

THE IMPACT OF PARIS AGREEMENT ON CLIMATE MANAGEMENT BY BRAZILIAN BUSINESSES

DANIEL KOULOUKOU
UNIVERSIDADE FEDERAL DA BAHIA

SONIA MARIA DA SILVA GOMES

EDNILDO ANDRADE TORRES

Introdução

The Paris Climate Agreement (PCA) represents a historic milestone for humankind when it comes to climate change. In fact, the 21st meeting of the Conference of the Parties (COP 21), a part of the United Nations Climate Change Conference (UNFCCC) that happened in 2015, yielded a new global pact to tackle climate change and global warming issues. The Paris accord is now ratified by about 185 countries. For some researchers, – Kinley, 2017, for example – COP 21 was the most successful climate change conference of all time. The main aim of the Accord is to reduce greenhouse gases emission.

Problema de Pesquisa e Objetivo

The imminent risks linked to climate change are seen as threats, taking into consideration the impact on the return of investments for investors. Thus, initiatives are being taken by businesses to reduce GHG emission and, consequently, increasing information disclosure and carbon performance (Pinkse e Kolk, 2009; Ziegler Busch e Hoffmann, 2011). There was an increase in the level of climate change disclosure (CCD) and climate performance (CP) of Brazilian businesses after the Paris agreement? The purpose is to investigate the level of CCD and CP by corporations before and after the agreement.

Fundamentação Teórica

According to the NDC (2016), Brazil committed itself to reduce emissions by 37% below 2005's levels by 2025, and to achieve a total reduction of 43% by 2030. In 2005, Brazil emitted 2.03 billion tons of CO₂. By 2030, the country can only emit 1.15 billion tons to fulfill the Agreement's commitment. Consequently, Brazil made a promise to increase the participation level of bioenergy in its energy mix by approximately 18% by 2030, besides restoring and reforesting 12 million hectares of forests, as well as achieving an energy mix consisting of 45% of renewable energy resource in 2030.

Metodologia

The population of this study is represented by all Brazilian companies. However, to compose the sample, the company must consistently respond to the Carbon Disclosure Project (CDP) questionnaire. This is the sine qua non condition to integrate the sample of the present work. Thus, the sample is made up of the Brazilian companies that answered the CDP questionnaire between 2013 and 2018, three years before the Paris agreement (2013 to 2015) and three years after the agreement (2016 to 2018). We accessed the official site CDP (<https://www.cdp.net/en>) to collect data from all Brazilian companies.

Análise dos Resultados

This article shows that the climate management scores obtained by the companies after the agreement are higher than the scores obtained before the agreement, indicating that the companies interpreted the agreement signed in Paris as a potential regulatory risk that could strongly affect their business through a climate regulation. Thus, Brazilian companies reacted proactively by increasing their climate management disclosures after the Paris agreement and consequently their level of commitment as a way of demonstrating that they are prepared to meet the challenges of climate.

Conclusão

The present study contributes to the literature that deals with corporate social and environmental disclosure, especially climate disclosure. The analysis in this study provided some insight into how companies have behaving after the Paris agreement on reducing GHG emissions. It is known that the climate changes as they were put in the agenda during the Paris conference require immediate and urgent action. The corporate sector is one of the main emitters due to the production process and therefore is identified as a major contributor to climate change (Sakhel, 2017, Kolk et al., 2008).

Referências Bibliográficas

Hoffman, A. J., & Woody, J. G. (2008). *Climate change: what's your business strategy?* Harvard Business Press. Kinley, R. (2017). *Climate change after Paris: from turning point to transformation*. *Climate Policy*, 17(1), 9-15. Kolk, A., & Pinkse, J. (2005). *Business responses to climate change: identifying emergent strategies*. *California Management Review*, 47(3), 6-20. Larkin, A., Kuriakose, J., Sharmina, M., & Anderson, K. (2017). *What if negative emission technologies fail at scale? Implications of the Paris Agreement for big emitting nations*. *Climate Policy*, 1-25.

Palavras Chave

Paris Climate Agreement, Business Carbon Disclosure Performance, Mitigation and Adaptation

Agradecimento a órgão de fomento

This work was carried out with support from CNPq (The National Council for Scientific and Technological. Thanks to the CNPq.

