady state indicating the sustainability of profit and corporate social responsibility. By comparing the location of companies to the steady state, analysts can predict the direction of the firms in the long-run according to the streamlines in the phase diagram. They will be able to suggest policy manipulation to the firms to move toward the steady state.

Keywords: Theory of the firm, mathematical modeling, phase diagram, sustainable development, corporate social responsibility.

JEL Classification: D21, C62, O12

1. Model of sustainable profit and corporate social responsibility

Sudtasan and Suriya (2013) proposed the model of sustainable profit and corporate social responsibility (CSR). The model tries to find a way to avoid the profit decline in the decline stage of the product life cycle (Vernon, 1966) and emphasizes the role of corporate social responsibility in strengthening the sustainable business (Friedman, 1970) and the income distribution which leads to poverty reduction (Techanan and Suriya, 2012). It finds the steady state in the long run by the intersection of two functions, sustainable profit and sustainable CSR expenditure. The phase diagram indicates four areas. They are called warm glow area, frozen area, charitable area and decayed area. The streamlines in these four areas lead the firm to different ends (Figure 1).

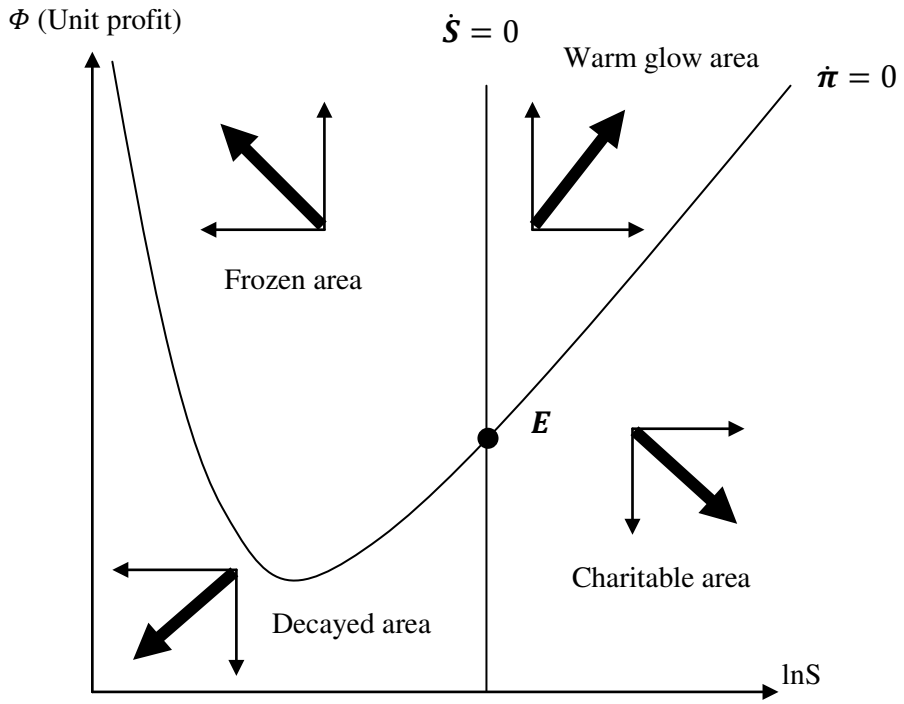

Figure 1: Phase diagram with streamlines and area classification in the model of sustainable profit and corporate social responsibility (Sudtasan and Suriya, 2013)

In the phase diagram, S is corporate social responsibility, π is profit, E is steady state, Φ is unit profit, lnS is natural logarithm of corporate social responsibility, $\dot{S}$ is change of corporate social responsibility over time, and $\dot{\pi}$ is change of profit over time. The model indicates the sustainable profit as $\dot{\pi} = 0$ and the sustainable corporate social responsibility as $\dot{S} = 0$.
When a firm is located in the warm glow area, it will achieve only the sustainable profit in the long run but it needs to spend more CSR expenditure. In another case, when the firm is located in the frozen area, it can still achieve only the sustainable profit but the CSR expenditure will shrink to a small number. A firm in the charitable area spends too much CSR expenditure and faces bankruptcy in the long-run. A firm in the decayed area will face both bankruptcy and zero CSR expenditure in the end.

