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**Original Article**

# Effect of the national business system on the disclosure of greenhouse gases emissions: multi-country evidence

## Efeito do sistema nacional de negócios na divulgação de emissões de gases de efeito estufa: evidência em múltiplos países

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## ABSTRACT

**Methodology:** Institutional Theory and the National Business System approach were used to propose the research hypotheses. The work evaluated 1,072 companies from the 10 largest economies in the world, using econometric models and statistical analysis.
**Purpose:** Investigate the effect of the national business system on the disclosure of greenhouse gases by companies from the largest economies in the world.
**Findings:** The results indicate that institutional factors, such as the political, financial and cultural systems affect the disclosure of greenhouse gases. Thus, institutional pressure from countries can determine the environmental performance of their firms. However, the results showed that the country's level of development is not an explanatory variable for the disclosure of atmospheric emissions.
**Practical implications:** The research presents the impact of formal and informal institutions on the disclosure practices of companies, suggesting that policy makers could influence it by strengthening certain institutional aspects.
**Originality/Value:** Although there is an increasing volume of research on the disclosure of corporate social responsibility, few studies are dedicated to comparing the disclosure of greenhouse gases in the light of the national business system.
**Keywords:** National business system; Institutional environment; Greenhouse gases

## RESUMO

**Metodologia:** A Teoria Institucional e a abordagem do Sistema Nacional de Negócios foram usadas

para propor as hipóteses de pesquisa. O trabalho avaliou 1.072 empresas das 10 maiores economias do mundo, utilizando modelos econométricos e análise estatística.
**Objetivo:** Investigar o efeito do sistema nacional de negócios na divulgação de gases de efeito estufa por empresas das maiores economias do mundo.
**Resultados:** Os resultados indicam que fatores institucionais, como o sistema político, financeiro e cultural, afetam a divulgação de gases de efeito estufa. Assim, a pressão institucional dos países pode determinar o desempenho ambiental de suas empresas. No entanto, os resultados mostraram que o nível de desenvolvimento do país não é uma variável explicativa para a divulgação de emissões atmosféricas.
**Implicações práticas:** A pesquisa apresenta o impacto de instituições formais e informais nas práticas de divulgação das empresas, sugerindo que os formuladores de políticas podem influenciá-las fortalecendo certos aspectos institucionais.
**Originalidade / Valor:** Embora haja um volume crescente de pesquisas sobre a divulgação da responsabilidade social corporativa, poucos estudos se dedicam a comparar a divulgação de gases de efeito estufa à luz do sistema nacional de negócios.
**Palavras-chave:** Sistema nacional de negócios; Ambiente institucional; Gases do efeito estufa

## 1 INTRODUCTION

Climate change has produced environmental, social, political, economic and psychological changes in society (Miles-Novelo & Anderson, 2019). In relation to environmental issues, global warming (increase in Earth's average surface temperature due to human activities) causes the melting of polar ice caps, reduces the biodiversity of fauna and flora, increases the sea level, increases severity and frequency of droughts as well as hurricanes and floods (Raftery et al., 2017). In this context, scientific evidence has shown that carbon emissions are the main cause of global warming (He et al., 2021).

While carbon emissions stand out as the key driver of global warming, the disclosure of greenhouse gases emissions (reporting by individuals or organizations of the amount and types of greenhouse gases they release into the atmosphere), especially carbon, remains unregulated in many countries (Luo, 2019). National differences in corporate social responsibility (a concept that refers to a company's commitment to operating in an economically, socially, and environmentally sustainable manner) can be associated to the different socioeconomic degrees in the country, institutional pressures and laws that require disclosure (Choi & Luo, 2020; Soares et al., 2020). It is

important to investigate CSR reporting as it pertains to a wide set of stakeholders, who are concerned with long-term and ethical issues (Christensen et al., 2021). According to Pinheiro et al. (2023), it is still unclear how national institutions shape companies' environmental behavior.

Companies, influenced by institutional pressures, disclose environmental information, including atmospheric emissions (Jensen & Berg, 2012; Luo et al., 2013). Thus, the formal and informal institutions of the countries affect their responsible behavior and impose certain expectations (Pinheiro, Sampaio, et al., 2021; Pucheta-Martínez & Gallego-Álvarez, 2019). Given the relevance and influence of the national context in environmental disclosure, several studies have analyzed how countries institutional environment can affect the environmental impact disclosure of their companies (Coluccia et al., 2018; Miniaoui et al., 2019a; Oliveira et al., 2018; Soares et al., 2020).

However, existing research exhibits limitations, notably the scarcity of studies focusing on greenhouse gas disclosure (Luo 2019; Luo et al., 2012). Soares et al. (2020) analyzed Brazilian and Canadian companies, focusing only on environmentally sensitive sectors. Oliveira et al. (2018) investigated the influence of the national business system on the disclosure of gender information. Other studies, such as García-Sánchez et al. (2013) and Soares et al. (2018) analyzed only one aspect of the national business system, the cultural system and the financial system, respectively.

In this sense, the role of the national business system in the disclosure of environmental information is still unclear, especially in emerging countries such as Brazil, China and India (Oliveira et al., 2018). According to Luo (2019) and He et al. (2021), studies should analyze the effect of institutional pressures on the disclosure of greenhouse gases. Therefore, the present study has as a guiding question: What is the effect of the national business system on the disclosure of information on greenhouse gases? To this end, the research aims to investigate the effect of the national business

system of the ten largest economies in the world, in terms of the disclosure of greenhouse gas information from their companies.

This study contributes to expanding institutional approaches to corporate social responsibility, shifting the focus from internal factors to the impact of national institutions on environmental disclosure (He et al., 2021; Walker et al., 2019). Carbon disclosure is one way for an organization to have social responsibility towards its stakeholders (Luo, 2019). At the managerial level, the study presents the implications of how national institutions can interfere in corporate decisions. Thus, suggesting that developed countries have greater institutional pressure for the disclosure of information on greenhouse gases.

