

# Environmental Disclosure Modelling in a Developing Economy: Does Corporate Governance Matter? A Double Hurdle Regression Approach

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## Abstract

The paper examines environmental Disclosure Modelling in a Developing Economy using the Craigg double hurdle model and controlling for the role of corporate governance. This study employs the ex-post research design and investigates firm's environmental disclosures in Nigeria, by controlling for corporate governance characteristics. The study employs a sample of 35 non-financial firms listed on the Nigerian Stock Exchange using the simple random sampling technique. Secondary data retrieved from the financial statements of the selected companies was used for the study. Both the Tobit and double-hurdle models were estimated but based on the Bayesian and Akaike's information criteria for model selection, the double-hurdle model is preferred. The result reveals that though Board size is not a significant determinant of probability to disclose environmental information in annual reports (-0.0408,  $p=0.175$ ), it is a significant determinant of the extent of environmental disclosure reports (0.1943,  $p=0.00$ ) given that a firm has decided to disclose. Board independence is a significant determinant of both probability to disclose environmental information and extent of disclosure (-2.2373,  $p=0.00$ ) with a negative coefficient. The Board gender diversity is not a significant determinant of probability to disclose environmental information in annual reports (-0.60076,  $p=0.461$ ), it is a nevertheless a significant determinant of the extent of environmental disclosure reports (-3.5913,  $p=0.00$ ) when firms then decide to disclose. Institutional ownership turns out to be a significant determinant of both the probability to disclose environmental information and extent of disclosure (0.0273,  $p=0.00$ ) when firms choose to disclose. Finally, the truncated model results also reveals that though managerial ownership is not a significant determinant of probability to disclose environmental information in annual reports (-0.01352,  $p=0.148$ ), it is nevertheless a significant determinant of the extent of environmental disclosure reports (-0.0206,  $p=0.001$ ) when firms then decide to disclose. The study thus brings to the light the fact that corporate governance may be stronger at influencing the extent of environmental disclosure when firms decide to disclose rather than in influencing the decision to disclose.

**Keywords:** double hurdle regression, environmental disclosures, corporate governance

## 1. Introduction

Concerns about the environment have grown globally since the last two decades and a lot of attention is being given to the need to ensure environmental sustainability and the roles that various stakeholders can play in this regard. From the business and accounting angle, the need for environmental disclosure (ED) can be seen as a response to these concerns about the environment. This concern emerges mainly from the threat caused by the harmful effects and environmental problems resulting from the impact of activities of corporations. In response, companies have begun to intensify their environmental performance initiatives across several dimensions. However, the depth and quality of these initiatives is still very debatable and varies considerably from firm to firm, industry to industry and even from country to country. Consequently, the established consensus now is that there is an urgent need to expand the business reporting model especially with environmental reporting issues in perspective (Meynhardt & Gomez, 2019; Panda, D'Souza, & Blankson, 2019). However, a key recognition that must be brought forward within the push for robust reporting model to incorporate environmental disclosure is the fact that environmental disclosure is still largely voluntary and

unregulated especially in developing economies (Lamarche & Bodet, 2018; Agudelo et al. 2019). Consequently, rigorous efforts have been made to explore the determinants of environmental disclosures, though Dabor and Dabor (2015) and Soyinka, Sunday, and Adedeji (2017) have pointed out that in depth studies in this area is still in its infancy and there exist considerable inconsistencies among studies on this contemporary issue (Egbunike & Tarilaye 2017). Nevertheless, there has been a proliferation of studies investigating these drivers such as corporate governance (Mgbame & Onoyase 2015; Larkin, Bernardi & Bosco 2012; Muhammad & Sabo 2015).

Prior research has suggested multiple ways in which corporate governance may contribute to environmental performance using the resource dependence perspective (Sundaramurthy & Lewis, 2003) and from an agency/control perspective (Golden & Zajac, 2001). The resource based-view theory, is of the perspective that corporate governance provides the firm with a robust pool of knowledgeable individuals whose contributions can also provide substantial leverage and competitive advantage for the firm while agency theory argues that corporate governance leads to effective monitoring of managers and reduces opportunistic behaviour. As Waldman et al. (2006) point out, corporate boards are charged with the responsibility of formulating corporate strategy and are often deeply involved in promoting the image of their firms through social responsibility. Some scholars working in this arena have recognized that corporate governance plays an important role in explaining the diversity of environmental practices (Bansal & Roth, 2000; Cordano & Frieze, 2000; Delmas & Toffel, 2008; Sharma, 2000).

