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MEASURING CORPORATIVE SOCIAL PERFORMANCE IN FIRMS: A BAYESIAN FACTOR ANALYSIS APPROACH

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Abstract. This paper proposes a new empirical procedure for measuring Corporate Social Performance in firms, taking the Carroll model and the Stakeholder theory as theoretical supports. To that aim we use a second order factor model and we adopt a Bayesian approach that allows us to carry out a more effective statistical treatment of the missing data, using all the available information and without appealing to asymptotic results. Furthermore, we identify significant patterns of firm's behavior by means of novel statistical classification techniques and we analyze which aspects of Corporate Social Responsibility are less developed. The methodology is applied to a sample of Spanish firms. Our results show that there is a positive relationship between the firms Corporate Social Performance and their size, degree of Corporate Social Responsibility awareness and stakeholder pressure. However, Corporate Social Responsibility is not well-known in micro and small Spanish firms, which leads to a low level of implementation.

Keywords: factor analysis, Bayesian inference, CSP, CSR, MCMC, Stakeholder theory.

JEL Classification: M14, C38, C11.

Introduction

In the past 50 years, a large research effort has been invested in the responsibility that companies have with Society which is known in the literature as Corporate Social Responsibility (CSR). Today, CSR is widely recognized as a strategic tool that enables companies to satisfy the stakeholder requirements and expectations (Papasolomou-Doukakis *et al*. 2005; Perrini *et al*. 2007; Lindgreen *et al*. 2009; Yang, Rivers 2009) and to improve their performance (Porter, van der Linde 1995; Pava, Krausz 1996; Waddock, Graves 1997; Stanwick, Stanwick 1998; Orlitzky *et al*. 2003; Porter, Kramer 2006; Lee 2008). Therefore, CSR allows firms to gain competitive advantage by generating greater loyalty and appeal to their customers (Murray, Vogel 1997; Bhattacharya, Sen 2004; Sen *et al*. 2006), improving the management of their human resources

(Turban, Greening 1997; Sen *et al*. 2006; Rupp *et al*. 2006) or making more and better investments positively positioned in the minds of their investors (Graves, Waddock 1994; Sen *et al*. 2006; Valor *et al*. 2009).

In order to make a proper strategic management of Social Responsibility, companies need to have objective measurement systems of their commitment degree to CSR practices, commonly known as Corporate Social Performance (CSP), not existing a method universally accepted in the literature.

Carroll (1979) was who presented the first conceptual model in which the CSP is the result of a combination of three dimensions (*Social Responsibility Categories*, *Social Issues Involved* and *Philosophy of Social Responsiveness*) and suggested that firms' CSR activities should be interpreted as their response to different stakeholder requirements. This model was posteriorly adopted by other authors (Strand 1983; Warttick, Cochran 1985; Clarkson 1988; Clarkson 1995; Clarkson *et al*. 1994; Murray, Vogel 1997 or Jamali, Mirshak 2007 among others) and it is considered as the most acceptable CSP model, although the categorization or identification of CSR activities is still contentious (Dahlsrud 2008; Mahmood, Humphrey 2012).

Even though the theoretical framework for CSP quantification is well established in the literature, the building of an empirical CSP measure is still an open problem. Academic researchers have used survey questionnaires, content analyses of annual reports, expert evaluations and regulatory compliance data (Wood 2010; Chen, Delmas 2011). More recently, there have been several for-profit organizations that have taken up the task of measuring CSP (SAM Group, Inc., the Riskmetrics Group, Kinder, Lydenberg and Domini, Inc database (KLD), the Canadian Social Investment Database (CSID) or the Arese-Vigeo among others), being the KLD database the most widely used and comprehensive information source for CSP research (Waddock 2003). The reasons for this popularity lie in the fact that investigators find difficult to provide other significant information about firms that is sufficient for such a measurement. Additionally, these assessments are made by third parties and do not depend on firms' own reports.

These CSP indicators are usually obtained by linear aggregation methods of the measurements of various aspects of CSR. However, many authors do not consider them adequate because they omit important management aspects (McWilliams, Siegel 2001) and provide business classifications of firms not meant for management studies (Maignan, Farrell 2000; Wartick, Mahon 2009; Wood 2010).

Furthermore, some of these linear aggregations approaches (for instance, Hillman, Keim 2001) assign the same importance to all CSR aspects, being this unrealistic because firms do not see their stakeholders as having the same importance. Other indicators assign different weights to specific CSP categories by gathering information on stakeholder preferences (Ruf *et al*. 1998), but they do not take into account the existence of interrelations between some aspects of CSR which can introduce implicit weights that increase/decrease inappropriately their importance. Besides, as Chen and Delmas (2011) argument, there are no universally agreed-upon weights for different stakeholder groups in different situations, existing little guidance regarding how managers can measure

stakeholder reactions and use information to facilitate decision-making (Epstein, Widener 2011).

Finally, other authors consider that CSP is a multi-dimensional construct that represents a broad range of economic, social and environmental impacts caused by business operations and, for this reason, it is not possible to use a one-dimensional indicator to measure it (Rowley, Berman 2000).

Against this background, the aim of this study is to propose a flexible empirical methodology to construct CSP indicators, which take into account how managers see the different aspects of CSR and their relationships by avoiding the above problems. The proposed methodology could be a useful guide for corporations willing to objectively implement sustainability management.

We take the Carroll model as theoretical support which collects, in our view, more comprehensively the most relevant aspects to measure CSP, being also the most used in the literature. Based on this model, we design a questionnaire containing a set of items traditionally considered in the CSR and the stakeholder literature and we build a factor model to obtain a CSP index. We adopt a Bayesian approach to estimate the parameters of the model, which allows us to carry out a more effective statistical treatment of the missing data, using all the available information and without appealing to asymptotic results (Dunson *et al*. 2007; Lee 2007; Das *et al*. 2008).

Our procedure enables, additionally, to study the CSP interrelationships with the characteristic of the organizations, by identifying significant firm's patterns of behavior. To that aim we use novel cluster and multivariate pattern recognition techniques. The information obtained allows to highlighting the less well-known and developed aspects of CSR, which may be very useful when designing policies aimed at increasing its degree of implantation in the firms.