To achieve the goal, the present study analyzed a sample of 1,072 companies from the world's ten largest economies in 2018, listed in the Forbes 2000 companies ranking, and with information available in the 2018 Carbon Disclosure Project database. The research represented the institutional environment of the countries through their national business systems (independent variables), and the disclosure of greenhouse gases was collected based on the Carbon Disclosure Project website. The data were analyzed using statistical techniques, such as descriptive and inferential statistics, correlation between variables and hierarchical data analysis.

This research is segmented into six sections, beginning with an introduction to the theme, followed by the literature review section, where institutional theory and corporate social responsibility are addressed, as well as the hypotheses developed. In the methodology section, the sample, the data collection process and the statistical analyses used are presented. The next section presents the results found and the discussion, followed by the conclusion section, which presents the findings of the study, the managerial implications, limitations and suggestions for future research in the field of atmospheric emissions disclosure.

## 2 LITERATURE REVIEW

Due to globalization and the technological advances produced by it, organizations have been operating in very dynamic environments. Thus, managers are worried about the macroeconomic forces that affect organizational performance in addition to the internal indicators. The Institutional theory states that the environment affects the companies and its activities, in addition to rebuilding itself at all times (Meyer & Rowan, 1977).

From an institutional point of view, companies are led to incorporate institutionalized practices into the society if they aim to increase their legitimacy and prospects (North, 1991). Thus, this theory suggests that the structure and functioning of companies are a socially constructed reality (Rosenzweig & Singh, 1991), since organizations act in accordance to rules, procedures, beliefs and values present in a given institutional environment (DiMaggio & Powell, 1983).

The term institution has been used massively in works that address institutional theory. According to Scott (1987), institutions are cognitive, regulatory and normative structures and activities. Thus, from the perspective of this author, institutions are mechanisms for resolving conflicts based on rules and punishments. In addition, March & Olsen (1989) defined that institutions are formed by formal elements (rules and customs) and informal elements (culture and behavioral aspects). According to one proponent of the Institutional Theory, Williamson (1981), institutions are companies, markets and contractual relationships.

Several studies have investigated how institutional environments have influenced organizational practices of corporate social responsibility. It was believed that companies performance depended exclusively on the rational and efficient efforts of managers (Zucker, 1987). However, today, it is known that environmental performance, for example, is the result of a number of factors, including the companies political, cultural and symbolic interactions with the institutional environment (Pinheiro, da Silva Filho, et al., 2021).

Based on this context, different institutional environments can influence the environmental practices of companies, that is, national institutions are responsible for differences in corporate attitudes regarding social responsibility (Campbell, 2006). Thus, companies based in developed countries tend to have a greater performance in corporate social responsibility, due to the increase of institutional pressures (Coluccia et al., 2018). In these environments, companies have a commitment not only to direct stakeholders (customers, managers and investors), but also to indirect stakeholders (community, media, NGOs, state).

The work of Tilt (2016) states that corporate social responsibility practices are determined by the institutional aspects of the country in which the company operates. Companies will disclose more information related to their atmospheric emissions, according to the political, social and economic characteristics of the country in which they operate. In addition, the legal system adopted in the country (Amor-Esteban et al., 2018), the cultural system (Stankov, 2015), the kind of capitalism (Pucheta-Martínez et al., 2019), the financial system (Soares et al., 2018), and the national business system (Jensen & Berg, 2012) interfere with corporate social responsibility engagement.

The term national business system was first used by Whitley (1999) to define the set of historically constructed institutional characteristics. The national business system is composed by the political, financial, educational, labor, cultural and economic aspects of a country (Whitley, 2003). In this sense, the social and environmental practices of a company are determined by the national business system of the country in which it is headquartered (Ioannou & Serafeim, 2012; Matten & Moon, 2008). More recently, Pinheiro et al. (2023) found that the institutional environment can shape companies' behavior in relation to ESG performance. Therefore, companies adopt different environmental policies according to the institutional environment in which they operate.

## 3 HYPOTHESES DEVELOPED

Corruption is a relevant factor in the political system (Oliveira et al., 2018), being characterized by misuse of a position or authority for personal interests. Corrupt governments have fewer resources to invest in education, welfare, economic development and infrastructure (Langseth et al., 1997). Moreover, in countries with lower corruption level, companies are expected to make a greater commitment to social and environmental responsibility (Brown & Knudsen, 2015). However, countries with a higher corruption level have weak courts, controlled institutions and regulatory agencies, contributing to the non-effective adoption of environmental policies (Ashforth et al., 2008). Soares et al. (2020) found that better public governance positively affects social and environmental disclosure in Brazil. The work of Oliveira et al. (2018) found that the country's international transparency does not affect the disclosure of gender information in Latin America. While Ioannou and Serafeim (2012) found that a lower level of corruption in the country positively affects social and environmental disclosure.

H1: A lower level of corruption positively influences the disclosure of information on greenhouse gases.

The financial system is another pillar of the national business system. Countries that have stock market-based financial markets such as Australia, United States and United Kingdom tend to disclose more information to investors, such as financial and corporate governance reports, than environmental reports (Walker et al., 2019). Large companies can access credit faster than smaller companies (Jensen & Berg, 2012). Moreover, these large companies have a wider range of stakeholders, who impose pressures on them for greater socio-environmental performance (Lourenço & Branco, 2013). Therefore, the easier access to credit can be considered a variable of influence on environmental disclosure. The work of Soares et al. (2018) found that in Australia, Brazil, Canada and India, the level of financial system focused on the capital market is positively related to environmental disclosure. This influence has been previously

explored by other authors (Ioannou & Serafeim, 2012; Jensen & Berg, 2012).

H2: Easier access to credit positively influences the disclosure of information on greenhouse gases.

The work system is characterized by the relation between employees and employers (Whitley, 2003). Ioannou and Serafeim (2012) state that in countries where there is a greater presence of trade unions, companies carry out a greater disclosure of corporate social responsibility. Thus, coordinated market countries such as Germany, Denmark, the Netherlands and Norway tend to encourage their companies to make decisions considering the expectations of all stakeholders, including workers (Pucheta-Martínez et al., 2019). The good relationship between unions and owners will reflect on more complete environmental reports (Jensen & Berg, 2012). Oliveira et al. (2018) found that a better relationship between employees and employers positively influences the disclosure of gender information, consistent with other results, such as Jensen and Berg (2012) e Ioannou and Serafeim (2012). While Soares et al. (2020) found that, in Brazil, the work system positively affects social and environmental disclosure, but it has no influence in Canada.