Methodologically, two options have been identified in the determinants of environmental disclosure literature. The first option is where environmental disclosure is modelled as a discrete outcome and categorical (binary) choice models such as probit and logit are employed for analyses (Awunyo-Vitor, 2012; Mokhtar, Natea & Gan, 2012). The second option is where environmental disclosure is modelled as a continuous outcome in which case, the studies will use disclosure check list and content analysis to generate an environmental disclosure score or index. In these cases, multiple regressions were taken into perspective (Munene & Guyo, 2013; Anigbogu et al., 2014) and these are generally regarded as one-step approaches. One methodological weakness with this approach is the assumption that the same set of factors determines probability environmental disclosures since it is voluntary on one hand and the extent of disclosure. The problem with this assumption is that, it is possible that the variable in this case, corporate governance could have different effects on the probability and extent of disclosure. The assumption is restrictive and hence, makes the one step approach restrictive. This study adopts the Cragg's (1971) double-hurdle model which has been used in several disciplines to overcome this restrictive assumption and instead sees disclosure or participation decision as a function of two hurdles. Since the Cragg model, its extensions have been widely used to analyze consumer and producer behavior as well as problems in environmental and agricultural economics and banking (e.g. Martinez-Espineira 2006; Moffatt 2003; Saz-Salazar and Rausell-Koster 2008; Teklewold et al. 2006). However, to the best of the investigators knowledge, no none study exist that has extended the Cragg's Double hurdle regression in modelling environmental disclosures. This brings to bear the novelty of this research which stems from the perspectives enumerated above. Also, developing economies constitute a fertile ground for vast majority of explorations on multiple dimensions and determinants of explorations on this contemporary and emerging issue, due to its infancy on researches on this domain. Noteworthy, the multitudinous policy and social implications from this research makes it a clear departure from previous studies investigated on this inter-related constructs. Ultimately, this study has adopted a sophisticated analytical statistical tool, which gives it a cutting edge and relevance in comparison to prior researched studies on this dimension.

The rest of this paper is thematically structured as follows: section two deals with the literature review and hypotheses development of the phenomena, which was subjected to empirical investigation, section three dwells on the theoretical framework on which the study was anchored, which is also replete with the precedence bothering on diverse views of proponents and scholars on this divide, section four demonstrates the presentation and interpretation of the results, as well as the methodology and model specifications, while section 5 elaborates on the conclusion drawn from diverse perspectives and dimensions of the study.

## **2. Literature Review and Hypotheses Development**

Environmental accounting disclosures have been signified using different nomenclatures such as environmental reporting and corporate social and environmental disclosure. Environmental accounting disclosures are the models/frameworks and activities in tandem with accounting rules / principles to recognize, measure, present and disclose environmental issues by an entity for the preparation of environmental financial statements. Environmental accounting disclosures is a front burner issue in environmental management, green accounting discourses and debates. Commentators on this topical perspective are yet to reach informed judgements based on its evolving trends and ramifications. What drives/ influences environmental accounting disclosures has been a subject of interest

among erudite scholars and practitioners. The extant academic literature of green accounting and previous empirical studies in this area has advanced series of arguments on the dimensions of corporate governance attributes and its influence on environmental accounting disclosures (EAD). These corporate governance attributes include board size, board independence, board diversity and ownership structure.

### 2.1 Board Size and Environmental Disclosures

The literature of environmental disclosures revealed diverse extreme positions as regards the effect of board size on environmental accounting disclosure.

The effect of board size on the extent of environmental reporting is quite uncertain. If the board of directors performs adequately, the level of corporate and social responsibility disclosure would be high and vice versa. Said, Zainuddin and Haron (2009) concluded that board size effects will increase communication and coordination problems, decrease ability of the board to control management and the spread among a larger group of the cost of poor decision making. In other words, small boards will mitigate agency conflict between managers and shareholders. Several studies have examined the relationship between board size and environmental disclosures.

