


## Do macroeconomic institutional factors matter for carbon disclosure? A study on the largest carbon emitters

Fatores institucionais macroeconômicos importam para a divulgação de carbono? Um estudo sobre os maiores emissores de carbono

¿Importan los factores institucionales macroeconómicos para la divulgación del carbono? Un estudio sobre los mayores emisores de carbono

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### Abstract

The present study aims to respond to the following research question: What is the influence of the institutional context on the disclosure of carbon emission? This study is supported by the Variety of Capitalism approach and the hypotheses were built considering the main characteristics of capitalism: the role of the state, the role of financial markets, the role of human capital, the role of social capital and the role of corporate governance. The sample in this research comprises the world largest carbon emitters, composed by 1579 companies headquartered in 19 countries. Our findings show that certain characteristics of capitalism influence carbon disclosure. The results provide contributions to the field of study, as it broadens the understanding of carbon disclosure from a macroeconomic perspective. Additionally, this study has managerial and governmental implications, promoting the debate of how the behavior of firms towards climate change is shaped by the state-society relationship.

**Keywords:** Carbon Disclosure; Macroeconomic Institutional Factors; Varieties of Capitalism; Climate changes

### Resumo

O presente estudo visa responder à seguinte questão de pesquisa: Qual a influência do contexto institucional na divulgação da emissão de carbono? Este estudo está apoiado na abordagem Variedade do Capitalismo e as hipóteses foram construídas considerando as principais características do capitalismo: o papel do Estado, o papel dos mercados financeiros, o papel do capital humano, o papel do capital social e o papel da governança corporativa. A amostra desta pesquisa compreende os maiores emissores de carbono do mundo, composto por 1.579 empresas sediadas em 19 países. Nossas descobertas mostram que certas características do capitalismo influenciam a divulgação de carbono. Os resultados trazem contribuições para o campo de estudo, pois ampliam a compreensão da divulgação de carbono a partir de uma perspectiva macroeconômica. Além disso, este estudo tem implicações gerenciais e governamentais, promovendo o debate de como o comportamento das empresas frente às mudanças climáticas é moldado pela relação Estado-sociedade.

**Palavras-chave:** Divulgação de Carbono; Fatores Institucionais Macroeconômicos; Variedades do Capitalismo; Mudanças Climáticas

## Resumen

El presente estudio tiene como objetivo responder a la siguiente pregunta de investigación: ¿Cuál es la influencia del contexto institucional en la divulgación de las emisiones de carbono? Este estudio se sustenta en el enfoque Variedad del Capitalismo y las hipótesis fueron construidas considerando las principales características del capitalismo: el rol del estado, el rol de los mercados financieros, el rol del capital humano, el rol del capital social y el rol del gobierno corporativo. La muestra de esta investigación comprende los mayores emisores de carbono del mundo, compuesta por 1579 empresas con sede en 19 países. Nuestros hallazgos muestran que ciertas características del capitalismo influyen en la divulgación de carbono. Los resultados proporcionan contribuciones al campo de estudio, ya que amplía la comprensión de la divulgación de carbono desde una perspectiva macroeconómica. Además, este estudio tiene implicaciones gerenciales y gubernamentales, promoviendo el debate de cómo el comportamiento de las empresas frente al cambio climático está moldeado por la relación estado-sociedad.

**Palabras clave:** Divulgación de Carbono; Factores Institucionales Macroeconómicos; Variedades de Capitalismo; Cambios Climáticos

## 1 Introduction

Previous studies have investigated which factors can influence the level of disclosure of corporate social responsibility (García-Sánchez, Rodríguez-Ariza, & Frías-Aceituno, 2013; Miniaoui, Chibani, & Hussainey, 2019; Pucheta-Martínez & Gallego-Álvarez, 2019). The findings of Ioannou and Serafeim (2012) show that aspects of the national business system, such as the level of education and corruption in the country, have an effect on the disclosure of corporate social responsibility. Cultural differences can affect the disclosure of social responsibility, for example, in Germany, companies disclose more environmental information, while in the United States, firms have greater social disclosure (Einwiller et al., 2016).

More recently, some research has been dedicated to understanding the dissemination of carbon, since the emission of greenhouse gases has been associated with damage to animals, humans, and diverse ecosystems (Buse et al., 2021). As all countries in the world have responsibility for the problem of carbon emissions, several have adopted measures to contain the increase in these atmospheric emissions (Yu, Kuo, & Ma, 2020). The disclosure of carbon emissions is a multidimensional concept, which includes issues such as low-carbon initiatives, emission reduction targets, energy consumption and determination of climate change risks and opportunities (Luo & Tang, 2014).

Studying the disclosure of climate change in the light of the Varieties of Capitalism approach can bring new implications for the academic and managerial fields. Varieties of Capitalism capture the institutional context provided by the State, financial markets, human capital and governance institutions in different regions (Fainshmidt et al., 2016). According to Hall and Soskice (2001), countries are divided into two groups: liberal economies and coordinated economies. In liberal economies there is a greater interest in the interests of shareholders, while in coordinated economies there is an interest in stakeholders. Although this dichotomous approach is widespread in the institutional literature, it does not consider economies outside the Organization for Economic Cooperation and Development (Schneider, 2009).

Expanding the dichotomy of capitalism, Schneider (2009) analyzed the institutional foundations of capitalism in Latin America, considering aspects such as union density, labor market regulation and job tenure. Witt and Redding (2013) analyzed the dimensions of capitalism in thirteen Asian business systems in relation to educational characteristics, labor relations, the financial system, and relations between firms. Fainshmidt et al. (2016) developed a model with the main institutional dimensions that characterize the varieties of capitalism. These institutional dimensions served as support for the selection of the explanatory variables in our article.

Although some studies have already examined determining factors for the disclosure of atmospheric emissions, some gaps still exist, especially regarding the chosen theoretical lenses. Most studies have analyzed social responsibility under the theoretical focus of Stakeholder Theory and Institutional Theory (Frynas & Yamahaki, 2016). In addition, many studies only analyze companies from one or two countries (Díaz-Becerra, Leon-Chavarri, & Ampuero-Alfaro, 2021; García-Sánchez, Rodríguez-Ariza, & Frías-Aceituno, 2013), as well as investigating internal factors of the organization itself, for example financial and corporate governance indicators (Tran & Beddewela, 2020). Additionally, carbon disclosure literature seems to focus on the more traditional notion of Institutional Theory (Hahn, Reimsbach, & Schiemann, 2015). There is a need to understand how capitalism characteristics affect the behavior of companies (de Bakker et al., 2020).

