



Analysis

A Multidimensional Analysis of the Relationship Between Corporate Social Responsibility and Firms' Economic Performance

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ABSTRACT

This paper analyses the relationship between firms' Corporate Social Responsibility activities and their economic performance, taking into account seven macro-categories of corporate social responsibility (CSR), six market-based and accounting-based performance indicators and by disaggregating for the firms' sector of activity. In particular, through a representative sample of 988 US-based companies from nine different sectors (Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrial, Oil & Gas, Technology and Utilities), we study the dynamics of possible endogenous and non-linear relationships through the Arellano-Bond technique in the dynamic panel. The results show some common patterns and sectorial specificities—CSR engagement in general raises firms' total stock returns and reduces financial risks, but this depends on the area of CSR in which the firms invest. The results of an accounting-based figure analysis are less univocal, showing patterns that depend both on the specific area of CSR and the sectorial activities conducted.

1. Introduction

Corporate social responsibility (CSR) can be broadly defined as the positive or “responsible” attitude of a company toward all its stakeholders. The definition is itself inherently linked to the idea that firms or companies can benefit from positively engaging with their various stakeholders, both internal and external, such as employees, board members, communities, workers' families and so on, as well as by caring for the (broadly defined) environments in which they operate. According to Sheldon (1924), CSR is voluntary engagement in social and environmental programmes. Ever since this seminal study, CSR has been considered a common practice to be promoted by governments, non-governmental organisations and consumers (Lee, 2008). However, the impact of CSR on the economic performance of companies has not always been viewed in a positive light. Milton Friedman (1972), for instance, saw CSR as an unfair and costly burden to shareholders. Benabou and Tirole (2010) discuss three different visions of CSR and the rationale for both a positive and a negative link between CSR and companies' performances. Thus, it is of no surprise that a large body of literature has been devoted to the empirical analysis of the relationship between CSR and economic performance, without any definitive conclusion. Some scholars have shown a positive relationship between CSR

and economic performance—Margolis and Walsh (2003), Orlitzky et al. (2003), Rettab et al. (2009), Lin et al. (2009) and Sun (2012) showed that companies involved in CSR take advantage of the positive environments they have created. Also, Chen and Wang (2011), Alafi and Hasoneh (2012) and Galbreath and Shum (2012) statistically assessed the positive impact that CSR has on its stakeholders. Quazi and Richardson (2012) conducted a meta-analysis of 51 prior studies included in Orlitzky et al. (2003) and showed that by increasing the sample size, the level of significance between the economic and CSR variables rises as well. However, other scholars found a negative relationship between the two. Vance (1975), Wood and Jones (2005), Brammer and Millington (2008), Anginer et al. (2008), Brammer et al. (2005) and Nejati and Ghasemi (2012) show that the market punishes companies' efforts to improve their CSR activities.¹ Ahamed et al. (2014), Aupperle et al. (1985) and McGuire et al. (1988) argue that the relationship between CSR and economic performance is unclear. A possible explanation lies in the timing of the analysis: there can be a short-run negative relationship, but the positive long-run relationship will ultimately dominate, according to Yang (2016) and Comincioli et al. (2012).

The empirical literature that considers the relationship between CSR and economic performance is not univocal also with regards to the

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¹ See also Lioui and Sharma (2012), who consider the relationship between the environmental dimension of CSR and the companies' economic performances, and the references therein.

economic measures used to test it. Indeed, it is possible to evaluate economic performance by looking at market values or companies' accounting values. The two families of variables are related but focus on different elements—the former represents the market evaluation that depends on firms' economic perspectives, management quality and so on, while the latter is the measurement of a company's economic life. CSR influences, in different ways, different aspects of firm performance and therefore different indicators may lead to inconsistent results when evaluating the relationship between economic results and CSR activities (McGuire et al., 1988). Each type of economic indicator is subject to particular biases (McGuire et al., 1987). Accounting-based measures, for example, consider only the historical aspects of firm performance and are subject to bias from managerial manipulation and differences in accounting procedures (Briloff, 1976); they should also be adjusted for risk, industry characteristics and other variables (Aaker and Jacobson, 1987). Stock market-based measures, on the contrary, represent investors' evaluation of a firm's ability to generate future economic earnings, rather than past performance; they need not reflect a fair evaluation of investors in conditions of market distortion such as limited competition or asymmetric information (McGuire et al., 1988). Moreover, market values such as stock prices refer only to financial stakeholders and therefore might not be suitable to represent a multi-dimensional concept like CSR, which refers to both economic and non-economic values (McWilliams et al., 2006). Perhaps not surprisingly, taking into account these differences, the meta-analysis of the empirical studies, conducted by Horvathova (2010), shows mixed results in assessing the relationship between CSR and companies' performances.

All these studies consider CSR without taking into account the firms' specificities. However, the definition of CSR itself refers to the broad set of multiple activities that companies can undertake in order to improve their relationships with their stakeholders. This is strongly influenced by the sector in which the firm operates, since it impacts the nature of the company, its average size, types and characteristics of products or services it delivers, the organisation of its work and so on. There exist some studies that have focused on the empirical relations between the two variables in specific sectors, e.g., the banking and financial sectors (Mallin et al. (2014); Comincioli et al. (2012), Soana (2011); Jo et al. (2014); Platonova et al. (2016)); the tourist sector (Theodoulidis (2017); Gu et al. (2013); Zhang (2014)). However, these studies do not compare the results across sectors, taking into account the possible impact on the empirical relationship due to differences in performance measures and the dynamic nature of the CSR-performance relationship. The aim of this study is to evaluate the relationship between CSR and economic performance, taking into account company and sectorial specificities and distinguishing across financial and accounting measures in a dynamic way. The latter is especially important since it is entirely possible that a company's engagement in CSR activities has an impact over time in a non-linear way. As discussed, engagement in CSR activities can have a cost and can also generate benefits, and these two components can change over time. Our model aims to capture these dynamic non-linear aspects as well.

