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Corporate social responsibility and dimensions of performance: An application to U.S. electric utilities

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ABSTRACT

This paper investigates the relationships among performance dimensions associated with corporate social responsibility (CSR) focusing on the U.S. electric utility sector. Results of a statistical copula approach suggest that economic performance of utilities is compatible with environmental, social, and governance performance, The CSR model has the potential to help U.S. electric utilities become better corporate citizens.

1. Introduction

The ways in which businesses interact with society has evolved over time. This evolution is reflected in alternative normative theories of the firm. According to the Ownership Theory, shareholder interests should be prioritized by using corporate resources to increase profits (Jensen, 2001). According to the Stakeholder Theory, a firm's objective is to create value for society (Donaldson and Preston, 1995), reflected by the integration of social demands into business plans. Relative to the Ownership Theory, the Stakeholder Theory frames firm management within a wider context and requires a reformulation of the corporate objectives (Evans and Freeman, 1988). Specifically, it identifies the stakeholders, who are the individuals and groups that have an interest or concern in the firm (employees, customers, suppliers, creditors, the community, investors, regulators, policymakers, etc.), and considers them to have both the right and obligation to participate in the firm management. The main objective of the company should be the flourishing of all stakeholders (Werhane and Freeman, 1999). Some authors, such as Jensen (2001), disagree with firms having this multidimensional objective, as it may create confusion and disorder and preclude effective decision-making.

Corporate Social Responsibility (CSR) Theory is a hybrid "*whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis*" (Commission European, 2001, p. 6). The goal of CSR is to align the financial activities of the company with social objectives. While there is no universal characterization of the CSR, it is usually regarded as a four-dimensional concept. The economic dimension relates to the direct and indirect financial performance of the firm. The environmental dimension concerns the impact of business activity on natural ecosystems. The social dimension includes issues related to the quality of life for employees, customers, and future generations (Ioannou and Serafeim, 2012a) (Ioannou and Serafeim, 2012a). Finally, the corporate governance dimension deals with relationships among directors, managers, and other stakeholders.

According to CSR Theory, a firm has four main responsibilities in

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decreasing order of priority: the economic, the legal, the ethical, and the philanthropic. After meeting the top obligation, attention is turned progressively to the remaining obligations as long as they do not compromise the financial viability of the firm. The logic behind this prioritization is that if a firm goes out of business, it will be unable to meet its other obligations, including the philanthropic ones (Brusseau, 2011).

Interest in CSR has gained ground with increasing societal demands for firms to take responsibility for their social impacts and serve the general interest and not just the one of the shareholders minority (Blair, 1996; Wagner-Tsukamoto, 2006). An increasing number of firms have changed their business models to reflect CSR concepts. While these changes were initially aimed mainly at including environmental and social targets (Du et al., 2011), more recently, firms have also become interested in the way they interact with stakeholders. Further, CSR has evolved from being considered detrimental to a firm's profitability, to be regarded as a potential competitive advantage, at least in the long-run (Castelo Branco and Lima Rodriques, 2007; Porter and Kramer, 2002).

These trends in the business world have brought about fundamental changes in the way that firm performance is measured. To the extent that viewing a corporation's financial prosperity in isolation from social, environmental, and governance practices is no longer acceptable, financial indicators have become insufficient for assessing firm performance (Hansen and Wernerfelt, 1989; Porter and der Linde, 1995). The 1990s saw an expansion in corporate reporting of social information. In 1997, the U.S.-based Coalition for Environmentally Responsible Economies (CERES) and the United Nations Environmental Program (UNEP) launched the Global Reporting Initiative (GRI) to develop economic, environmental, and social reporting guidelines (Ioannou and Serafeim, 2012b). The objective was to place sustainability reporting at the same level as financial reporting.

Given the central role that CSR can play in new business models, a considerable body of literature has been devoted to examining the "why" question, that is, why do firms change their business model to become better corporate citizens (Garay and Font, 2012; Matten, 2006), and the "what" question, that is, what is CSR (Matten and Crane, 2005). The question of "how" CSR affects business performance remains the most elusive one despite a relevant number of studies in this area. While some studies conclude that a positive relationship exists between CSR and financial performance (Berman et al., 1999; Roshayani et al., 2009; Brammer and Pavelin, 2006; Carmeli et al., 2007; Saeidi et al., 2015; Waddock and Graves, 1997), other findings suggest that social commitments can lead to relatively high costs and eventually erode financial results performance (Cornell and Shapiro, 1987; Friedman, 1970; Lima Crisóstomo et al., 2011; Teoh et al., 1999).

Our analysis sheds light on this debate by studying a sample of the major U.S. electric utilities from 2005 to 2016. Although several studies have assessed the relationship between financial performance and CSR, few have examined this relationship in the context of a single industry (Peloza, 2009). Given the heterogeneity in the economic, environmental, social, and governance dimensions across different industries, aggregate studies may lead to misleading results. To our knowledge, this article is the first focusing on the role of CSR in the U.S. electric utility industry, a $377 billion industry that employs more than 500,000 workers.[1] The strategic relevance of this industry is undisputable, as electricity makes all other economic activities possible, from agriculture, to manufacturing, to telecommunications. The electric industry's economic relevance is matched by its environmental impacts, as the sector is responsible for 29% of greenhouse gas emissions in the United States (US EPA, 2017). As a result, it is relevant to assess the financial implications of electric utilities becoming better corporate citizens along the environmental dimension.

2. Literature review

According to Arrowsmith and Maund (2009), CSR is one of the major developments affecting businesses over the last decade. The influence of CSR on firm financial performance has been found to be contingent as opposed to universal (Ullmann, 1985; Wang et al., 2016) and to vary across different operational environments. Consequently, the relationship between corporate social performance (CSP) and corporate financial performance (CFP) is likely to depend on different institutional factors such as public and private regulations or the degree of market development (Campbell, 2007; Wang et al., 2016). While regulations are likely to promote adoption of CSR practices, more loosely regulated environments will encourage firms to behave more irresponsibly. Wang et al. (2016) conduct a meta-analysis that considers the influence of the operational environment on the relationship between CSP and CFP and conclude that, overall, CSR enhances financial results, being the link stronger in developed economies relative to less developed ones.

In his meta-analysis comprising 159 studies during a period of 36 years (1972–2008), Peloza (2009) investigated the relationship between CSP and CFP, concluding that 77% of the examined articles do not identify the economic sectors studied. To the extent that the institutional context influences CSP and CFP, the relationship between the two shall vary across different economic sectors (Reed, 1999). Our analysis focuses on the U.S. electric utility sector. As concern about the environmental impact of economic activities has gained momentum and given that the electric utility industry is one of the most polluting, the environmental performance of electric utilities has become a highly relevant research area (Masters, 2013). In contrast, other CSR dimensions have received almost no attention.