Given these limitations, the present study aims to respond to the following research question: What is the influence of the institutional context on the disclosure of carbon emission? To achieve this objective, we analyzed the influence of five variables (Fainshmidt et al., 2016) on the disclosure of climate change by 1579 companies based in the 19 largest carbon emitting countries, according to the Global Carbon Atlas (2020). These companies operate in different industries and are headquartered in 19 different countries, which have different institutional configurations.

The results of this research have academic and managerial implications. First, the findings contribute to the development of studies on the influence of the varieties of capitalism on the disclosure of climate change, since previous research has focused on the dichotomy of liberal and coordinated economies (Ortas, Gallego-Álvarez, & Álvarez, 2019). This study contributes to the VoC approach, expanding this approach to emerging countries. In addition, the research increases the debate about the carbon disclosure, which has still been little explored (Choi & Luo, 2020). Second, the debate on macro institutional factors can provide insights into how firms' behavior towards climate change can be shaped by the state-society relationship. Third, the evidence provided allow managers to recognize that the environmental performance of companies does not depend only on the company's characteristics and resources, but also on the ideal adjustment of their organization to the characteristics of the country's capitalism.

## 2 Literature and Hypotheses

### 2.1 From dichotomy to varieties of capitalism

Hall and Soskice (2001) identified two types of capitalism that differ by the level of coordination that exists in the economy: Liberal Market Economies (LME) and Coordinated Market Economies (CME). LME (e.g., Australia, Canada, United States and United Kingdom) have certain characteristics, such as been susceptible to conflict among manager and employees, the prevalence of short-term employment, a financial system based on the stock market, and a strong emphasis on short-term price movements in the stock market. Most investments in research and development come from the private industry and relations between firms in the liberal context are competitive (Hall & Soskice, 2001).

In contrast, CME (e.g., Japan and Germany) are characterized by a consensual relationship between capital, workers' associations, and investors. The financial system is based on large banks and the governance is dispersed, i.e., decisions are made considering the interests of all stakeholders (Hall & Soskice, 2001). The industries make alliances for the development of research together, and the relations between firms occur in a cooperative way, as for suppliers, customers, employees (Benney, 2019).

Although the VoC approach is widely used in studies that compare different institutional environments, this approach is limited by the neglect of economies in Latin America, Africa and Asia (Kiran, 2018; Schneider, 2009). Thus, when analyzing the institutional configuration of countries outside the Organization for Economic Cooperation and Development (OECD), studies should insert new types of capitalism (Witt & Redding, 2013). Several studies have tried to extend this approach from the dichotomy LME and CME, to the varieties of capitalism, for example addressing capitalism in Latin America (Schneider, 2009), in Africa (Nattrass, 2014), in Asia (Witt & Jackson, 2016) and in emerging economies (Nölke & Vliegenthart., 2009).

Following previous studies (Ortas et al., 2019), for the hypotheses' development in this study, the five main characteristics of capitalism of Fainshmidt et al. (2016), as pointed by the same authors, were considered: (i) role of the state, (ii) role of financial markets, (iii) role of human capital, (iv) role of social capital, and (v) role of corporate governance. Table 1 presents the main characteristics of capitalism, as well as its explanations and examples of institutional elements. We adapted this table from Fainshmidt et al. (2016).

Ortas, Gallego-Álvarez and Álvarez (2019) analyzed the influence of different national institutions on disclosure of environmental, social and governance information. These authors used the framework developed by Fainshmidt et al. (2016), considering the effect of the type of state, the availability of knowledge capital, equity and credit markets, generalized trust, family ownership and family intervention in the management on the disclosure of information. The findings show that certain characteristics of capitalism can affect environmental and social disclosure.

### 2.2 Macroeconomic institutional factors and carbon disclosure: developing the research hypotheses

#### 2.2.1 The role of the state

In countries with stronger regulatory quality, there is a perception of high-quality public services. Under these conditions, companies understand the government's effort to encourage transparency and disseminate more environmental information (Coluccia, Fontana, & Solimene, 2018). A strong state implements environmental policies and companies located in these countries are better prepared to meet the demands of stakeholders (Hartmann & Uhlenbruck, 2015). Previous studies have shown that regulatory states tend to have companies with greater environmental transparency (de Villiers & Marques, 2016; Ortas, Gallego-Álvarez, & Álvarez, 2019). This leads us to the following hypothesis:

**H1:** In countries with greater regulation in business, companies will disclose more information about their carbon emissions.

Table 1  
**Characteristics of capitalism**

Characteristics of capitalism	Explanation of the characteristic	Institutional elements
Role of state	The state can intervene in the economy, creating regulations to shape the behavior of institutions. There are several types of state: developmental, predatory, regulatory, and welfare.	State direct dominance, state indirect dominance, and type of state
Role of financial markets	Financial markets are the central element of capitalism, as they explain how capital is acquired and distributed. The equity and credit market are the two main channels for obtaining financial capital.	Equity markets, credit markets, state-provided capital, capital market, and banking system performance
Role of human capital	Knowledge capital refers to the country's ability to have a robust educational system and the availability of technical skills. This characteristic is important, since it determines how the firm relates to its employees.	Knowledge capital, coordination with labor, educational system, and availability of qualified employees
Role of social capital	Social capital refers to the trust that members have in other members of society. When institutions and members of society lack trust, people engage in informal relationships, resulting in corruption and an ineffective state.	Generalized trust, public trust in institutions, level of corruption, government effectiveness
Role of corporate governance	Corporate governance is the way in which companies in the country are managed and controlled, the concentration of ownership being an important element, as it shapes the interactions between owners, managers, and employees.	Concentration of ownership, family intervention in management, participation of the main shareholder in total shares

**Source:** Fainshmidt et al. (2016).

## 2.2.2 The role of financial markets

In countries where financial markets are underdeveloped, companies rely on the domestic capital market, that is, when the state or the family assumes the role of capital-provider (Schneider, 2009). In these economies, there is a greater focus on financial issues to the detriment of social and environmental ones (Ortas, Gallego-Álvarez, & Álvarez, 2019). In their turn, in countries that have a developed credit market, companies can perform more innovative management practices, once there is greater freedom in relation to state agents (Hall & Soskice, 2001). In economies with a well-developed credit market, companies are under greater pressure from stakeholders for more responsible behavior (Berrone et al., 2013). The study by Goss and Roberts (2011) found that companies located in countries with a more developed banking system tend to have greater environmental disclosure. This leads us to the following hypothesis:

**H2:** In countries where banks are more robust, companies will disclose more information about their carbon emissions.

**H3:** In countries with easier access to credit, companies will disclose more information about their carbon emissions.