We stress that our aim is not to provide a theoretical accounting of all the possible relationships between CSR and each financial or economic performance measure in each sector but simply to provide an empirical evaluation of these relationships, without involving or assuming any pre-defined model for CSR. However, we do acknowledge the multidimensional nature of CSR, which considers both internal and external stakeholders. For this reason, we follow the Scholtens (2008) approach, which studies the economic performance of 289 companies listed in the MSCI ESG KLD STATS Dataset and its relationship with seven dimensions of CSR activities, as reported in this Dataset:

- Environmental (ENV), which evaluates the existence of clean energy programmes, pollution prevention programmes and environmentally proactive activities;
- Community (COM), which measures community engagement

programmes;

- Human rights (HUM), which considers if the company has undertaken human rights initiatives;
- Employee relations (EMP);
- Diversity (DIV), which identifies gender diversity in the company's top management;
- Product (PRO), which evaluates the existence of quality control programmes and if the company invests in R&D and innovation;
- Governance (CGOV), which analyses the existence of transparency programmes and policies to prevent corrupt business dealings.

There exist several sources of information on CSR provided by different companies. Most of them include reviewing public and private information, including interviews to companies. We use the MSCI ESG KLD STATS Dataset which at present, provides the largest available survey on CSR.² It contains reviews of > 2600 firms in the US, for a panel that for a subset of the firms is up to 25 years long. This allows a deep longitudinal analysis of the firms' CSR activities. In particular, we extend Scholtens' (2008) work along several dimensions:

- We create a panel of 998 US-based companies, from 2003 to 2015, for a total of 12,844 observations;
- We elaborate on the CSR indicators to provide a standardised absolute index of CSR engagement, coherent over time and sector;
- We consider both lagged and non-linear variables to better capture the dynamics of the relationship and employ a statistical methodology that captures the endogenous dynamics;
- We consider both market-based financial values as well as accounting-based ones;
- We test the statistical significance as well as the overall impact of a company's CSR activities by dimension over a period of time.

In particular, and in line with our aims, this study provides statistical evidence on the impact of the various dimensions of CSR on a company's economic and financial performance indicators. By means of a dynamic panel model, we evaluate the impact of full engagement in CSR activities over a three-year horizon, accounting for the dynamics of the economic and financial performance indicators as well as for the lagged impact of CSR indicators on the dependent variables. Our approach being purely empirical will focus on the evaluation of the statistical significance of functions of parameters in the estimated dynamic panel model.

This study yields interesting results regarding the nature of the relationship between CSR activities and economic performance, which suggests some sectorial specificity. For instance, firms in the Oil & Gas sector invest more in all areas of CSR with an almost always-positive return on financial performance and a reduction of financial risk. This can be explained by the fact that Oil & Gas production significantly costs society in terms of air pollution, oil spills and so on; thus, in line with the stakeholder engagement view, the Oil & Gas industry invests in CSR to improve its economic and financial performance. Another sector that gives more attention to CSR is the Financial sector, albeit to a lower extent compared with the Oil & Gas sector. Firms belonging to different sectors, such as Basic Materials, Consumer Goods and Technology, invest even less in CSR. In the Consumer Services, Health Care, Industrial and Utilities sectors, firms focus their investments only in specific areas

² A stream of literature focuses on testing to what extent social rating in the environmental dimension of MSCI ESG KLD STATS correlates with objective measures such as harmful emissions. Chatterji et al. (2009) finds that MSCI ESG KLD STATS does a reasonable job in aggregating past environmental performances, yet the level of correlation between the environmental performances and the scoring provided by MSCI ESG KLD STATS shows unclear evidence. Chatterji and Toffel (2010) show that poor environmental ratings induce firms to improve their environmental performances more than other firms. This literature is rather new and further research on the link between the social rating and objective social performances is needed.

of CSR. In general, firms belonging to all sectors focus broadly on three areas of CSR—Governance, Community and Diversity—involving both internal and external stakeholders. In the other four areas, sectorial specificities emerge more clearly. Considering the different economic measures, we see that Total Stock Return (TSR) has a positive relationship with almost all CSR macro-categories, especially with Governance, Community and Diversity. Financial Risk reduces as well. Accounting-based measures yield more ambiguous results than market-based ones.

This paper is organised as follows: Section 2 presents the data and the economic and social performance measures; Section 3 explains the methodology used; Section 4 presents the results. The paper ends with the conclusion and references. Finally, the Appendix contains several detailed tables.

2. Data

The dataset is constructed by merging two different data sources: economic data, composed of stock market-based and accounting-based measures (source: Datastream) and CSR data taken from the MSCI ESG KLD STATS Dataset. The latter database divides CSR activities into seven macro-categories: governance, community, diversity, employee relations, environmental, human rights and product. Each macro-category is composed of a different number of entries (that take the value of 1 or 0 if the answer to specific questions is yes or no, respectively), which are further disaggregated into positives (strengths) and negatives (concerns). Positive indicators capture the company's good practices, negative indicators the bad ones (see Appendix A for further details). Each company receives a score on each macro-category in a given year, based on the assessment provided by MSCI ESG KLD STATS for each entry that composes a given macro-category in that year. Appendix A contains a list of all entries for all macro-categories for the year 2015.

The dataset is composed of different universes of companies, based on the duration of the observations and the number of firms. We used Universe D, composed of 2400 observations of US-based companies, ranging from 2003 to 2015. We reduced the number of firms by eliminating duplicates and firms from the dataset that were not followed throughout the whole duration of the panel. Moreover, the number of firms further decreased after merging with the economic indicators' dataset, in order to generate a merged and balanced pooled dataset. This process left 998 firms in the pool. Each company is categorised in one of ten economic sectors listed by the US Industry Classification Benchmark (ICB), as reported in Datastream. These ten sectors are Basic Materials, Consumer Goods, Consumer Services, Financials, Health Care, Industrial, Oil & Gas, Technology, Telecommunications and Utilities. In our panel, we do not include the Telecommunications sector because of its limited size. Table 1 describes the frequency and cumulative distribution of each sector in our panel.