The study of Handajani, Subroto, Sutrisino and Saraswati (2014) investigated the impact of board attributes on environmental and social disclosures of firms listed in the Indonesian Stock exchange and the study covered the period of 2010-2012. The study used the multiple regression analysis and results revealed amongst other variables, board size has a significant impact on environmental and social disclosure. Lone, Ali and Khan (2016) examined the impact of board characteristics on environmental disclosures using 50 listed firms over the period from 2010-2014. Regression analysis was used to examine the relationships between board characteristics and environmental disclosure and the results show that board size has a positive effect on environmental disclosures. Similarly, Muhammed and Sabo (2015) examined the extent to which board characteristics affects environmental and social disclosure using six listed food and beverages firms in Nigeria. The regression results show that board size has a significant positive impact on social and environmental disclosure. Based on these arguments, the study hypothesizes that;

H<sub>01</sub>: Board size has a significant effect on environmental Disclosures.

### 2.2 Board Independence and Environmental Disclosures

The literature between board independence and environmental disclosure is also mixed and inconclusive in the parlance of corporate reporting.

The existence of outside directors and independent board of directors may affect the environmental disclosures (Lim *et al.*, 2007; Haniffa & Cooke, 2002), because outside directors play an important role in establishing and overseeing the corporate policy on voluntary disclosure (Ajinkya *et al.*, 2005). Increasing the proportion of outside directors on board membership is associated with improved quality of information and acquisition of information proactively (Rutherford & Buchholtz, 2007). The empirical relationship between board independence and environmental disclosures has been examined by several studies with varying findings. For example, Cheng and Courtenay (2006) examines the effect of board independence on voluntary environmental disclosures for 104 Singapore companies. The multiple regression analysis results support the positive effect of board independence on environmental disclosure. Gul and Leung (2004), along with others (Allegrini & Greco, 2013; Rouf, 2011), documents a negative relationship between board independence and voluntary disclosure. Meanwhile, Haji (2013), Shamil *et al.* (2014) and Sartawi *et al.* (2014) finds no evidence of a significant association between board independence and environmental disclosures. Using firms quoted in the Australian Stock Exchange, Ong and Djajadikarta (2017) investigated the relationships between environmental disclosures and board independence. The result reveals the existence of significant positive effect of board independence on environmental disclosures. A similar positive effect was found by Rupley *et al* using 127 US firms covering the period from 2000-2005 as their results indicated the positive and significant effect of board independence on environmental disclosures.

On the contrary, Haziwan and Taha (2014) study investigates the impact of board attributes on environmental disclosures using 30 listed Malaysian firms. The study made use of content analysis in collecting the information on social and environmental disclosures and the findings using regression analysis did not support the presence of a significant positive relationship between board independence and social and environmental disclosures. Still focusing on Malaysian firms, Ahmad, Rashid and Gow (2017), investigated the impact of board independence on environmental reporting. The study used a reporting index made up of 51 items. The study employed the Ordinary Least Square (OLS) regression technique and the findings reveal that the relationship between board independence and environmental reporting tends to be industry specific.

Habbash (2016) using listed firms listed in Saudi Arabia Stock Exchange, used a study period from 2007-2011. The findings of the study support those of Haziwan and Taha (2014) showing the absence of a significant relationship between board independence and environmental disclosure. In the same vein, Muhammed and Sabo (2015) examines the effect of corporate governance on environmental disclosure using a sample of listed food and beverage firms in Nigeria. The findings of the study also support the absence of a significant positive relationship between board independence and environmental disclosure. Based on these arguments, we therefore hypothesize that;

H<sub>02</sub>: Board Independence has a significant effect on environmental Disclosures

### 2.3 Board Diversity and Environmental Disclosures

Board diversity is a significant corporate governance attribute that is widely explored in vast spectrum of studies on these phenomena. The discourses elucidated below reveal diverse variants pertaining to the domain subjected to investigation.