## 2.2.3 The role of human capital

Labor relationships are important to understand how human capital is used and how organizations coordinate activities with work (Hall & Soskice, 2001). In countries where labor relations are better regulated, there is less employee turnover, flexibility (Witt & Redding, 2013) and greater employee involvement in corporate decisions (Jensen & Berg, 2012). According to Ioannou and Serafeim (2012), in countries with a better employment relationship, companies have better social performance, because they seek to provide more benefits to employees and contribute to sustainable development. Previous studies have hypothesized the positive effect of a more regulated labor market on environmental disclosure (Gallego-Álvarez & Ortas, 2017; Jensen & Berg, 2012; Rosati & Faria, 2019). This leads us to the following hypothesis:

**H4:** In countries with greater regulation in the labor market, companies will disclose more information about their carbon emissions.

The degree of knowledge capital within the national context is relevant since it influences the engagement of employees in productive activities (Fainshmidt et al., 2016). When knowledge capital is available to firms, they can invest in specific skills, from training and development, diversity management, and environmental training (Jackson & Deeg, 2008). In addition, firms are encouraged to increase their

environmental disclosure to attract a more skilled workforce (Baldini et al., 2018). Some studies have found that a higher educational level in the country positively influences environmental disclosure (Ioannou & Serafeim, 2012; Jensen & Berg, 2012; Ortas, Gallego-Álvarez, & Álvarez, 2019). This leads us to the following hypothesis:

**H5:** In countries with higher expenditure on Research and Development (R&D), companies will disclose more information about their carbon emissions.

#### 2.2.4 The role of social capital

When there is a lack of generalized trust, organizations create informal networks that devalue meritocracy. Generalized trust is lower due to corruption and an ineffective state (Fainshmidt et al., 2016). The study by Ioannou and Serafeim (2012) reveals that in countries with higher levels of corruption, companies are discouraged from disclosing more environmental information. Thus, a higher level of trust in national institutions influences companies to be more transparent (Walker, Zhang, & Ni, 2019). Previous evidence has found that greater generalized confidence and a lower level of corruption can positively influence environmental disclosure (Ioannou & Serafeim, 2012; Ortas, Gallego-Álvarez, & Álvarez, 2019). This leads us to the following hypothesis:

**H6:** In countries with lower levels of corruption, companies will disclose more information about their carbon emissions.

#### 2.2.5 The role of corporate governance institutions

The level of property rights is one of the ways to analyze national governance institutions (Hall & Soskice, 2001). When a country is more open and has a higher level of property rights, there is more opportunity for business activities, which also favors greater operations by international NGOs to fight for the preservation of nature (Graafland, 2019). Furthermore, in general, countries with a higher level of property rights tend to allow free associations and organizing rights (Almeida & García-Sánchez, 2017). Based on these arguments, we hope that in countries with better property rights, people invest more in companies and therefore demand more transparency from them. Thus, there is greater pressure from stakeholders for information not only on financials, but also on atmospheric emissions. This leads us to the following hypothesis:

**H7:** In countries with greater property rights, companies will disclose more information about their carbon emissions.

Concentration of ownership is a relevant element of the institutional environment, because it shapes the relationships between owners, workers and managers (Fainshmidt et al., 2016). In countries with a high concentration of ownership, large investors tend to dominate the boards, which reduces the diversity and independence of directors (Ortas, Gallego-Álvarez, & Álvarez, 2019). In this perspective, dominant owners are not interested in disclosing clear information about the company's actions (Rosati & Faria, 2019). Previous studies found a negative influence of the concentration of ownership on environmental disclosure (Jensen & Berg, 2012; Ortas, Gallego-Álvarez, & Álvarez, 2019). This leads us to the following hypothesis:

**H8:** In countries with a lower level of ownership concentration, companies will disclose more information about their carbon emissions.

The variables and econometric tests used to investigate the hypotheses developed are presented below. As can be seen, each of the hypotheses refers to the country's institutional environment, which is addressed by Varieties of Capitalism.

### 3 Method

To address the research question, we made use of secondary sources. The initial sample considered all the companies in the 20 largest carbon emitters in the world identified in the Global 2000 list from Forbes (2020). This list includes 1579 companies from China, United States, India, Russia, Japan, Iran, Germany, Indonesia, South Korea, Saudi Arabia, Canada, South Africa, Brazil, Mexico, Australia, Turkey, United Kingdom, Italy, France, and Poland, which are the 20 countries that most emitted the greenhouse gases in 2020, according to the Global Carbon Atlas (2020).

Our study has a sample that represents 78.95% of the population of companies on the Global 2000 list. No Iranian companies were present on this list, therefore we analyzed companies from 19 countries. 2020 was the year analyzed in our study due to data availability. Globally, carbon emissions dropped by 8.3% in the first four months of 2020 compared with 2019 (Tollefson, 2020). Table 2 shows the number of companies by country, considered in the sample of study.

Table 2  
**Number of companies by country**

Country	Total companies	Country	Total companies
Australia	32	Mexico	12
Brazil	18	Poland	6
Canada	61	Russia	23
China	266	Saudi Arabia	14
France	57	South Africa	10
Germany	51	South Korea	58
India	50	Turkey	8
Indonesia	6	United Kingdom	77
Italy	26	United States	587
Japan	217	Total	1579

Source: Prepared by the authors.

The country with the highest representation is the United States with 37.18%, followed by Japan with 13.74% and China with 16.85%. In contrast, the countries with the lowest representation are Turkey, Indonesia, and Poland, with 0.51%, 0.38% and 0.38% respectively. The sample companies were grouped into eleven industries, as set out in the Forbes (2020). Table 3 shows the number of companies by economic industry name. The industries with the greatest representation are financials, industrials, and consumer discretionary with 24.76%, 13.43%, and 10.96%, respectively. On the other hand, the lowest representation comes from the energy sector with 4.69%, followed by the communication services sector with 4.94%.