One problem with the positive and negative indicators in the dataset is that the number of entries that form each indicator is not constant over time. Some entries have been added over the years while some

Table 1
Frequency and cumulative distribution of sectors.

Sector	Number	Percent	Cum.
Financials	222	22.47	22.47
Industrials	210	21.26	43.73
Consumer services	118	11.94	55.67
Technology	103	10.43	66.10
Consumer goods	101	10.22	76.32
Health care	83	8.40	84.72
Utilities	49	4.96	89.68
Basic materials	47	4.76	94.44
Oil & gas	47	4.76	99.20
Telecommunications	8	0.81	100.00
Total	988	100.00	

others have been discontinued. However, the number of macro-categories remains constant for the whole panel. We accounted for this issue by constructing a normalised measure of the relative CSR performance in each category. First, in each year, in each category and separately for strengths and concerns, we divided each company's score by the maximum number of possible entries. This yields a number ranging from 0 to 1, representing the normalised score a company can get in a given year in a given category for strengths and concerns. Then, we subtracted the score of the negative aspects (concerns) from the positive ones (strengths):

$$norm_diff X_{i,t} = norm X_{i,t}^{STR} - norm X_{i,t}^{CON}, \tag{1}$$

where

$$norm X_{i,t}^{STR} = \frac{\sum_{j=1}^z X_{i,t,j}^{STR}}{Z(X, t, STR)}, \text{ and } norm X_{i,t}^{CON} = \frac{\sum_{j=1}^z X_{i,t,j}^{CON}}{Z(X, t, STR)}$$

and where i is the company index; t is the year; STR denotes strengths; CON identifies concerns; X refers to the CSR macro-category (CGOV for governance, COM for community, DIV for diversity, EMP for Employee Relations, ENV for environment, HUM for human rights and PRO for product); z is the number of questions for each CSR macro-category X in year t and type CON or STR .

In this way, we obtain a measure that is independent from the number of entries considered in each category and in each year. That measure represents a standardised metric that evaluates the relative strength of the engagement of a company in each CSR macro-category with respect to the highest possible engagement. By construction, $-1 \leq norm_diff X_{i,t} \leq 1$, for all CSR macro-categories.

The indicators included in the dataset contain, in some cases, several missing values. The missing values might generate distortions to the analyses as they impact on the level of the normalised indicator we use. Note, however, that, on the one side, given that we are interested in the relative comparison among economic sectors which are all affected by the same distortion, the missing values, despite present, have limited impact on our analyses. On the other side, in order to reduce the impact of distortions, we limit our analyses to the indicators with an amount of missing values below the 50% of the available observations and treat a missing observation in an entry as a zero in order to balance the impact that missing observations can have on the CSR macro-indicator.³ Consequently, in a given year, for a given company and a given aspect of CSR, a missing observation is not treated as a concern or as a strength. This minimises ex-ante the possible bias induced by missing observations in the distribution of the normalised indicators. If a company has no observation at all in a given macro-category, we remove it from the panel.

As explained in the introduction, we consider both stock market-based and accounting-based economic measures of economic performances, downloading from Datastream a collection of standard performance accounting and financial indicators.⁴ For the stock market-based measures, we use the TSR (annual yield of the stock price, calculated as $\log P_t - \log P_{t-1}$) and the Financial Risk (standard deviation of returns, calculated as the standard deviation of daily observations over t). Note that for the latter, it is common to use the volatility of returns as a proxy for the financial market risk (see, among many others, the seminal contributions of Markowitz, 1952, and Sharpe, 1966). For the accounting-based measures, we consider Return on Equity (ROE), net income/shareholder equity (measured as percentages); Return on Asset (ROA), net income/total asset (measured as percentages); Return on Investments (ROI), net income/investment

³ Table 8 in Appendix C reports the entries included in our analyses that have missing observations and the number of missing over years.

⁴ For further information on the indicators, please refer to Datastream (https://www.fm.wi.tum.de/fileadmin/w00bno/www/IBES_on_Datastream_ver_5.0.pdf)

Table 2
Summary statistics of CSR macro-categories and economic performance indicators.

Variable	Obs	Mean	Std. dev.	Min	Max	N° of negative scores
norm_diff_CGOV	12,844	-0.03	0.19	-0.75	1.00	3669
norm_diff_COM	12,844	0.02	0.19	-1.00	1.00	917
norm_diff_DIV	12,844	-0.04	0.31	-1.00	1.00	4309
norm_diff_EMP	12,844	-0.01	0.17	-1.00	0.83	3408
norm_diff_ENV	12,844	0.03	0.15	-0.71	0.83	1315
norm_diff_HUM	12,844	0.00	0.11	-0.75	1.00	665
norm_diff_PRO	12,844	-0.03	0.18	-1.00	1.00	2267
Total stock return	8307	0.03	0.18	-1.62	1.12	2739
Financial risk	8307	0.92	0.80	0.00	10.86	-
ROE (%)	12,508	0.16	1.67	-21.56	121.09	1397
ROA (%)	7647	0.09	0.24	-0.96	18.21	165
ROI (%)	12,668	9.28	14.87	-396.33	251.73	1147
ROS (\$)	12,809	36.79	131.15	0.00	5587.54	-

(measured as percentages); Return of Sales (ROS), total revenues/sales (measured in dollars). Both ROE and ROA measure a company's ability to generate earnings from its investments. They differ in terms of the role of financial leverage or debt. Shareholder equity is equal to the difference between assets and liabilities, so if a company has no debt, its shareholders' equity and its total assets will be the same. When ROA is high, a high ROE means that managers are doing a good job generating returns from shareholders' investments. On the other hand, if ROA is low, a high ROE can give investors a false impression about the company's fortunes (Bodie et al., 2002). ROI is a measure of profit or loss that a company made in a fiscal year, expressed in term of investments, while ROS represents the per share amount of the company's revenues, proxied by sales per share (measured in dollars).