H3: Increased cooperation between employees and employers positively influences the disclosure of information on greenhouse gases.

The educational system is characterized by the qualification of the workforce, including quality of education and training (Ioannou & Serafeim, 2012). In this sense, an important aspect of the national business system is the quality of the countries education system, since it can interfere in the policies of sustainable development (Matten & Moon, 2008). Countries that have a greater involvement with research and academic knowledge tend to have companies with similar innovation capabilities (Jensen & Berg, 2012), which may favor action on environmental issues, such as the disclosure of information on greenhouse gases. Moreover, a higher level of education in the country can favor greater business transparency (Barkemeyer et al., 2018). According to Soares et al. (2020), the environmental disclosure of Brazilian and

Canadian companies, in the sectors of oil and gas, basic materials and utilities, is not affected by the educational system. The study of Ioannou and Serafeim, (2012) found that a better education system positively affects the corporate social performance of companies in 42 countries.

H4: A higher quality of the educational system positively influences the disclosure of information on greenhouse gases.

Culture is commonly defined as the social construction of reality or as the software of the mind (Hofstede, 2011). A factor of the country's cultural system is the distance to power. According to Hofstede (1983), the distance to power describes the perception of the social hierarchy in terms of equality and inequality. Thus, societies with a higher level of power concentration tend to have greater social inequality and less business transparency (García-Sánchez et al., 2013). The study of Garcia-Sanchez et al. (2016a) found that there is a negative influence of distance to power in the disclosure of corporate social responsibility. Other studies, such as Oliveira et al. (2018) and Pucheta-Martínez and Gallego-Álvarez (2019) did not find a statistically significant relationship between distance to power and disclosure. According to Barkemeyer et al. (2018), countries with a lower level of distance to power and no paternalistic structures have companies with a greater commitment to business communication, including the disclosure of information on atmospheric emissions.

H5: A greater distance to power negatively influences the disclosure of information on greenhouse gases.

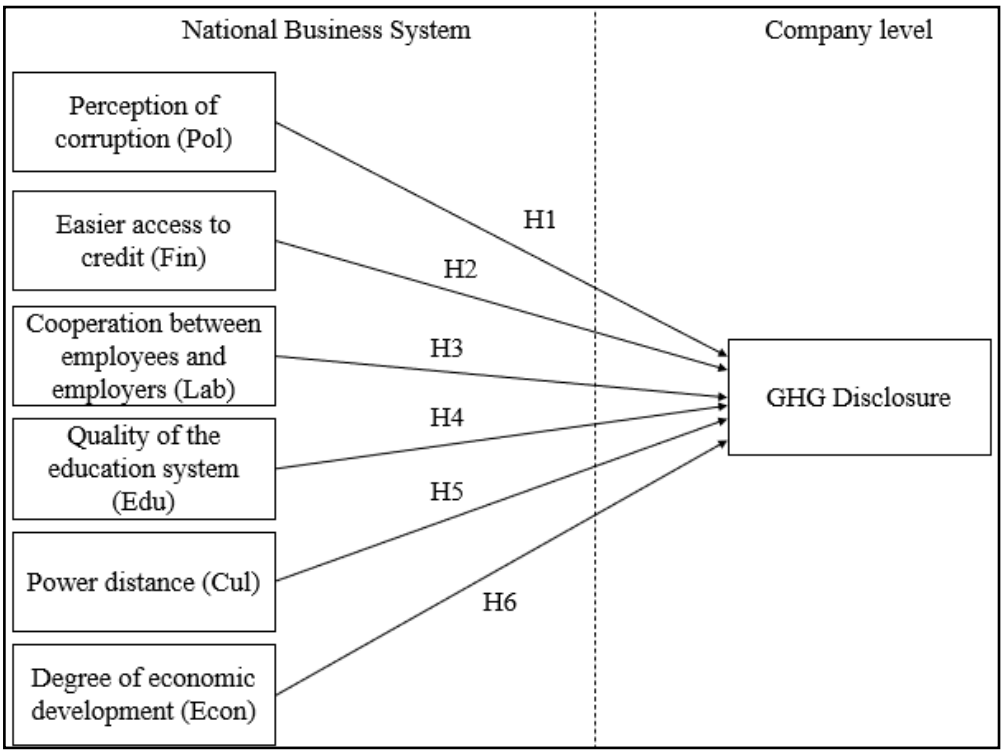
The economic system is represented by the degree of economic development for the nation (Whitley, 1998). Moreover, for Belal (2000) the quantity and quality of the disclosure of corporate social responsibility information are influenced by the level of economic development of the country. In this sense, the economic system is a relevant determinant in environmental disclosure. Emerging countries have poor disclosure when compared to environmental reports from developed countries in Europe (Matten & Moon, 2008). Islam and Deegan (2008) found that corporate transparency

is higher in companies based in developed countries, in line with Oliveira et al. (2018), who found that the more developed a country is, the more its companies disclose gender information about their employees. The findings of Jensen and Berg (2012) also show that greater economic development positively affects their socio-environmental disclosure.

H6: Further economic development positively influences the disclosure of information on greenhouse gases.

Figure 1 presents our research model, which relates the national business system to Greenhouse gases (GHG) disclosure.

Figure 1 – Research model




Source: The authors, 2021

## 4 METHODOLOGY

This study is characterized as descriptive and explanatory, since it measures, describes and explains the relationship and behavior of phenomena. It has a

quantitative nature, employing resources and statistical techniques for data collection and processing, in addition to measuring the relationship between variables: national business system and disclosure of greenhouse gases. Secondary data were used, i.e., the data were collected and published for other purposes (Sampieri et al., 2013).

