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Executive Compensation Structure and Environmental Innovation: Evidence from Brazil

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1 Introduction

Environmental innovation refers to processes, practices, or systems that benefit the environment (Rennings, 2000). In other words, this innovation acts to prevent or reduce environmental damage (Kemp & Pontoglio, 2011), i.e., innovation with an environmental objective (van den Bergh et al., 2011). This type of innovation differs from conventional innovation because it requires skills outside organizational boundaries (Truong & Berrone, 2022) and emphasizes environmental advances rather than focusing only on profit-making activities (Pan et al., 2021). Although environmental innovation is more expensive than conventional innovation, companies can sacrifice short-term profits to achieve long-term goals (Hizarci-Payne et al., 2021). Environmental innovation can promote environmental pro-activity through the evolution of organizational environmental management (Dias Angelo et al., 2012). It is worth noting that environmental innovation is a long-term process that requires a commitment from firms to formulate strategies, decision-making processes, and investment in research and development (Kyaw, 2022). Thus, a better understanding of the determinants of environmental issues such as environmental innovation is needed. And one of these determinants is executive compensation (McGuire et al., 2003; Sarhan & Al-Najjar, 2022).

Executive compensation can prevent some behavioral characteristics of executives (Kang, 2017), such as opportunistic behavior that may induce executives to act for their benefit (Dias et al., 2020). In this line, executive compensation can be an instrument to reduce agency conflict by providing incentives for managers to act to maximize shareholders' interests (Zoghlami, 2021). Executive compensation reflects the firm's strategy for top executives (Janani et al., 2022), and the design of executive compensation affects the temporal orientation of corporate decision-making (Ortiz-de-Mandojana et al., 2019). Moreover, executives consider investments in corporate social responsibility (CSR) as a strategy to improve the firm's performance (Karim et al., 2018a) and attract the interest of investors (Maas, 2018). Thus, the compensation structure can signal the firm's commitment to social and environmental policies (Deckop et al., 2006).

Previous studies show the influence of fixed compensation (Cai et al., 2011; Mahoney & Thorne, 2006; McGuire et al., 2003), short-term compensation (Deckop et al., 2006; Mahoney & Thorne, 2006; Manner, 2010; Okafor & Ujah, 2020; Simerly et al., 2012) and long-term compensation (Adu et al., 2022; Berrone & Gomez-Mejia, 2009a; Mahoney & Thorne, 2005, 2006; Manner, 2010; McGuire et al., 2003; Okafor & Ujah, 2020; Park et al., 2022) on sustainability performance. However, to the best of our knowledge, there are no studies that address the relationship between compensation structure and environmental innovation. Based on the above discussion, this paper aims to explore the effect of compensation structure on environmental innovation. Theoretically, the study uses agency theory.

The study has several contributions. First, the study expands the knowledge of how compensation structure influences environmental innovation in Brazilian firms. Our results complement previous studies that focused on countries such as Germany (Profitlich et al., 2021), Canada (Mahoney & Thorne, 2005, 2006), France (Dardour & Husser, 2016; Hassen & Militaire, 2020), Spain (Blanes et al., 2021), and the United States (Adu et al., 2022; Berrone & Gomez-Mejia, 2009a; Cai et al., 2011; McGuire et al., 2003; Ortiz-de-Mandojana et al., 2019; Peng, 2020). Brazil is a developing, highly industrialized country with the fifth largest territory in the world (Abreu et al., 2022). This

country has renewable energy and hydropower as its dominant energy source and has promised under the Paris agreement to reduce carbon emissions by 37% and 43% in 2030 and 2035, respectively, relative to 2005 carbon emissions (Udemba & Tosun, 2022). Among the BRICS countries, Brazil has the highest percentage of renewable energy (45%) in total energy consumption (Wolde-Rufael & Weldemeskel, 2020). Moreover, in the context of corporate governance, the presence of institutional voids characterizes Brazil (Parente et al., 2013). Institutional voids occur when market-supporting institutions are absent or inefficient (Khanna & Palepu, 1997, 2010). Thus, the study extends the knowledge of environmental innovation and remuneration structure. Finally, this study contributes to agency theory by indicating that executive compensation can mitigate the conflict between principal and agent.

