Energy and Environment

Energy-related Contextual Determinants of Climate Change Reported to the CDP: Evidence From BRICS Nations

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We investigate country-specific energy-related contextual determinants that influence companies in BRICS nations (Brazil, Russia, India, China, and South Africa) to participate in and disclose climate change information to the Carbon Disclosure Project (CDP). We find that the Paris Climate Agreement and country-level carbon emissions influence CDP reporting and disclosure scores. National legislations do not influence the reporting status, but they influence higher-level disclosure. Our study supports institutional theory.

I. INTRODUCTION

In this paper, we examine how energy-related contextual determinants influence the climate change reporting of Forbes Global 2000 companies from BRICS (Brazil, Russia, India, China, and South Africa) nations to the Carbon Disclosure Project (CDP). BRICS nations bring together the major emerging economies that have been the engines of global economic growth. This study examines the status and level of CDP reporting based on national regulations, the Paris Climate Agreement, and energy-related contextual determinants.

Corporate disclosure studies have used institutional theory to understand how companies respond to external processes built on the assumption regarding how structures, such as schemes and rules, become authoritative guidelines for firm behavior (DiMaggio & Powell, 1983; Scott, 2005). Yang and Farley (2016) investigated how international and domestic guidelines influenced Chinese companies' climate change reporting. They found that Chinese national reporting guidelines have a greater impact than international guidelines. Narayan and Smyth (2007) studied the stationarity of per capita energy consumption, and Narayan et al. (2016) found evidence for an environmental Kuznets curve in 181 countries. Grauel and Gotthardt (2016) found that country-level environmental regulations and national contexts determine the voluntary carbon reporting of large companies.

This study looks at major environmental reporting regulations in BRICS as follows: (a) Brazil: resolution on Socio-environmental Responsibility Policy (2014); (b) Russia: no environmental legislations on carbon emission disclosure;

(c) India: Business Responsibility Report (2012); (d) China: National Development and Reform Commission–mandated greenhouse gas (GHG) reporting (2014); and (e) South Africa: National Greenhouse Gas (GHG) Emission Reporting (2017).

Based on the above discussion, we hypothesize that (a) different energy-related national contextual and regulatory regimes influence the CDP reporting status of companies in BRICS; and (b) different energy-related national contextual and regulatory regimes influence the extent of the CDP disclosures by companies in BRICS.

These hypotheses are important because organizations are increasingly concerned about climate change risks to maintain their license to operate and to ensure their long-term success in a competitive business environment, as well as comply with national or regional policies aimed at reducing GHG emissions. Developed countries introduced mandatory corporate GHG reporting regulations in the early 2000s (Brouhle & Harrington, 2010; Freedman & Park, 2017; Stolaroff et al., 2009; West & Peña, 2003), but emerging economies followed with increased economic activity and resultant emissions.

Our study attempts to understand the underlying energy-related contextual factors determining corporate reporting and disclosure on climate change aspects to the CDP by companies in BRICS. Voluntary frameworks/guidelines positively influence higher-level categories of disclosure, while mandatory regulations negatively influence them. The Paris climate agreement has influenced companies' reporting status and all levels of CDP reporting. This study adds to the literature in two ways. First, it examines country-specific energy-related contextual determinants to

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investigate CDP reporting in the context of emerging economies. Second, this research validates institutional theory in the context of CDP reporting by companies in BRICS.

Section 2 covers the data and results, and Section 3 presents concluding remarks.

II. DATA AND RESULTS

A. Data and Model

This is an empirical study. It uses secondary data such as a) participation in CDP questionnaires and b) the CDP scores of companies based on their CDP questionnaire responses. As mentioned in the companies' CDP questionnaires, the scoring methodology measures the respondents' progress toward environmental stewardship (CDP, 2020). A company's environmental stewardship is assessed on four levels: 1) disclosure, 2) awareness, 3) management, and 4) leadership.

