Sociality of a Firm and the CSP-CFP Relationship: using Artificial Neural Networks

Daisuke Okamoto

As criterion of a good firm, a lucrative and growing business has been said to be important. Recently, however, high profitability and high growth potential are insufficient for the criteria, because social influences exerted by recent firms have been extremely significant. In this paper, high sociality is added to the list of the criteria. Empirical CSP-CFP (corporate social performance vs. corporate financial performance) relationship studies that consider sociality are very limited in Japan, because of scant data and the inappropriate methods, especially for supporting the linearity hypothesis which these studies are based on. In this paper, the CSP-CFP relationship is analyzed by an artificial neural networks model, which can deal with a non-linear relationship, using 10 years follow-up survey data.

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ABSTRACT. As criterion of a good firm, a lucrative and growing business has been said to be important. Recently, however, high profitability and high growth potential are insufficient for the criteria, because social influences exerted by recent firms have been extremely significant. In this paper, high sociality is added to the list of the criteria. Empirical CSP-CFP (corporate social performance vs. corporate financial performance) relationship studies that consider sociality are very limited in Japan, because of scant data and the inappropriate methods, especially for supporting the linearity hypothesis which these studies are based on. In this paper, the CSP-CFP relationship is analyzed by an artificial neural networks model, which can deal with a non-linear relationship, using 10 years follow-up survey data.

KEY WORDS: ANNs (artificial neural networks), CSP-CFP (corporate social performance vs. corporate financial performance) relationship, CSR (corporate social responsibility), growth potential, linearity, profitability, sociality

Increasing Importance of Corporate Sociality

The study of corporate appraisal is an academic field where definitions of good firms and bad firms are explored. Its main research themes are classified broadly into two categories. One is research on perspectives where assessment criteria of corporate appraisal are examined and the other is research on methods where techniques of corporate appraisal are examined. The former research area can be named as “WHAT research”, and the latter, “HOW research”.

For “WHAT research”, assessment criteria are necessary for corporate appraisal and, in the past, a lucrative and growing business has been said to be important. High profitability and high growth potential are still important these days, however, they are insufficient for the criteria, because social influences exerted by recent firms have been significant. A firm that seeks only its own profitability and growth potential is no longer a good firm (Shimizu, 2000; Paine, 2003). I have argued that sociality should be added to the list as the third criterion. Here, profitability is the short-term criterion, growth potential is the mid-and-long-term criterion, and sociality is the ultralong-term criterion (Okamoto et al., 2006c).

To examine these relationship deductively and also inductively, existing methods are insufficient and the second research area of corporate appraisal, “HOW research”, is required. In addition to multivariate analysis, application of artificial intelligence to corporate appraisal is assumed to have great potential for this purpose. In this paper, the significance of sociality for assessment criteria for corporate appraisal will be discussed as “WHAT research”, and the relationship among profitability, growth potential and sociality will be examined using “HOW research”. Let me elaborate the research questions of this paper, as follows;
1. In light of the rising CSR argument, sociality of firm should be important for management. However, is it also important as a criterion of corporate appraisal? What kind of relationship is there between sociality and existing criteria (profitability and growth potential)?

There used to be an argument that a firm should not necessarily be concerned about its social responsibility but it should naturally fulfill the responsibility by attaining managerial economies (Friedman, 1962). In recent years, however, corporate social responsibility (CSR) has attracted a lot of attention in the academic and business worlds, and no one insists that CRS is unnecessary for management anymore (Frederick, 1986, 1994, 1998; Carroll, 1999; Carroll et al., 2003). Then, what kind of role does sociality perform as a new criterion of corporate appraisal? What is the significance of sociality as a new criterion of corporate appraisal? Is there any difference between corporate appraisal using existing (profitability and growth potential) criteria and new corporate appraisal which adds sociality as its criterion?

2. What consequences does sociality of a firm have in its management?

If sociality of a firm is important for management of the firm, what effect will result when the top manager places importance on sociality of the firm? Even though sociality and/or CSR are said to be important for considering a relationship between business and society, are they really important for corporate management? In Japan, there has been very few empirical studies on the CSP-CFP(corporate social performance vs. corporate financial performance) relationship, so this kind of study should be implemented.