Handajani, Subroto, Sutrisino and Saraswati (2014) examines the effect of board diversity on corporate social disclosure, in which case the board diversity is proxied by board age, board gender, board independence, board size and board tenure. Testing were conducted at public firms listed on the Indonesia Stock Exchange that disclose corporate social responsibility in annual report or sustainability report during the period of 2010-2012 using multiple regression analysis. The results showed that Board gender have significant negative effect on corporate social disclosure.

Ibrahim and Hanefa (2016) investigate the impact of board diversity characteristics, namely, independence, gender, age and nationality of directors on the level of corporate social responsibility (CSR) disclosures in Jordan. Content analysis was used to determine CSR disclosure. This study used panel data analysis to investigate the influence of board diversity characteristics on CSR disclosures. Panel data analysis revealed that the level of CSR disclosure has increased over the period of the study. Results also reveal a positive and significant association between the level of CSR disclosure and board diversity variables.

Muttakin, Khan, and Subramaniam (2015) examine the nexus between board diversity and corporate environmental sustainability disclosure from the perspective of a developing economy context. The variables comprising of director gender and nationality were subjected to empirical examination. The study was executed using a sample of 116 listed Bangladeshi non-financial companies spanning the period 2005 -2009. The investigators employed multiple regression analysis for the empirical inquiry to explore its inextricable relationship with firm characteristics and two features of board diversity – female and foreign directorship. They submitted that foreign directorship has a positive impact on disclosures.

In view of the above, the null hypothesis is provided below;

H<sub>03</sub>: Board Gender Diversity has a significant effect on environmental Disclosures

### 2.4 Ownership Structure and Environmental Disclosures

Ownership structure as proposed by the agency theory is one of the most important corporate governance mechanisms to solve agency problems and suggests that concentrated ownership will result in more effective monitoring (Jensen & Meckling, 1976). Ownership structure is a mechanism that aligns the interest of shareholders and managers (Chau & Gray, 2018). The ownership structure of a firm can be categorized into two groups: proportion of shares owned by insiders and outsiders; proportion of shares owned by institutional versus individual shareholders (Wong, Loo & Shamsher, 2009). The relationship between environmental disclosures and ownership structure has been examined by a number of studies. For example, Uwuigbe (2011) examines the impact of managerial ownership on social disclosure of listed firms in Nigeria using a sample of 35 listed firms covering the period from 2006-2010. The regression results confirmed the managerial ownership has a positive and significant impact on social disclosures. Furthermore, Haladu and Salim (2016) study also focused on the impact of ownership structure on environmental information disclosure using a sample of 67 firms for the period 2009-2014. The findings though supporting a significant impact revealed a negative coefficient.

The work of Dam and Scholtens (2012) finds that the ownership owned by employees, individuals and corporate is associated with poor corporate social responsibility, while the ownership owned by banks, institutional investors and state appear to be Neutral. Ghazali (2007), based on Malaysian firm data, found lower managerial stock ownership and higher government ownership associated with greater environmental disclosure. Based on this study, we will therefore hypothesize that;

H<sub>04</sub>: Ownership Structure has a significant effect on environmental Disclosures

### 3. Theoretical Framework

#### 3.1 The Resource-Based View (RBV)

This study is anchored by the resource based view due to its complementary antecedents with studies bordering on environmental disclosure. This conjecture has been visibly expressed by the pertinent views masterminded by notable authorities in the field of strategic management on these phenomena.

The issue of what drives firm performance whether financial or non-financial such as environmental performance have been central in environmental strategy research for decades and encompasses most other questions that have been raised in the field, as for instance, why firms differ, how they behave, how they choose strategies and how they are managed (Porter, 1991). The resource-based view (RBV) emphasizes the firm's resources as the fundamental determinant of competitive advantage and performance. In this respect, Teece et al (1997), define resources 'as firm-specific assets that are difficult if not impossible to imitate'. These resources can be classified into three categories: 1) physical capital, 2) human capital and, 3) organizational capital. This research adopts Barney's (1991) definition of resources: firm resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies. Hence the study argues that firms resources such as the nature of its ownership structures; managerial, institutional and foreign presence can influence whether a firm adopts environmental reporting as part of its stewardship strategy and even its competitive strategy and this is even more relevant given the emphasis in recent times that environmental initiatives can drive financial performance.