Table 3  
**Number of companies by industry**

Economic industry name	Total companies	Companies' frequency	Cumulative frequency
Communications	78	0.0494	0.0494
Consumer discretionary	173	0.1096	0.1590
Consumer staples	116	0.0735	0.2324
Energy	74	0.0469	0.2793
Financials	391	0.2476	0.5269
Health care	100	0.0633	0.5902
Industrials	212	0.1343	0.7245
Materials	130	0.0823	0.8068
Real Estate	82	0.0519	0.8588
Technology	141	0.0893	0.9481
Utilities	82	0.0519	1.0000
Total	1579	1.0000	

Source: Prepared by the authors.

The dependent variable is the level of carbon disclosure, measured by a number value, which varies between 100 (greater disclosure) and 0 (no disclosure). All the information was collected from the Carbon Disclosure Project database. The Carbon Disclosure Project questionnaire answered by the companies classifies the companies in grades ranging from A + to F, depending on the quality of the responses given by the companies in relation to their atmospheric emissions. Thus, the study used numerical values for each of these letters, following the study by Kouloukoui et al. (2019). Table 4 presents the description of the variables in this study.

The independent variables measure characteristics of capitalism, from macro institutional factors perspective, in the countries analyzed. The institutional environment of the countries was measured using the methodology employed by Fainshmidt et al. (2016). These authors state that there are five characteristics for measuring the varieties of institutional systems, for example: role of the state, role of financial markets, role of human capital, role of social capital and role of corporate governance. We adopted this theoretical model because it is more recent than Hall and Soskice (2001) and because of that it brings emerging economies to the discussion of typologies of capitalism.

For each of these characteristics of capitalism, we elaborate research hypotheses. For example, the level of business regulation represents the role of the state, sound banking and ease of access to credit represent the role of financial markets, regulation in the labor market and expenditure on research and development represents the role of human capital, the level of corruption in the country represents the rule of social capital and, property rights and the level of ownership concentration represents the role of corporate governance institutions. These variables were extracted from reports by international organizations such as the World Bank, World Economic Forum, Heritage Foundation, Fraser Institute and Transparency International.

Table 4  
Variable's description

Variables	Description	Source
CARDIS	Carbon disclosure level: This variable measures the level of carbon disclosure of companies, ranging from 0 (no disclosure) to 100 (higher disclosure).	Carbon Disclosure Database
BUSREG	Business regulations: It is the average of six indicators: administrative requirements, regulatory burden, starting a business, impartial public administration, licensing restrictions and cost of tax compliance. It ranges from 1 (poorly regulated businesses) to 9 (well-regulated businesses).	Economic Freedom of the World: Annual Report, Fraser Institute
SOUNBA	Soundness of banks: How do people assess the soundness of banks? It ranges from 1 (low banks may require recapitalization) to 7 (high banks are generally healthy with sound balance sheets).	The Global Competitiveness Report, World Economic Forum
EASLOA	Ease of access to loans: How easy is it for businesses to obtain a bank loan? It ranges from 1 (difficult) to 7 (easy).	The Global Competitiveness Report, World Economic Forum
LABMAR	Labor market regulations: It is the average of six indicators: hiring regulations and minimum wage, hiring, and firing regulations, centralized collective bargaining, hours regulations, mandated cost of worker dismissal and conscription. It ranges from 1 (poorly regulated labor market) to 9 (well-regulated labor market).	Economic Freedom of the World: Annual Report, Fraser Institute
REDEXP	Research and Development expenditures: Expenditures on research and development, expressed as a percentage of GDP. It ranges from 1 (lower expenses) to 7 (higher expenses).	The Global Competitiveness Report, World Economic Forum
CORPER	Corruption Perceptions Index: This measures the country's level of transparency. It ranges from 88 (lower level of corruption) to 12 (higher level of corruption).	Transparency International
PRORIG	Property rights: This measures the right of individuals or organizations to control access to assets they own. It ranges from 10.1 (lower level of property rights) to 96.8 (higher level of property rights).	Index of Economic Freedom, The Heritage Foundation.
OWNCON	Ownership concentration: Dummy variable ranging from 0 (if the company does not operate in a country where firm ownership is highly concentrated) to 1 (if the company operates in a country where firm ownership is highly concentrated).	Fainshmidt et al. (2016), Ortas, Gallego-Álvarez and Álvarez (2019).
SALES	Annual sales (million USD).	Global 2000 list, Forbes
PROFITS	Annual profits (million USD).	Global 2000 list, Forbes
ASSETS	Annual assets (million USD).	Global 2000 list, Forbes
MKTVAL	Company's market value: It is the price an asset would fetch in the marketplace.	Global 2000 list, Forbes
ROA	Return on Assets: Net Income/ Average Total Assets.	Global 2000 list, Forbes
LEGALSYS	Legal system: 1 = if the company is in a civil law country and 0 = if the company is in a common law country.	The World Factbook, Central Intelligence Agency
AFRICA	Dummy variable: 1 = if the country is in Africa; 0 = Otherwise.	The World Factbook, Central Intelligence Agency
ASIA	Dummy variable: 1 = if the country is in Asia; 0 = Otherwise.	The World Factbook, Central Intelligence Agency
EUROPE	Dummy variable: 1= if the country is in Europe; 0 = Otherwise.	The World Factbook, Central Intelligence Agency
LATAME	Dummy variable: 1= if the country is in Latin America; 0 = Otherwise.	The World Factbook, Central Intelligence Agency
NORAME	Dummy variable: 1 = if the country is in North America; 0 = Otherwise.	The World Factbook, Central Intelligence Agency
OCEANIA	Dummy variable: 1 = if the country is in Oceania; 0 = Otherwise.	The World Factbook, Central Intelligence Agency

Source: Prepared by the authors.

Drawing on past evidence, we inserted some control variables into the econometric model, as these variables can affect carbon disclosure. We add five variables at the company level, for example number of sales, annual profits, company assets, market value and return on assets. These variables data were obtained from Forbes magazine (2020). At the country level, we use the country's legal system. In addition, the regional effect was controlled using six geographic regions: Africa, Asia, Europe, Latin America, North America, and Oceania. These variables are calculated as dummy variables and were obtained from The World Factbook report by the Central Intelligence Agency.