The model emphasizes that a firm can achieve both sustainable profit and corporate social responsibility only by policy manipulation. For example, a firm in warm glow area should reduce both its unit profit and CSR expenditure. A firm in the decayed area can avoid bankruptcy by increasing both the unit profit and CSR expenditure. A firm in the charitable

area should lessen the CSR expenditure to save its financial status. Last, a firm in the frozen area should spend more on social responsibility while reduce its unit profit.

2. Estimation problem

Locating a firm into the phase diagram faces two major problems. First, the unit profit is not directly observable. Second, the length of data may not enough for the statistic inference. This section proposes the estimation method to overcome these problems as follows.

Step 1: The natural logarithm of S can be directly observed from the financial statement of a company.

Step 2: The estimation of unit profit (Φ) can be done by modifying the original profit function of Sudtasan and Suriya (2013).

$$\pi = PQ - [FX + \delta FX + CQ + RD + S]$$

where

π = Gross profit
P = Unit price
Q = Quantity sold to the market
FX = Fixed cost
δFX = Maintenance cost
δ = Depreciation rate
C = Unit variable cost
CQ = Variable cost
RD = Research and development expenditure
S = Expenditure for corporate social responsibility

Then rearrange the equation and generate the unit profit by the difference between the unit price and unit variable cost, $(P - C) = \Phi$.

$$\pi = (P - C)Q - [(1 + \delta)FX + RD + S]$$

$$\pi = \Phi Q - [(1 + \delta)FX + RD + S]$$

The original paper defines the effect of corporate social responsibility on the quantity sold to the market as a function of natural logarithm of S to the power of α.

$$Q = (lnS)^{\alpha}$$

Then the equation can be viewed as follows.

$$\pi + [(1 + \delta)FX + RD + S] = \Phi(lnS)^{\alpha}$$

Define the left-hand side (LHS) as Z.

$$\pi + [(1 + \delta)FX + RD + S] = Z$$

Then,

$$Z = \Phi(lnS)^{\alpha}$$

To estimate this equation, take natural logarithm into both sides.

$$lnZ = ln\Phi + \alpha ln(lnS)$$

The addition of controlled variables (X_j) indicating macroeconomic environments and dummies of significant events that may affect the profit of the firm constructs an econometric model.

$$lnZ = ln\Phi + \alpha ln(lnS) + \sum_{j=1}^{J} \beta X_j + \varepsilon$$

where

Z	=	Gross profit plus other costs apart of the variable cost in the production
Φ	=	Unit profit
$ln\Phi, \alpha, \beta$	=	Parameters to be estimated
lnS	=	Natural logarithm of the expenditure for corporate social responsibility
X_1	=	Gross Domestic Product (GDP). This variable presents the economic situation in that period.
X_2	=	Gross Domestic Product per capita. This variable presents the purchasing power of people in that period.
X_3	=	Foreign direct investment in the previous period (t-1)
X_4	=	Foreign portfolio investment in the previous period (t-1)
X_5	=	Dummy for political unrest (1=yes, 0=no)
X_6	=	Dummy for natural disaster (1=yes, 0=no)
X_7	=	Real exchange rate weighted by total international trade volume to major markets.
X_8	=	Inflation rate measured by producer price index
X_9	=	Average minimum wage over the country
X_{10}	=	Interest rate measured by MLR (Minimum Loan Rate)
ε	=	Error term

The constant of this model is $ln\Phi$ which translates into the unit cost (Φ) by its exponential function, $e^{ln\Phi}$.

3. Proposed estimation method

Method 1: Ordinary Least Squares

The estimation method depends on number of observations. In case that the data of a firm consists of more than 30 observations from 30 years, Ordinary Least Squares (OLS) can be applied to the data. The reason why OLS is suitable for the estimation is that the dependent variable is lnZ which ranges from minus infinity to infinity. In this case the parameters in the model can be calculated by the formula

$$\beta = (X'X)'(X'Y)$$

where β represents the parameters to be estimated, X is the matrix of independent variables and Y is the vector of dependent variable. OLS can be used with Heteroscedasticity Consistent Estimator (HCE) to ensure the robustness of the result with the robust standard error (Suriya, 2011).