Sueyoshi and Goto (2009) investigated the impact of environmental expenditures and investments on the CFP of the U.S. electric utility industry. Environmental expenditure is measured by the environmental protection cost, environmental investment is measured by the total amount of investment for environmental protection facilities, and CFP is measured by return on assets. Using firm-level data and regression analysis for a sample of 167 utilities observed from 1989 to 2001 the authors find that environmental expenditures under the U.S. Clean Air Act have had a negative impact on CFP. In contrast, environmental investments have had no significant impact.

Gollop and Roberts (1983) investigated the effect of sulfur dioxide emission restrictions on the rate of productivity growth of the U.S. electric power industry during the period 1973 to 1979. Based on a cost function, their results suggest a negative relationship, as regulations generate higher costs and reduce the rate of productivity growth. Filbeck and Gorman (2004) analyzed the link between environmental and financial performance of 24 firms from the IRRC/S&P 500 electric company industry from 1996 to 1998. Environmental performance is based on five indices prepared from a raw dataset: hazardous waste clean-up, permit restriction, toxic chemicals, reported spills, and a compliance index. Using regression models, their results suggest a negative relationship.

Moving beyond the environmental dimension of CSR, Zhou and Wei (2016) assess the influence of the Chinese Renewable Energy Law on the relationship between the different CSP dimensions and CFP in the Chinese energy sector. Using a panel data of 26 renewable energy companies observed during 13 years (2001–2013),

[1] http://www.eei.org/resourcesandmedia/industrydataanalysis/industrydata/Pages/default.aspx. accessed April 15, 2016.

they conclude that the Renewable Energy Law has promoted a positive link between CSP and CFP. Outside the boundaries of the electric utilities sector, several studies have considered how the different dimensions of CSR influence CFP. Mayer (1997, p. 8) notes that "Despite the intense debate, evidence on the effects of different governance systems is still sparse." Some research findings support that promoting stakeholder engagement generates a positive image within the community, allowing firms to attract high quality employees (Cerin and Reynisson, 2010; Humphrey et al., 2012; Maditinos et al., 2011). Good corporate reputation is important (Eberl and Schwaiger, 2005; Fernández-Gámez et al., 2016) and positive portrayals in popular business magazines can positively impact CFP (Filbeck et al., 2013).

From a statistical perspective, linear regressions and correlations have been widely used to assess relationships. However, these methods involve endogeneity issues that are not always acknowledged and addressed and that can lead to inconsistently estimated regression coefficients (Hamilton and Nickerson, 2003). Research that studies the link between CSR and financial performance is plagued with endogeneity issues because the decision to engage in CSR is correlated with the error term (Bénabou and Tirole, 2010). Garcia-Castro et al. (2010) show how results on the relationship between CSP and CFP may be reversed when endogeneity is properly taken into account. Further, both linear regression and linear correlation methods may be misleading if dependencies are characterized by nonlinearities and/or non-normality (Manasakis et al., 2014; Manescu and Staricad, 2010; Nollet et al., 2015). Endogeneity issues can be addressed by estimating a simultaneous equation system (Al-Tuwaijri et al., 2004), which requires adopting a multivariate statistical distribution. The most commonly used multivariate statistical distributions are the normal and the Student's t. However, these have been shown to usually misrepresent real data. Our methodological approach seeks to improve on these shortcomings.

3. Methodology

To our knowledge, no one has assessed mutual relationships among the economic, environmental, social, and corporate governance dimensions of CSR within the U.S. electric utility sector. Lack of standardized data that allows comparing across firms is one of the main reasons. Our analysis uses a dataset that comprises 19 U.S. investor-owned electric utility holding companies observed from 2005 to 2012 and covers the four main pillars of CSR.

Statistical copulas are used in this study to assess the relational structure between the different CSR dimensions in the U.S. electric utility sector. A copula is a multivariate probability distribution function whose one-dimensional marginals are uniform and that is used to characterize dependence between random variables (Nelsen, 1999, p. 5). The copula approach adopted in our article does not rely on endogeneity-exogeneity assumptions, allows for nonlinear and non-normal dependencies, and does not require us to adopt any multivariate distribution function. The methodological approach adopted in this research thus represents a significant contribution to a literature that has mainly relied on linear regression models to assess the links between CSP and CFP.

Copulas are based on the Sklar's theorem (Sklar, 1959), that shows that any multivariate distribution function can be decomposed into the marginal cumulative distribution functions and a copula function which captures the relational structure between the components. Let F_1 and F_2 be two univariate continuous distribution functions of two random variables (x_1, x_2). The copula of (x_1, x_2) is the joint distribution function of $u_1 = F_1(x_1)$ and $u_2 = F_2(x_2)$, where u_1 and u_2 are the probability integral transforms of x_1 and x_2 and are distributed as Uniform (0,1). According to the Sklar theorem, there exists a unique copula C that can be expressed as:

$$H(x_1, x_2) = C(F_1(x_1), F_2(x_2)) = C(u_1, u_2) \tag{1}$$

where $C(u_1, u_2)$ is a bivariate distribution function with marginal distributions F_1 and F_2. The multivariate probability density function can be expressed as follows:

$$f(x_1, x_2) = c(u_1, u_2) f_1(x_1) f_2(x_2) \tag{2}$$

where c is the copula density and $f_1(x_1)$ and $f_2(x_2)$ are univariate density functions.

Copulas are used to investigate the relationships between the different dimensions of CSR. More specifically, this research aims at assessing the relationship between economic performance $(x_{1,t})$ and the environmental $(x_{2,t})$, social $(x_{3,t})$, and corporate governance $(x_{4,t})$ dimensions of performance. As a result, we focus on the following three joint probability distributions:

$$H(x_1, x_2) = C(F_1(x_1), F_2(x_2)) \tag{3}$$

$$H(x_1, x_3) = C(F_1(x_1), F_3(x_3)) \tag{4}$$

$$H(x_1, x_4) = C(F_1(x_1), F_4(x_4)) \tag{5}$$

A variety of copulas are considered. Different copulas include the Gaussian, T-student, Clayton, Gumbel, Frank, BB1, and BB7. These copulas allow for a wide variety of relational structures, including both positive and negative relationships and a wide range of upper and lower tail dependence, including asymmetric or symmetric tail dependence. While the Gaussian and the Student's t, belong to the class of Elliptical copulas, the rest of the copulas considered belong to the Archimedean copula group. Due to space limitations, we do not offer the density functions of the different copulas. Interested readers are directed to Joe (1997) and Nelsen (2006).