The remainder of this paper is structured as follows. The second section discusses the theory and literature review. Next, we discuss our research design and methodology, and the fourth section presents the empirical analyses of the study. Finally, we discuss the findings and make concluding remarks; we point out the research limitations and delineate the related future research directions.

2 Literature review and hypothesis development

2.1 Agency theory

An agency relationship refers to a contract in which one or more individuals hire another to perform a service on their behalf (Jensen & Meckling, 1976). In this line, one party (principal) delegates work to another (agent) (Eisenhardt, 1989), i.e., owners or directors delegate power to agents to make decisions on their behalf (Kayani & Gan, 2022). These agents tend to behave opportunistically due to the conflict of interest with the principal (Nguyen & Soobaroyen, 2022), which can lead to moral hazards or incentive problems (Holmström, 1979). One possible mechanism that can align the interests of owners and managers is executive compensation (Hart et al., 2015), with compensation contracts designed to provide incentives to meet current and long-term strategic goals and increase shareholder value (Demirer & Yuan, 2013)

2.2 Fixed compensation and environmental innovation

A fixed compensation structure involves short-term financial objectives (Mahoney & Thorne, 2006). Executives with fixed compensation are more risk averse. These executives are less willing to risk the firm's reputation and are more likely to take less responsible actions (McGuire et al., 2003). Hassen and Militaire (2020) argue that socially responsible companies are more prudent in fixed executive compensation. Salary is a fixed component of executive compensation (Mahoney & Thorne, 2006; McGuire et al., 2003; Okafor & Ujah, 2020). This compensation component refers to a protective incentive for executives to meet their basic needs (Zhou et al., 2021).

Since salary is the only compensation structure independent of performance, higher salaries make executives arrogant (Rekker et al., 2014), which results in executives being less interested in making decisions that promote the interest of society (Okafor & Ujah, 2020). Rekker et al. (2014) suggest that executives intrinsically motivated to engage in CSR activities accept a lower fixed compensation level during a financial crisis. Furthermore, executives compensated only with salary are pressured to maximize shareholder wealth in the short term (Simerly et al., 2012). Thus, these executives are not focused on factors that influence CSR (Mahoney & Thorne, 2005).

Using a sample of 100 Canadian firms from 1995-1996, Mahoney and Thorne (2006) suggest that salary positively influences CSR weakness. Cai et al. (2011) found that cash compensation is negatively related to CSR in 1946 US companies from 1996-

2010. Based on a sample of 374 companies from the Kinder, Lindenberg, and Domini Company database, McGuire et al. (2003) suggested that salary has a positive association with weak social performance. From a sample of 97 French companies from 2007 to 2016, Hassen and Militaire, (2020) indicated that salary negatively influences environmental performance. Gillan et al. (2010) documented a negative relationship between salary and ESG policies. For a sample of 1988 firms owned by Kinder, Lyndenberg, and Domini (KLD) database from 1996 to 2010, Rekker et al. (2014) found a negative relationship between fixed compensation and CSR. Blanes et al. (2021) indicated a negative relationship between cash compensation and CSR performance. However, Malik and Shim, (2022) suggest that salary does not influence CSR performance. Similarly, Karim et al. (2018) indicated an insignificant relationship between cash compensation and CSR performance. In line with theoretical discussions and prior empirical findings, the following hypothesis is proposed:

Hypothesis 1: There is a negative relationship between fixed compensation and environmental innovation.

2.3 Short-term compensation and environmental innovation

Executives' incentive systems are increasingly subject to debate for their complexity (Malik & Shim, 2022). Short-term actions can decrease the long-term value of the company (Hartikainen et al., 2021). Short-term compensation refers to short-term benefits, which are usually associated with the firm's growth (Profitlich et al., 2021). Theoretically, short-term compensation structures motivate managers to immediate short-term performance (Mahoney & Thorne, 2005). In this line, a compensation structure with short-term horizons can cause short-sighted executives to prioritize short-term performance over long-term value creation (Focke, 2022). Thus, executives compensated through short-term economic goals such as earnings per share or EBITDA can be negatively influenced by short-term expenses, such as immediate environmental expenses (Dardour & Husser, 2016).