Table 2 presents the summary statistics of the CSR macro-categories and economic performance indicators. Focusing on the summary statistic of the CSR macro-categories, we see that there are no companies that reach the highest possible normalised score in the macro-categories of EMP and ENV. The mean is (almost) centred around the null value, but the distribution is quite asymmetric, as can be seen in the last column that reports the number of companies for which the standardised indicator is negative. The distribution is also quite asymmetric for the economic variables. ROI is the parameter with the highest mean and that is relatively more dispersed. Note that the total number of observations for Total Stock Return, Financial Risk and ROA are less than the total number of observations relating to CSR, ROE, ROI and ROS indicators because of issues with data availability.

3. Methodology

We undertake several regression analyses with economic performance indicators as dependent variables and normalised indexes for CSR macro-categories as the independent ones. In a standard regression approach, CSR performance linearly affects the economic/financial performance. However, we cannot exclude a-priori the possibility of non-linear effects. Therefore, in order to verify whether the relation is linear or if the data show evidence of possible non-linear effects, we augment our regression model with squared normalised indexes of CSR, which we include among the set of explanatory variables. The following steps describe our methodology in detail:

a) We start our analyses by investigating the pairwise correlation between the dependent variables and regressors. Then, we undertake a cross correlation analysis to understand if there is a time-lagged relationship between social and economic indicators. For the series $x_{X, i, t}$ and $y_{i, t}$, where $x_{X, i, t} = \text{norm_diff_}X_{i, t}$ (as described above) and $y_{i, t}$ is one of the economic performance indicators of company i at time t , the cross correlation at the delay d is defined as:

$$R_d = \frac{\sum_{i,t} [(x_{X,i,t} - \mu_x)(y_{i,t-d} - \mu_y)]}{\sqrt{\sum_{i,t} (x_{X,i,t} - \mu_x)^2} \sqrt{\sum_{i,t} (y_{i,t-d} - \mu_y)^2}}$$

where μ_x and μ_y are the mean of $x_{X, i, t}$ and $y_{i, t}$, respectively. In our analyses, we consider values of d up to 2 because of the limited temporal dimension of the sample (note that for d equal to zero, we obtain the standard linear correlation). The evidence that emerges from the cross correlations shows the need to include in the model the lag in the CSR macro-categories' variables. Appendix B presents the aggregate results for the entire dataset and for each sector.

b) On top of the lagged impact of CSR normalised indicators, as suggested by the cross-correlation analysis, we can conjecture that economic performance indicators could depend, at least in part, on their own values in previous periods. To test this, we include the lagged dependent variables in the model. Therefore, the model we consider is:

$$y_{i,t} = \rho_1 y_{i,t-1} + \rho_2 y_{i,t-2} + \beta'_0 x_{i,t} + \beta'_1 x_{i,t-1} + \beta'_2 x_{i,t-2} + \delta'_0 x_{i,t}^2 + \delta'_1 x_{i,t-1}^2 + \delta'_2 x_{i,t-2}^2 + \varepsilon_{i,t} \tag{2}$$

where $x_{i, t}$ and $x_{i, t}^2$ are the vectors of the seven CSR macro-categories normalised indexes in the levels and in the squares, respectively. Moreover, ε_{it} is the error term of company i at time t , while the scalars ρ_1 and ρ_2 , and the vectors $\beta'_0, \beta'_1, \beta'_2, \delta'_0, \delta'_1,$ and δ'_2 are the parameters to be estimated. Note that we include two lags of the explanatory variables, coherently with the cross-correlation analyses and, similarly, we include two lags of the dependent variables. Given the presence of the lagged dependent on the right-hand side, we obtain parameter estimates by means of the Arellano-Bond estimators for the dynamic panel data (Arellano and Bond, 1991).

The panel regressions have a large number of explanatory variables. In fact, we have seven CSR dimensions, for each of which we have standardised indexes, and we include those indexes in the levels and in the squares, both contemporaneous and up to two lags. Clearly, not all these explanatory variables might be relevant, and the inclusion of irrelevant variables might have consequences on the efficiency of the estimators that, in turn, might impact the identification of the impact of the statistically relevant aspects of CSR. Therefore, we use a backward stepwise elimination procedure. In particular, we start with all the explanatory variables in the model and recover the significance tests (standard t-tests). We identify the non-significant variables at the 5% level and remove the less significant ones, i.e. the variables with the highest p-value. We repeat the procedure (estimation, t-stat computation and variable deletion) until the model contains only variables that are statistically significant at the 5% confidence level.

c) Following the previous procedure, it might happen that, at a given iteration, the lagged dependent variables are no more included in the model. For those cases, where no endogenous dependent variable is found significant ($\rho_1 = \rho_2 = 0$), we replace the dynamic panel estimation with a simple OLS analysis in the pooled dataset. We then follow

the same coefficient selection procedure described in (b) to further reduce, if needed, the number of explanatory variables to the statistically significant ones.

d) The betas and deltas parameters that remain after the model specification procedure measure the impact that a given CSR macro-category has on the given economic/financial performance variable. However, the model includes, potentially, lagged dependent terms, linear and quadratic explanatory variables. Therefore, the simple analyses of the estimated coefficients might not provide a complete picture of the impact of the various aspects of CSR on firms' economic/financial performances. In fact, the impact might be lagged, might be non-linear and might be affected by the auto-regressive dynamic of the dependent variables. Therefore, the impact is not simply related to the sign and size of the estimated coefficients. In order to test the impact of a given category of CSR on a given dependent variable, we consider a three-year horizon and define the total impact over three years as follows:

$$\frac{\partial y_{i,t,t+2}}{\partial x_{j,i,t}} = \frac{\partial y_{i,t}}{\partial x_{j,i,t}} + \frac{\partial y_{i,t+1}}{\partial x_{j,i,t}} + \frac{\partial y_{i,t+2}}{\partial x_{j,i,t}}$$

where $x_{j,i,t}$ is a given CSR normalised index (j refers to one of the seven CSR dimensions), and we measure the impact of a change in $x_{j,i,t}$ at time t on the dependent variable $\partial y_{i,t,t+2}$ (a given economic or financial performance measure for company i) both in year t as well as in years $t + 1$ and $t + 2$.