Here, I will define sociality of a firm for this paper as “A firm’s diverse commitment, other than profitability and growth potential, to its stakeholders”. It covers a variety of relationships such as employee relationships as the closest stakeholder (improvement in employment problems and the quality of life, etc.), shareholder and creditor relationships (corporate governance, business ethics), community/consumer relationships as stakeholders with broader perspectives (community and social contribution), and the global environment as a stakeholder with the broadest perspective (greening and eco-management).

If you think that CSR is an abbreviation of corporate social responsibility, it is hardly a new concept. Going back to the history of the Japanese economy, you can easily find three mighty swells of changing times. The first was the Social Responsibility Boom in 1960-70s. The postwar years of spectacular economic growth reached a climax and the so-called Izanagi Boom achieved the longest postwar prosperity record of 57 months, from November 1965 to July 1970. Simultaneously for the first time, Japanese companies experienced serious pollution problems and there was a resounding denunciation of the “trying to catch and pass the West” management policy that put the economic growth above anything else. Then, the phrase “Corporate Social Responsibility” came to the forefront and many companies were pressured to deal with the problem, e.g. setting up Code of Conduct.

The second swell was the Philanthropy Boom in 1980-90s. The so-called Bubble Economy or Heisei Economy lasted for 51 months, from December 1986 to February 1991.

The
During that term, stock prices and land prices skyrocketed, and Japan became the world’s largest creditor country. Again, there was criticism of corporate behavior such as: “large companies would resort to anything to make money”, “only the company itself would become affluent, not its employees”, and “companies should make more social contributions and cultural contributions”. Technical terms such as corporate philanthropy (social contributions) and mecenat (cultural contributions) came to the forefront and many companies created departments dealing with corporate philanthropy, mecenat, corporate citizenship, etc. Simultaneously, the 1% club (Nippon Keidanren) and the Association for Corporate Support of the Arts, Japan (Kigyo Mecenat Kyogikai: KMK) were also established.

The third swell is the current economic boom – the CSR boom of the 21st century. The current prosperity period started in February 2002, and is very likely to break the Izanagi Boom’s record by reaching 58 months in November 2006, and still counting (as of September 2007). Corporate social responsibility of large companies has come into the public limelight again, because of their huge social influence and responsibility to several types of stakeholders, CSR has gained social recognition. Due to the enormous geoenvironmental impact by corporate behaviors, new terms such as sustainability, triple bottom line, environmental management, eco management, and green accounting have become more common. Also, due to insufficient return to shareholders and successive emergence of corporate scandals in the lost decade before the current economic boom, new terms such as shareholder value, reconstruction of the Japanese management system, corporate governance, and business ethics have become more common.

There are great similarities between the first two swells. They are:
1. They were the longest postwar prosperity record of 57 months and then the comparable Bubble Economy prosperity of 51 months.
2. On the other hand, there was criticism of corporate behavior such as “large companies would resort to anything to make money”
3. Companies’ handling of the issues, such as social responsibility, social contributions, corporate philanthropy.
4. End of the “boom” by end of the economic prosperity.

The third swell also has some of these similarities i.e. prolonged prosperity, criticism and expectation on corporate behavior, CSR / environmental management / sustainability activities to address these issues. The current economic boom will eventually end, however, will the third swell CSR boom end as well? I estimate that it will not happen and insist that it should not happen (Matsuno et al., 2006). It is because of companies’ ever-increasing social influence, augmenting an important point of contact with society, and growing corporate social responsibility to various kinds of stakeholders (Freeman, 1983; Donaldson & Preston, 1995; Clarkson, 1998). Then, how should companies recognize sociality or CSR?

Even if there were phenomenal similarities among the three swells, there were differences in terms of recognition of sociality. In the Social Responsibility Boom in 1960-70s, the most and only important objective of firms was their long-term survival and growth by high profitability and high growth potential. On the other hand, social responsibility was a coping behavior to criticism, and, as it were, constraints or sub-objective. That’s why the Social Responsibility Boom ended when the economic boom ended and criticism ended.
In the *Philanthropy Boom* in 1980-90s, social contribution was thought to be irrelevant to a company’s main business. Every company was lucrative in those days, the general trend of public opinion was that companies should make donations and social contributions. As philanthropy and/or mecenat activity was dealt without logic of business, when the economic boom ended and philanthropy and/or mecenat activity drop from notice, the *Philanthropy Boom* naturally ended.