Short-term-oriented investment may not correctly evaluate environmental initiatives and consider them costly, uncertain, and unprofitable (Calza et al., 2016). Executives have little incentive to engage in environmental activities when their compensation focuses on short-term incentive packages. This is because resources spent on improving environmental aspects can harm the firm's short-term performance (Deckop et al., 2006). Short-term compensation can cause executives to forego or postpone investments, such as responsible environmental technology that may reduce the current year's profit (Ortiz-de-Mandojana et al., 2019). In this context, a higher proportion of short-term compensation may lead to lower CSR because executives will focus only on short-term objectives (Jain & Jamali, 2016). Therefore, short-term compensation may encourage managers to reduce the potential benefits of corporate social performance to focus on actions that bring short-term returns (McGuire et al., 2019).

Using a sample of 313 firms, Deckop et al. (2006) found that short-term compensation is negatively associated with corporate social performance. Simerly et al. (2012) found that short-term compensation negatively influences corporate social performance from 203 companies listed on the Kinder, Lydenburg, Domini database. From a sample of 650 U.S. companies, Manner (2010) suggested a negative relationship between short-term compensation and corporate social performance. Ortiz-de-Mandojana et al. (2019) found a negative relationship between short-term compensation and the use of environmentally responsible technologies from 81 U.S. companies during the years 1997, 2000, and 2005. Using a sample of 6734 observations from US firms during 2003

to 2012, Peng (2020) documented that short-term compensation negatively influences CSR engagement.

However, Mahoney and Thorne (2006) suggest that annual bonuses positively influence CSR Strengths. From a sample of 89 French companies from 2007 to 2011, Dardour amd Husser (2016) found that short-term compensation positively influences environmental disclosure. Using a sample of 1301 U.S. firms from 1993 to 2013, Okafor and Ujah (2020) concluded that short-term compensation does not influence CSR investments. In line with theoretical discussions and prior empirical findings, the following hypothesis is proposed:

Hypothesis 2: There is a negative relationship between short-term compensation and environmental innovation

2.4 Long term compensation and environmental innovation

Socially responsible firms consider long-term performance the main factor in executive compensation (Dardour & Husser, 2016). According to agency theory, stock-based compensation effectively reduces agency problems, aligning the interests of principals and agents (Zou et al., 2015). In this regard, long-term compensation provides better alignment between the interests of executives and shareholders (Okafor & Ujah, 2020; Park et al., 2022). Further, since executives' wealth will increase if future stock value increases, they are more likely to take actions consistent with maximizing the firm's long-term value (Mahoney & Thorne, 2006).

Long-term compensation has features that align the interests of managers with the long-term CSR goal (Peng, 2020). Concerns about environmental aspects are more likely to have positive financial effects in the long term (Deckop et al., 2006). Accordingly, long-term compensation reinforces the commitment to demanding and risky environmental strategies, such as pollution prevention (Berrone & Gomez-Mejia, 2009b). This compensation structure is more likely to align managers' interests with environmental aspects (Deckop et al., 2006; Peng, 2020; Sheikh, 2020; Yuan et al., 2020). Thus, long-term compensation tends to increase a company's environmental performance because it reduces agency problems and induces executives to align their interests with those of shareholders (Karim et al., 2018a).

Malik and Shim (2022) indicated that long-term compensation positively influences CSR performance in 1318 US firms from 2009 to 2013. Using a sample of 95 German firms from 2014 to 2018, Profitlich et al. (2021) concluded a positive relationship between corporate sustainability and stock-based compensation. Deckop et al. (2006) concluded that long-term compensation is positively associated with corporate social performance. Adu et al. (2022) found that long-term compensation improves the environmental performance in a sample of U.S. firms comprising 2579 firm-year observations. Similarly, Karim et al. (2018) concluded that there is a positive and significant relationship between long-term compensation and CSR performance. Examining 469 U.S. companies from 1997-2003, Berrone and Gomez-Mejia (2009) found that long-term compensation positively influences pollution prevention.

Mahoney and Thorne (2005) concluded that long-term compensation are more likely to mitigate weaknesses in the environment in a sample of 89 Canadian companies from 1992 to 1996. Peng (2020) suggest that executives with long-term compensation have a greater incentive to invest in CSR activities. Mahoney and Thorne (2006) found that executive stock options positively influences CSR performance. Using a sample of 167 Spanish firms from 2013 to 2018, Blanes et al. (2021) indicated there is a positive relationship between long-term compensation and CSR performance. Park et al. (2022)

suggest that managerial hedging opportunities, which help delink stock-based compensation from the firm's stock price, negatively influence CSR performance.