The research initially considered the population of all companies from the ten largest economies in the world (United States, China, Japan, Germany, India, United Kingdom, France, Italy, Brazil and Canada) presented in the Global 2000 companies list from the 2018 Forbes magazine. A total of 1,402 companies, that is, 70.10% of the 2000 largest companies in the world were headquartered in the ten largest economies in Gross Domestic Product. It was observed that 1,072 of these companies responded to the Carbon Disclosure Project questionnaire, which became the sample for this research, representing 53.60% of the population of 2,000 companies. Previous research (Lee, Raschke and Krishen, 2023; Bhaskaran, 2023) has also used the Forbes list to define the sample. Table 1 presents the sample information.

Table 1 – Sample of companies analyzed

| # | Countries | Population (companies) | Sample (companies) | Sample/Population (%) | Obs. |
|---|---|---|---|---|---|
| 1 | Brazil | 20 | 16 | 80% | 16 |
| 2 | Canada | 56 | 47 | 83,92% | 47 |
| 3 | China | 251 | 117 | 46,61% | 117 |
| 4 | France | 57 | 47 | 82,45% | 47 |
| 5 | Germany | 52 | 47 | 90,38% | 47 |
| 6 | India | 57 | 47 | 82,45% | 47 |
| 7 | Italy | 27 | 23 | 85,18% | 23 |
| 8 | Japan | 223 | 196 | 87,89% | 196 |
| 9 | United Kingdom | 83 | 76 | 91,56% | 76 |
| 10 | United States | 576 | 456 | 79,16% | 456 |
| Total | | 1,402 | 1,072 | 76,46% | 1,072 |

Source: The authors, 2021

For each of the 1,072 companies, seven observations were made, one observation for the disclosure of greenhouse gases and six observations for each indicator of the national business system of the countries: political system, financial system, labor

system, educational system, cultural system and economic system. The ten largest economies in the world have been chosen, as the countries with the largest economies are the main sources of power and determine much of the world's negotiations. The study investigates the year 2018, by availability of information on the webpage of the Carbon Disclosure Project. When the research was ongoing, the 2019 data had not been released yet. The companies are grouped into 11 activity sectors, with the Finances sector accounting to 20% of analyzed companies, followed by Consumer Discretionary (13.9%), Industry (13.8%), Technology (10.2%), Materials (9.1%), Consumer Staples (6.7%), Health Care (6.2%), and Other (20.1%).

From this perspective, the Carbon Disclosure Project is a global, non-governmental, non-profit organization that aims to provide a channel for companies to disclose their greenhouse gas emissions and other issues related to climate change. Companies are invited to participate in the survey and answer a questionnaire, which is made available to the public. For measurement purposes, the Carbon Disclosure Project also discloses a score for each firm, according to their responses and transparency when answering the questionnaire. This score is expressed in letters, which are A+, A-, B+, B-, C+, C-, D+, D- and F. Companies that carry out a more complete disclosure of their atmospheric emissions receive the A+ or A- grades. On the other hand, companies that disclose incomplete information receive D+, D- or F grades.

The study of Kouloukoui et al. (2019) assigned numerical values for each of these letters, to facilitate the performance of statistical tests and discover the influence of aspects such as company size and sector of action in the disclosure of greenhouse gases. Thus, values were assigned according to table 2. For the dependent variable, 1,072 observations were made, one for each company in the sample.

Table 2 – Values assigned to the disclosure level (GHG Disclosure) – dependent variable

| **Carbon Disclosure Project Grade (CDP)** | **A+** | **A-** | **B+** | **B-** | **C+** | **C-** | **D+** | **D-** | **F** |
|---|---|---|---|---|---|---|---|---|---|
| Score (%) | 100 | 95 | 85 | 80 | 60 | 40 | 20 | 5 | 1 |

Source: Adapted from Kouloukoui et al., 2019

The independent variables used in this study are the characteristics of the national business system of each country, composed by six systems: political system, financial system, labor system, educational system, cultural system and economic system. For each of these systems, an indicator was selected, being them: perception of corruption, easiness access to credit, cooperation between employees and employers, quality of the education system, distance to power and degree of economic development. For these independent variables, 6,432 observations were made, with data extracted from reports of the World Bank, World Economic Forum, Transparency International and the Hofstede website. The indicators and their sources are presented in Chart 1.

Chart 1 – Indicators analyzed

| National System | Hypoteses | Signal | Indicator | Source |
|---|---|---|---|---|
| Political System (Pol) | H1 | + | Perception of corruption | Transparency International (2018) |
| Financial System (Fin) | H2 | + | Easier access to credit | |
| Labor System (Lab) | H3 | + | Cooperation between employees and employers | World Economic Forum (2018) |
| Educational System (Edu) | H4 | + | Quality of the education system | |
| Cultural System (Cult) | H5 | - | Distance to power | Hofstede (2018) |
| Economic System (Econ) | H6 | + | Degree of economic development | World Bank (2018) |

Source: The authors, 2021

A correlation was performed between the variables analyzed, to test whether there were linear dependencies between the variables. Formula 1 expresses the proposed model, having the GHG Disclosure as a dependent variable, and six explanatory variables (Pol, Lab, Edu, Cult and Econ) in addition to the error term (u) and the constant (α).

$$GHG\ Disclosure = \alpha + \beta_1 Pol + \beta_2 Fin + \beta_3 Lab + \beta_4 Edu + \beta_5 Cult + \beta_6 Econ + u \quad (1)$$

This conceptual model was operationalized by STATA, version 13. In this econometric model, the dependent variable is expressed by "Disclosure _GHG". Moreover, $\beta_1 pol \beta_1 pol$ represents the political system as perception of corruption, $\beta_2 fin\, \beta_2 fin$ represents the financial system as easier access to credit, $\beta_3 lab \beta_3 lab$ represents the labor system as cooperation between employees and employers, $\beta_4 edu \beta_4 edu$ represents the educational system as quality of the education system, $\beta_5 cul \beta_5 cul$ represents the cultural system as distance to power, $\beta_6 eco \beta_6 eco$ represents the economic system as degree of economic development. Finally, μ represents the residue or error of the proposed model. It is noteworthy that hierarchical regression of data was chosen, as the study analyzes one year (2018) and it would not be relevant to perform a regression of data in panel, which considers the effect of years on the dependent variable.