THE IMPACT OF PARIS AGREEMENT ON CLIMATE MANAGEMENT BY BRAZILIAN BUSINESSES

1. INTRODUCTION

The Paris Climate Agreement (PCA) represents a historic milestone for humankind when it comes to climate change. In fact, the 21st meeting of the Conference of the Parties (COP 21), a part of the United Nations Climate Change Conference (UNFCCC) that happened in 2015, yielded a new global pact to tackle climate change and global warming issues. The Paris accord is now ratified by about 185 countries. For some researchers, – Kinley, 2017, for example – COP 21 was the most successful climate change conference of all time. The main aim of the Accord is to reduce greenhouse gases emission.

This Agreement's greatest novelty is the fact that a concrete goal was set to keep the global average temperature increase lower than 2°C in relation to pre-industrial levels and to continue efforts to limit the global temperature rise below 1.5°C (UNFCCC, 2016). This did not happen in previous conferences, where no concrete goals could be reached or set. Unlike the Kyoto Protocol (1997), that defined reduction targets for developed countries only, the PCA does not index certain countries responsible for emissions: instead, it focuses on a target agreed upon by all signatory countries. Moreover, for the first time, China has committed itself, keeping the country within an absolute emission limit, which should be subjected to measurements, reports and international verifications (Hilton and Kerr, 2017).

Regarding this issue, there are reasons to believe in a successful outcome for the Paris Climate Accord, including the subjacent positive economic realities, a strong determination by the involved governments in achieving success and the awareness that all parties must participate in the enormous global challenges which come with climate change (Kinley, 2017). Although it is known that this goal is far from being reached, it is also believed to be a great step forward in the fight against climate change. Research results have shown that gas emission of 25 countries represented more than 80% of all global emissions (Larkin et al., 2017) The study conducted by the authors above investigated implications of the Paris Accord for these 25 countries. It is observed that among these countries is Brazil.

The PCA success calls for a drastic change of actions by governments and organizations, which will imply the adoption of a new posture including both the search for new energy resources as well as changes in behavioral practices in all activity sectors. Moreover, actions like reducing or eliminating the consumption of fossil fuels, promoting the use of renewable energy resources, changing the productive processes, adopting power saving and reforestation strategies must be sought.

The imminent risks linked to climate change are seen as threats, taking into consideration the impact on the return of investments for investors. In order to mitigate climate risks and introduce new opportunities to financiers, companies need to identify, manage and report climate risks, besides finding new ways of doing business (CDP, 2017). In addition, in the business sphere, many initiatives are being used in order to reduce greenhouse gas (GHG) emission. As a way of anticipating, as earlier as possible, the likely GHG emission quota regulation, or even to improve operational efficiency, through the reduction of resource consumption and waste production, capital cost reduction, market share expansion and new capital access, companies are expected to expand their investments towards mitigating strategies and, consequently, increasing information disclosure and carbon performance (Wittneben e Kiyar, 2009; Pinkse e Kolk; 2009; Ziegler Busch e Hoffmann; 2011). In this context, the question of this study is: was there an increase in the level of climate change

disclosure (CCD) and climate performance (CP) of Brazilian businesses after the Paris agreement?

Therefore, the main purpose of this paper is to verify the level of CCD and CP by Brazilian corporations that responded to the Carbon Disclosure Project (CDP) before and after the Paris agreement. Thus, the main proposition of this study is that the 2015 climate agreement led to a significant change in carbon-related practices of Brazilian corporations. The present study is justified in the context of imminent more rigid regulations to reduce GHG emissions, and because stakeholders are asking for a better climate risk management. It expands the ongoing debate about the existence of a statistically significant increase in the climate risk disclosure level and carbon performance of companies that answered the Carbon CDP questionnaire.

This research contributes to knowledge development, as well as to a dialogue about an extremely relevant issue to society in general and to stakeholders in particular. It can also offer some clues on how Brazilian companies are behaving after the PCA. This investigation becomes even more relevant for the Brazilian scenario because, during the COP 21, Brazil made a commitment to reduce GHG emissions by 37% below the 2005's levels by 2025. In the energy sector, the objective was to reach a renewable energy resource participation of approximately 45%, by 2030; including the growth in usage of renewable resources, such as hydroelectricity to 28-33% by 2030 (EPE, 2016). The renewable proportion in the Brazilian energy mix rose from 41.3% (29.85% being non-hydroelectric resources) in 2015 to 43.5% in 2016 (EPE, 2016). Thus, Brazil's participation in the process of mitigation and adaptation is important and mainly the participation of Brazilian industries since, in general, the productive sector is one of the major emitters of GHG.