However, McGuire et al. (2003) concluded that long-term incentives are associated with poor social performance. Rekker et al. (2014) suggest that there is a negative relationship between long-term compensation and socially responsible firms Okafor and Ujah (2020) found that long-term compensation negatively influences CSR investments. Manner (2010) suggests that long-term compensation does not influence corporate social performance. Hassen and Militaire (2020) found that stock option plans do not influence environmental performance. In line with theoretical discussions and prior empirical findings, the following hypothesis is proposed:

Hypothesis 3: There is a positive relationship between long-term compensation and environmental innovation

3 Methodology

Since this paper aims to analyze the influence of compensation structure on environmental innovation, we extracted information on environmental innovation, compensation structure, and control variables from the Refinitiv database. Panel-Corrected Standard Error (PCSE) estimation method was employed to analyze this relationship.

3.1 Sample selection

The sample consists of 113 listed firms on the B3 (Brazil Stock Exchange and Over-the-Counter Market) collected from 2016 to 2020. The sample is unbalanced because full data is unavailable for all firms and years, and it consists of a total of 450 firm-year observations. Our data set comprises information from the Refinitiv database and the Reference Forms available on the Securities Commission ("CVM") website. The Refinitiv database includes about 150 indicators grouped into ten dimensions that measure a company's environmental, social, and governance performance and provide sector-specific rankings (Bătae et al., 2021). In addition, this base contains more than 450 different ESG metrics (Refinitiv, 2022). Table 1 provides details of this sample selection.

Table 1

Sample selection methodology

Filtering process	Observations
Brazilian firms' observations in the period 2016 – 2020	938
Less observations with missing values of executive compensation	455
Less observations with missing values of other financial data	33
Final sample	450

This study excluded all firms with missing annual data for executive compensation and financial data. In the first step, the study excluded all firms with missing executive compensation data, eliminating 455 firm-year observations. The study also excluded all firms with missing financial data, which excluded 33 firm-year observations. Thus, the final sample contains 450 firm-year observations from 113 firms from 2016-2020. Table 2 illustrates the sector classification based on the Global Industry Classification Standard (GICS) (Panel A) and year (Panel B).

Table 2

Sample distribution by sector of activity, countries and year

Panel A Distribution by sector					
Sector	N	%	Sector	N	%
Communication Services	15	3.33	Industrials	52	11.56
Consumer Discretionary	83	18.44	Information Technology	10	2.22
Consumer Staples	52	11.56	Materials	51	11.33
Energy	22	4.89	Real State	18	4.00
Financials	53	11.78	Utilities	68	15.11
Health Care	26	5.78	Total	450	100
Panel C Distribution by year					
Year	N	%	Year	N	%
2016	75	16.67	2019	104	23.11
2017	81	18.00	2020	105	23.33
2018	85	18.89	Total	450	100

Table 2, Panel A, shows the distribution of the sample based on the Global Industry Classification Sector (GICS) of the Refinitiv database. This table shows that the consumer discretionary is the most represented with 18.44%, followed by the utilities sector with 15.11%. The least represented sector is the information technology sector with only a percentage of 2.22%. Table 2, Panel B, reports the distribution of the sample by year. It is worth noting that the number of observations gradually increases each year.

3.2 Dependent variable

In line with (Kyaw, 2022; Shui et al., 2022; Wedari et al., 2022), the study adopts the environmental innovation score as the dependent variable. It is worth noting that the environmental innovation score has a scale of 100. Environmental innovation score "reflects a company's capacity to reduce the environmental costs and burdens for its customers, thereby creating new market opportunities through new environmental technologies and processes, or eco-designed products" (Refinitiv, 2022). This score measures a firm's ability to minimize its environmental footprint through environmental technologies and the performance of innovative products with technological design (Shui et al., 2022), i. e., this score documents the extent of the investment to reduce environmental impact and carbon emissions (Wedari et al., 2022). Thus, the environmental innovation score comprises a firm's input and output of activities related to environmental degradation mitigation and environmental improvement (Kyaw, 2022).