As an illustrative example, the methodology is applied to a sample of Spanish firms. Our results show that there is a positive relationship between firms' CSP and their size, degree of CSR awareness and stakeholder pressure.

CSR is not well-known, particularly in micro-small firms, which leads to a low level of implantation. Therefore, information campaigns are necessary in order to increase companies' awareness of the advisability of adopting courses of action based on CSR. Likewise, companies should improve their socially responsible behavior towards their shareholders, society and the environment, and increase the social and familiar benefits of their employees.

Summarizing, the contributions of this paper are:

1. The development of a Bayesian statistical framework to measure the CSP of a firm from a set of items traditionally used in the CSR and the stakeholder literature. The measurement process takes into account the interrelations between the different aspects of CSR and the importance assigned by the firms to them. The Bayesian approach let us to treat missing data in an effective way, using all the available information without appealing to asymptotic results, and to compare several models to determine the CSP.

2. The proposal of novel cluster and multivariate pattern recognition techniques to identify significant firm's patterns of behavior with respect to CSP and to highlight the less well-known and developed aspects of CSR, which can be very useful to design policies aimed at increasing CSR implantation in the firms.
3. An illustrative application of the methodology to the analysis of CSP in a sample of Spanish firms.

The rest of the paper is organized as follows. In Section 1 we establish the theoretical framework of the methodology and we described the questionnaire and the data analyzed in the paper. Section 2 describes the model and the statistical methodology used to build the CSP indicator. Section 3 contains the empirical results of the application of the methodology to a sample of Spanish firms and, finally, we present the main conclusions and the future lines of research. An Annex of the paper containing the mathematical details of the statistical procedures and additional tables are available from the authors upon request.

1. Preliminaries

1.1. Theoretical framework

As mentioned in the introduction, Carroll (1979) proposed the first conceptual model of CSP and opted instead for 'performance' as the operative term because the 'responsibility' (of CSR) was not measurable. In this model the CSP is the result of a combination of three dimensions. The first one, referred as *Social Responsibility Categories*, considers different types of social responsibility (economic, legal, ethical and discretionary). The second dimension, referred as *Social Issues Involved*, is related to the social affairs in which the firm is involved, considering the different stakeholders with which social responsibilities are related (clients, environment, discrimination, safety, health, shareholders, etc.). Finally, the third dimension, known as *Philosophy of Social Responsiveness*, considers the degree of commitment to social responsibility, including the different levels of response to social requirements (reaction, defence, accommodation and proaction). However, it is not clear how to combine all these aspects to obtain an empirical CSP measure of the firm. Our methodology proposes an statistical method to filling this gap.

Following the Stakeholder Theory (ST) we considered the following stakeholders: shareholders, employees, customers, suppliers, the environment and the community (see Spiller 2000; Papasolomou-Doukakis *et al*. 2005; Maignan *et al*. 2005; Perrini 2005). In addition, we identified some socially responsible commitments, actions and behaviors of the companies towards these groups, with a taxonomy similar to that proposed by Spiller (2000), Papasolomou-Doukakis *et al*. (2005) or Jamali (2008) among others.

We designed a questionnaire whose items were selected from those traditionally used in the CSR and the stakeholder literature (Clarkson 1995; Donaldson, Preston 1995; Freeman, Liedtka 1997; Spiller 2000; McWilliams, Siegel 2001; Papasolomou-Doukakis *et al*. 2005; Perrini 2005; Jamali 2008), the Triple Bottom Line (Norman, MacDonald 2004) and some international standards such as Global Compact or Global Reporting Initiative. The questionnaire consisted of 53 items: 51 items are consistent with the *Social Issues Involved* dimension and with the *Categories of Social Responsibility* dimension in the

model proposed by Carroll (1979) (see the Annex where the items are grouped according to the aspect of CSR they are related to). Each one measures, on a 0 to 10 scale, the degree of perception of the most important aspects of CSR of the manager of the firm. Value 0 means the enterprise does not even think about the possibility of adopting the aspect considered and 10 that it has been fully adopted. The last two items are general self-evaluation variables, on a 0 to 10 (none/maximum interest). They are related to the type of responsibility considered in the *Philosophy of Social Responsiveness* dimension: an attitude variable measuring the firm's "*Degree of interest in becoming associated to CSR initiatives*" and a performance variable measuring the "*Degree of implantation of CSR plans, initiatives or practices*".

1.2. Data

The questionnaire was given to the managers of a random sample of 416 Spanish companies drawn from a database of the 11,251 companies of Aragón in 2006. Aragón is a region in the North-East of Spain that is chosen because its socioeconomic indicators are very similar to the Spanish averages (J. Alcaide, P. Alcaide 2001). Furthermore, its sectorial distribution is very similar to that of Spain as a whole which makes our sample highly representative (see the Annex). It can be appreciated that items related to *employees* (satisfaction level, health and labor security, equality of opportunities, conciliation between labor and family life, dialogue with employees, medical-juridical benefits) and to *clients* (information, satisfaction level and quality of the product) are those most adopted by companies. On the contrary, aspects related to *corporate governance*, *relations with society* and *labor and family benefits* are considered the least important, with *relations with suppliers* and *concern about the environment* situated in the middle. Furthermore, it is worthwhile to notice that all the items have "missing data", with only 46.60% of the questionnaires having complete data. Therefore, it is necessary to use statistical procedures of data imputation in order not to significantly decrease the representativeness of the sample. Bayesian methods are ideally suited to deal with this kind of problem, as has been shown in the recent works of Lee (2007) and Das *et al*. (2008).

