Assessing the Corporate Social Responsibility Using Shannon’s Entropy and VIKOR Methods

Elham Ebrahimi 1*, Sepideh Zohrei 2, Mahboobeh Emadi 3

1 PhD Candidate of Human Resource Management, University of Tehran, Tehran, Iran
2 M.S. Candidate of Public Administration, University of Tehran, Tehran, Iran
3 M.Sc. of Business Management- Marketing, University of Semnan, Semnan, Iran
* Corresponding Author: E-mail: elhebrahimi@ut.ac.ir

ARTICLE INFO

Keywords:
Corporate Social Responsibility
VIKOR
Shannon’s Entropy

ABSTRACT

In today's modern society, companies are faced ever more with the increased demands in terms of corporate social responsibility (CSR) towards the economic, social, cultural and ecological environment. Thus development of tools for measuring progress in this field is crucial in order to show responsible behaviors in social terms. In this regard, the purpose of this paper is to develop a methodology based on the Multiple Criteria Decision Making (MCDM) approach in order to compare the probability of the companies’ success regarding to the implementation of the concept of corporate social responsibility. For achieving this goal, first the main aspects in the CSR field and their related criteria are recognized through the comprehensive survey of the relevant literature. In this paper, Shannon’s entropy method is applied to determine weights of these main aspects according to the experts’ opinions. Finally VIKOR method is used in order to rank the companies as our alternatives. Implementing this framework is demonstrated in an illustrative example.

1. Introduction

There are plenty of theories on the social responsibility and its aspects. According to Milton Friedman's viewpoint, maximizing revenue is the only responsibility of the firms. His focus was on the economic benefits of the agency theory. In the late 1970s Edward Bauman as the first one introduced an acceptable concept regarding social responsibility. Bauman argued that profit making is not the only responsibility of the organization and legal, ethical and discretionary or philanthropic responsibilities should take into account (Tafti, Hosseini, & Emami, 2012). While Corporate Social Responsibility is not a new phenomenon, in recent years the field has grown remarkably and CSR policy has become central to the strategic management decision of every business organization (Kabir, 2011). Nowadays, the necessity and importance of CSR makes the managers and planners to highlight CSR elements in corporate missions, visions, values and strategies (Pishvae, Razmi, & Torabi, 2012). Evaluating CSR is important for both stakeholders and managers. For stakeholders it is crucial to employ social responsibility information during their decision making process (Chen & Fan, 2011). On the other hand, in the view of firms’ managers, CSR can enhance the brand and social image of corporate besides reducing risks (Pishvae et al., 2012). Chen and Fan (2012) implied six main types of published research that attempted to measure corporate social activities. These are pollution control index, social accounting; reputational scales; KLD database; content analysis of corporation publications and finally analytical hierarchy process (AHP). Obviously all of these methods have primary limitations. For example social accounting can’t be used to compare among different firms due to its complexity and high relations to firm-level characteristics. As the problem with measuring CSR is very similar to a multiple-criteria decision making (MCDM), AHP could be a proper method for measuring social performance but this technique still have some limitations. For example AHP method assumes that the factors presented in the hierarchical structure are independent and it does not consider the possible dependencies among the factors (Yüksel & Dağdeviren, 2007). In this paper, MCDM method was applied to evaluate CSR capabilities. This study utilizes Shannon method to determine the relative weights of CSR main aspects as our criteria and then VIKOR method to rank the companies as our alternatives based on their CSR capability. The
paper is organized as follows. Section 2 reviews the literature related to corporate social responsibility and its dimensions. In Section 3 the proposed framework for evaluating and comparing CSR is described. The Shannon and VIKOR methods are also presented. The illustrative example and the application results are described in Section 4 and finally, the conclusion is presented in Section 5.