3.3 Independent variables and control variables

Compensation packages usually include salary, bonus, and stock options (Murphy, 1999; Rekker et al., 2014). We divide executive compensation into three groups: fixed compensation, short-term compensation, and long-term compensation. Since it is the only payment independent of performance, salary is the fixed component of executive compensation (Rekker et al., 2014). Fixed compensation is calculated as logarithm of total salary-based compensation (Adu et al., 2022; Mahoney & Thorne, 2006). Bonuses focus the executives' attention on short-term goals (Okafor & Ujah, 2020). The short-term incentive plan is usually paid out as annual bonuses (Ritz, 2022). Short-term compensation is calculated as the logarithm total bonus-based compensation (Adu et al., 2022; Deckop et al., 2006; Karim et al., 2018a; Peng, 2020). The long-term incentive plan is usually paid out as share-based compensation (Ritz, 2022). Thus, long-term compensation is calculated as the logarithm total stock-based compensation (Adu et

al., 2022; Mahoney & Thorne, 2006; McGuire et al., 2003). Table 3 presents a description of the variables in our model.

Table 3
Variables description

Variable name	Variable name	Model name	Proxy
Dependent	Environmental innovation	EIN	Sum of the environmental innovation initiatives that a firm adheres to in a given year.
Independent	Fixed compensation	FIXED	Logarithm of total salary-based compensation
Independent	Short-term compensation	STC	Logarithm of total bonus-based compensation
Independent	Long-term compensation	LTC	Logarithm of total stock-based compensation
Control	Board size	BSIZE	The total number of board members at the end of the fiscal year
Control	Analyst coverage	ANCOV	Total number of analysts covering a company in a given year
Control	CEO duality	CEODUAL	Dummy variable that equals one if the CEO and chairman are the same person and zero otherwise
Control	Profitability	ROA	Income after taxes for the fiscal period/Total assets
Control	Leverage	LEV	Total debt/Total assets
Control	Firm size	FSIZE	Natural logarithm of total assets

Control variables regarding environmental innovation were introduced to the regression model to decrease the likelihood of bias in the results. We include control variables at the board and firm-level that can affect the environmental innovation. At the board level, we included board size, analyst coverage and CEO duality. Board size is the total number of board members at the end of the fiscal year. Large boards allow for a greater variety of viewpoints and are more effective in engaging CSR practices (Campanella et al., 2021). Thus, we expect a positive relationship between board size and environmental innovation. The analyst coverage variable is measured by the total number of analysts covering a firm. Firms with higher analyst coverage are more likely to be evaluated positively by stakeholders (Chun & Shin, 2018). Thus, we expect a positive relationship between analyst coverage and environmental innovation. CEO duality is a dummy variable that equals one if the CEO and chairman are the same person and zero otherwise. CEO duality decreases board monitoring (Tibiletti et al., 2021). Thus, we expect a negative relationship between CEO duality and environmental innovation.

At the firm level, we included profitability, leverage, and firm size. Profitability is the ratio between income after taxes for the fiscal period and total assets. More profitable companies tend to show greater commitment to society (Fahad & Rahman, 2020). Thus, we expect a positive relationship between profitability and environmental innovation. Leverage is measured as debt over total assets. More indebted companies tend to seek a positive image in society; thus, these companies have greater engagement in environmental issues (Talha et al., 2016). Thus, we expect a positive relationship between leverage and environmental innovation. Firm size is the natural logarithm of total assets. Larger companies tend to suffer greater public scrutiny (Jouber, 2021). Thus, we expect a positive relationship between firm size and environmental innovation.

3.4 Empirical models

This study investigates the impact of compensation structure on environmental innovation. Breusch-Pagan Lagrange multiplier test was performed to check for

heteroscedasticity. The result indicated heteroscedasticity ($p<0.01$). The Wooldridge test was performed to check for first-order autocorrelation in the panel data. The result suggests first-order autocorrelation in the panel data ($p<0.01$). The highest VIF of the study was 1.43, indicating that the study does not suffer from a multicollinearity problem, which occurs when the VIF is higher than 10 (Hair et al., 2005). Thus, we employ the Panel-Corrected Standard Error (PCSE) estimation method. This technique assumes that the disturbances are, by default, heteroskedastic and correlated across the panel (Ismail et al., 2022). Therefore, PCSE is useful in estimating linear models in which disturbances are assumed to be both heteroscedastic and correlated across panels (Nyeadi et al., 2018). We employed the following equations using the PCSE method to investigate the link between compensation structure and environmental innovation:

$$EIN_{i,t} = \beta_0 + \beta_1 FIXED_{i,t} + \beta_2 BSIZE_{i,t} + \beta_3 ANCOV_{i,t} + \beta_4 CEODUAL_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \beta_6 FSIZE + \varepsilon_{i,t} \quad (1)$$

$$EIN_{i,t} = \beta_0 + \beta_1 STC_{i,t} + \beta_2 BSIZE_{i,t} + \beta_3 ANCOV_{i,t} + \beta_4 CEODUAL_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \beta_6 FSIZE + \varepsilon_{i,t} \quad (2)$$

$$EIN_{i,t} = \beta_0 + \beta_1 LTC_{i,t} + \beta_2 BSIZE_{i,t} + \beta_3 ANCOV_{i,t} + \beta_4 CEODUAL_{i,t} + \beta_4 ROA_{i,t} + \beta_5 LEV_{i,t} + \beta_6 FSIZE + \varepsilon_{i,t} \quad (3)$$

where, EIN is the environmental innovation. FIXED is the fixed compensation. STC is the short-term compensation. LCT is the long-term compensation. BSIZE is the board size. ANCOV is the analyst coverage. CEODUAL is the is the duality between CEO and chairman. ROA is the profitability. GROWTH is the growth opportunities. LEV is the leverage. FSIZE is the firm size. All continuous variables are winsorized at the 1st and 99th percentiles. Furthermore, β_0 is the intercept and $\beta_1 \ldots \beta_n$ are the regression coefficients and ε_{it} is the remainder error term.

4. Results

We test the hypotheses to determine whether compensation structure influences environmental innovation. We show the mean and standard deviation of the study variables and report the correlation analysis of these variables. We also exhibit the results of the multivariate analysis and sensitivity tests. In addition, we discuss these results.

4.1 Descriptive statics

Table 4 reports the descriptive statistics for environmental innovation, executive compensation and control variables. The average environmental innovation is 0.24, which is higher than 0.20 reported by Kyaw (2022), and lower than 0.37, 54.71 and 59.75 reported by Shui et al. (2022), Konadu et al. (2022), and Wedari et al. (2022), respectively. The standard deviation is 0.33 and the values range from 0 to 0.99.

Table 4

Descriptive statics

Variables	Mean	SD	Minimum	Maximum
EIN	0.246	0.331	0	0.997
FIXED	15.503	1.174	8.439	18.804
STC	15.531	1.159	8.340	18.902
LTC	14.345	3.809	0	19.200
BSIZE	8.888	2.949	1	21
ANCOV	8.938	4.640	0	19
CEODUAL	0.275	0.447	0	1

ROA	0.721	0.109	-0.982	0.643
LEV	0.341	0.221	0	1.928
FSIZE	22.38	1.554	17.019	26.797

The mean logarithm of the salary-based total compensation is 15,503, with a standard deviation of 1,174. With regard to the logarithm of the bonus-based total compensation, we note that the mean is 15,531, with a standard deviation of 1,158. Finally, the mean of the logarithm of total compensation based on shares is 14,299, with a standard deviation of 3,888, which means that the main form of compensation for Brazilian managers is through bonuses tied to financial performance.

4.2 Correlation analysis

Table 5 presents Pearson correlation matrix. The results indicate that environmental innovation has a positive linearity with fixed compensation and long-term compensation. The results also indicate that board size and firm size are positively and significantly correlated with environmental innovation.

Table 5

Correlation Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
EIN	1.00									
FIXED	0.39*	1.00								
STC	-0.40	-0.01	1.00							
LTC	0.25*	0.19*	-0.03	1.00						
BSIZE	0.23*	0.11*	0.05	0.12*	1.00					
ANCOV	0.05	0.12*	-0.03	0.13*	0.13*	1.00				
CEODUAL	-0.01	0.04	0.06	0.03	-0.18*	0.01	1.00			
ROA	0.02	-0.02	-0.09*	-0.02	-0.01	0.23*	0.01	1.00		
LEV	-0.01	-0.04	0.09*	-0.02	0.04	-0.02	0.07	-0.01*	1.00	
FSIZE	0.50*	0.50*	0.04	0.34*	0.37*	0.15*	-0.04	0.01	-0.04	1.00