Tables 1 and 2 below show the most relevant properties of the elliptical and Archimedean copulas considered in this study, respectively. More specifically, the parameters of each copula and their value range are presented. Since different copulas imply different parameters that are not directly comparable, Tables 1 and 2 also present the equivalent Kendall's τ, which measures dependency in the central area of the bivariate distribution, as well as the corresponding lower and upper tail dependency measures in order to compare across copulas. For each pair of CSR dimensions, the optimal copula is chosen based on the Goodness of Fit (GoF) tests described below.

Copula parameters are estimated using maximum likelihood techniques. Let β denote the vector of marginal parameters and α be the vector of the copula parameters. Let $\theta = (\beta, \alpha)$ be the parameter vector to be estimated. The log-likelihood function is given by (6).

$$l(\theta) = \sum_{i=1}^{n} \log c\, \{F_1(x_{i1}; \beta), F_2(x_{i2}; \beta); \alpha\} + \sum_{i=1}^{n} \sum_{J=1}^{2} \log f_j(x_{ij}; \beta) \tag{6}$$

The ML estimator of θ is. $\widehat{\theta}_{ML} = \underset{\theta \in \Theta}{\text{argmax}}\ l(\theta)$.

GoF tests assess the discrepancy between an estimated copula model and the unknown true copula and are used to select the best copula for each pair of variables. In this article we use the Crámer-Von Mises (CvMc) and Kolmogorov-Smirnov (KSc) test statistics and their p-values derived from bootstrapping. The latter are copula GoF tests based on Kendall's process for bivariate data, as

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Table 1
Properties of bivariate elliptical copulas considered in this study.

Elliptical Copulas	Parameter range	Kendall's τ	Tail dependence (Lower, Upper)
Normal	$\rho \in [-1, 1]$.	$\frac{2}{\pi}\arcsin(\rho)$	(0,0)
Student-t	$\rho \in [-1, 1], \ \nu > 2$	$\frac{2}{\pi}\arcsin(\rho)$	$\left(2T_{\nu+1}\left(-\sqrt{\nu+1}\sqrt{\frac{1-\rho}{1+\rho}}, \ 2T_{\nu+1}\left(-\sqrt{\nu+1}\sqrt{\frac{1-\rho}{1+\rho}}\right)\right.\right.$[a]

[a] Where $T_{\nu+1}$ is the cumulative distribution function of the univariate Student-t distribution with $\nu+1$ degrees of freedom.

Table 2
Properties of bivariate Archimedean copulas considered in this study.

Archimedean copula	Parameter range	Kendall's τ	Tail dependence (Lower, Upper)
Frank	$\theta \in \mathbb{R} \backslash \{0\}$	$1 - \frac{4}{\theta} + 4\frac{D_1(\theta)}{\theta}$	$(0, \ 0)$
Gumbel	$\theta \geq 1$	$1 - \frac{1}{\theta}$	$\left(0, \ 2 - 2^{\frac{1}{\theta}}\right)$
Clayton	$\theta > 0$	$\frac{\theta}{\theta+2}$	$\left(2^{-\frac{1}{\theta}}, \ 0\right)$
BB1	$\theta > 0, \ \delta \geq 1$	$1 - \frac{2}{\delta(\theta+2)}$	$\left(2^{-\frac{1}{\delta\theta}}, \ 2 - 2^{\frac{1}{\delta}}\right)$
BB7	$\theta \geq 1, \ \delta > 0$	$1 + \frac{4}{\delta\theta}\int_0^1 \left(-(1-(1-t)^{\theta})^{\delta+1} \times \frac{(1-(1-t)^{\theta})^{-\delta} - 1}{(1-t)^{\theta-1}}\right) dt$	$\left(2^{-\frac{1}{\delta}}, \ 2 - 2^{\frac{1}{\theta}}\right)$

investigated by Genest and Rivest (1993) and Wang and Wells (2000). These tests can be expressed as follows: $CvMc = \sum_{i=1}^{T}\{C(u_1, u_2\widehat{\theta}_T) - \widehat{C}_T(u_1, u_2)\}^2$ and $KSc = \max_t \left|C(u_1, u_2\widehat{\theta}_T) - \widehat{C}_T(u_1, u_2)\right|$.

Finally, we also rely on the Vuong (1989) and Clarke (2007) tests, which compare nonnested models and constitute an alternative to likelihood ratio specification tests. Based on Vuong (1989) and Clarke (2007), Belgorodski (2010) provides a selection test for bivariate copulas. The test compares a bivariate copula C_0 to all other possible bivariate copula models taken into account, in order to determine which fits the data best. If a copula C_0 is favored over another copula, it gets a score of $+1$. A score of -1 is assigned if the other alternative copula is identified to be better. The total score is the sum of the scores from all pairwise comparisons. Further details on the selection tests can be found in the cited literature.

4. Empirical approach

Our research uses data from Thomson Reuters (ASSET4 dataset).[2] The dataset provides objective, auditable, and comparable financial and extra-financial information for a sample of global firms. Based on the definition and collection of over 250 key performance indicators (KPIs), ASSET4 measures firm performance by distinguishing among the four CSR main pillars: economic, environmental, social, and corporate governance. The economic performance score is based on client loyalty; financial performance; and shareholders' loyalty. The environmental performance score is based on the reduction of resource use by the firm; emission reduction; and product innovation. The social score is based on indicators of employment quality; health and safety; training and development; diversity; human rights; community; and product responsibility. Finally, the corporate governance indicator is based on information on board structure; compensation policy; board functions; shareholder's rights; vision and strategy.

Performance scores are equally weighted computations of the relative performance of the firm, being the benchmark the ASSET4 universe. Performance scores are then z-scored and normalized so that they lie between 0 and 100%. ASSET4 is strictly built on publicly available information, including firm sustainability reports, company websites, annual reports, proxy filings, news of major providers, as well as NGOs, and the Carbon Disclosure Project (Thomson Reuters, 2013). In this study, we focus on 19 U.S. investor-owned electric utility holding companies (see Table 3) observed from 2005 to 2012.[3] Collectively, these 19 firms account for more than 57 million customers in the United States, represent more than 40% of the total electric utility industry revenue, and account for more than 16% of sales from renewable energy resources in the United States.

Table 4 shows the summary statistics for the economic, environmental, social, and corporate governance scores for our sample of U.S. electric utilities from 2005 to 2012. While there is slight evidence of skewness and kurtosis, the Jarque-Bera test suggests a normal distribution for most of the scores at the 5% significance level.