## 5 ANALYSES OF RESULTS AND DISCUSSION

Table 3 presents the values of the independent variables of the study: perception of corruption, easier access to credit, cooperation between employees and employers, quality of the education system, distance to power and degree of economic development.

Table 3 – Description of independent variables

| # | Country/Indicator | Pol | Fin | Lab | Edu | Cult | Econ |
|---|---|---|---|---|---|---|---|
| 1 | Brazil | 35 | 3.6 | 4 | 2.6 | 69 | 0 |
| 2 | Canada | 81 | 4.9 | 5.4 | 5.4 | 39 | 1 |
| 3 | China | 39 | 4.5 | 4.6 | 4.5 | 80 | 0 |
| 4 | France | 72 | 4.1 | 3.9 | 4.3 | 68 | 1 |
| 5 | Germany | 80 | 5.2 | 5.3 | 5.4 | 35 | 1 |
| 6 | India | 41 | 4.5 | 4.5 | 4.6 | 77 | 0 |
| 7 | Italy | 52 | 3 | 4 | 3.7 | 50 | 1 |
| 8 | Japan | 73 | 5.2 | 5.7 | 4.4 | 54 | 1 |
| 9 | United Kingdom | 80 | 4.4 | 5.3 | 4.7 | 35 | 1 |
| 10 | United States | 71 | 5.5 | 5.4 | 5.6 | 40 | 1 |
| | Mean Sample | 67.12 | 5.03 | 5.19 | 4.99 | 49.80 | 0.83 |

Source: The authors, 2021

Based on Table 3 one can observe that, in general, developed countries have a better national business system than emerging countries. Thus, it is observed that Brazil, China and India have more corrupt institutions than Germany, Canada, the United States, France, Italy, Japan and the United Kingdom.

Moreover, it is noticed that, in 2018, the country of the sample that had the worst education system was Brazil, while the best education system was present in the United States. The education system closest to the Brazilian was the Italian, being it 29.72% better than the Brazilian educational system. While regarding the distance to power, it is perceived that Brazil, China, France and India accept more the inequalities of concentration of power than Germany, Canada, the United States, Italy, Japan and the United Kingdom. Finally, countries such as Germany, Canada, the United States, France, Italy, Japan and the United Kingdom are considered developed, while Brazil, China and India are considered emerging.

Table 4 shows the descriptive statistics for the dependent variable, i.e., the disclosure of greenhouse gas emissions on the Carbon Disclosure Project webpage, measured through the carbon disclosure project (Kouloukoui et al., 2019). The minimum disclosure is equivalent to 1, that is, the letter F of the degree of disclosure. It is also noticed that French companies, on average, released more information about their atmospheric emissions than companies in other countries. UK companies ranked second in terms of disclosure. By contrast, Chinese and Indian companies were less transparent in the disclosure of greenhouse.

In relation to the mean term, it is observed that Chinese and Indian companies have the numerical value 1 as the median. This means that in the distribution of the sample of companies in these countries, more than half disclosed only the minimum information. On the other hand, companies based in Germany, France, Japan and the United Kingdom had an average term of 85, 95, 85 and 85, respectively. In other words, companies in these countries have strived to carry out a more complete greenhouse gas disclosure, given that the maximum disclosure value is 100.

Table 4 – Descriptive statistics of the GHG Disclosure – dependent variable

| # | Country | Nº of Companies | GHG Disclosure | | | | |
|---|---|---|---|---|---|---|---|
| | | | Min. | Max | Mean | Median | Standard Deviation |
| 1 | Brazil | 16 | 1 | 95 | 63.19 | 72.5 | 31.54 |
| 2 | Canada | 47 | 1 | 100 | 42.38 | 60 | 34.9 |
| 3 | China | 117 | 1 | 20 | 1.89 | 1 | 3.55 |
| 4 | France | 47 | 1 | 100 | 74.38 | 95 | 34.52 |
| 5 | Germany | 47 | 1 | 100 | 62.43 | 85 | 36.21 |
| 6 | India | 47 | 1 | 100 | 26,15 | 1 | 36.86 |
| 7 | Italy | 23 | 1 | 100 | 49.35 | 60 | 44.43 |
| 8 | Japan | 196 | 1 | 100 | 59.59 | 85 | 37.81 |
| 9 | United Kingdom | 76 | 1 | 100 | 68.22 | 85 | 33.46 |
| 10 | United States | 456 | 1 | 100 | 43.78 | 60 | 38.34 |

Source: The authors, 2021

The data for the standard deviation show the variation of the data in relation to the mean. Thus, in Italy, there are large differences in the disclosure of greenhouse gases, that is, there are companies that disclose little information about their emissions and other companies that disclose a lot of information about their atmospheric emissions. In contrast, China has a smaller standard deviation – all its companies have a similarly low level of greenhouse gas disclosure.

The high level of disclosure for French companies may be associated to the adoption of a law called Grenelle Acts, which requires large companies, since April 2012, to publish an annual sustainability report (Kaya, 2016). In this way, companies are under pressure to be more transparent about their environmental policies than Chinese companies, since in China, disclosure is carried out voluntarily (Li et al., 2019). In addition, companies based in European developed countries carry out a more explicit environmental disclosure, that is, more detailed than American companies, which carry out a more implicit disclosure (Matten & Moon, 2008).

In Brazil, the disclosure of greenhouse gases was higher than some developed countries, such as Germany, Canada, the United States, Italy and Japan. Thus, reflecting the commitment of Brazilian companies to social and environmental transparency. However, it is worth mentioning the supposed reasons for this disclosure. First, only

16 Brazilian companies answered the Carbon Disclosure Project questionnaire and were mentioned on the Global 2000 companies list. Thus, it can be inferred that only companies with a high engagement for corporate social responsibility participated in this questionnaire, which may reflect a high level of greenhouse gases disclosure. Thus, not considering all Brazilian companies.