#### 4. Methodology and Model Specification

This study employs the widely used ex-post facto research design and investigates firm's environmental disclosures in Nigeria, by controlling for corporate governance characteristics. The rationale for using ex post facto research design is because the dependent variable has already been affected by the independent variables in a retrospective study. The study employs a sample of 35 non-financial firms listed on the Nigerian Stock Exchange (NSE) using the simple random sampling technique. Secondary data retrieved from financial statements of the selected companies was used for the study. Environmental reporting in annual reports is quite low and largely non-existent and hence a considerable amount of observations are zero given that most firms do not disclose on environmental issues as compared to disclosure on social issues. As noted by Amemiya (1985), such a condition requires making an all important decision of the appropriate statistical tool to handle such mass of zero observations failure of which can result in biased and inconsistent estimates.

The ordinary least squares would have been an obvious choice, however applying it to analyse our data would result in biased estimates especially in the presence of many zeros which represent non-participation by companies (Wooldridge, 2010). Instead, there exists a number of econometrics approaches to deal with the issue of preponderance of zeros in the data with most of these approaches classed as limited dependent variable estimation techniques. One of the most contemporary approaches is the double hurdle regression approach based on double-hurdle specification (Cragg, 1971; Jones, 1989; Yen and Jones, 2000). Double-hurdle model was formulated by Cragg (1971); the model assumes in this case that firms will make two sequential decisions with regard to disclosure of environmental information and the extent of disclosure. The double-hurdle model contains two equations and can be given the interpretation of a combined probit and Tobit estimator. We first specify the relationship between environmental disclosures and corporate governance in its linear baseline form and the fit it into the hurdle specification;

##### 4.1 Baseline Linear Model

$$ENVD_{it} = \partial_0 + \partial_1 BS_{it} + \partial_2 BDIND_{it} + \partial_3 BGD_{it} + \partial_4 OWNS_{it} + \mu_{it} \quad (1)$$

Where:

ENVD= Environmental disclosure, BS= Board size, BDIND= Board independence, BGD= Board gender diversity and OWNS= Ownership Structure and  $\mu_{it}$  = error terms

##### 4.2 Double Hurdle Model

The specification in equ 1 is fitted into the Crag (1971) double-hurdle specification. The participation stage of the double-hurdle model is described by the equations

$$d_i^* = z_i\gamma + u_i \quad u_i \sim N(0,1)$$

$$d_i = \begin{cases} 1 & \text{if } d_i^* > 0 \\ 0 & \text{if } d_i^* \leq 0 \end{cases} \tag{2}$$

In the above equations,  $d^*i$  stands for the unobserved latent variable representing the participation hurdle and  $i d$  is the observed binary variable ( $d_i = 1$  means that the household participates in environmental disclosures while  $d_i = 0$  indicates no participation). The level of environmental disclosure in the second stage is then given by

$$y_i^* = x_i\beta + v_i \quad v_i \sim N(0, \sigma^2)$$

$$y_i = \begin{cases} y_i^* & \text{if } d_i = 1 \text{ and } y_i^* > 0 \\ 0 & \text{else} \end{cases} \tag{3}$$

$$l_i(\theta) = 1[y_i = 0] \log [1 - \Phi(z_i\gamma)] + 1[y_i > 0] \log [\Phi(z_i\gamma)] +$$

$$+ 1[y_i > 0] \left\{ -\log \left[ \Phi \left( \frac{x_i\beta}{\sigma} \right) \right] + \log \left\{ \phi \left[ \frac{(y_i - x_i\beta)}{\sigma} \right] \right\} - \log(\sigma) \right\} \tag{4}$$

Where  $y^*_i$  stands for the unobserved latent variable and  $y_i$  is the actual environmental disclosure when both hurdles are overcome, i.e. the observed environmental disclosure given by  $i y$  is equal to  $y^*_i$  only if the latent variable  $y^*_i$  takes positive values and the first participation stage is fulfilled.