Fig. 1 shows the evolution of sample average scores over time. The economic score is the lowest and is characterized by an increasing trend and the highest volatility. Economic performance volatility over time can be explained by the fact that electricity production costs and prices are variable, as electricity is a non-storable product and companies may need a few years to adapt their operations to supply and demand shifts (Graves et al., 2007). The smaller volatility of the non-economic CSR dimensions is indicative of more stable and long-term practices in these areas. The social score follows closely the economic score at a slightly higher level. With a much flatter trend, environmental performance starts at a higher level, but shows less improvement over time. There seems to be a convergence in the economic, environmental. and social performance dimensions over time, at around 70–75%. The corporate governance scores, notably above the rest, show a mild improvement over time as well as little variability.

Table 5 shows the results of the relational assessment between the economic and the non-economic CSR dimensions by year (Table 6 reports the copula selection tests). All Kendall's τ dependencies are positive and show a stronger link of economic

[2] Founded in 2003, ASSET4 is a private Switzerland-based firm (Goldman Sachs and Bank of America Merrill Lynch), and was acquired by Thomson Reuters in 2009.

[3] The 2012 series presents only 12 firms. This is not the choice of the authors but rather the data were not available through DataStream in 2013.

Table 3
Revenues, Sales and Customers of sample Electric Utilities compared to the whole U.S. Electricity Market in 2012.

	Revenues (Thousands Dollars)	Sales (Megawatt/hours)	Customers (Count)	Renewable Electricity Sales (Megawatt/hours)
Duke Energy	17.697.71	205.843.04	7.130.32	6.775.40
Exelon	9.182.60	158.350.80	6.648.89	4.700.00
Southern	14.187.01	156.054.01	4.432.19	71.32
First Energy	8.392.16	146.655.78	5.982.08	3.318.80
American Electric Power	14.945.00	137.865.32	4.233.24	3.649.65
Entergy	7.293.83	107.006.91	2.778.02	682.57
NextEra Energy, Inc.	9.745.55	102.127.93	4.576.42	1.318.43
Xcel	7.419.14	89.197.69	3.417.33	16.157.01
Edison International	11.121.83	86.480.01	4.941.08	14.415.20
PPL Corporation	3.899.78	66.922.74	2.338.93	1.130.46
Pepco holdings	3.636.44	48.145.83	1.840.48	1.623.97
DTE Energy	5.187.92	47.990.73	2.129.92	1.989.41
Public Service Enterprise Group Inc.	3.972.20	41.641.44	2.164.59	2.051.41
Pinnacle West Capital Corporation	3.055.49	28.154.14	1.132.30	1.507.02
AES	2.105.49	28.014.22	984.04	148.75
Wisconsin Energy Corporation	2.944.99	27.043.20	1.123.78	1.532.20
Alliant Energy	2.348.75	25.732.53	986.76	1.391.00
TECO Energy, Inc.	1.953.72	18.408.58	684.24	NA
Dynegy	1.230.00	36.000.00	NA	NA
Total for the 19 sample utilities	130.319.61	1.521.634.91	57.524.58	62.462.58
U.S. Electric Market	363.687.00	3.694.650.00	145.293.84	368.712.45[a]

Note: NA = not available.
[a] In 2012, renewable energy sources accounted for about 9,3% of total U.S. energy consumption (NREL, 2013).
Source: CERES (2014) (http://www.ceres.org/resources/reports/benchmarking-utility-clean-energy-deployment-2014)

Table 4
Descriptive statistics for the four CSR indicators 2005–2012.

	GOV	ECN	ENV	SOC	GOV	ECN	ENV	SOC	GOV	ECN	ENV	SOC	GOV	ECN	ENV	SOC
	2005				2006				2007				2008			
Mean	82,29	65,43	71,11	64,14	82,25	57,26	69,51	65,50	84,68	65,81	71,45	68,25	88,72	63,39	74,07	68,44
Std.Dev.	14,64	25,25	23,81	24,78	13,12	26,48	20,88	23,96	7,58	22,33	18,73	19,16	7,50	24,42	18,12	20,07
Min	41,9	13,82	18,65	15,26	41,32	11,75	29,88	19,52	70,50	25,20	25,88	15,92	70,55	20,05	23,77	29,94
Max	95,73	98,74	96,38	97,44	96,11	94,73	94,68	94,67	95,57	96,54	91,37	91,43	96,04	96,83	92,41	95,15
Skewness	−1,25	−0,49	−0,88	−0,38	−1,57	−0,02	−0,60	−0,56	−0,21	−0,40	−0,96	−1,23	−0,93	−0,26	−1,12	- 0,58
Kurtosis	0,77	−1,13	−0,39	−1,21	2,43	−1,45	−0,92	−1,18	−1,01	−1,28	−0,24	0,74	−0,42	−1,37	0,61	- 1,11
Jarque - Bera Normality Test	7,02[a]	1,55	2,92	1,35	16,49[a]	1,29	1,70	1,91	0,65	1,53	3,47	6,68[a]	3,26	1,36	5,47	1,87
pvalue	0,02	0,46	0,23	0,51	0,00	0,52	0,43	0,39	0,72	0,47	0,18	0,04	0,20	0,51	0,06	0,39
	2009				2010				2011				2012			
Mean	86,31	69,87	74,21	75,02	87,16	65,49	70,61	73,32	85,01	68,77	73,58	70,38	85,59	70,19	73,28	75,07
Std.Dev.	10,24	21,75	18,12	19,22	8,04	21,14	19,11	15,91	9,42	28,28	19,87	19,29	8,39	23,30	16,47	19,69
Min	55,13	34,88	30,37	40,57	69,58	29,54	20,63	37,50	68,51	13,67	30,25	32,32	71,69	24,84	40,82	36,27
Max	96,05	98,31	93,31	95,30	96,14	98,11	90,85	95,91	96,35	98,07	92,92	97,13	94,43	98,61	92,12	92,49
Skewness	−1,48	−0,06	−0,88	−0,52	−0,75	−0,14	−1,16	−0,57	−0,28	−0,74	−1,00	−0,30	−0,45	−0,62	−0,57	−0,88
Kurtosis	2,02	−1,67	−0,32	−1,51	−0,66	−1,23	0,37	−0,87	−1,51	−1,05	−0,47	−1,23	−1,55	−1,11	−1,08	−0,87
Jarque - Bera Normalality Test	13,51[a]	1,84	2,87	2,44	2,23	0,91	5,46	1,51	1,71	2,59	3,78	1,18	1,34	1,29	1,08	2,14
pvalue	0,00	0,40	0,24	0,29	0,33	0,63	0,07	0,47	0,43	0,27	0,15	0,55	0,51	0,52	0,58	0,34

Note: GOV denotes the Corporate Governance, ECN the Economic, ENV the Environmental and SOC the Social performance scores.
[a] Indicates statistically significant at 5% level.

performance with environmental and social performance than with corporate governance. The relationship between economic and environmental scores has an average of $\tau = 0.594$ and a range of 0.541–0.644 over the period studied. The relationship between economic and social scores fluctuates around an average of $\tau = 0.611$ and has a range of 0.506–0.684. Hence, on average, the U.S. electric utilities with better (worse) economic performance, usually stand out as companies with better (worse) environmental and social performance too. The degree with which economic and governance scores are correlated is, on average, much smaller, with an average of $\tau = 0.423$ and a range of 0.307–0.561.