Additionally, some characteristics of the firms (size, sector, degree of knowledge about CSR, to be or not to be under pressure from stakeholders to adopt CSR) were used for the purposes of comparison. It can be noticed (see the Annex) that most of the companies have a micro/small size[1] (71.88%); they carry out their activity in the industrial (44.47%) and services (24.04%) sectors. With respect to the degree of knowledge about

[1] Staff headcount and financial ceilings determining enterprise categories (European Commission (2003):
The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding EUR 43 million.
The small enterprise is defined as an enterprise which employ fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million.
The micro-enterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million.

what CSR means and its implications, the distribution of the three possible answers is roughly uniform. Finally, an important majority (72.60%) claimed not to be under pressure from stakeholders to adopt CSR. The high percentage of *"missing data"* in the covariates related to the size of the enterprise (32.21% in turnover and 16.59% in number of workers) is again noteworthy, very probably due to labor and fiscal suspicions of some of the companies polled.

2. Statistical analysis

In order to build the CSP indicator of a firm, we use a second order factor model where the factors of the first level measure the commitment degree of the firm with respect to its stakeholders and the second level corresponds to the CSP indicator. The model assumes that CSP of a firm is reflected through socially responsible commitments, actions and behaviors of the companies towards its stakeholders in such a way that the larger (lower) is the value of the CSP indicator, the larger (lower) will be its commitment degree to its stakeholders. A previous exploratory factor analysis did not shown significant evidence against this model.

Next we describe the model and the statistical and mathematical procedures used to estimate its parameters and the CSP indicator. The mathematical details can be found in the Annex.

2.1. The model

Let $\{Y_{i,j};\ j = 1,\ldots, J_i;\ i = 1,\ldots, I\}$ the set of items of the questionnaire where $Y_{i,j}$ denotes the j^{th} item related to the i^{th} factor F_i. Let N be the size of the random sample of firms to whom the questionnaire was given. The mathematical expressions of the model are given by:

a) Measurement model for $l = 1,\ldots, N;\ j = 1,\ldots, J_i;\ i = 1,\ldots, I$

$$y_{i,j,l} = \mu_{i,j} + \beta_{i,j} f_{i,l} + \phi'_{i,j} \mathbf{z}_l + \varepsilon_{i,j,l} \text{ with } \varepsilon_{i,j,l} \sim N\left(0, \sigma^2_{i,j}\right); \quad (1)$$

b) Factor model

$$f_{i,l} = \gamma_i f_{I,l} + v_{i,l} \text{ with } v_{i,l} \sim N\left(0, 1-\gamma_i^2\right) l = 1,\ldots, N, i = 1,\ldots, I-1 \quad (2)$$

$$f_{I,l} \sim N(0,1) \text{ for } l = 1,\ldots, N, \quad (3)$$

where:

$y_{i,j,l}$ is the value of the j^{th} item related with the i^{th} factor corresponding to the l^{th} firm;

$\mu_{i,j}$ is the mean value of variable $Y_{i,j}$;

$\beta_{i,j}$ is the factor loadings of variable $Y_{i,j}$ with respect to factor F_i;

$f_{i,l}$ is the value of the score of the l^{th} firm in factor F_i;

$\mathbf{z}_l = (z_{1,l}, \ldots, z_{Q,l})'$ is the vector of the values of the covariates of the l^{th} firm;

$\boldsymbol{\phi}_{i,j} = (\phi_{i,j,1}, \ldots, \phi_{i,j,Q})'$ is the vector of the regression coefficients that quantifies the effects of covariates $Z_1, \ldots, Z_Q$ on the variable $Y_{i,j}$;

$\gamma_i \in (-1,1)$ is the factor loading of F_i with respect to the second order factor, F_I;

N is the number of firms analyzed;

J_i is the number of indicator variables in factor F_i;

$F_1, \ldots, F_{I-1}$ are the first order factors that measure the degree commitment of a firm to its stakeholders and F_I is the second order factor that measure its CSP;

$\{\varepsilon_{i,j,l};\ l = 1,\ldots,N;\ j = 1,\ldots, J_i;\ i = 1,\ldots, I\}$ and $\{\nu_{i,l};\ l = 1,\ldots, N;\ i = 1,\ldots, I\}$ are supposed to be internally and mutually independent and independent of the factors $\{f_{i,l};\ l = 1,\ldots, N;\ i = 1,\ldots, I\}$.

Finally, in order to make the model identifiable, it has been required that $E[f_{i,1}] = 0$ and $Var(f_{i,l}) = 1$ for $l = 1,\ldots, N;\ i = 1,\ldots, I$.

It is expected that factor loadings $\{\beta_{i,j};\ j = 1,\ldots, J_i;\ i = 1,\ldots, I\}$ and $\{\gamma_i;\ i = 1,\ldots, I–1\}$ are significantly positive, reflecting that the higher (the lower) the level of CSP of a firm is, the higher (the lower) will be the scores in the first order factors and, therefore, in the different items of the survey.

2.1.1. Imputation of covariates Z

Given that missing values of covariates Z exist for some firms of our sample, we carry out a Bayesian random imputation process similar to that proposed in Das *et al*. (2008). Taking into account that the covariates considered are discrete, the imputation process is based on the following model:

$$Z_1 \sim \text{Multinomial}(\boldsymbol{\pi}_1), \tag{4}$$

$$Z_q | Z_1, \ldots, Z_{q-1} \sim \text{Multinomial}\ (\boldsymbol{\pi}_q(Z_1, \ldots, Z_{9-1}));\ q = 2, \ldots Q, \tag{5}$$

where $\boldsymbol{\pi}_1 = (\pi_{1,1},\ldots,\pi_{1,s_1})$ with $\pi_{1,k} = P(Z_1 = u_{1,k})$; $k = 1,\ldots, s_1$ and $U_1 = \{u_{1,1}, \ldots, u_{1,s_1}\}$ is the support of Z_1 and $\boldsymbol{\pi}_q(Z_1,\ldots, Z_{q-1}) = \left(\pi_{q,1}\left(Z_1,\ldots,Z_{q-1}\right),\ldots,\pi_{q,s_q}\left(Z_1,\ldots,Z_{q-1}\right)\right)$; $k = 1,\ldots,s_q$; $q = 2,\ldots,Q$, where $\pi_{q,k}(z_1,\ldots, z_{q-1}) = P(Z_q = u_{q,k} | Z_1 = z_1, \ldots, Z_{q-1} = z_{q-1})$ and $U_q = \{u_{q,1}, \ldots, u_{q,s_q}\}$ is the support of Z_q; $q = 1,\ldots, Q$.