2. Literature Review

2.1. Corporate Social Responsibility

The collapse of corporate giants such as Enron and WorldCom due to their corruption and mismanagement shows the importance of ethics like social responsibility. In fact, concepts like corporate governance, social responsibility and business ethics have been in a popularization trend since the 1990s (Taşır & Pazarcık, 2013). According to Legitimacy theory, since an organization relies on societal resources society evaluates the usefulness and legitimacy of the organization's activities. Thus organizations continually seek to ensure that their activities are acceptable to the society (Kabir, 2011). In this relation, the term corporate social responsibility is used in order to describe a company's commitment toward society demands (Almendros, Anke, & Valdés, 2013). There have been many attempts to establish a proper understanding of CSR and to develop a comprehensive definition. However, in both the corporate and the academic world there is uncertainty about how CSR should be defined. Hopkins (1998) implied that corporate social responsibility is concerned with treating the stakeholders of the firm ethically or in a socially responsible manner. He believed that stakeholders exist both within and outside a firm and suggested that behaving socially responsible will increase the human development of stakeholders both within and outside the corporation. Holmes and Watts (2000) define CSR as the continuing commitment by business to behave ethically, contribute to economic development, improving the workforce and their families' quality of life, and the local community and society. Van Marrewijk (2003) implied that CSR refers to voluntary company activities demonstrating the inclusion of social and environmental concerns in business operations and in interactions with stakeholders. Barnett (2007) defined CSR as volunteer activities of companies to supply social goods such as human resource management, plans, controlling environmental effects, philanthropic projects and local business supply. While these definitions vary in detail, many definitions focus on volunteer firm actions designed to improve social or environmental conditions (Tafti et al., 2012).

2.2. CSR Measures

Generally, it is very difficult to measure CSR because of the extensive scope and complex nature of social and environmental issues. In fact since CSR is a multidisciplinary and multi-stakeholder issue, it is impossible to measure all aspects of it. However, according to importance and growth of CSR concept, a number of researches with different viewpoints have developed measures to support the implementing social responsibility in firms and corporations (Pishvaae et al., 2012). Table 1 summarizes the CSR measures which are used as criteria in this study. Each CRS criterion contains sub-criteria which play the role of recommendation for decision-makers to carry out more exact comparisons and evaluations of CSR major criteria. The main CSR criteria and their related sub-criteria are described briefly as follows.

<table>
<thead>
<tr>
<th>CSR measures</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Activities (C1)</td>
<td>Chen and Fan (2011); Kabir (2011); Inoue and Lee (2011); Tafti et al. (2012); Fernando and Almeida (2012); Harwood, Humby and Harwood (2011); Pishvaae et al. (2012); Johnson, Connolly and Carter (2011); Dahlsrud (2008); Velde, Vermeir and Corten (2005); Taghizadeh, Fasghandis and Zeinalzadeh (2013); SİRB (2013); Bayoud, Kavanagh and Slaughter (2012)</td>
</tr>
<tr>
<td>Human Resource Activities (C2)</td>
<td>Chen and Fan (2011); Kabir (2011); Inoue and Lee (2011); Tafti et al. (2012); Harwood et al. (2011); Johnson et al. (2011); Dahlsrud (2008); Mason and Simmons (2011); Velde et al. (2005); Taghizadeh et al. (2013); SİRB (2013); Bayoud et al. (2012)</td>
</tr>
</tbody>
</table>
Environmental activities encompass company concern for the environment. According to the literature, its related sub-criteria could be pollution control, energy saving and recycling of waste materials (Chen & Fan, 2011; Tafti et al., 2012; Harwood et al., 2011). Human resource activities imply to how organizations interact with their employees (Dahlsrud, 2008). They include staff supporting policies regarding training, health, safety, and welfare affairs (Chen & Fan, 2011; Tafti et al., 2012). Activities such as disclosure of employee data and pension data, consultation with employees, employment of disabled, share ownership and equal opportunities could be categorized in this field (Bayoud et al., 2012). SİRB (2013) enumerated activities such as providing medical care and complaints the law fines and complaints as the related human resource activities. Activities related to products and services include providing quality, safety and innovation, and also improving technical characteristics of products or services (Chen & Fan, 2011; Tafti et al., 2012). Social activities and community involvement means supporting and participating in social plans such as education, charity and political donation; supporting the public health, arts and culture; and sponsoring sporting or recreational projects (Chen & Fan, 2011; Tafti et al., 2012; Harwood et al., 2011; Bayoud et al., 2012). Economic Impact refers to socio-economic or financial aspect, including describing CSR in terms of business operation. Examples are contribute to economic development, preserving the profitability, promote procurement from suppliers and payment of taxes and fees (Dahlsrud, 2008; SİRB, 2013). Customers and suppliers relation refers to how organizations interact with their stakeholders such as suppliers and customers. This measure include examples like provision for disabled, provision for difficult-to-reach customers and accountability to consumer complaints (Dahlsrud, 2008; SİRB, 2013). Corporate governance is a matter of enforcing accountability. Companies adopt corporate governance principles to decrease firm's level of autonomy while making it more transparent and accountable. It can be argued that corporate governance and social responsibility concepts have shared characteristics and that these two concepts are interrelated. Scholars believe a coherent theory of CSR cannot be created without corporate governance (Taşşir & Pazarcık, 2013). Some of the sub-factors of corporate governance measure are management independence from shareholders, ethics in business and public commitments and audit independence (SİRB, 2013). Regulatory bodies like Organization for Economic Co-operation and Development (OECD) have published a complete list of measures for corporate governance evaluation (Taşşir & Pazarcık, 2013).