Fig. 2 shows the evolution over time of the Kendall's τ for each pair of performance scores considered. The figure indicates an improvement in the compatibility between the economic and all the non-economic CSR dimensions over time. Increasing trends in Kendall's τ are especially strong for the economic and corporate governance pair. In a time span of 8 years, the relational measure increases from $\tau = 0.323$ to $\tau = 0.561$, bringing economic-governance relationship closer to the economic-social and economic-environmental relationship levels. The bottom line of our results is that the U.S. electric utilities have not only improved their economic performance over time, but have also been capable to make this economic performance compatible with the adoption of further responsibilities embedded in the CSR. In short, the U.S. electric utility holding companies in our sample have become better corporate citizens. There does not seem to be a trade-off between economic and non-economic dimensions of performance for our sample of firms.

Tail dependencies, i.e., the lower tail (λ_L) and upper tail (λ_U) coefficients for the economic and non-economic CSR performance

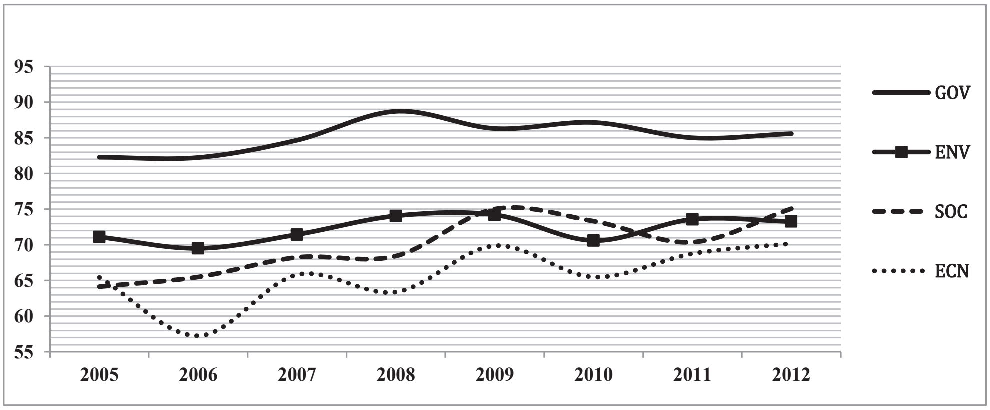

Fig. 1. Evolution of average SCR scores (2005–2012).

Table 5
Bivariate copula analysis results.

Pairs	Copula	θ_1	θ_2	SE_1	SE_2	Kendall's τ	λ_L	λ_U	Copula	θ_1	θ_2	SE_1	SE_2	Kendall's τ	λ_L	λ_U
	2005								2006							
ECN-ENV	Clayton	2,36	–	0,86	–	0,54	0,75	0,00	BB7	3.32	0.82	0,79	1,19	0,61	0,43	0,77
ECN-SOC	BB7	1.53	2.26	0,45	1,04	0,57	0,74	0,43	Gumbel	2,03	–	0,38	–	0,51	0,00	0,59
ECN-GOV	Normal	0,49	–	0,13	–	0,32	0,00	0,00	Normal	0,46	–	0,15	–	0,31	0,00	0,00
	2007								2008							
ECN-ENV	Normal	0,76	–	0,08	–	0,55	0,00	0,00	Normal	0,76	–	0,08	–	0,55	0,00	0,00
ECN-SOC	Normal	0,81	–	0.06	–	0,60	0,00	0,00	Clayton	3,04	–	0,96	–	0,60	0,80	0,00
ECN-GOV	Clayton	1,52	–	0,67	–	0,43	0,63	0,00	BB7	1,00	1,12	0,17	0,63	0,36	0,54	0,00
	2009								2010							
ECN-ENV	Clayton	3,54	–	1,14	–	0,64	0,82	0,00	Frank	9,26	–	2,29	–	0,64	0,00	0,00
ECN-SOC	Clayton	4,33	–	1,30	–	0,68	0,85	0,00	Clayton	3,33	–	1,13	–	0,63	0,81	0,00
ECN-GOV	Clayton	1,79	–	0,72	–	0,47	0,68	0,00	Clayton	1,66	–	0,70	–	0,45	0,66	0,00
	2011								2012							
ECN-ENV	Frank	7,59	–	2,02	–	0,59	0,00	0,00	BB7	1,00	3,31	0,52	1,52	0,62	0,81	0,00
ECN-SOC	Frank	8,47	–	2,15	–	0,62	0,00	0,00	Clayton	4,29	–	1,66	–	0,68	0,85	0,00
ECN-GOV	Clayton	1.84	–	0,68	–	0,48	0,69	0,00	BB7	1,22	2,44	0,27	1,35	0,56	0,73	0,23

Note: GOV denotes the Corporate Governance, ECN the Economic, ENV the Environmental and SOC the Social performance scores.
θ_1 and θ_2 represent the copula parameters. SE_1 and SE_2 represent the standard errors corresponding to each copula parameter, respectively. λ_L and λ_U are the Lower and Upper tail dependence coefficients, respectively.

measures for each year are summarized in Fig.3. Tail dependence takes either positive or zero values. Zero tail dependence is associated to the Archimedean Clayton and Gumbel copulas that only allow for either lower or upper tail dependence. In contrast, the two-parameter BB7 allows for both lower and upper tail dependence. The left panel in Fig. 3 reports the lower tail dependence. The average lower tail dependence between economic and social performance is 0.809,[4] with a range of 0.735–0.852. This suggests that those firms with poorest economic performance levels are also characterized by lowest social performance ratings. The economic and corporate governance also shows lower positive tail dependence, with an average magnitude of 0.653, and a range of 0.537–0.725. Hence, poor economic performance also seems to go hand in hand with poor governance performance. The relationship between the economic and environmental performance has half of the lower tail dependencies equal to zero. This may indicate that firms that have lower environmental scores, are not necessarily the ones with lower economic scores.