2. LITERATURE REVIEW

2.1 Paris Climate Agreement (PCA)

The COP 21, which happened in 2015, yielded an agreement considered to be a new universal objective – to combat climate change and global warming issues – and it was signed by 195 nations. In fact, the international community recognized that climate change poses an urgent threat, potentially irreversible for humankind and several other species of life on the planet itself and, therefore, requires the broadest possible co-operation of all countries, to accelerate the reduction of GHG emissions on a global scale (UNFCCC, 2016).

The Agreement was approved by the UNFCCC, on January 29th, 2016. The advocacy and promotion of local and international cooperation were then defended by the Agreement, as a way of mobilizing stronger and more ambitious climate acts by all signatory nations as well as interested parties, including the private sector, the public community, financial institutions, cities and other sub-national authorities, local communities and indigenous people (UNFCCC, 2015).

However, for the Agreement to come into force, it needed the ratification of at least 55 countries responsible for 55% of GHG emission. Therefore, the United Nations (UN) Secretary-General established the period between April 22nd, 2016 and April 21st, 2017 so countries could sign the treaty in New York City. Countries had to make decisions so the Agreement could be fulfilled, as its purpose is to reinforce a global response to climate change threats, in a sustainable development context as well as observing the efforts to eradicate poverty, according to Article 2 of the referred Agreement.

Described in the aforementioned Article, there is the need to expand the capability to adapt to the adverse climate change impacts, while promoting climate resilience and developing low GHG emissions without affecting food production. Article 3 determines contributions, at a national level, towards global responses to climate changes. Participants should engage in and share ambitious

efforts, in compliance with Articles 4, 7, 9, 10, 11 and 13, with the purpose of meeting the Agreement's goal.

The PCA aims to keep the increase of the average global temperature below 2°C above pre-industrial levels, while pursuing efforts that aim to limit the temperature increase to 1.5 °C, thus, reducing significantly, the risks and impacts caused by climate change. To reach such objectives, governmental parties started to develop their own strategies and commitments, based on the Nationally Determined Contribution (NDC). With the NDCs, each country committed to its own emissions reduction target, taking into consideration the local socioeconomic viability.

2.2 The PCA in the Brazilian scenario

According to NDC Brasil (2016), in order to achieve the UNFCCC's objective and in compliance with 1/CP.19 and 1/CP.20 resolutions, the Brazilian government reported its NDC to UNFCCC's Secretary, using a negotiation protocol context, another juridical tool or result agreed upon with legal status under UNFCCC requirements, applicable to all parties involved.

As stated by the Ministry of Environment and Natural Resources (2017) after the National Congress' approval, Brazil completed, on September 12th, 2016, the ratification process of the PCA. The document was delivered to the UN on September 21st, 2016, turning Brazilian intentions into official commitments.

It is important to note that, all the policies, initiatives and actions to implement the Brazilian NDC are conducted by the National Policy on Climate Change Bill (Bill 12.187/2009), by the Native Forest Protection Bill (Bill 12.651/2012, known as the Brazilian Forest Code), by the National System of Conservation Units Bill (Bill 9.985/2000) and by legislation, instruments and planning processes that are related to them. It can be observed that, even before the PCA in 2015, the Brazilian government took upon itself, by the end of 2009, a national voluntary commitment to implement mitigating actions, so to reduce national emission rates, by 36.1% to 38.9%, by the year 2020 (MDIC, 2013).

For the Ministry of Development, Industry and Foreign Trade (2013), the national voluntary commitment to reduce emissions was consolidated with the law 12.187, approved on December 29th, 2009 (National Policy on Climate Change law), which defined the instruments to be used in its implementation – among them are the National Communication report to the UNFCCC, the emission inventories and financing mechanisms. The bill also deals with the Brazilian Emissions Reduction Market and the Mitigation and Adaptation to Climate Change Sector Plan.