After data collection, we performed statistical tests. First, descriptive statistics tests (mean, standard deviation, minimum and maximum) of the variables were performed, and second, Pearson's correlation to measure the level of relationship between the variables analyzed. Third, before applying the hierarchical linear modelling technique, we applied the following tests: variance inflation factor (VIF) and tolerance to measure the collinearity between the predictors, Shapiro-Francia W test for normality and Breusch-Pagan test to accept or reject the hypothesis of heteroscedasticity. Finally, to verify the effect of the independent variables on the dependent variable, hierarchical data regression was operationalized. This technique was chosen, since panel data regression is used for samples of companies that vary over time. Panel data regression analyses many consecutive years in the same econometric model (Garcia-Sanchez, Cuadrado-Ballesteros, & Frias-Aceituno, 2016), and this study analyses the year 2020.

The econometric model that expresses the hierarchical regression is expressed below:

$$\begin{aligned} \text{CARDIS}_i = & \beta_0 + \beta_1 \text{BUSREG}_i + \beta_2 \text{SOUNBA}_i + \beta_3 \text{EASLOA}_i + \beta_4 \text{LABMAR}_i + \beta_5 \text{REDEXP}_i + \beta_6 \text{CORPER}_i \\ & + \beta_7 \text{PRORIG}_i + \beta_8 \text{OWNCON}_i + \beta_9 \text{SALES}_i + \beta_{10} \text{PROFITS}_i + \beta_{11} \text{ASSETS}_i + \beta_{12} \text{MKTVAL}_i \\ & + \beta_{13} \text{ROA}_i + \beta_{14} \text{LEGALSYS}_i + \beta_{15} \text{AFRICA}_i + \beta_{16} \text{ASIA}_i + \beta_{17} \text{EUROPE}_i + \beta_{18} \text{LATAME}_i \\ & + \beta_{19} \text{NORAME}_i + \beta_{20} \text{OCEANIA}_i + \varepsilon_i \end{aligned}$$

Where: the subscript "i" represents the firm, "β" is the estimated parameter, and "ε" refers to the error term.

The data were operationalized with the aid of the STATA® software, version 13. After operationalizing the main tests, we performed a sensitivity analysis. In these additional tests, we excluded financial sector companies as well as US-based organizations. This is important to give more robustness and reliability to our findings.

## 4 Results

### 4.1 Descriptive statistics

Table 5 presents the main descriptive statistics of the analyzed variables. Regarding carbon disclosure, the data show that, on average, the sample disclosed 42.83% of the expected information. Additionally, we verified that there are companies that have not disclosed any information about their carbon emissions, as well as there are companies that disclose as much information as possible.

Table 5  
Descriptive analysis

Variable	Nº. of observations	Mean	Std. Dev.	Min.	Max.
CARDIS	1579	42.83	42.80	0.00	100
BUSREG	1579	7.83	0.85	4.55	8.50
SOUNBA	1579	5.42	0.58	3.90	6.20
EASLOA	1579	4.89	0.66	3.00	8.17
LABMAR	1579	7.56	1.48	3.10	8.98
REDEXP	1579	2.43	1.95	0.10	74.0
CORPER	1579	62.31	13.65	30.0	86.6
PRORIG	1579	77.66	10.75	0.00	92.2
OWNCON	1579	0.56	1.20	0.00	44.2
SALES	1579	31.64	19.99	0.00	44.47
PROFITS	1579	15.90	21.01	-0.98	44.47
ASSETS	1579	21.57	22.07	0.00	44.47
MKTVAL	1579	30.27	20.59	0.00	44.47
ROA	1579	277.24	1969.38	-328.2	42333.1
LEGALSYS	1299	0.37	0.48	0.00	1.00
AFRICA	1579	0.00	0.08	0.00	1.00
ASIA	1579	0.38	0.48	0.00	1.00
EUROPE	1579	0.15	0.36	0.00	1.00
LATAME	1579	0.01	0.13	0.00	1.00
NORAME	1579	0.41	0.49	0.00	1.00
OCEANIA	1579	0.02	0.28	0.00	1.00

Source: Prepared by the authors.

Regarding the independent variables, business regulations is 7.83 out of 8.50, soundness of banks is 5.42 out of 6.20, ease of access to loans is 4.89 out of 8.17, labor market regulations is 7.56 out of 8.98, research and development expenditures is 2.43 out of 74, corruption perceptions index is 62.31 out of 86.6, property rights is 77.66 out of 92.20, ownership concentration is 0.56 out of 44.2. Sales average 31.64



(expressed in US dollars), profits is 15.90, assets, on average, is 21.57, market value is 30.27 and return on assets has an average of 277. 37% of the firms of our sample operate in a country with civil law. Additionally, 38% of the countries in our sample are in Asia, 15% in Europe, 1% in Latin America, 41% in North America and 2% in Oceania.

Multicollinearity concerns have been checked by calculating the Pearson correlations. According to the correlation matrix in Table 6, there is no strong correlation between the independent variables. Therefore, multicollinearity is not a problem in this analysis. However, the effects of possible collinearity are eliminated in the hierarchical regression by removing some variables from the econometric model (Frias-Aceituno et al., 2013). In this way, we operationalize models, in which some variables are removed, to avoid that the dependencies between the variables are strong. Additionally, we perform sensitivity analysis, restricting the sample.

## 4.2 Multivariate analysis

Table 7 shows the results of the five econometric models, which were built to test our hypotheses. Model 1 presents the effect of independent variables on the carbon disclosure of companies headquartered in emerging countries. This sample includes companies based in Brazil, China, India, Indonesia, Mexico, Poland, Russia, Saudi Arabia, South Africa, and Turkey. In Model 2, we explore this effect in developed countries, including Australia, Canada, France, Germany, Italy, Japan, South Korea, the United Kingdom, and the United States. In Model 3, only the independent variables were considered. Model 4, we consider the independent and control variables. In Model 5, we add the regional effect.