In addition, companies from emerging countries, including Brazil, can carry out a more complete disclosure to legitimize their business actions and attract more foreign investment, since in emerging markets there is less ease of access to credit. The companies carry out the disclosure of environmental information in response to social pressure, in order to legitimize their long-term operations and execute the social contract voluntarily (Cho & Patten, 2007).

The model was tested based on the assumptions for applicability of multiple linear regression. The presence of collinearity was verified through the Variance Inflation Factor (VIF) test, as the values were greater than 5 (the model presented an average VIF of 10.23), being desirable that the VIF values be less than 5. The Durbin Watson (DW) test, on the other hand, did not indicate the existence of autocorrelation of the residuals (value of 1.6), and DW test values close to 2 indicate the absence of autocorrelation. The high VIF model indicated the presence of heteroscedasticity according to the results of the Breusch/Pagan-Cook/Weisberg (BP/CW) test, with a value of 21.94 and a p-value of 0.000. In this last test, it is desired to accept the null hypothesis of homoscedasticity, that is, to obtain a p-value greater than the determined significance.

To adjust the model, the identification of data series that contained collinearity was carried out, generating heteroscedasticity in the model, with the variables related to finance (Fin), Political system (Pol) and economic system (Econ) being identified as such. In order to deal with the problem without losing quantitative data, two methodologies were used (except for the Econ variable, as it is dichotomous): 1st) use of the logarithm of the values of the data series; 2nd) the sample mean of each variable was measured,

and 1 was assigned for values above the mean and 0 for values below the mean (for variables for which a positive relationship is expected). This methodology follows the framework of García-Sánchez et al., (2013) and Garcia-Sanchez et al. (2016a). After the data transformations, the models were estimated again, and the collinearity constant was obtained for the distribution of data for the Econ variable. Based on these results, it was decided to remove the Econ variable from the model and re-estimate it. Thus, the adjusted model is expressed in formula 2.

$$GHG\ Disclosure = \alpha + \beta_1 Pol + \beta_2 Fin + \beta_3 Lab + \beta_4 Edu + \beta_5 Cult + u \quad (2)$$

The explanatory variables contained in formula 2 were transformed following the 2nd methodology presented in the previous paragraph. The results of the VIF, DW and Breusch-Pagan / Cook-Weisberg (BP/CW) tests are shown at the end of each of the tables with the results of the estimations, and all results are consistent with the absence of collinearity and heteroscedasticity. According to the assumptions for estimating OLS models, the model expressed in formula 2 provides a degree of certainty that the estimated results can be generalized without bias arising from the structuring of the data.

To remove and compare the bias due to the participation of companies in the financial sector, estimation 2 of the model was carried out with a sample excluding companies belonging to this sector, which resulted in a new sample of 857 observations. The presence of multicollinearity due to the Cult variable resulted in its removal from the refactored model.

The results show that in environments with less corruption, companies can disclose less information about their emissions. This result contradicts the findings of Jensen and Berg, (2012), who found that in environments with less corruption, companies do more in terms of GHG disclosure. One of the possible justifications for this finding is that companies based in more corrupt environments try to disassociate themselves from the negative institutional image by adopting environmentally acceptable postures.

Table 5 – OLS regression of data – sample: All Sectors

| Variables | Estimation 1 $\beta$ | Estimation 2 $\beta$ |
|---|---|---|
| Pol | -56.66*** | -61.46*** |
| Fin | 14.04*** | -0.71 |
| Lab | -25.54*** | -9.02 |
| Edu | -34.09*** | -24.08*** |
| Cult | 19.38*** | |
| α | 74.38*** | 79.60*** |
| R | 0.1755 | 0.1965 |
| R2 ajusted | 0.1716 | 0.1927 |
| F de Chow | p-value = 0.000 | p-value = 0.000 |
| Mean VIF | 4.74 à no multicollinearity | 3.37 à no multicollinearity |
| BW | 1.53 à no negative autocorrelation of residuals | 1.64 à no negative autocorrelation of residuals |
| BP/CW | p-value = 0.6485 à no heteroscedasticity | p-value = 0.3598 à no heteroscedasticity |
| Obs | 1,072 | 857 |

Note: ***: p-value: 1%; **: p-value: 5%; *: p-value: 10%

Source: The authors, 2021

The data showed that easier access to credit positively affects the disclosure of greenhouse gases information. Therefore, countries where financial institutions favor the creation of new businesses and growth of existing businesses tend to have companies with better performance in the disclosure of greenhouse gases (Pinheiro et al., 2020). Thus, countries with a strong banking system and a developed capital market have companies that adopt a more responsible environmental behavior. These results were similar with those presented by Soares et al. (2018) and Soares et al. (2020). The financial system can play a key role in the environmental practices of companies, furthermore, those located in countries with bank-based financial systems tend to take into account all stakeholders, favoring greenhouse gases disclosure practices (Jensen & Berg, 2012; Matten & Moon, 2008).

A country's financial system is important for understanding environmental issues, as countries with greater economic freedom and a well-developed capital market can reduce the effects of corruption and encourage companies to be more committed to the environment (Rosati & Faria, 2019).

While regarding the labor system, the data revealed that there is a negative influence of better cooperation between employees and employers in the disclosure of greenhouse gases. This finding contradicts the results of Oliveira et al. (2018). Countries with better cooperation between employees and employers tend to have companies with less disclosure. Countries such as the United States and Canada have a good relationship between employees and employers. However, their companies do not have a detailed disclosure of greenhouse gases. Countries that follow the common law legal system, such as the United States and Canada, tend to have companies that value the disclosure of information to investors, such as financial and corporate governance data (Miniaoui et al., 2019b; Walker et al., 2019). Therefore, for the managers of the companies analyzed, it may be more profitable to invest in employees to have more satisfied workers, which can generate more profitability and benefits to investors.