This study also considers national regulations on climate change reporting by companies and categorizes them into a) mandatory reporting regulations, b) voluntary reporting frameworks/guidelines, and c) the absence of regulations. The sample includes the Forbes list of 2000 global companies in BRICS, resulting in 281 companies from BRICS countries (Brazil, 19; Russia, 22; India, 53; China, 177; and South Africa, 10), with 1,931 firm–year observations for the period of 10 years from 2010 to 2019.

The logit model is ideal for studying categorical dependent variables. The logit model restricts estimated values to zero (non-reporting) and one (reporting). A binomial logit model can be used to assess CDP reporting status. A multinomial logit model can also be used to determine the CDP score, since it has multiple categories. The model can thus be specified as follows:

$$
\begin{aligned}
CDPST_{it} = 1 \div [1 + e - (\beta_0 + \beta_1 PCA_{it} \\
+ \beta_2 MAND_{it} + \beta_3 VOL_{it} \\
+ \beta_4 LnCE_{it} + \beta_5 LnED_{it} \\
+ \beta_6 LnFE_{it} + \beta_7 LnFI_{it} + \varepsilon_{it})]
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
CDPSC_{it} = 1 \div [1 + e - (\beta_0 + \beta_1 PCA_{it} \\
+ \beta_2 MAND_{it} + \beta_3 VOL_{it} \\
+ \beta_4 LnCE_{it} + \beta_5 LnED_{it} \\
+ \beta_6 LnFE_{it} + \beta_7 LnFI_{it} + \varepsilon_{it})]
\end{aligned}
\tag{2}
$$

where

$CDPST$ = CDP reporting status
$CDPSC$ = CDP reporting score
PCA = dichotomous variable, where one indicates the country's ratification of the Paris Climate Agreement, and zero otherwise
$MAND$ = dichotomous variable, where one indicates the existence of country-specific mandatory climate change reporting regulation, and zero otherwise
VOL = dichotomous variable, where one indicates the existence of country-specific climate change reporting frameworks/guidelines, and zero otherwise
$LnCE$ = natural logarithm of annual carbon emissions by the country of origin
$LnED$ = natural logarithm of the annual level of energy depletion by the country of origin, which is the ratio

of the value of the stock of energy resources to the remaining reserve lifetime
$LnFE$ = natural logarithm of annual fuel exports by the country of origin
$LnFI$ = natural logarithm of annual fuel imports by the country of origin

B. Results

Table 1 presents descriptive statistics for the variables used in our study.

The variables *CDPST*, *PCA*, *MAND,* and *VOL* are dummy variables, where *CDPSC* has four scores categorized as 1 through 4. The variable *LnCE* ranges from a minimum of 6.02 to a maximum of 9.23, with a mean of 1.54; *LnED* has a minimum of 21.70 and a maximum of 26.19, with a mean of 24.64; *LnFE* ranges from a minimum of 0.20 to a maximum of 4.26, with a mean of 1.54; and *LnFI* ranges from a minimum of -0.32 to a maximum of 3.68, with a mean of 2.70.

Table 2 shows the analysis of variance results for country-wise differences in *CDPST*. The variable *CDPST* varies greatly across BRICS nations. A post hoc test shows that Chinese and Russian firms report less often than South African and Brazilian firms, due to varied national corporate reporting cultures and laws. South Africa's early adoption of integrated reporting (King Code of Governance, 2009) improved CDP reporting. China and Russia (authoritarian regimes) hinder company participation in international reporting platforms.

Table 3 provides the results of the binomial logistic regression model. The variable *CDPST* is positively and significantly influenced by *LnCE* by country (at the 1% level of significance) and by *LnFE* (at the 1% level of significance). The *PCA* variable positively and significantly influences *CDPST* at the 10% level of significance.