[4] Copulas that do not allow for lower tail are not considered in the computation of this average.

The right panel of Fig. 3 reports the upper tail dependence over the period studied: the predominance of zero upper tail dependence suggests that firms exceling in economic performance do not necessarily excel in the non-economic dimensions. In short, while poor and average economic results seem to bring, respectively, poor and average social, environmental and governance results, economic results in the upper quartiles do not seem to go hand to hand with the other dimensions of CSR. This may suggest that while firms may be able to become average corporate citizens, exemplar corporate citizens are less apparent in the U.S. electric utilities sector.

5. Conclusion

The manner in which businesses interact with society has changed over time. As the concept of CSR has gained reputation, companies have taken responsibility for their impacts on societies and the environment. The relationship between the different CSR dimensions is likely to be different in different industries (Reed, 1999). This article studies relationships among the four main CSR dimensions: economic, environmental, social, and corporate governance in the U.S. electric utility sector. For this purpose, we

Table 6
Goodness-of-fit tests for bivariate copulas.

	GOF Tests	Gaussian	T-Copula	Clayton	Gumbel	Frank	BB1	BB7
2005								
ECN-ENV	Vuong	0	1	0	−1	0	0	0
	Clarke	0	0	0	0	0	0	0
	statistic.CvM	0,13	0,09	0,09	0,10	0,11	0,09	0,09
	p.value.CvM	0,40	0,50	0,50	0,30	0,10	0,70	0,50
	statistic.KS	0,84	0,66	0,77	0,74	0,70	0,74	0,75
	p.value.KS	0,40	0,70	0,40	0,40	0,20	0,40	0,40
Selected Copula: Clayton								
ECN-SOC	Vuong	0	1	0	−1	0	0	0
	Clarke	−1	1	0	−1	0	0	1
	statistic.CvM	0,11	0,12	0,07	0,15	0,14	0,09	0,08
	p.value.CvM	0,20	0,00	0,60	0,30	0,10	0,30	0,70
	statistic.KS	0,71	0,78	0,62	0,80	0,77	0,70	0,67
	p.value.KS	0,40	0,20	0,80	0,40	0,10	0,40	0,60
Selected Copula: BB7								
ECN-GOV	Vuong	0	0	0	0	0	0	0
	Clarke	1	0	0	−1	0	0	0
	statistic.CvM	0,10	0,11	0,15	0,00	0,11	0,13	0,14
	p.value.CvM	0,60	0,70	0,40	–	0,50	0,30	0,40
	statistic.KS	0,77	0,79	0,81	0,00	0,76	0,79	0,80
	p.value.KS	0,40	0,40	0,40	–	0,20	0,60	0,50
Selected Copula: Gaussian								
2006								
ECN-ENV	Vuong	−3	2	−2	1	−4	1	5
	Clarke	1	0	−5	2	−2	2	2
	statistic.CvM	0,08	0,00	0,13	0,08	0,09	0,08	0,07
	p.value.CvM	0,50	–	0,40	0,50	0,40	0,40	0,60
	statistic.KS	0,78	0,00	0,90	0,75	0,69	0,75	0,75
	p.value.KS	0,00	–	0,10	0,40	0,70	0,10	0,40
Selected Copula: BB7								
ECN-SOC	Vuong	0	1	0	0	−1	0	0
	Clarke	0	1	0	0	−1	0	0
	statistic.CvM	0,08	0,10	0,14	0,08	0,08	0,09	0,09
	p.value.CvM	0,80	0,50	0,10	0,90	0,40	0,50	0,40
	statistic.KS	0,82	0,91	1,01	0,75	0,79	0,86	0,88
	p.value.KS	0,30	0,00	0,00	0,60	0,10	0,00	0,00
Selected Copula: Gumbel								
ECN-GOV	Vuong	0	0	0	0	0	0	0
	Clarke	0	0	0	0	0	0	0
	statistic.CvM	0,15	0,17	0,15	0,00	0,17	0,15	0,15
	p.value.CvM	0,30	0,30	0,20	–	0,10	0,30	0,20
	statistic.KS	0,90	0,96	1,00	0,00	0,94	0,98	1,00
	p.value.KS	0,30	0,20	0,10	–	0,00	0,20	0,00
Selected Copula: Gaussian								
2007								
ECN-ENV	Vuong	0	0	0	0	−1	1	0
	Clarke	0	0	−1	0	0	−1	2
	statistic.CvM	0,10	0,10	0,14	0,07	0,08	0,13	0,14
	p.value.CvM	0,40	0,40	0,10	1,00	0,50	0,10	0,00
	statistic.KS	0,76	0,75	0,94	0,64	0,74	0,92	0,94
	p.value.KS	0,30	0,60	0,00	1,00	0,30	0,00	0,00
Selected Copula: Gaussian								
ECN-SOC	Vuong	1	1	0	−2	0	0	0
	Clarke	−1	0	0	−1	1	0	1
	statistic.CvM	0,12	0,12	0,14	0,13	0,16	0,14	0,14
	p.value.CvM	0,20	0,10	0,00	0,10	0,00	0,00	0,00
	statistic.KS	0,73	0,76	0,91	0,69	0,86	0,91	0,91
	p.value.KS	0,20	0,10	0,00	0,40	0,00	0,10	0,00
Selected Copula: Gaussian								
ECN-GOV	Vuong	2	0	2	−6	−2	2	2
	Clarke	−2	−2	4	−5	−3	4	4
	statistic.CvM	0,09	0,09	0,08	0,00	0,06	0,08	0,08
	p.value.CvM	0,70	0,60	0,70	–	1,00	0,60	0,60
	statistic.KS	0,69	0,70	0,77	0,00	0,54	0,77	0,77
	p.value.KS	0,60	0,40	0,60	–	1,00	0,30	0,40
Selected Copula: Clayton								
2008								
ECN-ENV	Vuong	1	1	0	−2	0	0	0
	Clarke	1	1	−1	−4	0	2	1
	statistic.CvM	0,06	0,05	0,07	0,05	0,06	0,07	0,07

(*continued on next page*)

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Table 6 (*continued*)