In fact, according to what was established by the NDC (2016), Brazil committed itself to reduce emissions by 37% below 2005's levels by 2025, and to achieve a total reduction of 43% by 2030. In 2005 (the baseline year), Brazil emitted 2.03 billion tons of CO₂. By 2030, the country can only emit 1.15 billion tons to fulfill the Agreement's commitment. Consequently, Brazil made a promise to increase the participation level of bioenergy in its energy mix by approximately 18% by 2030, besides restoring and reforesting 12 million hectares of forests, as well as achieving an energy mix consisting of 45% of renewable energy resource in 2030.

2.3 Climate disclosure and research hypotheses

In the face of the challenges pointed out by climate change, companies around the world are designing strategies and outlining urgent actions to deal with the issue. For Jeswani, Wehrmeyer e Mulugetta, (2008), in response to the increasing consensus among scientists and governments, mitigation and adaptation actions should be taken rapidly to avoid climate change's dangerous impacts (IPCC, 2004). Mitigation, for example, is basically related to the GHG emission reductions through the adoption of specific actions. Adaptation, on the other hand, is related to measures taken in order to counteract negative environmental impacts that are already occurring.

Note that strategic responses to climate change vary from one company to another (Matisoff et al., 2013). The authors affirm that some companies have good governance practices and therefore

disclose detailed information about GHG emissions to their stakeholders. On the other hand, other companies continue not to disclose information regarding GHG emissions, electricity usage and some other climate-related commercial activities. In the end, each business adopts different strategies to deal with this phenomenon.

In Kim's (2008) opinion, coping with climate changes has demonstrated a corporate political behavior based on three levels: (1) supportive posture – which involves the participation of companies in the climate legislation development process; (2) neutral posture – indicates a cautious approach from companies to reduce carbon emissions when a strong governmental positioning is expected and while they articulate themselves through voluntary initiatives; and (3) defensive posture – indicates a company's defensive, critical or pessimistic posture, while mainly discrediting scientific evidence and pointing out uncertainty related to the subject.

In recent years, many large companies established policies related to climate change, defined goals to reduce emissions and disclosed GHG emission information (Sullivan, 2010). In this context, information disclosure related to climate change is relevant for the interested parties, since they are used to evaluate risks and uncertainties involved in the corporate business; in addition, they also enable the interested parties to make consolidate decisions regarding a certain company when climate issues are in question (Garnaut, 2011; Stern 2006; Bebbington & González, 2008).

After the PCA, there was a noticeable growth in the number of researchers who became interested in analyzing eventual political challenges, possible obstacles or the diversity of likely interpretations. For example, Sharma (2017) analyzed scientific uncertainties and political challenges that the PCA might likely face to meet its objective. Hilton and Kerr's (2017) examined the changes that occurred between 2009 and 2015, observing that China played a more constructive role in the global climate system. On the other hand, Kinley's (2017) research presented eight main approaches in which the Agreement changed the game. Viñuales et al. (2017) also analyzed the diversity of possible interpretations of the PCA, among other studies (see for example, Dovie and Lwasa, 2017)

However, until the conclusion of this research, no study was found neither in the international and or the national context which verified the Agreement's impact on CCD and CP of Brazilian companies. The present study aims to verify whether, after the PCA, Brazilian companies improved or increased the level of climate information disclosure and carbon performance as a positive feedback that assures the Agreement's fulfillment. Based on the problem and the proposed objective, the hypotheses which drive the development of this research are hereon explained as follows:

H0: Ceteris paribus, a statistically significant increase in the level of climate information disclosure happened after the PCA.

H1: Ceteris paribus, a statistically significant increase in the level of carbon performance happened after the PCA.

3. METHOD

The main objective of this study is to examine whether there is a statistically significant difference in the mean of the Brazilian companies' climate management scores after the Paris agreement, that is, if companies improved their climate management actions, policies and strategies after the agreement. To do so, we perform a descriptive research, because it is intended to describe the characteristics of a given phenomenon. According to Gil (2002), the purpose of the descriptive research is the description of characteristics of a particular population or phenomenon or, then, the establishment of relations between variables.