4.3 Multivariate analysis

Table 6 presents the results from estimating model (1) using the PCSE method. The results reveal a positive and insignificant relationship between fixed remuneration and environmental innovation. These findings indicate that fixed compensation does not influence environmental innovation. This evidence is consistent with Karim et al. (2018) and Malik and Shim (2022). These findings contradict the idea that fixed remuneration makes managers less concerned about environmental issues (Okafor & Ujah, 2020). Since executives compensated mainly with salary are more concerned with achieving short-term goals (Simerly et al., 2012), these executives tend not to engage with environmental innovation, which is a long-term process (Kyaw, 2022). Thus, hypothesis 1 is not supported.

Table 6

Regression of board diversity on the systematic risk

Dependent variable: Environmental innovation						
Panel-Corrected Standard Error						
	Model 1		Model 2		Model 3	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
FIXED	0.013	0.164				
STC			0.002	0.762		
LTC					0.008	0.000***
BSIZE	0.004	0.076*	0.004	0.126	0.007	0.000***
ANCOV	-0.009	0.000***	-0.009	0.000***	-0.007	0.000***

CEODUAL	0.046	0.014**	0.046	0.017**	0.031	0.026**
ROA	0.081	0.022**	0.072	0.083*	0.010	0.775
LEV	0.117	0.000***	0.114	0.000***	-0.243	0.494
FSIZE	0.095	0.000**	0.102	0.000***	0.091	0.000***
Constant	-2.171	0.000***	-2.160	0.000***	-1.980	0.000***
Observations			450			
Firms			113			
R-squared		0.2078	0.2103		0.2093	
Wald chi2	146.31	0.000***	143.94	0.000***	86.66	0.000***
Period	5		5			

Note: This table presents the result of estimating baseline equation using the Panel-Corrected Standard Error estimation technique. EIN is the environmental innovation. FIXED is the fixed compensation. STC is the short-term compensation. LCT is the long-term compensation. BSIZE is the board size. ANCOV is the analyst coverage. CEODUAL is the is the duality between CEO and chairman. ROA is the profitability. GROWTH is the growth opportunities. LEV is the leverage. FSIZE is the firm size. All continuous variables are winsorized at the 1st and 99th percentiles. ***, **, * indicate statistical significance at 1%, 5%, and 10% level, respectively.

Short-term compensation shows a positive sign, contrary to our expectations, and statistically not significant. This indicates that short-term remuneration does not influence environmental innovation. This evidence is consistent with Okafor and Ujah (2020). These findings contradict the thesis that short-term compensation discourages investment in environmental innovation. Executives rewarded annually may refrain from making environmental investments because they seek to engage in activities that increase the company's short-term profitability (Zimon et al., 2022). Since bonus-paid executives have to meet short-term financial targets, they may consider investment in environmental aspects as expenditures that will undermine the company's short-term performance (Deckop et al., 2006; Manner, 2010; Ortiz-de-Mandojana et al., 2019; Peng, 2020; Simerly et al., 2012). Thus, the short-term compensation structure should negatively affect environmental innovation performance. However, the study's results suggest that short-term compensation does not influence environmental innovation. Thus, hypothesis 2 is not supported.

Finally, long-term compensation has a positive and significant relationship with environmental innovation. This result suggests that stock-based compensation encourages environmental innovation (Berrone & Gomez-Mejia, 2009a; Blanes et al., 2021; Karim et al., 2018b; Mahoney & Thorne, 2005, 2006; Malik & Shim, 2022; Park et al., 2022). Blanes et al. (2021) suggest that managers are more willing to accept long-term compensation when they believe that investment in CSR will increase the firm value. Most social investments require a future perspective because they are associated with long-term returns (Ortiz-de-Mandojana et al., 2019). Profitlich et al. (2021) concludes that CFOs with stock-based compensation invest more in corporate sustainability to enhance the company's reputation. Adu et al. (2022) suggest that firms can implement share-based compensation to encourage managers to engage in environmental activities. Berrone and Gomez-Mejia (2009) found that long-term compensation is an important incentive for pollution prevention. Peng (2020) suggest that executives with long-term compensation have greater incentive to engage in corporate social activities.