Given the model structure, we compute the quantity above as follows:

$$\frac{\partial y_{i,t}}{\partial x_{j,i,t}} = \beta_{0,j} + 2\delta_{0,j}x_{j,i,t} + \rho_1 \frac{\partial y_{i,t-1}}{\partial x_{j,i,t}} + \rho_2 \frac{\partial y_{i,t-2}}{\partial x_{j,i,t}} = \beta_{0,j} + 2\delta_{0,j}x_{j,i,t}$$

$$\frac{\partial y_{i,t+1}}{\partial x_{j,i,t}} = \beta_{1,j} + \delta_{1,j}2x_{j,i,t} + \rho_1 \frac{\partial y_{i,t}}{\partial x_{j,i,t}} + \rho_2 \frac{\partial y_{i,t-1}}{\partial x_{j,i,t}} = \beta_{1,j} + \delta_{1,j}2x_{j,i,t} + \rho_1(\beta_{0,j} + 2\delta_{0,j}x_{j,i,t})$$

$$\frac{\partial y_{i,t+2}}{\partial x_{j,i,t}} = \beta_{2,j} + \delta_{2,j}2x_{j,i,t} + \rho_1 \frac{\partial y_{i,t+1}}{\partial x_{j,i,t}} + \rho_2 \frac{\partial y_{i,t}}{\partial x_{j,i,t}} = \beta_{2,j} + \delta_{2,j}2x_{j,i,t} + \rho_1[\beta_{1,j} + \delta_{1,j}2x_{j,i,t} + \rho_1(\beta_{0,j} + 2\delta_{0,j}x_{j,i,t})] + \rho_2(\beta_{0,j} + 2\delta_{0,j}x_{j,i,t})$$

Therefore, the net effect in the three years $t, t + 1$ and $t + 2$ reduces to:

$$\frac{\partial y_{i,t,t+2}}{\partial x_{j,i,t}} = \beta_{j,0} + \beta_{j,1} + \beta_{j,2} + \rho_1(\beta_{j,0} + \beta_{j,1}) + \rho_1^2\beta_{j,0} + \rho_2\beta_{j,0} + [2(\delta_{j,0} + \delta_{j,1} + \delta_{j,2}) + 2\rho_1(\delta_{j,0} + \delta_{j,1}) + 2\delta_{j,0}(\rho_2 + \rho_1^2)]x_{j,i,t} \tag{3}$$

Eq. (3) provides the overall measure for the impact of the change in

a given aspect of CSR (a normalised index) on an economic/financial performance indicator over the three-year horizon.

The normalisation of the CSR macro-categories' variables allows us to calculate the net effect in the three years of the full engagement in a given macro-category X as a non-linear combination of the parameters estimated in the regressions (3) and setting $x_{j,i,t} = 1$. Moreover, note that whenever the endogenous dynamics parameters of the Arellano-Bond estimators are not significant (i.e. $\rho_1 = \rho_2 = 0$), Eq. (3) simplifies to:

$$\frac{\partial y_{i,t,t+2}}{\partial x_{j,i,t}} = \beta_{j,0} + \beta_{j,1} + \beta_{j,2} + 2(\delta_{j,0} + \delta_{j,1} + \delta_{j,2})x_{j,i,t} \tag{4}$$

Assuming that the estimators of the parameters are asymptotically normal, we can easily recover the asymptotic distributions for the quantities in Eqs. (3) and (4) by means of the delta method (Papke and Wooldridge, 2005). The distribution remains normal, and this allows designing a test statistic to evaluate the significance of $\frac{\partial y_{i,t,t+2}}{\partial x_{j,i,t}}$, a standard significance test. To verify if there is a statistically significant net effect over a three-year horizon of the full engagement in a given CSR macro-category (and if so, of which sign), we thus test the hypothesis $\frac{\partial y_{i,t,t+2}}{\partial x_{j,i,t}} = 0$. The impact of full engagement might be either positive or negative, as the quantities in (3) and (4) might be either positive or negative; we do not impose any restriction on the estimated coefficients. Therefore, besides a simple two-sided significance test, we design one-sided tests contrasting the null hypothesis of no impact with an alternative of a positive (or negative) impact. In our results, we provide the information on the significance of the impact of CSR as well as on the sign of the quantities in (3) and (4).

4. Results

Table 3 summarises the results of the analysis undertaken following the steps described above for the whole dataset, without disaggregating for economic sectors.

Community, Diversity, Employment and Environment are the CSR macro-categories that are the most related to economic performance, while Product is, perhaps unsurprisingly, related to it the least and related only to financial variables. When looking at economic performance indicators, the market-based measures, contrary to the accounting-based ones, are relatively more related to CSR. TSR, for instance, is positively related to almost all CSR macro-categories (the only exception is Diversity in which even though isolated CSR variables are correlated to TSR, the overall net effect of each CSR macro-category is not significantly different from zero). For the financial risk, there is almost always a negative correlation. Notice however that this is an algebraic measure showing that when the CSR macro-category increases, the financial risk reduces, which is a positive consequence for the company. For the accounting-based measures, the results are more

Table 3
Aggregate results for the whole dataset.