Considering the importance of sociality for modern firms, it is not desirable or permissible that the *CSR boom* will end when the current economic boom ends as in the case of the *Social Responsibility Boom* or the *Philanthropy Boom*. This means that recognition of sociality should not be “sub-objective” nor “out of logic of business” for its enduringness. It is important that sociality should be recognized as a coherent factor for corporate strategy (Takada, 1970; Sakurai, 1976). Formulating a coherent strategy on profitability, growth potential and also sociality is important because it offers many advantages to every stakeholder and also the company itself (Dore, 2005; Sogawa, 2005). These perspectives and differences are shown in Figure 1. In “Management in the *CSR Boom* (Sociality “for” a firm)”, sociality is the same level objective as profitability and growth potential objectives. It is very different from “Management in the *Social Responsibility Boom*” where sociality is a “sub-objective” of profitability and growth potential. It is also very different from “Management in the *Philanthropy Boom*” where sociality is “out of the logic of business”. Although there are differences of time scope between profitability (short-term), growth potential (mid-and-long-term), and sociality (ultralong-term), the point is that they are all in the same level of objectives in “Management in the *CSR Boom* (Sociality “for” a firm)”.

As mentioned above, because of the huge social impact of a firm’s behavior, it should attach importance to its sociality as a super ordinate level objective as it brings many advantages to a firm such as: acquisition and maintenance of capable human resources, customer retention, productivity improvements with environmental management, attracting social-and-ethical oriented investors, improving local community relationship, and so on (Porter & van der Linde, 1995a; Reinhardt, 1999; Singh, 2000; Williams & Barrett, 2000; Bhattacharya & Sen, 2004). There is a favorable feature that the earlier a firm works on a problem, the bigger its merit. There is also a virtuous circle that, in order to work on these problems, it needs long-term perspective without being captivated by daily affairs (Waddock & Bodwell, 2004). In the following sections, several empirical studies on the results of firms’ behaviors which actually have worked on these problems will be discussed using real date from Japanese firms.
Empirical Study on Sociality 1

An aim of the first empirical study was to measure sociality and verify the relationship to profitability and growth potential which were traditional criteria of corporate appraisal. Data were obtained from the questionnaire survey of Sogawa Project (Sogawa et al., 1995). Data from 252 manufacturing firms (which are listed on the Tokyo Stock Exchange) were analyzed using multiple correlation analysis and QAQF (Quantitative Analysis for Qualitative Factors). Summarizing the result, there seemed to be a strong positive relationship between Sociality and Financial Performance (Profitability + Growth Potential). Thus, a firm with high Financial Performance has a high Sociality score. Looking at only this result, there might be no use adding Sociality as a new corporate appraisal criterion to the traditional criteria of Profitability and Growth Potential. To further consider this relationship, however, I developed the following four classification types.

Type I: Firms with high Financial Performance and high Sociality
Type II: Firms with low Financial Performance and low Sociality
Type III: Firms with high Financial Performance but low Sociality
Type IV: Firms with low Financial Performance but high Sociality

As there is a strong positive relationship between Financial Performance and Sociality, there should be many Type I and Type II firms. Actually, however, there exists both Type III and Type IV firms. Type III firms have high Financial Performance but low Sociality and they might be unaware of the importance of sociality. Generally, it is inconceivable that a firm with low Financial Performance has a great awareness of sociality, therefore, it is assumed that the strong positive relationship between Financial Performance and Sociality begins with a causality of ‘high Financial Performance --- > high Sociality’. Considering the importance of sociality for modern firms, a firm with low Sociality cannot maintain its Financial Performance in the long run. That is a causality of ‘low Sociality --- > low Financial Performance’. Conversely, high Sociality would be a necessary condition of its future high Financial Performance, and a causality of ‘high Sociality --- > high Financial Performance’ would be observed. Then, a virtuous circle of ‘high Financial Performance --- > high Sociality --- > high Financial Performance’ would be conceivable. If a Type III firm cannot create this virtuous circle, it would fall into a vicious circle of ‘low Sociality --- > low Financial Performance --- > low Sociality --- > low Financial Performance’. Since type III firms are obviously classified into good firms in terms of the traditional Profitability and Growth Potential corporate appraisal criteria, one significance of adding sociality to corporate appraisal criteria can be the ability to tell Type I firms from Type III firms. For the next empirical study, the following two hypotheses are proposed.