Table 4 presents the results of multinomial logistic regression. The results show the determinants of a firm's progress toward environmental stewardship under four categories of CDP scoring, namely, *Disclosure, Awareness, Management,* and *Leadership*. The variable *PCA* has a positive and significant influence (at the 1% level of significance) for *Disclosure*, *Awareness*, *Management,* and *Leadership*; *VOL* positively and significantly influences companies to be in the categories *Management* (1% level of significance) and *Leadership* (1% level of significance), whereas *MAND* negatively and significantly influences companies to be in the *Leadership* (5% level of significance) category. The variable *LnCE* by country of origin negatively and significantly influences *CDPSC* (1% level of significance) in all four categories. The *LnED* variable in the country of origin negatively and significantly influences the level of *CDPSC* in the *Management* (1% level of significance) and *Leadership* (1% level of significance) categories, whereas it is positive and significant at the 1% level of significance for the *Disclosure* category. The variable *LnFE* has a positive and significant influence on companies to be in the *Disclosure* category (1% level of significance), and *LnFI* has a positive and significant influence on companies to be in the *Management* (10% level of significance) and *Leadership* (1% level of significance) categories.

Table 1. Descriptive statistics

Variable	Obs.	Mean	SD	Min	Max
CDPST	1931	0.32	0.465	0	1
CDPSC	1931	0.45	1.062	0	4
PCA	1931	-	-	0.00	1.00
MAND	1931	-	-	0.00	1.00
VOL	1931	-	-	0.00	1.00
LnCE	1931	8.28	1.09	6.02	9.23
LnED	1931	24.64	1.06	21.70	26.19
LnFE	1931	1.54	1.29	0.20	4.26
LnFI	1931	2.70	0.85	-0.32	3.68

This table reports selected descriptive statistics (namely, observations (Obs.), mean, standard deviation (SD) minimum and maximum) for *CDP Reporting Status (CDPST), CDP Reporting Score (CDPSC), Paris Climate Agreement (PCA), Mandatory Regulation (MAND), Voluntary frameworks/guidelines (VOL), Carbon Emission (LnCE), Energy Depletion (LnED), Fuel Exports (LnFE) and Fuel Imports (LnFI).* "-" denotes the omitted numbers due to the dichotomous variables.

Table 2. ANOVA of country-wise differences in the CDP reporting status

	Sum of Squares	df	Mean Square	F	Sig.
Between countries	115	4	28.75	182.683	0.00***
Within countries	305.939	1944	0.157		
Total	420.939	1948			

Post- Hoc Test					
	N	1	2	3	4
China	1060	0.16			
Russia	208		0.25		
India	453			0.4	
Brazil	154				0.93
South Africa	74				0.93

This table presents the results of ANOVA and Post-Hoc Test for country-wise differences in the *CDPST* by the sample companies, which belong to five countries – Brazil, Russia. India, China and South Africa; *** Significant at 1% level.

Table 3. Results of binomial logistic regression

CDPST	Odds Ratio	Std. Err.	z	P>z
PCA	0.75	0.12	-1.84	0.07*
MAND	1.02	0.21	0.08	0.94
VOL	1.22	0.27	0.88	0.38
LnCE	0.19	0.03	-11.81	0.00***
LnED	0.93	0.12	-0.55	0.58
LnFE	0.49	0.05	-6.82	0.00***
LnFI	1.08	0.12	0.68	0.50
_cons	7022141.00	20900000.00	5.29	0.00
Number of obs.	1,931			
LR chi2(7)	561.78			
Prob > chi^2	0.000			
Pseudo R^2	0.2334			

This table provides the results of binomial logistic regression. The dependent variable is *CDPST* and the independent variables are the *PCA, MAND, VOL, LnCE, LnED. LnFE* and *LnFI*; *** Significant at 1%; * Significant at 10%.