		Sectors							Row sum		
		CGOV	COM	DIV	EMP	ENV	HUM	PRO	+	-	TOT
Economic variables	TSR	+	+	(0)	-	+	-	+	4	2	6
	FR	-	-	-	(0)	-	(0)	-		5	5
	ROE			+					1		1
	ROA	(0) [^]		-	+	(0) [^]	+		2	1	3
	ROI	+	-	-	-	-			1	4	5
	ROS		-		+	+	-	(0)	2	2	4
	Sum								10	14	24

Each cell indicates if for the specific economic variable, the particular aspect of CSR has a significant impact over the three years and, if yes, if the sign is positive or negative. The symbol + indicates that the impact at the end of the three years is positive; - indicates that the impact is negative; (0) indicates that although there is an impact significantly different from zero for at least one of the variables (current, delayed, linear/or quadratic), we accept the null hypothesis that the net effect at the end of the three years is not significantly different from zero. [^] denotes estimators obtained from pooled OLS regressions (no endogenous correlation).

ambiguous. ROE is correlated only with Diversity. The relationships between ROA and ROS with the CSR macro-category are less univocally determined. ROI is almost always negatively correlated with the CSR indicators. In line with Friedman (1972) and Sun (2012), this seems to denote that CSR programmes increase costs without yielding sufficient monetary benefits.

Tables 4 and 5 show the results disaggregated per sector, grouped for sectors and for CSR macro-categories, respectively.

Looking at Table 4, we can see that companies in the Oil & Gas Sector show the highest number of correlations to CSR macro-categories, with 28 non-null relationships between CSR macro-categories and economic performance variables. A possible rationale might be that the Oil & Gas sector has a complex set of social institutions, norms and expectations. Some of these expectations take the form of legal requirements, but others reflect ethical norms that may turn out to be as important to companies in the long run as laws (Spence, 2010). Society might look at the Oil & Gas sector suspiciously, since it is an industry that imposes many externalities onto society—air pollution, oil spills, social dislocation and conflicts. This leads governments, NGOs and people to pay close attention to the companies in this sector and, as a response to these external pressures, the companies tend to invest in CSR and engage with both environmental issues like emission reduction programmes and non-environmental issues like human rights, educational opportunities and workplace/employment practices. Beyond the Oil & Gas sector, the sectors that show a rather high number of correlations with CSR are Financial, Consumer Goods and Industrial, followed by Consumer Services and Utility. The sectors showing the least correlation are Technology, Health Care and Basic Materials with 16, 15 and 12 correlations, respectively. For Consumer Goods and Consumer Services, the CSR macro-category of Community is the most correlated to the economic performance variables, while for Financial and Industrials, Governance is the most related. For companies in the Health Care sector, there are few correlations between CSR and economic performance variables, with the notable exception of the CSR macro-category of Product: indeed, it is the sector that has the highest correlation for this CSR macro-category among all the sectors. In the Utilities sector, most correlations are negative, while for the other sectors there is no clear pattern in the correlations, with perhaps the exception of the Oil & Gas sector with 18 negative and 10 positive correlations. For all sectors, looking at the sign of correlations, different patterns emerge when comparing financial variables with accounting variables. For financial variables, whenever there is a significant correlation, this is almost always positive (remember that for financial risk, a negative correlation means that there is a reduction in the risk, i.e. a positive impact). On the contrary, for the accounting variables, the evidence is more mixed.

Table 5 presents results grouped by the CSR macro-categories. TSR has a positive relationship with the CSR macro-categories of Governance and Community and, to a lesser extent, with Diversity and Human rights. There is hardly any correlation for the other CSR macro-categories. Further, for Financial Risk, we can say that an improvement in each of the CSR macro-categories leads to a risk reduction; the only exceptions are the CSR macro-category of Human Rights and Environment for the Consumer Service and Consumer Goods sectors. There is also an increase in risk for the Consumer Goods sector when the CSR macro-category Diversity rises, and this is true also for the Basic Materials sector. The accounting-based measures show more ambiguous results compared with the market-based ones in terms of numbers and signs of correlations. Indeed, there are 36 and 30 correlations between ROS, ROI and CSR macro-categories, respectively, a comparable number of correlations for financial variables and a much smaller number of correlations for ROE and ROA. The pattern of the signs is much less clear. The numbers of positive and negative correlations are almost evenly distributed within CSR macro-categories for accounting-based measures. Even if ROE, ROA and ROS seem to be relatively more negatively correlated to all CSR macro-categories, while for ROI it is the

Table 4
Aggregate results grouped by sector.

Economic Variables	Sectors												Row sum																				
	Financials			Industrials			Consumer Services			Technology			Consumer Goods			Health Care			Utilities			Basic Materials			Oil & Gas								
	C	D	G	C	D	G	C	D	G	C	D	G	C	D	G	C	D	G	C	D	G	C	D	G	C	D	G	C	D	G			
TSR	+	(0)	-	+	-	-	+	(0)	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	21	6	27
FR	-	-	-	-	-	-	-	(0)	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	36	43
ROE																															8	10	18
ROA	(0)	+	+	+	+	+	+	(0)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	8	13	21
ROI	+	-	-	+	+	+	+	(0)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	18	12	30
ROS	+	+	+	+	+	+	+	(0)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15	21	36
sum	77	98	175	10	12	10	7	9	10	12	10	10	8	7	7	3	15	15	5	7	7	5	7	7	10	18	18	77	98	175			
TOT +	13	10	10	10	12	10	7	9	10	12	10	10	8	7	7	3	15	15	5	7	7	5	7	7	10	18	18	77	98	175			
TOT -																																	

Each cell indicates if for the specific economic variable, the CSR dimension (row) in that sector (column) has a significant impact over the three years and, if yes, if the sign is positive or negative. The symbol (+) indicates that the impact at the end of the three years is positive; (-) indicates that the impact is negative; (0) indicates that the impact is not significantly different from zero. The total shows the total number of times in which there is a significant impact for each sector (column) and for each CSR dimension (row). ^ denotes estimators obtained from pooled OLS regressions (no endogenous correlation).

between performance measures, sectorial activities and CSR measures. We welcome future research on this.