H1 (Financial Performance maintenance hypothesis)
Insofar as high Financial Performance firms,
Type I (high Sociality) firms have a larger probability of maintaining high Financial Performance
than Type III (with low Sociality) firms

H2 (Financial Performance deterioration hypothesis)
Insofar as high Financial Performance firms,
Type I (high Sociality) firms have a smaller probability of deteriorating high Financial Performance than Type III (with low Sociality) firms.

Type IV firms have high Sociality but low Financial Performance. As mentioned above, however, it is inconceivable that a firm with low Financial Performance has a great awareness of sociality, therefore, it is believed that these firms used to have high Financial Performance in favorable business conditions such as during the *Philanthropy Boom*, but after that its performance deteriorated. These firms might be able to utilize the virtuous circle because their Sociality is high. However, it cannot be so optimistic because of the ultralong-term nature of sociality. Even if this assumption is true, these Type IV firms’ probability of vicious circle that low Financial Performance bring low Sociality and then low Financial Performance is considered to be lower than Type II firms (low Financial Performance and low Sociality). The probability of Type IV firms’ business recovering is also considered to be higher than that of Type II firms even if the nature of sociality is ultralong-term. Therefore, another significance of adding sociality to corporate appraisal criteria can be an ability to tell Type II firms from Type IV firms. Therefore, the following two hypotheses are proposed.

**H3 (Financial Performance recovery hypothesis)**
Insofar as low Financial Performance firms,
Type IV (high Sociality) firms have a larger probability of recovering to become high Financial Performance than Type II (with low Sociality) firms.

**H4 (Financial Performance stagnation hypothesis)**
Insofar as low Financial Performance firms,
Type IV (high Sociality) firms have a smaller probability of stagnating to be low Financial Performance than Type II (with low Sociality) firms.

**Empirical Study on Sociality 2: [1994-2004 Analysis]**

In the second empirical study on sociality, the above mentioned four hypotheses were tested. This test was to conduct a ten-year follow up survey for Type I - Type IV firms using fiscal 2004 data with original fiscal 1994 data. As a base of ‘high’ and ‘low’ for Financial Performance and Sociality, a one-third basis was used, e.g. upper third firms in terms of Financial Performance were regarded as high Financial Performance firms, and lower third, low Financial Performance firms. The same held for Sociality. Middle third firms in terms of Financial Performance or Sociality in 1994 were excluded from the test.

Results showed Financial Performance transitions as in Figure 2. Forty seven percent of the high Financial Performance and high Sociality Type I firms could maintain high Financial Performance after 10 years, however, only 35% of high Financial Performance but low Sociality Type III firms could do it. Also, only 17% of Type I firms’ Financial Performance deteriorated after 10 years, whereas 35% of Type III firms’ Financial Performance deteriorated. From these Financial Performance transitions for high Financial Performance firms, tendencies for supporting H1 (Financial Performance maintenance hypothesis) and H2 (Financial Performance deterioration
hypothesis) were observed.

On the other hand as in Figure 3, 33% of low Financial Performance and high Sociality Type IV firms could recover their Financial Performance after 10 years, however, only 11% of low Financial Performance and low Sociality Type II firms could do it. Also, only 29% of Type IV firms had stagnated in their Financial Performance after 10 years, while 54% of Type II firms had stagnated. From these Financial Performance transitions for low Financial Performance firms, tendencies for supporting H3 (Financial Performance recovery hypothesis) and H4 (Financial Performance stagnation hypothesis) were observed.

As there were only small-and-large tendencies, statistical significant tests were conducted. From these results, H1 was rejected, and H2, H3, H4 were supported at the 5% level\(^3\). The results showed that sociality might not be a sufficient condition; but it might be at least a necessary condition for good financial performance.