Regarding *Model 1 - emerging countries*, our evidence shows that greater regulation in business has a positive effect on carbon disclosure. In emerging countries with greater banking strength, companies tend to disclose more information about their carbon emissions. Additionally, in a more fragmented labor market, firms disclose more carbon information. Research and development expenses positively influence carbon disclosure. Thus, in countries with greater research incentives, companies tend to include additional issues, such as carbon disclosure, in corporate decisions. In emerging markets, the level of property rights has a negative effect on carbon disclosure. Regarding the legal system, the data reveal that in countries that have common law, companies disclose more information about their carbon emissions. In this model, no company-level variable was proven.

Regarding *Model 2 - developed countries*, the data show that business regulations are a factor that influences the level of carbon disclosure of companies. Furthermore, the greater ease of access to credit is not a determining factor for companies to disclose more carbon information in developed countries. More regulated labor markets have a positive effect on carbon disclosure. Research and development expenditure negatively influences carbon disclosure. In countries with a higher level of ownership concentration, companies are more likely to disclose more carbon information. Regarding the control variables, we found that the number of annual sales negatively influence disclosure, while profits have a positive effect on carbon disclosure. Furthermore, the results indicate that in developed countries that follow the civil law legal system, companies have greater carbon disclosure.

Regarding *Model 3 - without the control variables*, the results show that greater regulation in business negatively influences carbon disclosure. Furthermore, in countries with more solid banking system, companies tend to be more engaged with carbon disclosure. However, the ease of access to credit has a negative effect on carbon disclosure. The results also indicate that having more regulated labor markets is a determining factor for firms to increase the level of carbon disclosure. The data show that expenditure on research and development is a variable that positively influences carbon disclosure. Another determining factor in the level of carbon disclosure is corruption in the country. The results suggest that in countries with less corruption, companies engage more in carbon disclosure. In countries with a higher level of property rights, firms have greater disclosure and ownership concentration negatively influences carbon disclosure.

Regarding *Model 4 - without the regional effect*, our findings show that greater regulation in business has a negative effect on carbon disclosure. In countries with better banking systems, companies engage more in carbon disclosure. We find that the ease of access to credit has a negative effect on carbon disclosure. Furthermore, other institutional characteristics are crucial for companies to increase their carbon disclosures, such as a more regulated labor market, greater investment in research and development, less corruption, and a greater level of property rights. Ownership concentration has a negative effect on carbon disclosure. The number of annual sales has a negative influence on disclosure and companies with higher annual profits are more likely to fully disclose their carbon emissions.

Regarding *Model 5 - inserting the regional effect*, the results indicate that greater regulation in business and greater banking soundness negatively influence carbon disclosure. However, in countries with easier credit for business financing, firms disclose more information on their carbon emissions. Better regulated labor markets have a negative influence on carbon disclosure. Furthermore, countries with higher levels of property rights positively encourage their companies to have greater carbon disclosure. The number of sales negatively influences carbon disclosure and annual profits have a positive effect on disclosure, indicating that more profitable companies are more committed to disclosing their carbon emissions.

Table 6  
Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) CARDIS	1.00																			
(2) BUSREG	0.27***	1.00																		
(3) SOUNBA	0.28***	0.74***	1.00																	
(4) EASLOA	0.04*	0.64***	0.60***	1.00																
(5) LABMAR	0.21***	0.78***	0.72***	0.81***	1.00															
(6) REDEXP	0.01	0.19***	0.13***	0.27***	0.04*	1.00														
(7) CORPER	0.36***	0.90***	0.77***	0.54***	0.71***	0.23***	1.00													
(8) PRORIG	0.37***	0.90***	0.74***	0.42***	0.70***	0.02	0.93***	1.00												
(9) OWNCON	0.04*	0.17***	0.23***	0.29***	0.21***	0.84***	0.24***	0.05***	1.00											
(10) SALES	-0.14***	0.00	0.01	0.03	0.03	-0.04*	-0.02	-0.02	-0.02	1.00										
(11) PROFITS	0.21***	-0.00	0.00	0.00	0.02	-0.03	0.01	0.01	-0.00	-0.25***	1.00									
(12) ASSETS	-0.05**	0.11***	0.12***	0.13***	0.12***	0.05**	0.08***	0.08***	0.07***	0.27***	-0.28***	1.00								
(13) MKTVAL	-0.09***	-0.09***	-0.08***	-0.12***	-0.12***	-0.04*	-0.08***	-0.07***	-0.07***	0.21***	-0.28***	0.17***	1.00							
(14) ROA	0.04*	-0.01	-0.00	0.00	-0.00	-0.00	-0.00	-0.01	0.00	-0.09***	0.18***	-0.13***	-0.10***	1.00						
(15) LEGALSYS	0.15***	-0.24***	-0.36***	-0.50***	-0.62***	0.05***	-0.06***	-0.07***	-0.29***	-0.07***	-0.01	-0.11***	0.07***	-0.02	1.00					
(16) AFRICA	0.04*	-0.18***	0.03	-0.07***	-0.07***	0.21***	-0.08***	-0.19***	0.23***	0.03	-0.03	-0.05***	0.02	-0.00	-0.07***	1.00				
(17) ASIA	-0.21***	-0.39***	-0.51***	-0.29***	-0.57***	0.02	-0.41***	-0.39***	-0.37***	-0.00	-0.05**	-0.09***	0.11***	0.00	0.57***	-0.06***	1.00			
(18) EUROPE	0.22***	-0.02	-0.23***	-0.43***	-0.14***	-0.11***	0.15***	0.15***	0.03	-0.07***	0.06***	-0.09***	-0.01	-0.01	0.32***	-0.03	-0.34***	1.00		
(19) LATAME	0.07***	-0.38***	0.09***	-0.25***	-0.24***	-0.10***	-0.27***	-0.25***	-0.06***	-0.02	-0.00	0.02	0.02	-0.00	0.20***	-0.01	-0.11***	-0.06***	1.00	
(20) NORAME	0.00	0.52***	0.59***	0.69***	0.74***	0.06***	0.34***	0.36***	0.30***	0.04*	0.01	0.14***	-0.11***	0.01	-0.76***	-0.06***	-0.66***	-0.36***	-0.11***	1.00
(21) OCEANIA	0.00	-0.00	0.08***	0.11***	-0.05**	0.78***	0.11***	-0.12***	0.82***	-0.00	-0.02	0.04*	-0.02	-0.00	-0.07***	0.25***	-0.07***	-0.03	-0.01	-0.07***

Source: Prepared by the authors.