	GOF Tests	Gaussian	T-Copula	Clayton	Gumbel	Frank	BB1	BB7
	p.value.CvM	0,90	0,90	0,60	0,90	1,00	0,80	0,60
	statistic.KS	0,58	0,57	0,62	0,54	0,53	0,58	0,59
	p.value.KS	0,80	0,80	0,60	0,80	1,00	0,80	0,90
Selected Copula:Gaussian								
ECN-SOC	Vuong	−2	1	3	−6	−2	3	3
	Clarke	−3	1	2	−4	0	2	2
	statistic.CvM	0,09	0,08	0,06	0,14	0,10	0,06	0,06
	p.value.CvM	0,50	0,80	0,80	0,20	0,30	0,50	0,70
	statistic.KS	0,74	0,79	0,70	0,81	0,79	0,70	0,70
	p.value.KS	0,50	0,40	0,50	0,30	0,10	0,20	0,20
Selected Copula: Clayton								
ECN-GOV	Vuong	2	0	0	−2	0	0	0
	Clarke	0	0	0	0	0	0	0
	statistic.CvM	0,16	0,16	0,06	0,00	0,13	0,06	0,06
	p.value.CvM	0,30	0,30	0,90	0,00	0,30	0,80	1,00
	statistic.KS	0,76	0,77	0,69	0,00	0,68	0,69	0,69
	p.value.KS	0,60	0,60	0,60	0,00	0,50	0,60	0,70
Selected Copula: BB7								
2009								
ECN-ENV	Vuong	−3	1	3	−4	−3	3	3
	Clarke	−4	1	1	−4	1	2	3
	statistic.CvM	0,07	0,06	0,18	0,05	0,09	0,18	0,18
	p.value.CvM	0,90	0,80	0,10	0,90	0,50	0,00	0,10
	statistic.KS	0,51	0,79	1,12	0,49	0,81	1,12	1,12
	p.value.KS	1,00	0,30	0,00	0,90	0,10	0,00	0,00
Selected Copula: Clayton								
ECN-SOC	Vuong	0	0	1	0	−3	1	1
	Clarke	1	1	0	−2	−3	1	2
	statistic.CvM	0,06	0,06	0,08	0,13	0,08	0,08	0,08
	p.value.CvM	0,60	0,90	0,30	0,20	0,50	0,30	0,20
	statistic.KS	0,64	0,62	0,65	0,82	0,66	0,65	0,65
	p.value.KS	0,60	0,90	0,40	0,30	0,50	0,30	0,30
Selected Copula: Clayton								
ECN-GOV	Vuong	1	1	2	−5	−3	2	2
	Clarke	1	1	1	−2	−3	1	1
	statistic.CvM	0,10	0,11	0,21	0,00	0,10	0,21	0,21
	p.value.CvM	0,63	0,60	0,07	0,00	0,90	0,00	0,00
	statistic.KS	0,96	0,99	1,25	0,00	0,93	1,25	1,25
	p.value.KS	0,09	0,10	0,00	0,00	0,30	0,00	0,00
Selected Copula: Clayton								
2010								
ECN-ENV	Vuong	−4	1	1	−1	1	1	1
	Clarke	−6	2	0	−4	2	3	3
	statistic.CvM	0,09	0,00	0,22	0,08	0,14	0,22	0,22
	p.value.CvM	0,50	–	0,00	0,70	0,10	0,00	0,00
	statistic.KS	0,81	0,00	0,96	0,79	0,71	0,96	0,96
	p.value.KS	0,00	–	0,00	0,50	0,20	0,00	0,00
Selected Copula: Frank								
ECN-SOC	Vuong	−3	1	1	−1	0	1	1
	Clarke	−5	2	0	−3	0	4	2
	statistic.CvM	0,07	0,00	0,14	0,05	0,07	0,14	0,14
	p.value.CvM	0,70	–	0,10	1,00	0,90	0,20	0,10
	statistic.KS	0,54	0,00	1,01	0,52	0,71	1,01	1,01
	p.value.KS	0,80	–	0,10	1,00	0,70	0,00	0,00
Selected Copula: Clayton								
ECN-GOV	Vuong	2	0	2	−6	−2	2	2
	Clarke	2	0	2	−6	−2	1	3
	statistic.CvM	0,13	0,12	0,06	0,00	0,09	0,06	0,06
	p.value.CvM	0,40	0,50	1,00	–	0,40	1,00	0,80
	statistic.KS	0,70	0,69	0,65	0,00	0,66	0,65	0,65
	p.value.KS	0,50	0,60	0,90	–	0,40	0,80	0,60
Selected Copula: Clayton								
2011								
ECN-ENV	Vuong	0	0	0	0	0	0	0
	Clarke	1	1	0	−3	1	0	0
	statistic.CvM	0,09	0,09	0,08	0,17	0,09	0,08	0,08
	p.value.CvM	0,70	0,50	0,30	0,20	0,80	0,30	0,30
	statistic.KS	0,81	0,79	0,61	1,04	0,74	0,60	0,61
	p.value.KS	0,40	0,10	0,60	0,00	0,50	0,40	0,80
Selected Copula: Frank								
ECN-SOC	Vuong	0	0	0	−3	3	0	0
	Clarke	−3	−3	3	−6	3	3	3

Table 6 (*continued*)

	GOF Tests	Gaussian	T-Copula	Clayton	Gumbel	Frank	BB1	BB7
	statistic.CvM	0,25	0,25	0,09	0,00	0,12	0,09	0,09
	p.value.CvM	0,00	0,00	0,40	–	0,10	0,20	0,10
	statistic.KS	1,00	0,98	0,63	0,00	0,72	0,63	0,63
	p.value.KS	0,00	0,00	0,70	–	0,10	0,20	0,40
Selected Copula: Frank								
ECN-GOV	Vuong	0	0	0	0	0	0	0
	Clarke	0	0	0	0	0	0	0
	statistic.CvM	0,19	0,20	0,08	0,41	0,14	0,12	0,11
	p.value.CvM	0,10	0,00	0,40	0,00	0,00	0,40	0,50
	statistic.KS	0,95	0,98	0,73	1,23	0,79	0,84	0,83
	p.value.KS	0,20	0,20	0,30	0,00	0,10	0,30	0,10
Selected Copula: Clayton								
2012								
ECN-ENV	Vuong	−2	−2	4	−6	−2	3	5
	Clarke	1	1	2	−5	−3	2	2
	statistic.CvM	0,17	0,18	0,06	0,00	0,12	0,06	0,06
	p.value.CvM	0,10	0,30	0,90	0,00	0,50	0,90	1,00
	statistic.KS	0,95	0,95	0,61	0,00	0,82	0,61	0,61
	p.value.KS	0,10	0,20	0,80	0,00	0,20	0,70	1,00
Selected Copula: BB7								
ECN-SOC	Vuong	−3	0	3	−3	−3	3	3
	Clarke	−4	−1	2	−4	3	2	2
	statistic.CvM	0,15	0,00	0,12	0,23	0,14	0,12	0,12
	p.value.CvM	0,60	–	0,20	0,10	0,10	0,10	0,30
	statistic.KS	0,91	0,00	0,83	1,06	0,71	0,83	0,83
	p.value.KS	0,30	–	0,20	0,00	0,20	0,00	0,20
Selected Copula: Clayton								
ECN-GOV	Vuong	1	1	0	−2	0	0	0
	Clarke	1	1	0	−3	0	0	1
	statistic.CvM	0,10	0,11	0,06	0,00	0,09	0,06	0,06
	p.value.CvM	0,50	0,70	0,80	–	1,00	1,00	0,90
	statistic.KS	0,61	0,64	0,56	0,00	0,54	0,56	0,57
	p.value.KS	0,80	0,80	0,80	–	1,00	1,00	0,90
Selected Copula: BB7								