3. Research Methodology

3.1. Research Framework

The main purpose of this study is to propose a framework based on Multiple Criteria Decision Making approach for ranking companies regarding to their CSR capability. According to this goal, first by studying the literature related to CSR, the main measures were recognized. Then the CSR measures as our criteria are being weighted through Shannon’s Entropy method.
Finally, according to these weights, the VIKOR method was applied for the purpose of ranking companies as our alternatives. The overall framework of the study is shown in figure 1.

![research framework diagram]

**Figure 1.** Research framework

### 3.2. A Shannon's Entropy Method

Entropy algorithm is a useful tool to acquire weights of criteria. Consider $P_{ij}$ in decision matrix for alternatives’ evaluation. There are $n$ alternatives and $K$ criteria in decision matrix. The element of this matrix for $j$th criterion is as below:

$$
P_{ij} = \frac{f_j(a_i)}{\sum_{i=1}^{n} f_j(a_i)} \quad (1)
$$

Entropy is calculated as below:

$$
E_j = M \sum_{i=1}^{n} P_{ij} \ln P_{ij} \quad (2)
$$

$M$ is calculated as a constant value in next step:

$$
M = \frac{1}{\ln n}
$$

$E_j$ is a value between 0 and 1.

Next step is to calculate deviation degree ($d_i$) which shows that to what extent $j$th criterion has useful information for decision maker. If there is little difference between one criterion values, it means that alternatives are indifferent according to this criterion so its effect in decision making should be diminished. Deviation degree is calculated as below:

$$
d_i = 1 - E_i
$$

The final step in shanon entropy is to obtain weights based on following equation:

$$
W_j = \frac{d_i}{\sum_{i=1}^{n} d_i}
$$

### 3.3. VIKOR

#### 3.3.1. Introduction to VIKOR

The VIKOR method is a compromise MADM method, developed by Opricovic (Opricovic, 1998; Opricovic et al, 2002) started from the form of $L_p$-metric:

$$
L_{pi} = \left\{ \frac{1}{n} \sum_{i=1}^{n} \left[ w_j \left( f_{j}^i - f_{j}^l \right) / \left( f_{j}^i - f_{j}^l \right) \right]^p \right\}^{1/p} \quad 1 \leq p \leq +\infty; \quad l = 1, 2, \ldots, l.
$$
The VIKOR method can provide a maximum ‘“group utility”’ for the “majority” and a minimum of an individual regret for the “opponent” (Opricovic, 1998; Opricovic et al, 2002; Opricovic et al, 2004).

### 3.3.2. Working Steps of VIKOR Method

1) Calculate the normalized value

Assuming that there are m alternatives, and n attributes. The various I alternatives are denoted as $x_i$. For alternative $x_j$, the rating of the jth aspect is denoted as $x_{ij}$, i.e. $x_{ij}$ is the value of jth attribute. For the process of normalized value, when $x_{ij}$ is the original value of the ith option and the jth dimension, the formula is as follows:

$$f_{ij} = x_{ij} / \sqrt{\sum_{j=1}^{n}x_{ij}^2}, i = 1,2,...,m; j = 1,2,...,n$$  \hspace{1cm} (3)

2) Determine the best and worst values

For all the attribute functions the best value was $f_j^+$ and the worst value was $f_j^-$, that is, for attribute $J=1-n$, we get formulas (4) and (5)

$$f_j^+ = \max f_{ij}, i = 1,2,...,m$$  \hspace{1cm} (4)

$$f_j^- = \min f_{ij}, i = 1,2,...,m$$  \hspace{1cm} (5)

Where $f_j^+$ the positive ideal solution for the jth criteria is, $f_j^-$ is the negative ideal solution for the jth criteria. If one associates all $f_j^+$, one will have the optimal combination, which gets the highest scores, the same as $f_j^-$. 

3) Determine the weights of attributes

The weights of attribute should be calculated to express their relative importance.