2.1.2. Estimation and comparison of models

Given that we adopt a Bayesian approach, the inferences about the parameters of the model are made by using their posterior distribution which is calculated by means of the Bayes Theorem and where we have used diffuse standard prior distributions.

As the posterior distribution is analytically intractable and we turn to Monte Carlo Markov Chain (MCMC) methods and, more exactly, Gibbs sampling (see Robert, Casella 2004 for more details) in order to obtain a sample of that distribution. From this sample,

we make inferences about the model parameters *by* using the posterior median as a point estimator and the appropriate quantiles to build Bayesian credibility intervals. In particular, we estimate the CSP of the firms, $\{f_{i,l}; l = 1,\ldots, N\}$ without recurring to asymptotic methods.

In order to make the interpretation of the results easier as well as to obtain more accurate estimations, we carry out a model simplification process removing the non significant variables and parameters. This is achieved by means of Bayesian techniques of comparison of models by using the DIC criterion of Spiegelhalter *et al*. (2002). Furthermore, we analyze the goodness of fit of the selected model by means of the empirical coverage of the Bayesian posterior predictive intervals of a 99% level of credibility. The mathematical details of the used procedures can be found in the Annex.

3. Empirical results

3.1. Estimation of the model

The scheme of the model (1)-(3) corresponds to that of Figure 1 in which I = 14, q = 5 and $J_1 = J_{11} = 5$, $J_2 = J_4 = 3$, $J_3 = J_6 = J_7 = J_8 = J_{10} = J_{14} = 2$, $J_5 = 6$, $J_9 = 4$, $J_{12} = 7$ and $J_{13} = 8$. The number of firms is N = 416.

The parameters of 16 models of the form (1)–(3) were estimated. These models were obtained taking each of the 16 possible subsets of the 4 general characteristics of the companies considered in the study as covariates Z in the equation of measure (1). 10,000 iterations of the Gibbs sampling were run and, in all the estimated models, we discarded the first 5,000 to guarantee convergence. A sample was taken every 10 iterations in order to significantly reduce the level of autocorrelation.

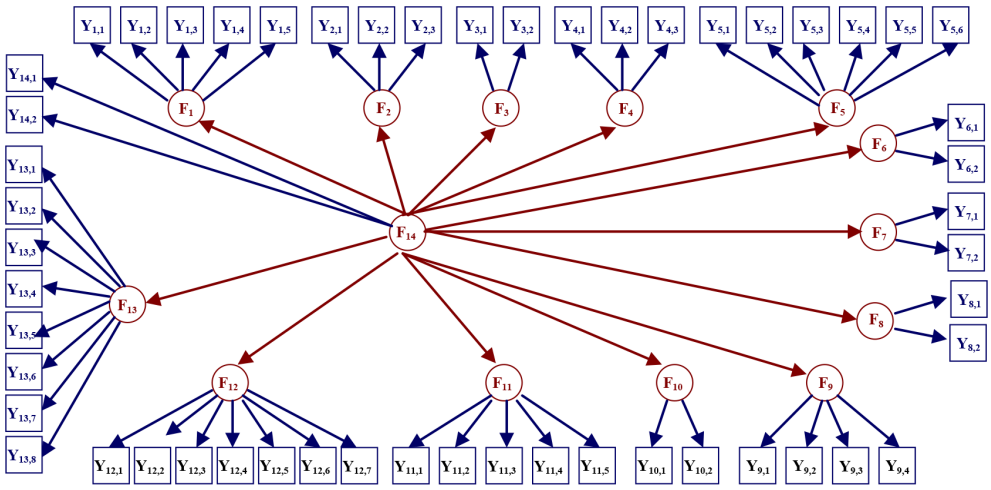

Fig. 1. Sequence diagram of the model

According to the criterion DIC, the best model corresponds to the cases in which the only covariate is the constant, i.e. without covariates (see the Annex). As we will see in the following subsections, this result does not imply that the covariates do not exert any influence on the variables Y; in fact this influence is captured by the factor scores of the model.

Tables 1 and 2 show the estimations of the parameters of the measurement model (1) (Table 1) and those of the structural model (2) (Table 2) corresponding to the constant model which was the selected model. They show, for each parameter, the posterior median (column Q50) and the limits of the Bayesian credibility interval of 99% built with the quantiles 0.5 (Q0.5) and 99.5 (Q99.5).

It can be seen that the estimations of the parameters $\mu_{i,j}$ maintain the same patterns previously commented with regard to the means of the variables Y (see Table 1); that is to say, the aspects related to employees and clients (factors F_2, F_3, F_4, F_5, F_7, F_8, F_9, and F_{10}) are those most adopted by the firms, while those related to corporate governance (factor F_1), relations with society (factor F_{13}) and, especially, labor and family benefits (factor F_6) are considered the least important. Relations with suppliers (factor F_{11}) and worries about the environment (factor F_{12}) occupy intermediate positions.

Both the factor loadings $\beta_{i,j}$ of the measurement equation (1) and the coefficients γ_i of the structural equation (2) are significantly positive, corroborating the validity of the hypothesis proposed in the Introduction and, especially, the validity of factor F_{14} as a measure of CSP of a company.

Finally, Table 1 presents the empirical coverage of the Bayesian predictive intervals of 99% (column COV_{99}). The global coverage is 99.43% which does not differ significantly from the nominal coverage of 99%, so we conclude that, in predictive terms, the estimated model properly fits the data.

3.2. Cluster analysis

Having estimated the model (1)–(3) and confirmed the validity of factor F_{14} as a measure of CSP of a company, in this Section we analyze the degree of homogeneity of the firms with regard to their attitude to CSR. We use the factor scores $\{f_{14,\ell};\ \ell = 1,\ldots,N\}$ estimated by means of their posterior medians and we apply cluster analysis to locate the more significant subgroups of firms. More concretely we use a hierarchical agglomerative algorithm based on Ward's method and obtain 3 groups. The results of the comparative study of the groups with respect to their factor scores, items and covariates Z are shown in Figure 2 and in the Annex.