The positive relation of *LnCE* with *CDPST* and its negative relation with *CDPSC* indicates that companies from countries with greater emissions participate in CDP reporting, but their level of disclosure is lower. The positive relation of *LnFE* with *CDPST* and *the Disclosure* category of *CDPSC* indicates that more companies from fuel-exporting

Table 4. Results of multinomial logistic regression

CDPSC	Coef.	Std. Err.	z	P>z
0 (base outcome)				
1. Disclosure				
PCA	2.92	0.52	5.65	0.00***
MAND	0.51	0.74	0.69	0.49
VOL	-0.10	0.60	-0.16	0.87
LnCE	-1.66	0.22	-7.60	0.00***
LnED	0.87	0.28	3.07	0.00***
LnFE	0.11	0.28	0.39	0.70*
LnFI	0.50	0.28	1.79	0.07
_cons	-14.27	7.14	-2.00	0.05
2. Awareness				
PCA	1.60	0.38	4.18	0.00***
MAND	0.03	0.71	0.04	0.97
VOL	0.46	0.40	1.15	0.25
LnCE	-1.91	0.19	-10.11	0.00***
LnED	-0.17	0.21	-0.80	0.43
LnFE	-0.27	0.26	-1.04	0.30
LnFI	0.10	0.24	0.40	0.69
_cons	15.31	5.28	2.90	0.00
3. Management				
PCA	1.84	0.45	4.13	0.00***
MAND	-0.13	0.78	-0.16	0.87
VOL	1.53	0.42	3.60	0.00***
LnCE	-3.77	0.59	-6.42	0.00***
LnED	-0.69	0.24	-2.88	0.00***
LnFE	0.75	0.77	0.97	0.33
LnFI	2.24	1.33	1.68	0.09*
_cons	30.47	5.97	5.10	0.00
4. Leadership				
PCA	3.45	0.62	5.57	0.00***
MAND	-1.93	0.89	-2.16	0.03**
VOL	6.39	2.21	2.89	0.00***
LnCE	-6.41	1.49	-4.31	0.00***
LnED	-3.69	1.07	-3.46	0.00***
LnFE	1.72	1.30	1.32	0.19
LnFI	6.26	2.36	2.66	0.01***
_cons	98.85	25.25	3.91	0.00
Number of obs.	1,931			
LR chi2(28)	972.84			
Prob > chi^2	0.000			
Pseudo R^2	0.3571			

This table provides the results of multinomial logistic regression. The dependent variable is *CDPSC* and the independent variable are the *PCA, MAND, VOL, LnCE, LnED. LnFE* and *LnFI*; *** Significant at 1%; ** Significant at 5%; * Significant at 10%.

countries tend to participate and disclose more to the CDP. The influence of *PCA* on *CDPST* and all levels of *CDPSC* indicates the strong influence of international climate change protocols. Among national regulations, the positive influence of *VOL* and the negative influence of *MAND* on the higher-level category of *CDPSC* indicate that national voluntary reporting frameworks/guidelines make companies disclose extensive information more than mandatory reporting regulations.

III. CONCLUDING REMARKS

The BRICS nations exhibit rapid economic growth rates, large populations, and fast-growing markets for goods and capital. The resultant growth in carbon emissions has led to legislation requiring corporations to reduce GHG emissions. This study finds that national legislation (*MAND* and *VOL*) has little effect on *CDPST,* whereas *LnCE, LnFE,* and *PCA* influence *CDPST*. Further, national legislation (*MAND* and *VOL*), *PCA*, *LnCE*, *LnED,* and *LnFI* significantly influence *CDPSC* at higher levels of disclosure, such as in the *Management* and *Leadership* categories. The variable *PCA* and *LnCE* significantly influence the lower levels of disclosure, such as in the disclosure and awareness categories. By affirming a) the influence of *PCA* on *CDPST* and all levels of *CDPSC,* b) the positive effect of *VOL,* and c) the negative influence of *MAND* on the higher-level category of *CDPSC*, our study validates institutional theory in the context of CDP reporting by companies in BRICS. It is also clear that, as the carbon emissions in the country of origin increase, large companies in BRICS are taking on greater leadership roles in carbon disclosure than ever before.

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