In sum, short-term compensation consists of salary and bonus, and long-term compensation consists of stock compensation (Rekker et al., 2014). Since fixed remuneration (salary) and short-term remuneration (bonus) do not influence environmental innovation and stock compensation positively influences environmental innovation. The results demonstrate that environmental innovation is a long-term process.

4.4 Sensitive analysis

We employ two-stage least squares regression analysis (2SLS) as an alternative analysis method to address potential endogeneity bias. This method involves identifying an instrument, a variable that is correlated with the independent variable but not with the dependent variable (Angrist & Krueger, 2001; Saeed & Zamir, 2021). A valid instrument must correlate with executive compensation and influence environmental innovation through executive compensation (Bhandari & Javakhadze, 2017). For instrumental variables, we consider the following: The executive compensation industry mean and the lagged executive compensation. Table 7 presents the results.

Table 7

Regression of board diversity on the systematic risk

Dependent variable: Environmental innovation						
Two-stage least squares (2SLS) approach						
	Model 1		Model 2		Model 3	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
FIXED	0.011	0.512				
STC			0.005	0.759		
LTC					0.009	0.085*
BSIZE	0.003	0.585	0.002	0.697	0.012	0.111
ANCOV	-0.012	0.003***	-0.013	0.002***	-0.005	0.261
CEODUAL	0.029	0.441	0.025	0.507	0.037	0.374
ROA	0.241	0.172	0.257	0.149	0.031	0.883
LEV	0.111	0.134	0.111	0.136	0.089	0.360
FSIZE	0.096	0.000**	0.100	0.000***	0.072	0.000***
Constant	-2.080	0.000***	-2.053	0.000***	-1.640	0.000***
Observations			450			
Firms			113			
R-squared	0.2130		0.2164		0.2093	
Wald chi2	90.32	0.000***	90.61	0.000***	86.66	0.000***
Period			5			

Note: This table presents the result of estimating baseline equation using the Two-stage least squares (2SLS) approach. EIN is the environmental innovation. FIXED is the fixed compensation. STC is the short-term compensation. LCT is the long-term compensation. BSIZE is the board size. ANCOV is the analyst coverage. CEODUAL is the is the duality between CEO and chairman. ROA is the profitability. GROWTH is the growth opportunities. LEV is the leverage. FSIZE is the firm size. All continuous variables are winsorized at the 1st and 99th percentiles. ***, **, * indicate statistical significance at 1%, 5%, and 10% level, respectively.

5 Conclusions

This study examined the impact of compensation structure on environmental innovation for a sample of 113 Brazilian firms from 2016 to 2020. The study uses agency theory, and the study's dependent variable is the Refinitiv database environmental innovation score. As independent variables, the study used the logarithm of total salary-based compensation, the logarithm of bonus-based compensation, and the logarithm of stock-based compensation. This study employed Panel-Corrected Standard Error (PCSE) estimation technique.

Our results suggest that long-term compensation positively influences environmental innovation. Executive compensation can be a tool to align the interests of principal and agent (Deckop et al., 2006). According to agency theory, the interests of executives and shareholders align when executives receive a share of the firm (Wang et al., 2021). Executives who are firm shareholders perform activities that increase the value of the firm's shares in the future, such as social activities (Zimon et al., 2022). Managers should pay attention to long-term compensation because they are more effective in

increasing the environmental performance (Adu et al., 2022). Thus, executives with stock-based compensation tend to take actions to enhance their firms' environmental performance (Mahoney & Thorne, 2006). Moreover, since long-term compensation links executives' wealth to changes in a firm's stock price, this compensation can lead to higher shareholder wealth (Dardour & Husser, 2016). In this regard, since environmental innovation is a long-term process, executives paid by shares have greater incentives to invest in environmental innovation. Furthermore, the results suggest that fixed and short-term compensation does not influence, environmental innovation.

The study has limitations. First, this study does not insert macro-institutional issues that can influence environmental innovation, such as social, cultural, and political factors. Second, the study considers only the Brazilian context, and future studies can analyze the influence of compensation structure on environmental innovation in different institutional contexts. Finally, the study used an environmental innovation metric that does not address qualitative aspects, such as word count. Thus, future studies could use other metrics.

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