The first group is the biggest and contains 205 firms (49.28%) which have a medium CSP. The second group contains 117 (28.13%) that are characterized by a level of CSP that is higher than the rest of the groups, whereas the third group contains 94 firms (22.60%) whose level of CSP is significantly lower than the rest (see Fig. 2). These results are corroborated by the average values of the items in each group (see the Annex). The mean levels of group 2 are, in general, the highest in all the items, followed

Table 1. Estimation of the parameters of the measurement equation

	$\mu_{i,j}$			$\beta_{i,j}$			$\sigma_{i,j}$			
Variable	Q0.5	Q50	Q99.5	Q0.5	Q50	Q99.5	Q0.5	Q50	Q99.5	COV_{99}
$Y_{1,1}$ Code of conduct for the organs of government	3.5008	4.3660	5.1390	0.5496	0.7192	0.8997	3.2179	3.5142	3.9219	100.00
$Y_{1,2}$ Representation in organs of government	2.5053	3.3425	4.1163	0.4514	0.6242	0.8457	3.2340	3.5869	4.0131	100.00
$Y_{1,3}$ Training and awareness in CSR	2.9673	3.7751	4.6360	0.5116	0.6921	0.8702	2.8745	3.1599	3.5119	100.00
$Y_{1,4}$ Strategy of communication with stakeholders	3.8081	4.7944	5.6895	0.6026	0.7776	0.9456	2.9433	3.3052	3.6818	100.00
$Y_{1,5}$ Report of the corporate government	1.8598	2.9346	3.8081	0.4544	0.6320	0.7986	2.6024	2.9297	3.2644	99.46
$Y_{2,1}$ Plans of prevention of labor risks	8.6380	9.6345	10.6250	0.4071	0.7278	1.0382	0.6298	0.8295	1.0472	99.51
$Y_{2,2}$ Training in prevention of labour risks	8.2825	9.4000	10.6235	0.4784	0.8215	1.1156	1.3086	1.4520	1.7263	97.33
$Y_{2,3}$ Programs of medical check-ups	8.4525	9.5080	10.6660	0.3299	0.6870	0.9758	1.2876	1.4773	1.7096	97.56
$Y_{3,1}$ Programs of flexible hours	5.6145	6.5090	7.3445	0.3555	0.5792	0.7947	3.4926	3.8949	4.2694	100.00
$Y_{3,2}$ Facilities for special permissions	7.3945	8.3025	9.2210	0.5387	0.7038	0.8854	1.3963	2.0202	2.5914	100.00
$Y_{4,1}$ Equality of opportunities in contracting	8.6380	9.3315	10.1810	0.1605	0.4221	0.6447	1.6814	1.9913	2.2600	96.61
$Y_{4,2}$ Development, promotion and training of the employees	8.0300	8.7935	9.5375	0.4518	0.6814	0.9007	1.8367	2.1374	2.4766	97.93

(*Continue of Table 1*)

$Y_{4,3}$ Wages	7.7775	8.6005	9.4995	0.3760	0.6327	0.8498	2.3169	2.6091	2.9284	97.07
$Y_{5,1}$ Surveys of employee satisfaction	3.7253	4.4328	5.3425	0.3833	0.5321	0.6659	3.5439	3.8674	4.2529	100.00
$Y_{5,2}$ Evaluation of employee performance	4.2919	5.0640	5.7680	0.3795	0.5249	0.6997	3.5945	3.9182	4.2716	100.00
$Y_{5,3}$ Plans of internal communication	5.5885	6.3550	7.1940	0.4765	0.6190	0.7789	2.9989	3.3725	3.7749	100.00
$Y_{5,4}$ Channels of complaints and suggestions from employees	5.8435	6.7440	7.5105	0.4730	0.6223	0.7739	2.9134	3.2277	3.6125	100.00
$Y_{5,5}$ Systems of measurement of client satisfaction	4.7197	5.4540	6.2355	0.5551	0.7427	0.9142	3.4178	3.8531	4.3392	100.00
$Y_{5,6}$ Channels of complaints and suggestions from clients	1.5865	2.3019	3.1494	0.3503	0.5618	0.7854	3.0970	3.5396	3.9422	99.75
$Y_{6,1}$ Pension plans	6.7550	7.6105	8.4205	0.5989	0.7651	0.9272	1.9011	2.5790	3.1158	100.00
$Y_{6,2}$ Aid for services of care for relatives	4.9032	5.7475	6.5420	0.4251	0.6082	0.8145	3.6805	4.1083	4.6363	100.00
$Y_{7,1}$ Medical and accident insurance	0.3175	1.0651	2.0073	0.2907	0.4833	0.6864	1.6815	2.0250	2.3402	98.43
$Y_{7,2}$ Juridical advice	6.6255	7.6925	8.5955	0.5191	0.7529	0.9499	1.9832	2.5177	3.1178	100.00
$Y_{8,1}$ Union representation	5.7580	6.5610	7.4760	0.5577	0.7623	0.9586	3.3391	3.6440	4.0432	99.73
$Y_{8,2}$ Dialog opened with representatives of the workers	5.0485	5.8715	6.6165	0.5166	0.7436	0.9551	3.6823	4.0499	4.4695	100.00
$Y_{9,1}$ Principles of transparency and defence of the consumer	7.8945	8.7140	9.5725	0.3345	0.5542	0.7849	2.0388	2.3554	2.6845	98.96
$Y_{9,2}$ Non recurrence of unfair advertising	8.2615	8.9940	9.7070	0.3393	0.5492	0.7503	1.7655	2.0338	2.3324	98.12

(*Continue of Table 1*)