Nevertheless, the analyses performed here point out the importance of considering sectorial specificities when assessing the empirical relationship between CSR and firms' performance. We call for further theoretical research that focuses on each sector to account for and explain the different and somehow unclear pattern of relationships that we discovered. In particular, these studies should consider how sector differences in firms' types, natures and sizes, product chains, working environments, level and types of innovations and other variables

Appendix A. MSCI ESG KLD STATS Social Performance Indicators

The table below presents a summary of the methodology of the MSCI ESG KLD STATS Database. It is composed of seven CSR macro-categories, each of which is represented by an indicator that is constructed by summing up the answers to a list of entries that refer to each positive and negative indicator of each dimension. The researchers working on MSCI ESG KLD STATS make these evaluations based on a mix of sources (macro data from academic, government and NGO datasets; company disclosure; 1600+ media, NGO other stakeholder sources, surveys). Companies are invited to participate in a formal data verification process. The scoring rule of each entry is 1 if the company complies with the given criterion, 0 if it does not NR if it is not reached. For instance, if a company has a good social reporting system, it receives a 1 in the macro-category of Governance for its strengths. The sum of all the 1 s in each category yields the score of a company in that year for the macro-category of Governance—Strengths. The list of entries changes over time. The following table summarises these entries for each category and for the last available year. For further reference, see: https://www.msci.com/eqb/methodology/meth_docs/MSCI_KLD_400_Social_Index_Methodology_May_2016.pdf

Table 6
Summary of MSCI ESG KLD STATS CSR macro-categories.
Source: Our elaborations on KLD data.

Positive performance indicators analyse if the company	Negative performance indicators analyse if the company
<p>Governance</p> <ul style="list-style-type: none"> • Has a good social reporting system; • Has limited level of compensation to its top manager or its board members; • Owns the 20%–50% of another social responsible company (according KLD); • Has an accountability system based on transparency; • Supports public policy; • Has an anti-corruption policy, a compliance program, an ethical business practices and transparency around government spending; • Increases regulatory scrutiny as a result of its contribution to systemic risk in financial market; • Has other initiatives not covered by KLD indicators. <p>Community</p> <ul style="list-style-type: none"> • Has made generous donations to charities; • Supports non-profit organisations; • Has public private partnership to support housing initiatives; • Has a program to support primary and secondary education; • Brings contribution in non US country; • Has volunteer programs; • Has other programs not covered by KLD indicators. <p>Diversity</p> <ul style="list-style-type: none"> • Has a woman or a member of a minority group as chief executive officer; • Has at least one woman inside the executive management team; • Has women inside the board of directors; • Has introduced work/life benefits; • Has contracts with women and/or minority-owned businesses; • Has an innovative hiring program for disable; • Has policies toward its gay and lesbian employees; • Promotes diversity in its workforce; • Has other programs not covered by KLD indicators. 	<ul style="list-style-type: none"> • Has high level of compensation to its top manager or its board members; • Has been involved in tax disputes; • Owns the 20%–50% of a company involved in social concerns (according KLD); • Has been involved in accounting system controversies; • Has an incomplete social reporting system; • Has been involved in controversies about public policies and has a not transparent reporting system; • Does not support public policies; • Has few severity about controversies related to a firm's corporate governance practices; • Has been involved in bribery and fraud cases; • Has other concerns not covered by the above indicators. <ul style="list-style-type: none"> • Is a financial institution, whose lending or investment practices have led to controversies; • Has controversies born by the interaction with society; • Has been involved in tax disputes; • Has other concerns not covered by KLD indicators. <ul style="list-style-type: none"> • Has controversies related to workforce diversity; • Has no women on its senior line managers; • Has no women on its board of directors; • Has no minorities on its board of directors; • Has other concerns not covered by KLD indicators.

Employee relations

- Has no-layoff policies;
 - Has strong retirement benefit programs;
 - Has employees' compensation and benefit programs;
 - Has practices to develop employees' relations;
 - Has employees training and develop programs;
 - Has human capital develop programs;
 - Has labour management programs;
 - Has human right policies and initiatives;
 - Has other programs not covered by KLD indicators.
- Has controversies related to firm's union relations practices;
 - Has controversies related to the health and safety of a firm's employees;
 - Has workforce reduction programs;
 - Has inadequate retirement benefits programs;
 - Has controversies related to workers' conditions;
 - Has child labour controversies;
 - Has controversies related to a firm's labour-management relations;
 - Has other concerns not covered by KLD indicators.

Environment

- Has a positive environmental impact and invests in green technologies;
 - Has programs to reduce emissions and wastes;
 - Has recycling programs;
 - Invests in low carbon technologies;
 - Has environmental reports;
 - Maintains its properties, plants and equipment with above average environmental performance for its industry;
 - Has an environmental management system;
 - Has a water management strategy;
 - Has programs regard biodiversity, land use, community impact;
 - Has environmentally intensive agricultural raw materials, sustainable sourcing policies, commitments, certifications;
 - Includes ESG risk management policies into company's structure;
 - Puts effort to increase green building certifications across portfolios of real estate assets;
 - Develops renewable power production;
 - Develops program to collect and recycle electronic waste (only for the company that produce and sell electronic products);
 - Has programs to reduce the energy consumption over time;
 - Has programs to reduce carbon footprint;
 - Integrates climate change risks into product strategy and risk management process;
 - Has other programs not covered by KLD indicators.
- Has paid penalties for waste management violations;
 - Has paid penalties due to non-compliance with U.S. environmental regulations;
 - Is the top manufacture of ozone depleting chemical;
 - Has controversies related to accidental spills or release;
 - Produces agricultural chemicals (pesticides, etc.);
 - Has insufficient energy policies and initiatives;
 - Has controversies related to the environmental impact of firm's products and services;
 - Has a negative environmental impact;
 - Has controversies regards firm's non-hazardous and non-toxic operational waste;
 - Uses inputs that have a negative environmental impact;
 - Has inadequate water management practices;
 - Has other concerns not covered by KLD indicators.

Human rights

- Has positive record in South Africa;
 - Has labour right innovative initiative.
- Has controversies about its operations in South Africa;
 - Has operations in Northern Ireland;
 - Supports controversial regimes;
 - Has operations in Mexico;
 - Has low labour standards in its supply chain;
 - Has been involved in controversies about the indigenous people;
 - Has operations in Sudan;
 - Damages in any way Civil Liberties;
 - Violates human rights;
 - Has other concerns not covered by KLD indicators.