3.1 Sample and data

The population of this study is represented by all Brazilian companies. However, to compose the sample, the company must consistently respond to the Carbon Disclosure Project (CDP) questionnaire. This is the sine qua non condition to integrate the sample of the present work. The base selection criterion (CDP) used in the present study was previously defined according to the research objective, since the variables that will be tested derive from the scores obtained from that base. Thus, the sample is made up of the Brazilian companies that answered the CDP questionnaire between 2013 and 2018, three years before the Paris agreement (2013 to 2015) and three years after the agreement (2016 to 2018).

These years were chosen because the agreement took place in December of 2015. Since then, three years after, that is, 2016, 2017 and 2018. For the purpose of comparison, before and after the agreement, we also consider the three years that preceded the agreement, that is, 2013, 2014 and 2015. By the time this research was performed, the CDP reports for the year 2019 were not yet available. To achieve the objective, this study is based on publicly available CDP data. CDP is a non-profit organization that, in the name of investors, companies, and policy makers, operates the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts (CDP, 2018).

The CDP collects data from companies on climate change and other environmental issues (forests, supply chain etc.) voluntarily. It asks companies to provide data on their environmental performance. The CDP then transforms this data into detailed analyzes of critical risks, opportunities and environmental impacts. Finally, decision makers such as investors, companies and policy makers use these data and insights to inform their decisions, manage risks and capitalize opportunities (CDP, 2018). The CDP database is generally used by investors and academics for commercial and academic purposes (Hahn et al., 2015) and is rated as one of the most reliable sources of sustainability data by specialists (SustainAbility, 2012).

We first accessed the official site CDP (<https://www.cdp.net/en>) in order to collect data from all Brazilian companies that answered the CDP questionnaire from 2013 to 2018. We found about 857 published reports. The 857 questionnaires answered are distributed as follows, 125, 122, 123, 138, 133 and 217, respectively, in 2013, 2014, 2015, 2016, 2017 and 2018. It is observed that the number of companies that participated in the CDP questionnaire remained almost constant over the period with the exception of the year 2018 where there was a considerable increase. Of these companies, only 77 provided consistent data that were assessed by CDP during the period from 2013 to 2018 (see Table 1).

Table 1 - Sample composition

Sector	N
Banks and Financial Institutions	9
Chemicals	1
Construction & Engineering	4
Education Services	1
Electric Utilities	14
Food, beverage & tobacco	8
Forest exploration	1
Health Care	3
Household & Personal Products	1
Information Technology	1
Insurance	2
Machinery and Equipment	1
Metals & Mining	2
Oil & gas	3

Other Services	2
Paper & Forest Products	3
Real Estate	2
Retailing	5
Services	1
Telecommunications	2
Transportation	9
Water Utilities	2
<hr/>	
Firm-year observations (average of the years 2013–2018)	77
<hr/>	
Firm-year observations (2013–2018)	420
<hr/>	

Source: Created by author based on CDP data (years 2013–2018).

Thus, the sampling procedure resulted in a sample of 77 companies per year totalizing 420 observations (77 * 6), of which 210 observations before the agreement and 210 observations after the agreement.

3.2 Variable description

After collecting data from companies, the CDP evaluates the answers provided according to predefined criteria. It is important to remember that the information provided by companies on climate change can be in the quantitative form (for example, the number of climate projects implemented, total annual carbon emissions among others) or qualitative (strategies of political engagement in relation to climate change issues). The CDP developed a methodology for evaluating companies' responses, with the contribution of scoring partners, respondents, investors, NGOs and other partners (CDP, 2017).

At the end of the evaluation, the methodology provides two scores for each respondent of the questionnaire: the first is climate disclosure score and the second is the carbon performance score. Then, the number of points assigned to a company (the numerator) is divided by the maximum number that could have been assigned (the denominator). The fraction is then converted to a percentage (multiplying by 100) and rounded to the nearest whole number. The formula for calculating percentage score is given in the equation below:

$$\text{Disclosure / Performance} = \left(\frac{\text{Points Achieved}}{\text{Points achievable}} \right) * 100 \quad (1)$$

Where:

Disclosure = represent the climate disclosure score; Performance = represent the climate performance score; Points Achieved = represent the point actually reached by the company after the evaluation of the CDP; Points Achievable: represent the maximum point that could be achieved.