Figure 2  Financial Performance transitions of 50 high Financial Performance firms after 10 years

*Figure 2: Financial Performance transitions of 50 high Financial Performance firms after 10 years*
CSP-CFP Relationship

The above mentioned empirical studies can be regarded as CSP-CFP (corporate social performance vs. corporate financial performance) relationship studies. This kind of study is very rare in Japan, while there have been many studies in the world. There used to be many studies which supported negative or no CSP-CFP relationship. In recent years, however, studies which support a positive relationship have been increasing.

For instance, Kraft & Hage (1990) demonstrated that high performance firms had considered their contributions and services to local communities (one of corporate social responsibilities) as a long-term method for maintaining their assets and reputation. They also argued that there was a positive relationship between fulfillment of corporate social responsibility and profitability. Williams & Barrett (2000) also demonstrated that there was a strong positive relationship between corporate philanthropy activity and reputation using U.S. Fortune 500 firms’ data. Tanimoto (2004) argues that there are two groups of theories which explain the relationship between CSR and financial performance. One is ‘slack resources theory’ in which fulfillment of CSR is attributed to slackness of its fund, and the other is ‘good management theory’ in which a motivation for building a good relationship with stakeholders is explained by having a good reputation. He stated that the validity of the latter theory would increase along with maturity of CSR discussions. In fact, Margolis & Walsh (2003) surveyed 127 articles on CSP-CFP relationships from 1972 to 2002 and rounded up the result as follows\(^4\).

- 109 articles: CSP (predictor variable) , CFP (objective variable)
  - 54 articles: positive relationship
  - 7 articles: negative relationship
  - 28 articles: not significant
  - 20 articles: combined result

- 22 articles: CFP (predictor variable) , CSP (objective variable)
  - 16 articles: positive relationship
  - 3 articles: not significant
According to *The 15th Corporate White Paper* (Keizai Doyukai, 2003), “It is difficult to demonstrate a causal relationship of CSR and corporate performance.”, “Just like chicken-or-the-egg controversy, in the existing circumstances, we have scarce information to determine whether high performance induces active CSR behavior or active CSR behavior induces high performance.”, “Although a goodness of CSR is widely recognized nowadays, it gets no forrader unless there is an incentive of achieving concrete result.”

Necessity for Further Analysis [Artificial Neural Networks Model]

Why have empirical analyses on sociality made little progress? Why have they led to various conclusions? I think there are two main types of reasons. One is the nature of sociality, i.e. ultralong-term. Working on sociality will not bring concrete results immediately and useful data for sociality is not readily obtainable. Although 10 years of follow-up survey data was used, in this paper, further analysis will be necessary for the ultralong-term analysis. Another reason relates to the method of empirical analyses (Margolis & Walsh, 2003; Waddock & Bodwell, 2004). In many analyses, a liner hypothesis has been applied for analyzing the relationship between sociality and profitability / growth potential. For instance, this is true of the cases where multiple regression analysis, correlation analysis, or other multi-variate analyses are used. The same holds for the lately popular structural equation model. Although applying linear hypothesis is beneficial as a research strategy because analysts can simplify and comprehend reality easily and can utilize many models and statistical significance tests, they should also conduct non-linear analysis when linear hypothesis is uncertain. In this section, an analysis on sociality using ANNs (artificial neural networks) will be introduced as one of the solutions to the linear hypothesis problem.

ANNs are an attempt to actualize information processing model of a human brain neuron on a computer (Okamoto, 2004). For instance, let us consider capturing a relationship between two groups of variables by using an image of a three-layer structured ANNs model as Figure 4. There are 9 brain neuron units in the three-layer structure. One group of (two) variables is inputted to brain neuron units in the bottom layer and their information are transmitted to brain neuron units in the middle layer (units with 1 are kind of a constant which does not receive any information but only transmits information). In this model, each unit which receives information has its own threshold and it transmits information to the next unit only when received information exceeds its threshold, which is the same way a human brain processes information. Information from units in the middle layer is transmitted to a unit in the upper layer, which also has its own threshold and only when the information exceeds the threshold, does it output information. Therefore, flows of information are as follows;

\[
\text{vector } y_1 \rightarrow \text{vector } x_2 \rightarrow \text{vector } y_2 \rightarrow \text{vector } x_3 \rightarrow \text{vector } y_3
\]
A weight $w_{ijk}$ is multiplied when information transmission is between units (i.e. $y_i \rightarrow x_i$) and formula $x_i = W_{yi}^{-1}$ is used. For information transmission within units (i.e. $x_i \rightarrow y_i$), which include conditional judgment (using threshold) of whether transmit or not, formula $y_i = 1/(1+\exp(-x_{ij}))$ is used. There is no linear hypothesis in these processes. The biggest difference from traditional methods is the lack of linear hypothesis. Not only that, there is no hypothesis for a model and ANNs itself learn and construct the model from scratch.