Product

- Has safe and quality products;
 - Has a leader in its industry for R&D;
 - Provides social opportunity access;
 - Provides finance access;
 - Provides communications access;
 - Provides opportunities in health and nutrition access;
 - Has chemical safety products;
 - Has financial safety products;
 - Provides products protect by privacy and data security;
 - Invests responsibly;
 - Insures health and demographic risks;
 - Has other programs not covered by KLD indicators.
- Has controversies related to the quality and/or safety of products;
 - Has controversies related to firm's marketing and advertising practices;
 - Has anticompetitive business practices;
 - Has controversies related to how the company treated its customers and its prospects.

Appendix B. Cross-correlations Analysis

The following table reports the aggregate results of the cross-correlation analysis. We write dependent variables in columns and independent variables in rows, and we consider only values not included between the range – 0.6 and 0.6. To simplify the reading of the table, we do not report values but simply indicate sectors for which the value respects the condition specified above. The sectors have been denoted as follows:

- 0: the entire database;
- A: Financial sector;
- B: Industrial sector;
- C: Consumer Services sector;
- D: Technology sector;
- E: Consumer Goods sector;
- F: Health Care sector;
- G: Utilities sector;
- H: Basic Materials sector;
- I: Oil & Gas sector

As we can see from the table, the accounting-based measures especially show an “instantaneous” relationship between the two time-series but also a delayed and distributed relationship across the years—this is a case of ROI and ROS indicators. The Financial Risk is related to CSR indicators at time $t + 2$, especially for the category Diversity; in fact, almost all sectors show a delayed response.

Table 7
Aggregate results for cross section analysis.

	LAG	Total stock return	CGOV	CGOV ²	COM	COM ²	DIV	DIV ²	EMP	EMP ²	ENV	ENV ²	HUM	HUM ²	PRO	PRO ²
Total stock return	-2															
	-1															
	0	1.0000														
	1															
	2			I												
Financial risk	-2															
	-1															
	0	1.0000							E						I	I
	1															
	2			D, I	D, I	A	A, G	0, A, B, D, E, F, G, H, I	0, A, D, E, F, G, H, I	A	D	D, E	E	C, E		
ROE	-2			C					G							
	-1			C		B							F	F	B	B
	0	1.0000							E, H	E	E	E			E	E
	1								E	E					E	E
	2						0	0							E	
ROA	-2								C, G	C						
	-1										D		E	E		
	0	1.0000							B, D	B, C, D	D		E	E		
	1			H	0	0, E	0	0	A	A, B						
	2						B	A				C		C		
ROI	-2							G	G		I	I				
	-1	D, E							I		E, I	E, I		G	I	
	0	1.0000					H, I	H, I	I	I	E	E	E, I	E, I		
	1	D, E					F	F	E	B, E	D, E	D			E	E
	2						0, B, D	0	E		D	0, C, D	D	D	E	E

ROS	LAG	ROS	CGOV	CGOV^2	COM	COM^2	DIV	DIV^2	EMP	EMP^2	ENV	ENV^2	HUM	HUM^2	PRO	PRO^2
	-2										H, I	I	B, C		E	E
	-1	0, B, C, D, E, F, H					H		H		0, B, C, E, F, H	0, B, F, H	0, B, C, D, F, H	0, B, D, F, H	B, C, E	B, C, E
	0	1.0000	0, A, B, C, E	0, C, E, H				E	0, B, C, E, H	0, B, E, H	0, A, C, E, F, H	0, B, C, F, H	0, A, B, D, F, H, H	0, B, D, F, H	0, B, C, E, G	0, B, C, E, G
	1	0, B, C, D, E, F, H		0					0, B, C, E, F, G, H	0, E, H			0, A, 0, A, B, H	E	E, G	
	2												A			

Appendix C. MSCI ESG KLD STATS Missing Observations

Table 8

Missing observations for entries that were used to form the normalised indicator in Eq. (1) (0 means that there was no missing observation for that entry in that year; - means that the specific entry in that year has been removed from the calculation. The table does not report the entries that were discontinued after some years or that were activated after the beginning of the sample observation).

MSCI KLD STATS 2015 Data set: ESG indicators - column headers	Year initiated	Missing 2010	Missing 2011	Missing 2012	Missing 2013	Missing 2014	Missing 2015
ENV-str-A	1991	308	292	-	-	-	-
ENV-str-B	1991	219	196	64	43	228	77
ENV-str-D	1991	2	0	202	339	242	72
ENV-str-G	2006	2	0	-	-	-	-
ENV-str-H	2012	0	0	4	37	249	87
ENV-str-X	1991	26	6	-	-	-	0
ENV-con-H	2010	250	232	0	0	0	0
ENV-con-I	2010	301	282	0	0	0	0
COM-str-H	2010	152	-	-	-	245	0
COM-con-B	1991	1	0	0	0	0	1
HUM-str-X	1994	4	1	-	-	-	-
EMP-str-A	1991	-	-	-	-	184	0
EMP-str-C	1991	-	-	-	-	183	-
EMP-str-D	1991	-	-	-	-	65	341
EMP-str-G	2003	3	0	64	45	247	80
EMP-str-H	2010	4	0	-	-	-	-
EMP-str-L	2012	0	0	10	-	-	-
EMP-str-M	2013	0	0	0	29	184	221
EMP-str-N	2013	0	0	0	-	-	-
EMP-str-X	1991	2	0	0	0	-	333
DIV-str-B	1991	-	-	0	0	0	524
DIV-str-C	1991	-	-	5	0	0	0
DIV-con-C	2010	2	0	0	0	0	0
PRO-str-A	1991	18	10	387	-	-	-
PRO-str-C	1991	250	252	0	0	0	0
PRO-con-D	1991	239	240	0	0	0	0
PRO-con-E	1991	2	0	0	0	0	0
PRO-con-G	2015	0	0	0	0	0	1

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