Note: \*\*\*p<0.01. \*\*p<0.05. \*p<0.10.

Table 7  
Multivariate analysis results

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
BUSREG	63.36**	2.28	103.90**	2.30	-18.80***	-4.84	-17.35***	-4.59	-12.84**	-2.28
SOUNBA	24.77***	3.15	12.78	0.85	5.61*	1.88	6.58**	2.27	-34.67***	-2.81
EASLOA			-62.66**	-2.17	-17.18***	-4.46	-18.35***	-4.88	22.20***	2.54
LABMAR	-48.49***	-2.48	30.96**	2.23	6.48***	3.24	6.89***	3.54	-7.15*	-1.84
REDEXP	120.89***	2.39	-17.77*	-2.73	2.94**	2.28	3.46***	2.76	-0.59	-0.18
CORPER	-0.34	-0.35	-0.00	-0.01	1.04***	3.80	1.01***	3.79	0.10	0.16
PRORIG	-7.06***	-2.50	-1.72	-1.26	1.23***	2.81	1.09***	2.55	3.23***	2.91
OWNCON			40.04***	2.69	-3.26*	-1.69	-4.17**	-2.22	2.45	0.24
SALES	-0.25	-1.41	-0.19***	-3.14			-0.17***	-3.44	-0.20***	-3.45
PROFITS	0.13	0.73	0.47***	7.85			0.37***	7.47	0.42***	7.41
ASSETS	0.03	0.21	0.04	0.76			0.25	0.54	0.03	0.61
MKTVAL	-0.11	-0.59	0.01	0.19			-0.02	-0.50	0.00	0.00
ROA	-0.00	-0.19	0.00	1.28			0.00	0.36	0.00	1.24
LEGALSYS	-85.62***	-3.57	88.30***	2.81					8.78	1.48
AFRICA									60.06	1.05
ASIA									-42.46	-0.84
EUROPE									-37.94	-0.67
LATAME									33.27	0.63
NORAME									-36.50	-0.62
OCEANIA									-8.93	-0.15
Obs.	133		1166		1579		1579		1299	
Prob>F	0.0001		0.0000		0.0000		0.0000		0.0000	
R <sup>2</sup>	0.2696		0.1526		0.1921		0.2400		0.1574	

Source: Prepared by the authors.

Note: \*\*\*p<0.01. \*\*p<0.05. \*p<0.10.

### 4.3 Sensitivity analysis: restricting the sample

Having evidenced the above results, we conducted additional tests to reinforce the results obtained. In Model 6 and Model 7, we remove the financial sector from the analysis. In Model 8 and Model 9, we excluded firms headquartered in the United States, as the high representation of American firms can bias the sample. In Table 8, we present the results.

Table 8  
Sensitivity analysis to the sample

	Model 6		Model 7		Model 8		Model 9	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t
BUSREG	-17.80***	-3.67	-13.87***	-2.51	-17.49***	-2.94	-12.49*	-1.91
SOUNBA	-0.78	-0.18	-51.47***	-2.43	-2.83	-0.54	-51.92***	-3.14
EASLOA	-6.50	-1.16	46.65*	1.64	-4.83	-0.67	20.92*	1.89
LABMAR	1.56	0.55	-8.58**	-2.21	4.85	1.43	-4.61	-0.95
REDEXP	1.05	0.61	13.59	0.76	-0.36	-0.12	-1.39	-0.36
CORPER	1.23***	3.11	-1.08	-0.71	0.31	0.80	0.36	0.49
PRORIG	0.52	1.04	3.77***	3.23	1.91***	3.12	3.70**	2.52
OWNCON	-2.55	-0.88	27.70	0.86	-6.16	-1.22	12.37	0.97
SALES	-0.15**	-1.97	-0.16**	-2.15	-0.14**	-2.15	-0.15**	-2.26
PROFITS	0.45***	5.99	0.46***	6.25	0.25***	3.61	0.26***	3.86
ASSETS	0.06	0.90	0.09	1.27	-0.29***	-4.27	-0.26***	-3.92
MKTVAL	0.13***	1.70	0.15**	2.05	-0.07	-1.18	-0.06	-1.02
ROA	0.00	0.59	0.00	0.97	-0.04**	-2.13	-0.00**	-1.97
LEGALSYS	6.12	1.30	5.44	0.70	14.12***	2.47	15.39**	2.09
AFRICA			-129.35	-0.53				
ASIA			-267.19	-0.96			-92.03**	-2.56
EUROPE			-257.13	-0.94			-104.42***	-2.75
LATAME			-160.85	-0.66			8.09	0.31
NORAME			-248.95	-0.93			-94.41***	-3.12
OCEANIA			-227.42	-0.83			-76.11**	-2.59
Obs.	712		712		986		986	
Prob>F	0.0000		0.0000		0.0000		0.0000	
R <sup>2</sup>	0.1361		0.1804		0.1785		0.2025	

Source: Prepared by the authors.

Note: \*\*\*p<0.01. \*\*p<0.05. \*p<0.10.

Regarding *Model 7 – excluding the USA firms*, the results show that greater regulation in business has a negative effect on carbon disclosure. Banking strength has a negative effect on carbon disclosure and in countries with easier access to credit, companies disclose more carbon information. In less regulated labor markets, firms are more engaged in disclosing their carbon emissions. In countries with higher levels of property rights, firms perform better in carbon disclosure. Annual sales have a negative effect on disclosure. Profits and market value positively influence carbon disclosure.

Regarding *Model 9 – except financial industry*, the data show that greater regulation in business negatively influences carbon disclosure. In addition, the soundness of the banking system has a negative effect on carbon disclosure and the ease of borrowing by companies has a positive effect on disclosure. In countries with higher levels of property rights, companies engage more in carbon disclosure. Sales, assets, and ROA had a negative influence on carbon disclosure. Additionally, companies with higher profits disclose more carbon information. Companies headquartered in countries with a civil law legal system are more likely to disclose more information on their carbon emissions. Finally, firms based in Asia, Europe, North America, and Oceania show a negative impact on carbon disclosure.

## 5 Discussion and Implications

Our analysis has shown that countries' macroeconomic characteristics can affect corporate behavior in relation to carbon disclosure. We found that certain characteristics of capitalism are important for determining environmental policies related to disclosure in companies. Not only the organizational context, such as the firm's financial performance and corporate governance characteristics, is relevant to explain the level of carbon disclosure, but also national factors.