In the double-hurdle model, the disclosure decision and extent of disclosure stages can be determined by separate sets of explanatory variables  $z_i$  and  $x_i$  with the corresponding vectors of parameters  $\gamma$  and  $\beta$  to be estimated. Latent variables are specified as linear functions of the explanatory variables. The explanatory variables are also assumed to be uncorrelated with the error terms  $u_i$  and  $v_i$ . The coefficients of the double-hurdle model are estimated by maximizing the following log-likelihood function:

$$\text{Log}L = \sum_0 \ln \left\{ 1 - \Phi(z'_i\alpha) \Phi \left( \frac{x'_i\beta}{\sigma} \right) \right\} + \sum_+ \ln \left\{ \Phi(z'_i\alpha) \frac{1}{\sigma} \phi \left( \frac{y_i - x'_i\beta}{\sigma} \right) \right\} \tag{5}$$

### 5. Presentation of Results

Table 1. Descriptive statistics

	ENVD	BSize	BDIND	BGD	INOWC	DOWN
Mean	2.884892	9.1762	0.628993	0.080	47.49730	11.7382
Median	3.0000	9.0000	0.6300	0.0700	52.000	1.5900
Max	9.000	17.00	1.000	0.4000	87.950	20.020
Min	0.0000	4.0000	0.2500	0.000	0.000	0.000

Std. Dev.	2.9971	2.6966	0.1570	0.0953	25.812	19.055
Skewness	0.2683	0.5094	-0.0249	0.9743	-0.4861	2.4127
Kurtosis	1.3851	2.7878	2.4676	3.1287	2.0754	10.583
J.B	33.543	12.545	3.3117	44.1740	20.848	935.854
Prob	0.000	0.0019	0.1909	0.000	0.000	0.000
Obs	278	278	278	278	278	278

Source: Researcher's compilation (2020)

The descriptive statistics is presented in table 4.1 and as observed, ENVD has mean 2.9 which indicates that on the average firms disclosure approximately 3 items out the 10 items on the checklist with maximum and minimum values of 9 and 0 respectively. BDS has mean size of approximately 9 members with maximum and minimum values of 17 and 4 respectively. BDIND has mean ratio of 0.629 which indicates that on the average 62.9% of individuals on the board for the sampled companies are independent members. The mean for BGD has a ratio of 0.080 which suggests that on the average about 8% of board members are females with maximum and minimum values of 0.40 and 0 respectively. For INOWN, the mean stood at 49.497% with maximum and minimum values stood at 87% and 0% respectively. For DOWN, the mean stood at 11.74% with maximum and minimum values stood at 20.02 % and 0% respectively.

Table 2. The Pearson correlation results

Probability	BSIZE	BDIND	BGD	INOWC	DHOLD	ENVD
BSIZE	1					
BDIND	0.273167	1				
p-value	(0.000)					
BGD	-0.02395	-0.04933	1			
p-value	(0.6909)	(0.4126)				
INOWC	-0.00511	0.0100	-0.034	1		
p-value	(0.9324)	(0.868)	(0.5678)			
DOWN	-0.02828	-0.16314	0.0936	-0.2799	1	
p-value	(0.6387)	(0.006)	(0.1194)	(0.000)		
ENVD	-0.00105	0.0819	-0.0854	0.3304	-0.1894	1
p-value	(0.986)	(0.173)	(0.1556)	(0.000)	(0.002)	

Source: Researcher's compilation (2020)

The Pearson correlation results reveals that ENVD is negatively correlated with BSIZE ( $r=-0.001$ ) though not significant at 5% [ $p=0.989$ ] but positively correlated with BDIND ( $r=0.0819$ ) though not significant ( $p=0.173$ ). A negative correlation is also observed between BGD and ENVD ( $r=-0.0854$ ) though not significant at 5% [ $p=0.1556$ ]. A positive correlation is also observed between ENVD and INOWN ( $r=-0.3304$ ) and significant at 5% [ $p=0.000$ ] and also between ENVD and MOWN ( $r=-0.1894$ ,  $p=0.002$ ). However, correlations do not necessarily imply functional dependence and causality in a strict sense and regression analysis and more suitable for that purpose.