3.2.1 Disclosure Score

The climate disclosure score also called the Climate Transparency score evaluates the level of detail and comprehensiveness of a disclosure, indicating a complete and extensive response. The given answer has to clearly demonstrate the risks and opportunities related to climate change specifically connected with the business, as well as a good management practice for the evaluation and comprehension of the company's GHG emissions.

Thus, the score of the level of climate disclosure is normalized on a scale of 100 points (%). Generally, the range in which companies fit in suggests levels of commitment and experience related to Carbon Transparency (CDP, 2017). For those companies that have chosen to make their answers available publicly, this score is available on the CDP website. However, from 2016, there was a small change in the methodology adopted by the CDP, especially in the assignment of the flags. Thus, instead of providing punctuation in number form (%), the CDP chose to convert scores obtained in the form of flags. Thus, after 2016, after the calculation of the score, the CDP converts into one of the 8 flags: A +, A-, B, B-, C, C-, D and D-, where the band "A +" represents the higher and D- the lowest. For the operationalization of this work, in accordance with the methodology of the CDP (2016), it was considered for the score of the climatic diffusion variable as follows:

Table 2: Disclosure score from 2016

Flag	A+	A-	B+	B-	C+	C-	D+	D-
Score	100	100	95	90	85	80	75	39

Thus, we converted the flag obtained by each company to a corresponding score in Table 2. It was not necessary to do the conversion in the years 2013 to 2015 because the CDP already provides the score in number form (%).

3.2.1 Climate performance score

The climate performance score assesses the level of actions, policies and strategies taken on climate change based on the information provided in the CDP report. The carbon performance variable score is a complement of the climate disclosure score and can be seen as a tool of recognition for companies which are adopting concrete and positive measures regarding climate change mitigation (CDP, 2017). It provides a valuable perspective concerning the quality of answers given to the CDP Investor annual information request.

Finally, with the score obtained by the company, the CDP assigns one of the following flags: A+, A-, B, C, D and E. Where the "A +" band represents the highest, indicating "Strategy fully integrated, leading to maturity in climate change initiatives" (CDP, 2015). The band "E", for example, indicates little evidence of initiatives in climate management. For the purpose of this research, we consider the following climate performance (see Table 3) according to the CDP bands:

Table 3: Performance score until 2015

Flag	A+	A-	B	C	D	E
Score	100	95	85	60	40	20

It is important to remember that CDP does not give a performance score for companies whose climate disclosure score is below 50%. For this reason, it is common to see a company respond to the CDP questionnaire, however, it does not get any performance scores. It is also important to notice that, from 2016, there was a slight change in the attribution of the flags by CDP. Thus, the performance score from 2016 took into account one of the 8 flags: A; A-; B; B-; C; C-; D and D-. For the operationalization of this work in accordance with the methodology of the CDP (2016), it was considered of the level of climate performance as follows:

Table 4: Climate performance score from 2016

Flag	A+	A-	B+	B-	C+	C-	D+	D-
Score	100	95	85	80	60	40	20	0

Thus, each flag is converted according to its respective scores as shown in Table 4.

3.3 Statistical analysis

Two t-tests for paired samples were conducted to investigate (a) whether there were significant differences in firms' climate disclosure score three years before and after the Paris agreement; and (b) whether there were significant differences in companies' climate performance score three years before and after the Paris agreement.

T test for paired samples allows inferring on the equality of means of two paired samples. Frequently, each case is analyzed twice, before and after an intervention or treatment (which is the case of the Paris agreement), forming pairs of observations, whose differences are tested to see if the result is zero or not.

Before the statistical test itself, we conducted a series of preliminary tests. The data were tested for all assumptions that should be met when using a t-test of two paired samples, which means that the variable should be distributed normally, and there should be correlation between the two groups. All the assumptions have been fulfilled.

4. RESULTS AND DISCUSSIONS

4.1 Descriptive statistics

4.1.1 Disclosure scores

In this section the results of the descriptive statistics of the climate disclosure score are presented and discussed.