Our findings indicate that in countries with less business regulation, companies engage more in carbon disclosure. This result contradicts previous studies (Graafland, 2019; Ortas et al., 2019). According to the Varieties of Capitalism approach, the capacity of firms to develop relationships with stakeholders is coordinated by market institutions. Thus, freer markets are more receptive to new concepts and ideas, which favors a more proactive behavior of firms in relation to carbon disclosure.

In more liberal markets, consumers have more influence on the behavior of firms (Hall & Soskice, 2001). Many regulations can discourage competitive pressure between companies and reduce companies' costs of disclosing additional information, such as carbon emissions. According to Jackson and Apostolakou (2010), in a more open market, companies replace the lack of government regulation with voluntary carbon disclosure initiatives. Thus, carbon disclosure can legitimize business actions, reduce political costs in emerging countries and convey a good corporate image.

The country's banking robustness is not a determining factor for companies to increase their carbon disclosure. This finding confirms the thesis that in countries with a well-developed financial system (not just an efficient banking system), firms can develop innovative management practices, because they have a greater connection with economic agents (Hall & Soskice, 2001). In relation to the country's financial system, it is important that there is a diversification of corporate financing sources, since in countries with easier access to credit, companies disclose more carbon information. This result is supported by Berrone et al. (2013).

Better regulation of the labor market is not a determining factor in increasing carbon disclosure, according to our analysis. This contradicts the work by Ioannou and Serafeim (2012) and Ortas et al. (2019), who argue that more fragmented labor markets have fewer collective actions and human resource management is based on connections to political decisions. A more regulated labor market favors greater job satisfaction for employees. Thus, companies can inform their stakeholders that the company values a better relationship between employees and employer, disclosing information on social issues in their official reports, making carbon information less evident.

The results indicate that a better level of property rights is significant for firms' adherence to carbon disclosure. Since countries with a higher level of rights tend to allow free associations and organization rights, stakeholders demand greater responsibility from companies in relation to environmental issues, increasing carbon disclosure (Almeida & García-Sánchez, 2017). Additionally, in countries with more property rights, the financial system tends to be better developed, which favors greater investments in companies. Therefore, in these environments, companies are under greater pressure to behave in an environmentally correct manner.

Concerning the control variables, the findings show that the number of annual sales negatively affects carbon disclosure and that more profitable companies tend to disclose more carbon information. The market value variable had a positive effect on carbon disclosure when we removed US companies from the sample. We found that in civil law countries, companies are more likely to disclose more information about their carbon emissions. Companies located in countries with this legal system value decision-making that is more integrated with the needs of stakeholders. When we enter the regional effect, firms operating in Asia, Europe, North America, and Oceania show a negative impact on carbon disclosure.

Some implications can be derived from this study. First, the results of this study provide new evidence for research that addresses the nexus between institutional context and carbon disclosure. Our

study confirms one of the theses defended by Varieties of Capitalism approach, that institutional structures and certain characteristics of capitalism affect business behavior. Additionally, the research explored a sample of companies based in developed and underdeveloped economies, using the approach of Fainshmidt et al. (2016), to compose the institutional characteristics of the countries.

Therefore, our study expands the approach of VoC to emerging countries and analyses the carbon disclosure from a macroeconomic perspective. This research also has managerial implications. When managers set up new industries in developed or underdeveloped countries, they must understand what kind of state the country adopts (regulatory, predatory, developmental). In addition, they must consider other macroeconomic factors, such as the level of regulation in business and in the labor market, the country's financial system and governance institutions. Although several previous studies have found that organizational factors (financial performance, corporate governance, and managers background) affect the responsible performance of companies, a special look must be given to macroeconomic factors. Institutional pressures can affect carbon disclosure as well as internal company factors.

Although the results indicate that less regulation in business favors the engagement of companies in carbon disclosure, governments can implement regulations to establish minimum requirements for this type of disclosure and encourage investments in technologies to mitigate the effects of carbon emissions. Governments can encourage carbon disclosure by creating a national award for companies with the best disclosure. In addition, regulators can incorporate protection mechanisms into regulatory processes for other interest groups and not just for shareholders.

The findings of our study suggest that strong climate change policy and regulation is needed to move companies towards low-carbon operations. Government policies must be adopted, especially by countries that emit the most carbon, to mitigate and adapt their companies' strategies to climate change.

## 6 Conclusions

This study aimed to investigate the influence of the institutional context on carbon disclosure, responding to the research question: What is the influence of the institutional context on the disclosure of carbon emission? To achieve it, this study analyzed a sample of 1579 international companies, headquartered in 19 countries. We developed eight research hypotheses and the data revealed that certain characteristics of the macroeconomic context influence the disclosure related to carbon emissions. In countries with less regulation in business and in the labor market, companies tend to have greater carbon disclosure. Furthermore, in countries where financing is easier for companies and property rights are greater, companies disclose more carbon information.

This research has some limitations that must be overcome in future studies. We analyzed a specific year (2020), applied the framework from Fainshmidt et al. (2016), and examined the companies present in the database of the Carbon Disclosure Project, present in the Global 2000 list from Forbes. Therefore, our findings should be interpreted with caution, since unlike the studies by Graafland (2019) and Ortas et al. (2019), our results are restricted to 1 year. Another limiting factor is the use of secondary data since it does not allow us to make in-depth analyses and disregards cultural issues. Additionally, the results cannot be generalized for all companies in the countries, as this study examined only large companies.

Future studies should investigate other years or a longer period, as well as insert new characteristics of capitalism to compose the institutional context. In addition, new studies may select other international lists to select the sample. Future studies may include developing economies that were not included in the sample. We encourage other scholars to measure the climate change disclosure considering other information, such as other atmospheric emissions, not just carbon. When investigating a longer period of time, new research can answer the following research questions: (i) How do different stakeholders use carbon disclosure information? (ii) How can the level of corruption in the country influence the carbon disclosure in emerging and developed countries? (iii) Is being transparent about atmospheric emissions enough to respond to climate change? (iv) How can different national configurations affect the carbon disclosure of multinationals and their subsidiaries?

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## NOTES

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### DATASET

The dataset that supports the results of this study is not publicly available.

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Does not apply.

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Does not apply.

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