Note: GOV denotes the Corporate Governance, ECN the Economic, ENV the Environmental and SOC the Social performance scores.

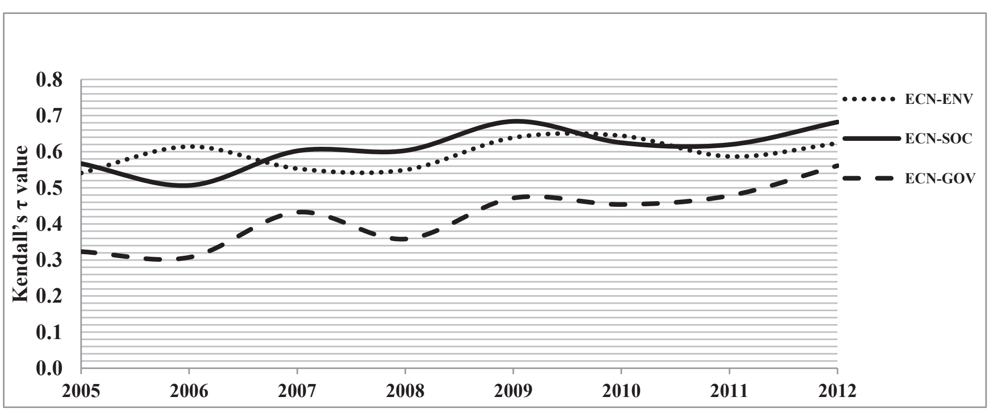

Fig. 2. Evolution of economic and non-economic CSR dimensions' dependence (2005–2012).

use a sample of U.S. investor-owned electric utility holding companies observed from 2005 to 2012.

The empirical regularities characterizing relationships are identified using statistical copulas. Results from copula analysis show a relatively strong positive link between economic and environmental performance (the Kendall's τ being on the order of 0.6), suggesting that adoption of environmentally friendly technologies may improve firm efficiency and financial health. Evidence of a strong positive relationship between economic and social performance is also found (the Kendall's τ being on the order of 0.6), which may indicate that providing better working environments leads to better economic outcomes. With a positive, albeit weaker relationship (the Kendall's τ being on the order of 0.42), results also suggest that economic performance improves when the interests of various stakeholders (including shareholders, customers, managers, suppliers, and the community) are better balanced.

The relationships among CSR dimensions follow an upward trend over time, a trend that is especially strong for the economic and corporate governance pair. Firms appear to have learned how to improve compatibility between financial goals and corporate citizenship. This compatibility, however, is not seen for the higher

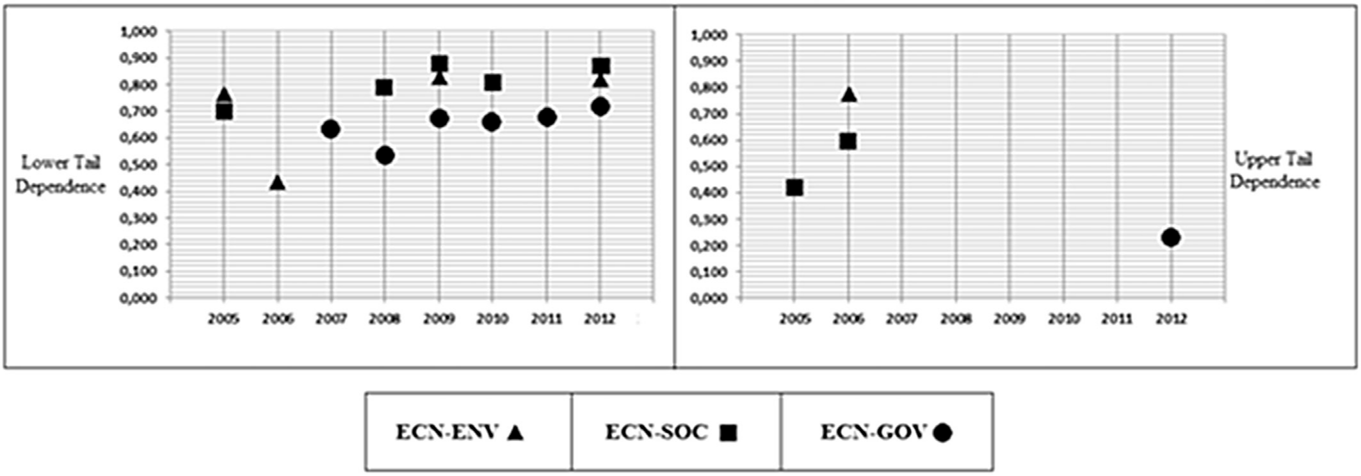

Fig. 3. Evolution of economic and noneconomic CSR dimension' tail dependence (2005–2012).

ends of the bivariate distributions. As a result, while poor and average economic results seem to be associated, respectively, to poor and average environmental, social, and governance results, economic performance in the upper quartiles do not seem to go hand to hand with the other dimensions of CSR. This may suggest that exemplar corporate citizens are less apparent in the U.S. electric utilities sector.

A major limitation of our research is that we do not identify the causes underlying the relationship between CSP and economic performance. The U.S. electric utility industry is a highly regulated industry and regulation is likely to influence our results. The impacts of regulations on the relationship between CSP and CFP can be identified by assessing dependency before and after regulation changes (Zhou and Wei, 2016) and offers scope for future research. Results from our research are useful for corporate accountability reports and should motivate shareholders to be active owners and encourage the company to improve environmental, social, and governance performance, which should eventually lead to better financial performance. Further, our results can be relevant for policy design, as they suggest that an institutional framework encouraging CSR could lead to better financial results for electric utilities.

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