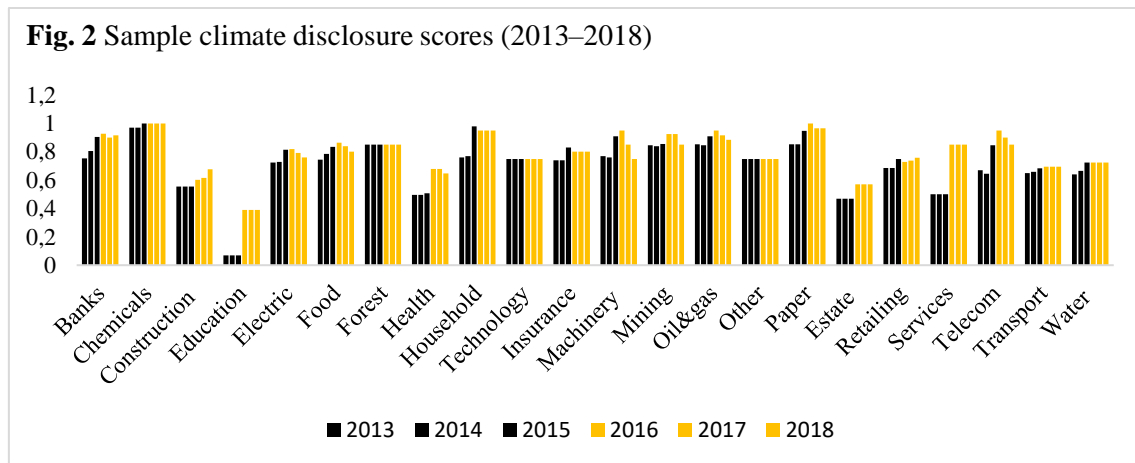


Figure 2 reveals that, in general, the climate disclosure scores for the three years before (2013-2015) of the agreement differ in relation to the scores for the years after (2016-2018). To better observe, we present Figure 3 of the average of the three years before and three years after:

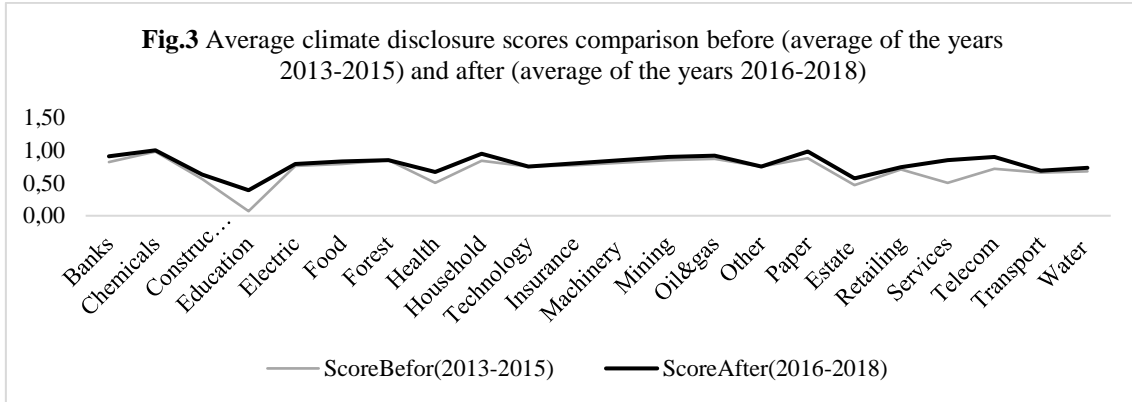


Figure 3 clearly shows that, in general, the mean of the climate disclosure scores above is below the average for climate disclosures later, regardless of sector. The sectors, chemicals, electric, forest, technology, and other presented the before-and-after averages almost the same. Particularly, the Education sector had a considerable increase, average before (7%) much lower than the average later (40%).

4.1.2 Climate performance score

In this section, we present and discuss the results of the descriptive statistics of the second variable, that is, the climate performance score.