However, the warning of this method is at the critics of time-invariant parameters, especially the unit profit. If it is assumed that a firm gains a constant unit profit over time regardless of the changing price and unit cost, i.e. the gap between them is constant while both of them are changing every year, then it is still reasonable to use this method.

Method 2: Panel data analysis

In case that the number of observations of a firm is less than 30 years, it needs to pool the observations from many firms and many periods. The pooled cross-section and time series data constructs the panel data.

Panel data analysis provides two options, the fixed effects model and the random effects model. This econometric method is useful for the analysis of empirical data both collected from the fields and experiments (Suriya, 2013).

Option 1: Fixed effects model

The simple setting of the fixed effects model can be written as follows.

$$Y_{it} = (\alpha_0 + \theta_i D_i) + \beta_0 X_{it} + \varepsilon_{it}$$

where

Y_{it} is the dependent variable,
α_0 is the common value in the constant,
θ_i is the firm-specific value in the constant,
D_i is the dummy variable indicate each firm in the group,
β_0 is the parameter of the independent variable,
X_{it} is the independent variable,
ε_{it} is the error term,
i is the specific firm,
t is the specific time.

It can be seen from the equation that the parameters of all firms in the industry are the same. The only different is at the constant of each firm. Notice that the constant of a firm is fixed over time. In the estimation of Sudtasan and Suriya model of sustainable profit and corporate social responsibility, the constant is the natural logarithm of the unit profit. Therefore, this option can separate the unit profit of each firm in the group. The calculation of the constant of each firm can be done following Judge et al (1988, pp.476-479) in the section of pooling time-series and cross-sectional data using dummy variables.

Option 2: Random effects model

The simple setting of the random effects model can be written as follows.

$$Y_{it} = \alpha_0 + \beta_0 X_{it} + \varepsilon_{it}$$

where $\varepsilon_{it} = \lambda_{it} + \gamma_{it}$

then $$Y_{it} = \alpha_0 + \beta_0 X_{it} + (\lambda_{it} + \gamma_{it})$$

and $$Y_{it} = (\alpha_0 + \lambda_{it}) + \beta_0 X_{it} + \gamma_{it}$$

where
Y_{it} is the dependent variable,
α_0 is the common value in the constant,
β_0 is the parameter of the independent variable,
X_{it} is the independent variable,
ε_{it} is the non-white noise error term,
γ_{it} is the common white noise error term of the group,
λ_{it} is the specific error term of a firm,
i is the specific firm,
t is the specific time.

In this setting, the constant term of a firm can vary from time to time. Notice that the subscript of λ_{it} varies for a specific firm (i) and a time period (t). Therefore, it can be seen that the value can be different along the firm and the time.

By this option, the constant of the model which represents the unit profit of a firm can be calculated for each year. The calculation can be done following the methods in Judge et al (1988, pp.487-488) in the section of pooling time-series and cross-sectional data using error components.

The selection criteria to choose between the fixed effects and random effects model can be done by Hausman test. However, it should be noted that both the fixed effects model and random effects model present the same parameters of the independent variables for the whole group of companies and not for a specific company. Only the constants are different among firms.

4. Data

The data of the profit and costs of the firms can be collected from their official financial statements. It is by law that the listed companies in the Stock Exchange of Thailand must report the financial statements to the authority. The report is called Form 56-1. It is downloadable from the official website of Stock Exchange of Thailand (www.settrade.com).

5. Conclusions

This paper suggests the estimation method for the empirical study of Sudtasan and Suriya model of sustainable profit and social responsibility. First, it constructs the econometric model by the combination of mathematical settings in Sudtasan and Suriya (2013) and some controlled variables. Second, it provides options to estimate the model which depends on number of observations. The possible methods include Ordinary Least Squares (OLS), fixed effects model and random effects model with the selection criteria by Hausman test. Last, it introduces the data that can be collected from the official financial statements that are downloadable at the website of the Stock Exchange of Thailand. This method will empower researchers and analysts to conduct empirical studies to shed light on the Sudtasan and Suriya model of sustainable profit and social responsibility. The location of firms on the phase diagram as results from these empirical studies will be guidelines for firms to achieve both the sustainability of profit and social responsibility in the long-run.

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