$Y_{9,3}$ Fulfilment of information protection law and privacy	5.2095	6.0840	6.9185	0.5428	0.7497	0.9292	2.7964	3.1615	3.6487	100.00
$Y_{9,4}$ Information and advice to the client	5.1075	6.1445	7.0645	0.5715	0.7592	0.9679	2.7441	3.2905	3.8177	100.00
$Y_{10,1}$ Development of the ISO 9001	5.7160	6.5685	7.4380	0.4696	0.6092	0.7812	3.1417	3.4639	3.8610	100.00
$Y_{10,2}$ Quality certification in products	6.1570	7.0345	8.0190	0.4171	0.5802	0.7222	2.9233	3.2738	3.6413	99.74
$Y_{11,1}$ Code of ethics with suppliers	4.4469	5.2595	6.0660	0.4077	0.5550	0.7050	3.6122	3.9398	4.3545	100.00
$Y_{11,2}$ Transparent selection criteria of suppliers	4.4457	5.3470	6.3385	0.5465	0.6985	0.8436	3.1802	3.4886	3.8300	100.00
$Y_{11,3}$ Trades relations based on mutual benefit	5.2895	6.1155	7.0295	0.6614	0.8240	0.9997	2.5469	2.8613	3.2067	100.00
$Y_{11,4}$ Supplier follow-up	5.6130	6.4670	7.3690	0.5794	0.7391	0.8868	2.7728	3.0745	3.4325	99.74
$Y_{11,5}$ Channels of dialog with suppliers	3.6854	4.6506	5.6035	0.6194	0.7895	0.9560	2.8581	3.1770	3.5348	100.00
$Y_{12,1}$ Minimization of the consumption of natural resources	5.2935	6.2090	7.1925	0.5679	0.7372	0.8976	2.9985	3.2908	3.6531	99.74
$Y_{12,2}$ Measures of pollution correction	5.8775	6.8235	7.6205	0.5236	0.6768	0.8189	2.7913	3.0966	3.4507	99.74
$Y_{12,3}$ Systems of environmental management	6.3360	7.0600	7.8900	0.5116	0.6603	0.8229	2.7560	3.0266	3.4129	99.74
$Y_{12,4}$ Environmental education and awareness	2.9227	3.6663	4.5115	0.4524	0.6184	0.7701	3.1248	3.4526	3.7616	99.48

(*End of Table 1*)

$Y_{12,5}$ Elaboration of an environmental report	4.7949	5.6825	6.4740	0.5616	0.7263	0.8724	2.9946	3.3366	3.6617	100.00
$Y_{12,6}$ Design of ecological products	2.7695	3.6417	4.4052	0.5106	0.6845	0.8439	2.8259	3.1836	3.5767	99.74
$Y_{12,7}$ Fomenting of responsible consumption	3.0265	3.9555	4.8011	0.4620	0.6033	0.7541	3.2584	3.6056	4.0285	99.73
$Y_{13,1}$ Support of cultural activities	2.7948	3.8291	4.6876	0.6233	0.7800	0.9295	2.8382	3.0947	3.3813	98.54
$Y_{13,2}$ Support of sports activities	3.6845	4.4658	5.2325	0.5030	0.6429	0.7922	3.4915	3.8450	4.1956	100.00
$Y_{13,3}$ Support of activities of health and well-being	1.7807	2.5651	3.3402	0.5237	0.6784	0.8549	2.4130	2.6862	2.9873	98.76
$Y_{13,4}$ Participation in public activities	2.6912	3.7652	4.6686	0.7027	0.8513	0.9935	2.4749	2.7377	3.0340	99.51
$Y_{13,5}$ Support of disadvantaged groups	2.4886	3.3933	4.1004	0.5960	0.7440	0.8975	2.8293	3.0675	3.3618	99.00
$Y_{13,6}$ Support of training activities	2.7118	3.6882	4.6255	0.6027	0.7802	0.9260	2.7599	3.0257	3.4151	98.76
$Y_{13,7}$ Support of environmental protection	2.2096	3.1333	3.9346	0.5540	0.6927	0.8736	2.7242	3.0104	3.2696	99.24
$Y_{13,8}$ Campaigns to support NGO's	1.4058	2.1617	2.9482	0.3562	0.5133	0.6585	2.7918	3.1283	3.4840	98.16
$Y_{14,1}$ Interest in adopting CSR initiatives	4.8749	5.2436	5.5521	1.9709	2.2999	2.5854	2.5166	2.7412	2.9832	100.00
$Y_{14,2}$ Degree of CSR implantation	3.3085	3.6990	4.0455	1.8413	2.1859	2.4766	2.3605	2.5769	2.8046	99.49

Table 2. Estimation of the parameters of the structural model

Factor	γ_i		
	Q0.5	Q50	Q99.5
Corporate governance (F_1)	0.7369	0.8007	0.8592
Health and labor security of the employees (F_2)	0.6509	0.7234	0.7832
Conciliation labor and family life (F_3)	0.6408	0.7911	0.8878
Equality of opportunities (F_4)	0.6745	0.7604	0.8208
Satisfaction of clients and employees (F_5)	0.7533	0.8139	0.8679
Labor and family benefits (F_6)	0.8027	0.8778	0.9512
Medical-juridical benefits (F_7)	0.2124	0.4860	0.6393
Dialog with employees (F_8)	0.6480	0.7642	0.8398
Information to clients (F_9)	0.5585	0.7080	0.8150
Quality of the product (F_{10})	0.8603	0.9233	0.9778
Suppliers (F_{11})	0.7691	0.8326	0.8859
Environment (F_{12})	0.4734	0.6364	0.7879
Society (F_{13})	0.7059	0.8123	0.8968

by the mean levels of group 1, while the firms of group 3 are those with the lowest mean levels. Finally, and in order to analyze the composition of the groups, we crossed the group with each characteristic of the firms. The results shown in the Annex proof that firms of group 2 tend to be larger, more knowledgeable with respect to CSR and are under greater pressure from stakeholders than those of group 1 and these, in turn, than those of group 3. Significant differences are not observed by sector.