The quality of the country's educational system negatively affects the disclosure of greenhouse gases from its companies. Soares et al. (2020) and Walker et al. (2019) also found a negative effect of the education system on disclosure. According Soares et al. (2020), in countries where the education system is government-centered, companies tend to develop more implicit environmental disclosure. Greening & Turban (2000) state that companies can disclose more environmental information to attract a greater number of skilled employees. However, in a country where skilled labor is abundant, companies do not have the need to compete for skilled employees. Thus, the quality of the educational system is not a determining factor for the disclosure of greenhouse gases.

Cultural differences can impact different levels of environmental information disclosure (Pucheta-Martínez & Gallego-Álvarez, 2019; Scott, 2008). The results confirm this, since it was found that the country's cultural system affects the disclosure of atmospheric emissions. The findings indicate that in environments with greater power distance, the disclosure of GHG is greater. In practice, this means

that in countries where the power is unequally distributed and people accept this inequality, companies disclose their GHG emissions more. This result contradicts most previous studies, as they found a negative effect of distance to power on environmental disclosure. This finding may suggest that distance from power may not be a determining factor for increasing transparency in relation to GHG emissions. Walker et al. (2019) suggest that companies in emerging markets, characterized by having more stratified societies, tend to disclose more environmental information to attract foreign investment.

To analyze the influence of nationality on the GHG Disclosure, nine new estimates were carried out, and in each of these new estimates a dummy variable was added to the model of formula 2. Each dummy representing a nationality was included separately in the model, without the accumulation of dummy variables in the model. The estimation with the inclusion of the dummy for China showed heteroscedasticity and for this reason it is not shown in Table 6.

The findings in Table 6 confirm the results of the independent variables shown in Table 3. When companies are based in economies such as Brazil, the UK, Italy, Canada, India, Germany and France, they are more likely to have greater GHG disclosure. On the other hand, firms in the United States and Japan tend to have less disclosure of GHGs. Although Matten and Moon (2008) and Tilt (2016) claim that the environmental disclosure of companies based in emerging economies is poor, our data have shown that companies in these economies have dedicated themselves to having greater disclosure of their GHG emissions. This type of disclosure has interested not only clients and potential investors, but also international organizations, media, NGOs and governments. Furthermore, in emerging markets with large social inequalities and high population growth rates, firms deal with environmental issues in their operations, playing an important social role.

Table 6 – OLS regression of data – sample: All Sectors, with country variable (dummy)

| Variables | | Estimation from 3 to 11 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $\beta$ | | | | | | | | |
| | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Pol | | -60.55*** | -56.66*** | -56.66*** | -56.66*** | -60.71*** | -56.66*** | -59.20*** | | -31.12*** |
| Fin | | 14.04*** | 18.68*** | 14.04*** | 14.04*** | 14.04*** | 17.64*** | 14.04*** | 13.65*** | 14.04*** |
| Lab | | -25.54*** | -29.09*** | -25.54*** | -6.15 | -25.04*** | -28.30*** | -25.54*** | | Omitted[2] |
| Edu | | -34.09*** | -23.77*** | -14.71*** | -34.09*** | -34.09*** | -37.99*** | -34.09*** | | -34.09*** |
| Cult | | 19.38*** | 22.93*** | Omitted[1] | Excluded[1] | 19,38*** | 22.14*** | 19.38*** | 19.38*** | 19.38*** |
| Dummy country | BR | 49.36*** | | | | | | | | |
| | USA | | -16.89*** | | | | | | | |
| | UK | | | 19.38*** | | | | | | |
| | JAP | | | | -19.38*** | | | | | |
| | ITA | | | | | 35.67*** | | | | |
| | CAN | | | | | | 12.15*** | | | |
| | IND | | | | | | | 10.97* | | |
| | GER | | | | | | | | 17.90*** | |
| | FRA | | | | | | | | | 25.54*** |
| α | | 74.38*** | 74.38*** | 74.38*** | 74.38*** | 74.38*** | 74.38*** | 74.38*** | 74.38*** | 48.84*** |
| R | | 0.1966 | 0.1869 | 0.1755 | 0.1755 | 0.1907 | 0.1782 | 0.1780 | 0.1835 | 0.1755 |
| R2 ajusted | | 0.1920 | 0.1824 | 0.1716 | 0.1716 | 0.1862 | 0.1736 | 0.1734 | 0.1789 | 0.1716 |
| F de Chow | | All 9 estimations presented p-value = 0.000 | | | | | | | | |
| Mean VIF | | All 9 estimations showed mean VIF between 4.14 and 4.93 | | | | | | | | |
| BW | | All 9 estimations presented BW between 1.55 and 1.57 → no autocorrelation | | | | | | | | |
| BP/CW | | All 9 estimations had p-value > significance → no heteroscedasticity | | | | | | | | |
| Obs. | | 1,072 → in all 9 estimations | | | | | | | | |

Note: ***: p-value: 1%; **: p-value: 5%; *: p-value: 10%. Omitted[1]: Although the software omitted the Cult variable in the estimation with the dummy for the UK, the VIF and DW tests of the model ensure the levels of autocorrelation and multicollinearity with respective values of DW = 1.53 and VIF = 3.17. Excluded[1]: the Cult variable was excluded from the model for presenting a high VIF value. Omitted[2]: Although the software omitted the Cult variable in the estimation with the dummy for the FRA, the VIF and DW tests of the model ensure the levels of autocorrelation and multicollinearity with respective values of DW = 1.53 and VIF = 3.45.

Source: The authors, 2021

Aiming to analyze the existence of influence of the activity sector on the GHG Disclosure, 2 new estimates were made. In estimation 11, a categorical variable (Sec) was included, and a discrete value was assigned to each sector. Using the i.Sec function in the Stata regression command, the values can be obtained for each of the categories. In estimation 12, a dummy variable is included to identify the financial sector (D.Financials), which was automatically excluded by the software in estimation 11. Table 7 shows the results.