Table 3. Double hurdle regression result

Variable	Tobit Model	Double Hurdle Model		
		Ist Hurdle	Marginal effects dy/dx	2 <sup>nd</sup> Hurdle (Truncated Regression)
C	0.9307 (0.9215) {0.313}	-1.04789* (0.4320) {0.015}	0.1433 (0.1772) {0.4200}	4.98387* (0.6069) {0.000}
BDS	-0.0189 (0.0643) {0.29}	-0.0408 (0.0301) {0.175}	0.1553* (0.8466) {0.001}	0.1943* (0.0385) {0.000}
BDIND	1.2580 (1.1224) {0.263}	1.3209* (0.8142) {0.011}	-2.2375* (0.8608) {0.009}	-3.4885* (0.7133) {0.000}
BGD	-2.2783 (1.7446) {0.193}	-0.60076 (0.5186) {0.461}	-3.5913* (1.3967) {0.010}	-3.1329* (1.1866) {0.008}
INOWN	0.03518* (0.0068) {0.000}	0.01471* (0.0032) {0.000}	0.04298* (0.0069) {0.000}	0.0273* (0.0059) {0.000}
DOWN	-0.01352 (0.0093) {0.148}	-0.0031 (0.0044) {0.484}	-0.0206 (0.0064) {0.001}	-0.0159* (0.0051) {0.002}
Log Likelihood	-684.50	-409.345		
LR chi2(5)	38.36	86.72		
Prob> chi2	0.000	0.000		
Pseudo R2	0.0273	0.096		
AIC	1383.002	844.69		
BIC	1408.446	891.94		

Source: Researcher's compilation (2020) Standard error ( ) p-values { }

Tobit and double-hurdle models were estimated using a pooled sample of cross-sectional data covering the period from 2011 to 2018 in table 1. The results show some similarities in the estimates but based on the Bayesian and Akaike's information criteria for model selection, the double-hurdle model is preferred to the Tobit model. Table 1 presents the maximum likelihood estimates of the independent double-hurdle model. The loglikelihood ratio (LR) and the information criteria attest to the reliability of the model. This implies that factors that influence the two-stage decision relating to decision to disclose and extent of disclosure can well be expressed in the independent double hurdle model. Coefficients in the first hurdle indicate how a given decision variable affects the likelihood (probability) of a firm to disclose environmental information. Those in the second hurdle indicate how decision variables influence the extent of disclosure. The result of the first hurdle (Probit Model) shows that BDIND (1.3209,  $p=0.011$ ) and INOWN (0.0147,  $p=0.0147$ ) are the only two statistically significant corporate governance decision variables that influenced the probability of firms disclosing environmental information in annual reports.

The result of the truncated model reveals that though BDS is not a significant determinant of probability to disclose environmental information in annual reports (-0.0408,  $p=0.175$ ), it is a significant determinant of the extent of environmental disclosure reports (0.1943,  $p=0.00$ ). This implies that though board size may not determine if a firm



discloses environmental information, it will determine the extent of disclosure given that a firm has decided to disclose. BDIND is a significant determinant of both probability to disclose environmental information and extent of disclosure (-2.2373,  $p=0.00$ ) with a negative coefficient. This implies that though board independence determines if a firm discloses environmental information and also the extent of disclosure given that a firm has decided to disclose. The truncated model results also reveals that though BGD is not a significant determinant of probability to disclose environmental information in annual reports (-0.60076,  $p=0.461$ ), it is nevertheless a significant determinant of the extent of environmental disclosure reports (-3.5913,  $p=0.00$ ) when firms then decide to disclose. INOWN turns out to be a significant determinant of both the probability to disclose environmental information and extent of disclosure (0.0273,  $p=0.00$ ) when firms choose to disclose. Finally, the truncated model results also reveals that though MOWN is not a significant determinant of probability to disclose environmental information in annual reports (-0.01352,  $p=0.148$ ), it is nevertheless a significant determinant of the extent of environmental disclosure reports (-0.0206,  $p=0.001$ ) when firms then decide to disclose.