3.3. Detection of multivariate patterns

The results of the cluster analysis carried out in the previous section suggest the existence of a direct relationship between CSP and the size of the company, its level of CSR knowledge and the pressure of its stakeholders. In order to analyze the existence of this relationship in more detail, in this section we carry out a multivariate analysis. From the covariates used in the paper, we try to identify subgroups of firms which show levels of CSP that are significantly higher or lower than those of the other firms. We use a multivariate pattern recognition procedure based on the location of subgroups of firms $G \subseteq \{1,\ldots,N\}$ such that $G = \left\{Z_{i_1} \in A_{i_1}\right\} \cap \ldots \cap \left\{Z_{i_p} \in A_{i_p}\right\}$[2] with $A_{i_j} \in \mathbf{C}\left(Z_{i_j}\right)$; j = 1,…,p, where $i_j \in \{1,\ldots,Q\}$ and $\mathbf{C}(Z_q) \subseteq \{\varnothing \subset A \subseteq U_q\}$ contains the subsets of U_q, where the search for significant groups is carried out. In order to make the interpretation of the results easier, we have taken $\mathbf{C}(Z_q) = \{A: \varnothing \subset A \subset U_q\}$ for ordinal variables

[2] $\{Z \in A\} = \{i \in \{1,\ldots,N\}: Z_i \in A\}$ that is to say, it is the set of firms such that the value of the covariate Z belongs to the subset A.

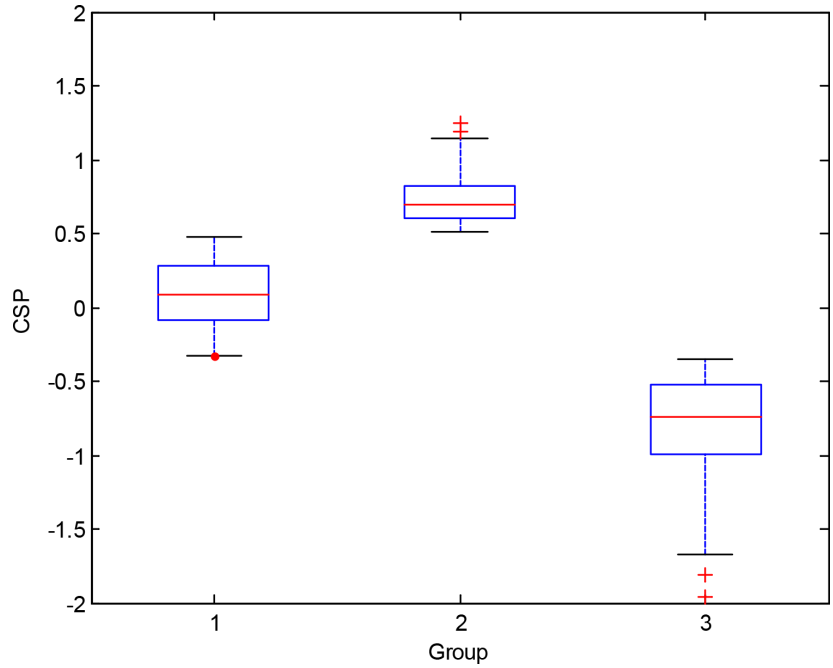

Fig. 2. Boxplot of CSP by groups

(turnover, company size and the degree of previous knowledge of CSR) and $\mathbf{C}(Z_q) = \{\{u_{q,i}\}; i = 1,\ldots,s_q\}$ for nominal variables (the sector and whether the firm is under pressure from its stakeholders).

Having fixed a level of credibility, $0 < \beta < 1$, the procedure locates groups G such that $P(\text{Median}(G) > \text{Median}(G^c)| \mathbf{Y}_{obs},\mathbf{Z}_{obs},\mathbf{I}(y),\mathbf{I}(z)) \geq \beta$ or $P(\text{Median}(G) < \text{Median}(G^c)| \mathbf{Y}_{obs},\mathbf{Z}_{obs},\mathbf{I}(y),\mathbf{I}(z)) \geq \beta$, where $G^c = \{1,\ldots,N\}\backslash G$, $\text{Median}(G) = \text{median}\{f_{14,\ell};\ \ell \in G\}$ and $\text{Median}(G^c) = \text{median}\{f_{14,\ell};\ \ell \in G^c\}$.

In the Annex is described the algorithm to locate the groups G so that cardinal (G) and cardinal (G^c) contain at least the $100p_{min}$% ($0 < p_{min} < 1$) of the firms of the sample. We take $p_{min} = 0.1$ in order to make the comparison of G and G^c trustworthy.

Table 3 shows the subgroups obtained taking $\beta = 0.99$. This Table shows the characteristics of the companies of each located subgroup, their size (in %) and the posterior median of the difference Median (G) – Median (G^c). So, the first subgroup contains 70.5% of the companies and declares they have a none-medium degree of CSR knowledge. The estimated value of Median (G) – Median (G^c) is –0.3659, and is significantly negative for a credibility level of 99%. This corporate subgroup has, therefore, a CSP that is significantly lower than the other companies. The second subgroup consists of companies with a medium-high degree of CSR knowledge and contains 65.70% of the firms, the estimated value of Median (G) – Median (G^c) being significantly positive and equal to 0.4144. This corporate group has, therefore, a CSP that is significantly higher than the other companies.

Analyzing the results, we observe that the firms which declare that they have a medium-high degree of CSR knowledge, with a medium or large size or which are under pressure from their stakeholders, tend to have a greater CSP. On the contrary, the companies with a none-medium level of knowledge of CSR, a micro size or that are not under pressure from their stakeholders, tend to have a lower CSP. Within these subgroups, the companies in the industrial sector show greater tendency to have a minor CSP.