4) Compute the distance of alternatives to ideal solution

This step is to calculate the distance from each alternative to the positive ideal solution and then get the sum to obtain the final value according to formula (6) and (7).

$$S_i = \sum_{j=1}^{n}w_j(f_j^+-f_{ij})/(f_j^+-f_j^-)$$  \hspace{1cm} (6)

$$R_i = \max\left[w_j(f_j^- - f_{ij})/(f_j^+ - f_j^-)\right]$$  \hspace{1cm} (7)

Where $S_i$ represents the distance rate of the ith alternative to the positive ideal solution (best combination), $R_i$ represents the distance rate of the ith alternative to the negative ideal solution (worst combination). The excellence ranking will be based on $S_i$ values and the worst rankings will be based on $R_i$ values. In other words, $S_i$, $R_i$ indicate $L_{1i}$ and $L_{di}$ of $L_p$-metric respectively.

5) Calculate the VIKOR values $Q_i$ for $i=1,2,\ldots,m$, which are defined as

$$Q_i = v\left[\frac{S_i-S^*}{S^*-S}\right] + (1-v)\left[\frac{R_i-R^*}{R^*-R}\right]$$  \hspace{1cm} (8)

Where $S^* = \max S_i$, $S^* = \min S_i$, $R^* = \max R_i$, $R^* = \min R_i$, and $v$ is the weight of the strategy of “the majority of criteria” (or “the maximum group utility”). $[(S-S^*)/(S^*-S^*)]$ represents the distance rate from the positive ideal solution of the ith alternative’s achievements In other words, the majority agrees to use the rate of the ith, $[(R-R^*)/(R^*-R^*)]$ represents the distance rate from the negative ideal solution of the ith alternative; this means the majority disagree with the rate of the ith alternative. Thus, when the $v$ is larger (> 0.5), the index of $Q_i$ will tend to majority agreement; when $v$ is less (< 0.5), the index $Q_i$ will indicate majority negative attitude; in general, $v = 0.5$, i.e. compromise attitude of evaluation experts.

6) Rank the alternatives by $Q_i$ values

According to the $Q_i$ values calculated by step (4), we can rank the alternatives and to make-decision.
4. An Illustrative Example

In this section we present a simple example in order to show how assessors could carry out the CSR evaluating process by means of the previously proposed model. With this intention, we suppose four typical companies as alternatives in order to determine which company has the better situation in terms of CSR criteria. Decision hierarchy for ranking companies is illustrated in figure 2. As it is shown in the first level of the hierarchical structure, the overall goal of the decision is ranking companies based on their CSR capability. The second level consists of seven major criteria that are identified to achieve the overall goal. The third level contains sub-criteria for five major criteria which play the role of guidance for decision makers to carry out more exact comparisons and evaluations of CSR major criteria. Finally the forth level of the hierarchy represents four alternative companies.

![Decision hierarchy for ranking companies](image)

**Figure 2.** The conceptual framework: goal, criteria, sub-criteria and alternatives

4.1. Application of Shannon’s Entropy

According to Shannon method, for obtaining the weights, first we should normalized the decision matrix (Table 2), the normalized decision matrix and the weights of criteria are shown in Table 3.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>C₁</th>
<th>C₂</th>
<th>C₃</th>
<th>C₄</th>
<th>C₅</th>
<th>C₆</th>
<th>C₇</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company 1</td>
<td>46.00</td>
<td>38.60</td>
<td>40.43</td>
<td>52.00</td>
<td>56.00</td>
<td>28.90</td>
<td>53.00</td>
</tr>
<tr>
<td>Company 2</td>
<td>52.00</td>
<td>29.20</td>
<td>48.00</td>
<td>41.00</td>
<td>39.00</td>
<td>37.62</td>
<td>29.50</td>
</tr>
<tr>
<td>Company 3</td>
<td>33.30</td>
<td>61.00</td>
<td>63.00</td>
<td>40.00</td>
<td>60.00</td>
<td>47.25</td>
<td>55.00</td>
</tr>
<tr>
<td>Company 4</td>
<td>28.00</td>
<td>28.10</td>
<td>36.00</td>
<td>38.00</td>
<td>45.00</td>
<td>59.00</td>
<td>46.00</td>
</tr>
<tr>
<td>Sum</td>
<td>159.3</td>
<td>156.9</td>
<td>187.4</td>
<td>171.0</td>
<td>200.0</td>
<td>152.7</td>
<td>183.50</td>
</tr>
</tbody>
</table>
Assessing the Corporate Social Responsibility Using Shannon’s Entropy