Resulting from the nonlinear nature of the double-hurdle model, it is challenging to interpret the estimated coefficient as marginal effects (elasticities). Therefore, the computed elasticities of the corporate governance variables of the double-hurdle model is also presented in Table 3 and as observed, the elasticity of firm environmental disclosure with respect to BDS indicates that a 1% increase in Board size will lead to a 0.155% increase in the probability of firms disclosing environmental information. 1% increase in Board independence will lead to a 2.2374% decline in the probability of firms disclosing environmental information. Furthermore, a 1% increase in board gender diversity will result in a decline in the probability of firm environmental disclosures while a 1% increase in institutional ownership will increase the probability of firms disclosing environmental information in financial statements. Finally, a 1% increase in director ownership will reduce the probability of firms disclosing environmental information in financial statements by 0.026%. The outcomes of the results provide very insightful considerations that has never be explored previously in terms the relationship between corporate governance and environmental disclosures in developing countries like Nigeria.

## 6. Conclusion and Recommendations

The paper examines environmental Disclosure Modelling in a Developing Economy using the Cragg double hurdle model and controlling for the role of corporate governance. However, a handful of studies have explored the relationship between corporate governance and environmental disclosures, the pattern indicated earlier, has been to investigate the relationship at a single stage level. One weakness with this approach is the assumption that the same set of factors determines probability environmental disclosures since it is voluntary on one hand and the extent of disclosure as well. The complication with this presumption is that, it is possible that the variable in this case corporate governance could have different effects on both the probability and extent of disclosure. This study adopts the Cragg's (1971) double-hurdle model to overcome this restrictive assumption and instead sees disclosure decision as a hurdle function. The result of the truncated model reveals that though board size may not determine if a firm discloses environmental information, it will determine the extent of disclosure given that a firm has decided to disclose. Board independence is a significant determinant of both probability to disclose environmental information and extent of disclosure. The truncated model results also reveals that though Board gender diversity is not a significant determinant of probability to disclose environmental information in annual reports, it is nevertheless a significant determinant of the extent of environmental disclosure reports when firms then decide to disclose. Furthermore, institutional ownership turns out to be a significant determinant of both the probability to disclose environmental information and extent of disclosure when firms choose to disclose. Finally, the truncated model results also reveals that though managerial ownership is not a significant determinant of probability to disclose environmental information in annual report, it is nevertheless a significant determinant of the extent of environmental disclosure reports when firms then decide to disclose. The study thus brings to the light the fact that corporate governance may be stronger at influencing the extent of environmental disclosure of firms rather than in influencing the decision to disclose environmental information. Therefore, we may need to look outside of corporate governance to identify why firms choose to disclose environmental information in a voluntary reporting setting. Retrospectively, this research will add to the emerging and evolving body of literature on African management scientific discourses on corporate governance and environmental disclosure, being a field emerging from multiple paths, with many challenges ahead. Introspectively, following the findings obtained from the analysis, independent variables of board size, board gender diversity and ownership structure on environmental disclosure, this goes a long way in affirming and advancing the fact that a noteworthy improvement in these aforementioned dimensions will significantly enhance performance in developing economies. We therefore infer from the empirical findings of the study that, propositions should be initiated and put into perspective for companies in developing economies to follow

corporate governance codes and acts pertaining to recommended size of the board to enable them sustain high performances that go in tandem with appropriate environmental disclosures. Environmental initiatives should be followed hook, line and sinker as well in multiplicity of industrial sub-sectors in order to rejuvenate green accounting practices, that will ameliorate energy related costs and also bolster well-informed policy analysis. Noteworthy, this report also serves as a framework to educate policy makers and industry experts on the contextual factors surrounding corporate governance, environmental disclosures antecedents, controversies and contradictions pertaining to the aforesaid subject domain and, it will also provide erudite scholars with a forecast for new management thoughts and techniques. Specifically, environmental disclosure components should be implemented at the Federal Government levels in developing economies to strengthen the overall policy and institutional framework across all sectors and to help mobilise international resources for environmental disclosure programmes. This study is bereft of several dimensions and determinants of environmental disclosure such as environmental quality, which appears to be a controversy worthy of note. A study inculcating an advanced dimension of environmental disclosure quality using a period spanning 2005 to 2020 that will generate critical robust findings for a wider audience of pedagogues, academicians and key industry chieftains, which will ultimately bolster green manufacturing and sustainability success stories should be taken into paramount consideration.

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