Table 3. Characteristics of the firms with behaviour significantly different from the rest with regard to CSP

CSR knowledge	Stakeholder pressure	Size	Sector	Support (%)	Med(G)-Med(G^c)
None, medium				70.50	–0.3659
Medium, high				65.70	0.4155
	No			85.34	–0.3662
		M,S$^+$		71.88	–0.3253
		S,L		70.67	0.2579
None, medium	No			61.54	–0.3742
None, high	No			54.33	–0.2252
Medium, high	No			54.81	0.2262
None, medium		M,S		50.00	–0.3801
None, high		M,S		38.70	–0.3047
None, medium		M,L		48.32	–0.1914
None, high		S,L		39.42	0.1775
Medium, high		S,L		49.28	0.3399
Medium, high		S,L		47.12	0.3521
None, medium			Industry	31.97	–0.2619
	No	M,S		52.40	–0.4026
	No		Industry	38.46	–0.1307
None, medium	No	M,S		43.27	–0.4144
None, medium	No	M,L		42.31	–0.2055
None, high	No	M,L		42.79	–0.1333
None, medium	No	M,L		37.50	–0.1115
Medium, high	No	S,L		41.35	0.2220
Medium, high	No	M,L		39.90	0.2435

Notes: In grey (black) the patterns with a CSP significantly smaller (higher). $^+$M: Micro; S: Small; L: Medium or Large.

Table 4. Comparative analysis of the factor scores of the micro-small *versus* medium-large firms

Size	Corporate governance	Health and labor security	Conciliation labor and family life	Equality of oportunities	Satisfaction of clients and employees	Labor and family benefits	Medical and juridical benefits
Micro-small	173.29	181.43	173.61	202.28	189.05	176.75	174.96
Medium-large	256.23	271.25	244.70	219.08	209.54	233.96	213.19
pvalue U Mann-Whitney	0.000	0.000	0.000	0.019	0.101	0.000	0.002

Size	Dialog with employees	Information to clients	Quality of the product	Suppliers	Environment	Society	CSP
Micro	186.89	183.17	189.10	198.46	208.32	196.01	179.72
Small	262.41	258.19	212.57	228.61	203.67	219.64	240.35
pvalue U Mann-Whitney	0.000	0.000	0.054	0.007	0.697	0.034	0.000

3.4. Implications for managerial decisions

Once the significant patterns about CSP have been found and the less developed groups with respect CSR have been detected, it is important to find out which are the aspects of CSR that these groups must to improve in order to increase their levels of CSP. In this way, these firms might take adequate strategies to manage competitive advantages. To that aim the factor scores of the groups for each of the aspects considered in the study should be analysed. By way of example, Table 4 shows the results of this analysis corresponding to the group of micro-small firms that, according to the results of Table 3, is one of the groups with lower CSP scores. Concretely, we have made a comparative study of micro-small *versus* the medium-large firms of the posterior mean of the firm's factor scores and we apply the Mann-Whitney test[3] (see Daniel 1990).

It can be seen that with the only exceptions of Satisfactions of Clients and Employees, Quality of Product and Environment, micro and small firms should take managerial decisions in order to improve their behaviour with respect these aspects.

Conclusions

In this paper, we have developed a methodology to measure the CSP of a company. Taking the Carroll's model and the Stakeholder theory as theoretical supports we have

[3]All the calculations were made using SPSS 18.0.

designed a questionnaire whose items are traditionally used in the CSR literature, to obtain information from the firms. The measurement of CSP has been obtained by means of a second order factor model that relates CSP indicator with a set of actions directed towards its stakeholders (shareholders, clients, suppliers, employees, society and environment). The statistical analysis has been carried out from a Bayesian point of view, which allows us to treat missing information more effectively, using all the available information and without appealing to asymptotic results.

The proposed methodology could be a useful business management tool for firms that wish to undertake social responsibility strategies and develop competitive advantage with stakeholders, because it allows organizations to measure the degree of achievement of the objectives of social responsibility by highlighting the aspects of CSR less developed. In addition, we have proposed some novel cluster and multivariate pattern recognition techniques, which let identify groups of firms with homogeneous levels of CSP providing information about which CSR aspects should be improved which could be useful to design policies aimed at increasing the CSR degree of implantation in the firms.

The methodology has been applied to a sample of Spanish companies and our results show they tend to adopt an integral CSR strategy, initiating and developing a great variety of sustainable initiatives that try to satisfy the demands and expectations of stakeholders, such as Székely and Knirsch (2006) found. The aspects most commonly adopted are the health, safety and protection of the rights of the employees, information to clients, quality of products and some environmental issues. These aspects are considered to be strategic and represent valuable sources of competitive advantages, such as Perrini (2005) points out, and the results are consistent with other studies as Jo and Harjoto (2011).

To have knowledge of what CSR is, to be under pressure from stakeholders and the size of the companies are factors that positively affect the degree of CSP. These results suggest that, in order to increase the degree of implantation of CSR in Spanish companies, it is necessary to increase their CSR knowledge. We find that this is especially important for micro and small companies which should increase the interaction and number of communication channels with the stakeholders in order to improve their CSP. More concretely actions directed towards good corporate governance, health and labor security, conciliation of labour and family life, labour, family and medical-juridical benefits, dialog with employees, information to clients and relation with suppliers must be promoted because they are the aspects less developed by these kinds of companies.

Recently, Perrini *et al*. (2007) and Russo and Tencati (2009), by means of an exploratory factor analysis, have found that Italian small firms have a different profile to approach CSR that can be explained by their familiarity and consciousness of CSR. It would be interesting to extend our confirmatory methodology to check if this result is also verified in Spanish firms. Furthermore, we are working on the analysis of the obstacles found by the companies in the adoption of CSR strategies. This might lead us to establish more effective guidelines to enable adoption.

The validity of our empirical results could be, however, limited. On the one hand, the model used in the paper might be inappropriate in other contexts (Kanji, Chopra 2010). It is a daunting task to build a CSP with a general validity because there exist different stakeholder groups in different situations (countries, sectors, periods). However the proposed methodology is flexible enough to select and estimate new factor models which show and appropriate goodness of fit to data. On the other hand, it would be interesting to analyze the influence of CSP to the economical results of the firms. In these cases it would be necessary to use Structural Equation Models (SEM) and the Bayesian techniques could be used. These problems form a part of our current agenda of research whose results will be reported elsewhere.

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