**Table 3. The normalized decision matrix**

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>C₁</th>
<th>C₂</th>
<th>C₃</th>
<th>C₄</th>
<th>C₅</th>
<th>C₆</th>
<th>C₇</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1</td>
<td>0.289</td>
<td>0.246</td>
<td>0.216</td>
<td>0.304</td>
<td>0.280</td>
<td>0.189</td>
<td>0.289</td>
</tr>
<tr>
<td>Company 2</td>
<td>0.326</td>
<td>0.186</td>
<td>0.256</td>
<td>0.240</td>
<td>0.195</td>
<td>0.246</td>
<td>0.161</td>
</tr>
<tr>
<td>Company 3</td>
<td>0.209</td>
<td>0.389</td>
<td>0.336</td>
<td>0.234</td>
<td>0.300</td>
<td>0.309</td>
<td>0.300</td>
</tr>
<tr>
<td>Company 4</td>
<td>0.176</td>
<td>0.179</td>
<td>0.192</td>
<td>0.222</td>
<td>0.225</td>
<td>0.255</td>
<td>0.251</td>
</tr>
</tbody>
</table>

**4.2. Application of VIKOR**

The weights of Criteria are calculated by Shannon’s Entropy up to now, and then these values can be used in VIKOR. So, the VIKOR methodology must be started at the second step. Thus, weighted normalized decision matrix can be prepared. This matrix can be seen from Table 4.

**Table 4: Weighted normalized decision matrix**

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>C₁</th>
<th>C₂</th>
<th>C₃</th>
<th>C₄</th>
<th>C₅</th>
<th>C₆</th>
<th>C₇</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1</td>
<td>0.379</td>
<td>0.318</td>
<td>0.333</td>
<td>0.428</td>
<td>0.461</td>
<td>0.238</td>
<td>0.436</td>
</tr>
<tr>
<td>Company 2</td>
<td>0.488</td>
<td>0.274</td>
<td>0.450</td>
<td>0.384</td>
<td>0.366</td>
<td>0.353</td>
<td>0.276</td>
</tr>
<tr>
<td>Company 3</td>
<td>0.239</td>
<td>0.439</td>
<td>0.453</td>
<td>0.288</td>
<td>0.432</td>
<td>0.34</td>
<td>0.396</td>
</tr>
<tr>
<td>Company 4</td>
<td>0.347</td>
<td>0.348</td>
<td>0.446</td>
<td>0.471</td>
<td>0.557</td>
<td>0.483</td>
<td>0.57</td>
</tr>
<tr>
<td>Wᵢ</td>
<td>0.0629</td>
<td>0.0639</td>
<td>0.0626</td>
<td>0.0619</td>
<td>0.2488</td>
<td>0.2489</td>
<td>0.2509</td>
</tr>
</tbody>
</table>

By following VIKOR procedure steps and calculations, the ranking of Companies are gained. The results and final ranking are shown in Table 5.

**Table 5: Final evaluation of the alternatives**

<table>
<thead>
<tr>
<th>i</th>
<th>Eᵢ=Σeᵢ</th>
<th>Fᵢ=Max(eᵢ)</th>
<th>Pᵢ</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company 1</td>
<td>0.500244</td>
<td>0.2489</td>
<td>0.996014</td>
<td>4</td>
</tr>
<tr>
<td>Company 2</td>
<td>0.448767</td>
<td>0.2509</td>
<td>0.948549</td>
<td>3</td>
</tr>
<tr>
<td>Company 3</td>
<td>0.356727</td>
<td>0.148755</td>
<td>0.652996</td>
<td>2</td>
</tr>
<tr>
<td>Company 4</td>
<td>0.074957</td>
<td>0.035741</td>
<td>0.146145</td>
<td>1</td>
</tr>
</tbody>
</table>

According to the result of Table 4, Companies are ranked as follow:

Company 4 > Company 3 > Company 2 > Company 1

**5. Conclusions**

Nowadays companies are faced ever more with the increased demands in terms of corporate social responsibility (CSR) towards the economic, social, cultural and ecological environment. Thus development of tools for measuring progress in this field is crucial in order to show responsible behaviors in social terms. In this paper a two-step Shannon’s Entropy and VIKOR methodology is structured here that VIKOR uses Shannon’s Entropy result weights as input weights. According to this methodology, Company 4 is selected as the best Company. As a future direction, other decision-making methods such as...
fuzzy ELECTRE and Fuzzy GTMA can be used in this area.

Acknowledgement

The authors wish to thank an anonymous referee for the valuable suggestions which considerably improve the quality of the paper.

References