The learning mechanism of ANNs is as follows. At first, random numbers are given for initial values of weight $w_{ijk}$. By using first sample input data, ANNs consequentially output totally irrelevant values. Then, correct answers of the outputs are given and weights are slightly modified accordingly. Next sample data are inputted, its outputs are compared to their correct answers, and weights are slightly modified accordingly again. These processes recur tens of thousands of times. The reason why ‘slightly modified’ is that if weights are perfectly modified according to specified sample, that outputs will be perfectly correct for that sample but perfectly irrelevant to other samples. These processes are called “network learning”. It is just the same as the human learning process when a baby learns how to respond, by associating parents’ behavior with his/her own behavior, such as the baby who does nothing but crying at first learns how to react, for example, to smile when happy, cry when sad, frown when angry, etc. ANNs itself construct a model by learning several relationship between variables. Therefore, ANNs model is an optimum method to apply when the relationship model is unknown and a fact finding
process is necessary, for instance, the relationship between sociality and financial performance.

ANNs-1 model is set as follows:

output variables: Profitability 2004, Growth Potential 2004

For analyzing the relationship between input variables and output variables and determining the ability to distinguish output variables by input variables, upper third firms in terms of Profitability 2004 and Growth Potential 2004 are regarded as high Profitability and high Growth Potential. Same holds as lower third. Therefore, ANNs-1 model tries to distinguish 4 groups of 2004 status (i.e. 1: low Profitability and low Growth Potential, 2: low Profitability and high Growth Potential, 3: high Profitability and low Growth Potential, 4: high Profitability and high Growth Potential) by three 1994 input variables (samples that are not classified into any groups were excluded from analysis and, as a result, there were 108 samples).

Summary of the result is shown in Figure 5. Contribution rates of input variables to distinguishing output variables suggest that Profitability 1994 has the strongest explanatory power for Profitability 2004 at 56%, followed by Profitability 1994 for Growth Potential 2004 at 53%. As for Sociality 1994, the contribution rate is 31% for Profitability 2004 and 25% for Growth Potential 2004. It can be said that sociality has positive impact on financial performance 10 years later, ever though it is not as strong as profitability. On the other hand, the contribution rate of Growth Potential 1994 is 13% for Profitability 2004 and minus 22% for Growth Potential 2004. As mentioned earlier, there is a strong positive correlation between financial performance (profitability or growth potential) and sociality. It is also identified that the correlation between profitability and growth potential is even stronger. Although in ANNs-1, overall power of explanation is fairly good, this strong correlation within input variables implies that there may be a problem similar to multicollinearity in multi-variate analysis. Therefore, input variables should be modified to two variables as follows.

ANNs-2 model

output variables: Profitability 2004, Growth Potential 2004
For the ANNs-2 model, let us compare its distinguishability with that of traditional discriminant analysis using same variables. In Figure 6, ‘Actual’ in the row means whether a sample was actually ‘high’ or ‘low’ in terms of Profitability 2004 and Growth Potential 2004. ‘Discriminant’ or ‘Neural’ in the column means that into which group of four the sample was classified by the model using 10 year-old Financial Performance and Sociality. As the diagonal elements show correct classification, the distinguishability is calculated by the (sum of diagonal elements) / (total samples). The distinguishability of the ‘Discriminant’ model is only 36%, however, that of the ‘Neural’ model is 96% and an explanatory power of ANNs model which takes into account the non-linear relationship is undoubtedly high.