Table 7 – OLS regression of data – sample: All Sectors, with activity sector variable (categoric)

| Variables | | Estimation 12 $\beta$ | Estimation 13 $\beta$ |
|---|---|---|---|
| Pol | | -54.53*** | -55.63*** |
| Fin | | 5.73 | 6.93 |
| Lab | | -18.74*** | -19.71*** |
| Edu | | -27.77*** | -29.29*** |
| Cult | | 13.45** | 13.96** |
| Activity sector variable (categoric). | Sec2 | 3.71 | |
| | Sec3 | 8.29* | |
| | Sec4 | 19.51*** | |
| | Sec5 | -5.62 | |
| | Sec6 | 11.68** | |
| | Sec7 | 14.03*** | |
| | Sec8 | 9.74* | |
| | Sec9 | 1.41 | |
| | Sec10 | 8.99* | |
| | Sec11 | 13.99** | |
| D.Financials | | | -9.04** |
| α | | 65.77*** | 76.11*** |
| R | | 0.1965 | 0.1798 |
| R2 ajusted | | 0.1851 | 0.1752 |
| F de Chow | | p-value = 0.000 | p-value = 0.000 |
| Mean VIF | | 3.05 → no multicollinearity | 5.03 → no multicollinearity |
| BW | | 1.52 → no negative autocorrelation of residuals | 1.53 → no negative autocorrelation of residuals |
| BP/CW | | p-value = 0.3946 → no heteroscedasticity | p-value = 0.8982 → no heteroscedasticity |
| Obs | | 1,072 | 1,072 |

Note: Sec2: Communications; Sec3: Consumer discretionary; Sec4: Consumer Staples; Sec5: Energy; Sec6: Health Care; Sec7: Industrial; Sec8: Materials; Sec9: Real Estate; Sec10: Technology; Sec11: Utilities. ***: p-value: 1%; **: p-value: 5%; *: p-value: 10%.

Source: The authors, 2021

The results show that companies operating in sectors such as consumer discretionary, consumer staples, health care, industrial, materials, technology and utilities tend to have greater disclosure of their GHG emissions. On the other hand, financial services companies tend to have lower disclosure than other sectors. These findings are in line with previous research (Ioannou & Serafeim, 2012; Pinheiro, da Silva Filho, et al., 2021; Soares et al., 2018), as they have shown that sectors such as utilities, industrial and materials tend to have a greater environmental commitment, as they deal directly with natural resources.

The results also show that the financial sector has a negative effect on GHG disclosure. The financial sector does not work directly with natural resources and follows

specific legislation, so it is important to understand its effect separately. This study may bring insights for further research to analyze environmental issues in this sector, because banks can lend money to ventures that are not environmentally friendly.

## 6 CONCLUSIONS AND MANAGERIAL IMPLICATIONS

This research aimed to investigate the effect of the national business system of the world's ten largest economies regarding the disclosure of greenhouse gases information from their companies. To achieve this goal, the work analyzed the disclosure of greenhouse gas information from 1,072 companies from 2018. The national business system of the countries was analyzed through variables such as: level of corruption, easier access to credit, cooperation between employees and employers, quality of the education system, distance to power and degree of economic development.

The results show that the disclosure of greenhouse gases can reflect the country's national business system. The lowest level of corruption in the country may not be a determining factor in the disclosure of GHG, not confirming Hypothesis 1. In addition, the easier access to credit positively affects the disclosure of greenhouse gases. Otherwise, in countries where financing takes place more easily, companies tend to have greater transparency of their air pollutants. Thus, proving Hypothesis 2. However, it was found that cooperation between employees and employers and quality of the education system negatively affect disclosure. Therefore, it is not possible to prove Hypothesis 3 and 4.

The results cannot confirm Hypothesis 5, as they pointed out that the distance to power can positively influence GHG disclosure. Finally, it was not possible to verify the influence of the economic system, measured through the degree of economic development of the country, in the disclosure of greenhouse gases. The statistical results were not significant, so Hypothesis 6 was not confirmed.

Institutional factors can be as determinant of environmental disclosure as

internal factors such as financial performance and corporate governance. Moreover, the study intends to contribute managerially, demonstrating that different institutional environments can provide different environmental disclosure practices. Furthermore, multinationals should analyze the country's institutional environment before settling in, verifying how formal and informal institutions work in relation to sustainability.

Our study can be useful to raise the discussion about the regulation of the disclosure of environmental information. In addition, our findings can help international policy makers strengthen certain institutional aspects to promote the disclosure of information. The paper also advances institutional theory by demonstrating how socially constructed institutions directly influence corporate policies and decision-making processes. The empirical results of this work prove that organizational behavior is shaped by the institutional environment, which is one of the assumptions of Institutional Theory.

Managers should be aware that in developed countries the practices of greenhouse gases disclosure are clearer. In addition, in these countries there is greater social pressure for the company to act with greater environmental transparency. Therefore, when installing themselves in these environments, managers should allocate more resources to this task, in order to meet the interests of all stakeholders. On the other hand, emerging countries may have less power for institutions to pressure companies to act more responsibly. However, it is up to managers from these countries to promote environmental debate, for their companies to be references to other companies and to foster a more critical thinking in these societies.

The findings obtained in this study should be interpreted with caution, given its limitations. The results cannot be fully generalized. In addition, this research covers the year of 2018, therefore, the results may differ when analyzing other years, especially in 2008 when a global financial crisis was faced and 2020 when the global pandemic of Covid19 was confronted. In view of these limitations, it is suggested that future studies expand the sample used and the number of countries studied, as well as investigate

the disclosure of greenhouse gases in other years and add other variables to represent the national business system.

Additionally, future studies can use new metrics to measure the disclosure of greenhouse gases. For example, selecting carbon disclosure variables from the Refinitiv Eikon database may be an alternative. Although the national business system is measured by six variables, new studies can better analyze just one of the pillars, such as the political, labor and education environment, since these findings were unexpected and need to be proven in new research.

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| 1. Definition of research problem | √ | √ | | √ | √ |
| 2. Development of hypotheses or research questions (empirical studies) | √ | √ | | √ | √ |
| 3. Development of theoretical propositions (theoretical work) | √ | √ | | √ | √ |
| 4. Theoretical foundation / Literature review | | √ | √ | | |
| 5. Definition of methodological procedures | √ | | | √ | √ |
| 6. Data collection | | √ | | √ | |
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