**Figure 6 Discriminant model vs. ANNs-1**

<table>
<thead>
<tr>
<th>Actual</th>
<th>Discriminant</th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low P &amp; low G</td>
<td>low P &amp; high G</td>
<td>high P &amp; low G</td>
<td>high P &amp; high G</td>
</tr>
<tr>
<td>low P &amp; low G</td>
<td>13</td>
<td>13</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>low P &amp; high G</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>high P &amp; low G</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>high P &amp; high G</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>

Distinguishability
- Discriminant: 36.11% (SPSS ver.12.0J (SPSS Inc.))
- Neural (ANNs-1): 96.30% (KNNA ver.5.1 (Keio Univ.))

P: Profitability, G: Growth Potential, LC: learning count

Ninety six percent is a high figure, however, ANNs have a problem of over-learning. ANNs sometimes learn too much for a specific sample and the applicability to other samples would decline. Unfortunately, the probability of over-learning may be high in the above mentioned case in which the learning count was 10,000,000. Coping with this problem, the Reconstruction-learning method is effective (Aoyama & Ichikawa, 1991). It is just like a human learning process, i.e. learns to some extent, takes a rest and forgets a little, learns again, and does these processes over again and again, and finally, learns only important things. In this paper, the Reconstruction-learning method is utilized, and to stop the learning process at the right time, the cross validation method is simultaneously utilized.

The result is shown in Figure 7. ANNs-2 has two input variables, i.e. Financial
Performance 1994 (Profitability 1994 + Growth Potential 1994) and Sociality 1994, and two output variables, i.e. Profitability 2004 and Growth Potential 2004. With the Reconstruction learning and 10-split cross validation method (which made the sample size 1080), the optimum learning count was 100,000. The distinguishability decreased to 52%. However, it still holds priority to the traditional discriminant analysis (+16 percentage points or 1.44 times compared to 36%). In Figure 8, the contribution rates of input variables are shown and those of Profitability 1994 are still bigger than those of Sociality. The contribution rate of Profitability 1994 for Profitability 2004 is 75% and for Growth Potential 2004 is 79%. However, contribution rate of Sociality 1994 for Profitability 2004 is 25% and for Growth Potential 2004 is 21% and their positive contributions are considerably large.

**Figure 7 ANNs-2**
*Reconstruction learning + Cross validation*

<table>
<thead>
<tr>
<th>Actual</th>
<th>Profitability 1994</th>
<th>Sociality 1994</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low P &amp; low G</td>
<td>low G</td>
</tr>
<tr>
<td></td>
<td>264</td>
<td>14</td>
</tr>
<tr>
<td>low P &amp; low G</td>
<td>14</td>
<td>38</td>
</tr>
<tr>
<td>high P &amp; low G</td>
<td>38</td>
<td>40</td>
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<td>high P &amp; high G</td>
<td>40</td>
<td>8</td>
</tr>
<tr>
<td>distinguishability</td>
<td>52.04%</td>
<td></td>
</tr>
<tr>
<td>distinguishability I</td>
<td>70.09%</td>
<td></td>
</tr>
<tr>
<td>Neural (ANNs-1)</td>
<td>84</td>
<td>68</td>
</tr>
<tr>
<td>low P &amp; low G</td>
<td>84</td>
<td>231</td>
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<tr>
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<td>54</td>
<td>68</td>
</tr>
<tr>
<td>high P &amp; low G</td>
<td>123</td>
<td>40</td>
</tr>
<tr>
<td>high P &amp; high G</td>
<td>36</td>
<td>11</td>
</tr>
</tbody>
</table>

Using ANNs has an advantage in that it allows consideration of a non-linear relationship. In this paper, the positive contributions of the sociality factor to future financial performance have been verified. Although concrete figures had not been shown in existing articles, the positive contributions of the sociality factor after ten years have been ascertained as one-fifth to a quarter, compared to the contributions of the financial performance factor of three quarters to four-fifths.

**Figure 8 ANNs-2**

<table>
<thead>
<tr>
<th>output</th>
<th>Profitability 2004</th>
<th>Growth Potential 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>input</td>
<td>Financial Performance 1994</td>
<td>Sociality 1994</td>
</tr>
<tr>
<td></td>
<td>Financial Performance 1994</td>
<td>Sociality 1994</td>
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<tr>
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Conclusion and Limitations

In this paper, study of corporate appraisal is divided into “WHAT research” and “HOW
research” and importance of sociality factor for the criterion of corporate appraisal was discussed as “WHAT research”. As “HOW research”, a necessity of a research method which takes account of non-linear relationship was discussed and models using ANNs (artificial neural networks) were introduced as a promising solution to the linear hypothesis problem.

Considering the increasing importance of sociality of a firm, traditional criteria like high profitability and high growth potential are insufficient for the corporate appraisal criterion. Sociality of a firm is an important new criterion. Measuring sociality by using actual data, a strong correlation to traditional criteria was found and its intrinsic role was ambiguous. Using 10 year follow-up survey data showed, however, that sociality was anticipated to have important effect for a firm’s own future financial performance. Although this role was difficult to examine by the traditional method using linear hypothesis, by using ANNs model, the positive contribution of sociality to a firm’s future financial performance has been empirically ascertained with tangible data. The positive contributions of the sociality factor after ten years have been ascertained as one-fifth to a quarter, compared to the contributions of the financial performance factor of three quarters to four-fifths and a CSP-CFP relationship study in Japan has been reinforced.

We have to note, however, that there are some limitations. First, the number of samples was small. In this paper, there were 252 samples for the empirical study 1 and 108 for ANNs, because using data was limited to a current data with 10 year-old data. This kind of data will be accumulated with the increased interest in CSR and further studies will be expected.

Second, related to the small number of samples, the contribution rates of variables were not so determinative. Passable figures of one-fifth to a quarter for sociality compared to three quarters to four-fifths for financial performance were shown in this paper, however, these figures are not established because of the influence of over-learning and use of random numbers as initial weights. That’s why I used the expression “one-fifth to a quarter”, instead of 21% to 25%. As this problem relates to the problem of small samples, further studies will be expected as well.

Third, the coverage of Sociality variables is not enough. In this paper, sociality of a firm is defined as “A Firm’s diverse commitment, other than profitability and growth potential, to its stakeholders”. As these stakeholders, employee relationships (improvement in employment problem and the quality of life, etc.), shareholder and creditor relationships (corporate governance, business ethics), community / consumer relationships (community and social contribution), and the global environment (greening and eco-management) are envisioned. The study in this paper, required data with ultralong-term sociality, and the 1994 data used was considered most desirable for this purpose. Although employee, community / consumer, global environment relationships were contained in the data, shareholder and creditor relationships were not available. This was because the term corporate governance was not commonly used and business ethics had not received a lot of attention yet in 1994 Japan. A CSP-CFP relationship study which includes these items is also necessary. Considering the importance of sociality for modern firms, more studies will be expected further in future.

Notes

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1 Official economic assessment will be made ex post facto by Index of Business Conditions Committee in Cabinet Office, Government of Japan.
Sociality variables were quantified by using items ‘Employee related’, ‘Local community related’, ‘Society in general related’, and ‘Environment related’ in the questionnaire survey. Profitability variable was calculated as ordinary income ratio to net sales and Growth Potential variable was calculated as 4 year moving average of sales growth rate. The Financial Performance variable was defined as Profitability + Growth Potential. For details, see Okamoto et al. (2006c) pp.82-93. To indicate these four variables, upper case letters will be used hereafter, i.e. Profitability, Growth Potential, Sociality, and Financial Performance.

Upon the significance tests, two more bases of ‘high’ and ‘low’ for Financial performance and Sociality were used in addition to above mentioned one-third (1/3) basis, i.e. 1/3.5 and 1/2.5. Further, not only fiscal 2004 data but also fiscal 1999 data were used. Accordingly, 24 statistical significant test were conducted, i.e. 2 time periods (after 5 years and 10 years), 3 bases of ‘high’ and ‘low’, and 4 hypotheses created 2 x 3 x 4 = 24. For details, see Okamoto et al. (2006c) pp.102-105.

Four articles conducted a dual directional study and were counted as both group.

For the calculation, a software KINNA (Keio Neural Network Analysis) was used. For detail, see Okamoto (2004).

For instance, the distinguishability of the ‘Discriminant’ is calculated as (13+6+2+18) / 108 = 36.11%.

Although non-diagonal elements are incorrect classification, they are mixing of two groups, i.e. ‘incorrect in terms of both Profitability and Growth Potential’, and ‘one is incorrect but other is correct’. The distinguishability II considers these half-correct classifications.

See note 2.

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References