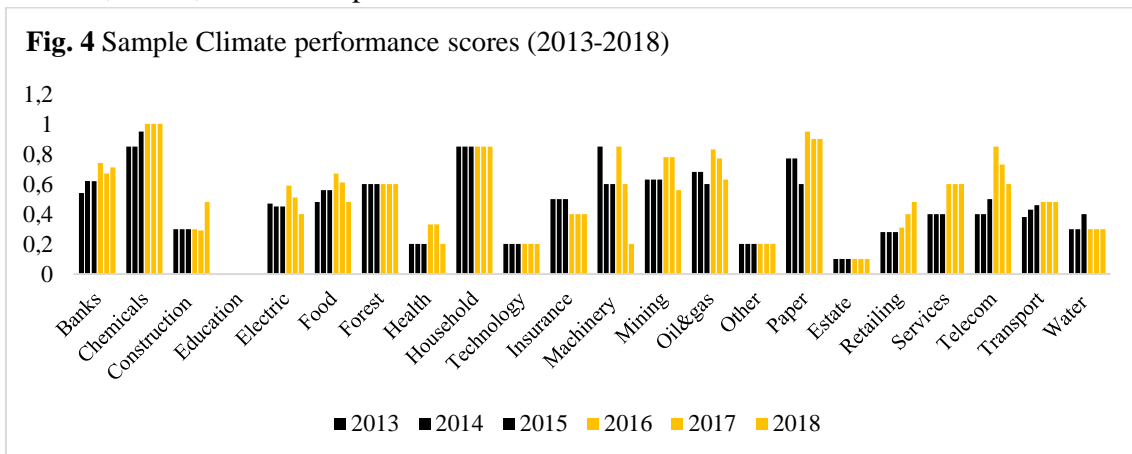


Figure 4 reveals that the three-year climate performance scores are slightly higher than earlier performances, particularly in the chemicals, health, mining, oil & gas, retailing, services and Telecommunications sectors. Meanwhile, in some sectors, there was no difference in the average before and after the Paris agreement (see Forest, Household, Technology, other sectors). To better observe, we present Figure 5 of the mean of the three years before and three years later:

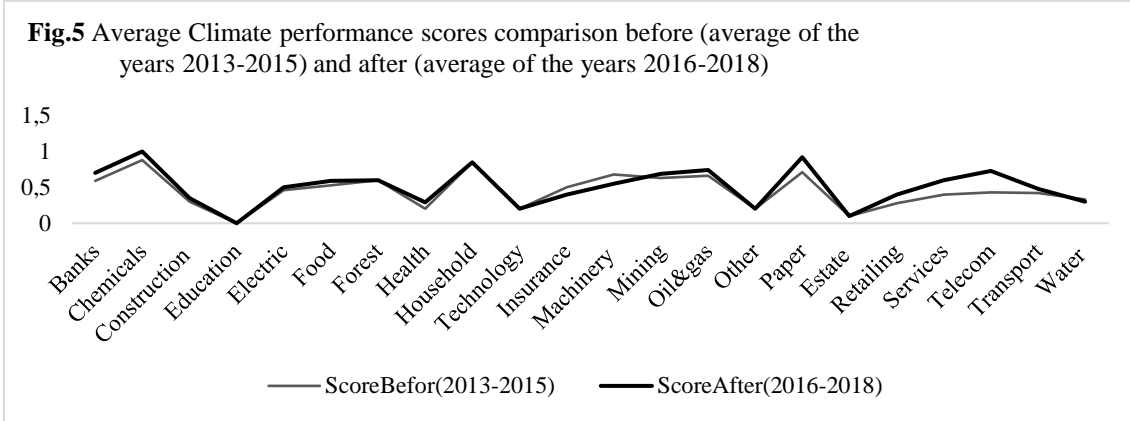


Figure 5 shows that, while overall the average scores for the three years after the agreement are roughly equal to the mean scores in some sectors, there is a slight difference. It can be noticed that the performance scores after being somewhat higher than before the agreement (see for example banks, chemicals, insurance chemical, paper etc.). As can be noted, no industry had a big difference in score after compared to before. But is this difference statistically significant enough to say that there was an increase in the average performance score after the Paris agreement?

4.2 Hypothesis Testing

4.2.1 Disclosure Score

In order to analyze whether there was an increase or not, in the mean of the level of disclosure before and after the Paris Agreement, we used the paired T-test for dependent samples. In fact, we tested the average of the "Before" (2013-2015) and "After" (2016-2017) climate disclosure scores of the Paris agreement. In Table 5 we present the statistics and the correlation:

Table 5 - Paired sample statistics and correlation

	Paired sample statistics				Correlation	
	N	Mean	SD	SE	Coefficient	Sig.
Disclosure scores (years 2016-2018)	77	79.32	20.14	2.29	0.92	0.000
Disclosure scores (years 2013-2015)	77	72.77	21.62	2.46		

SD = Standard deviation, SE = Standard error of the mean

Table 5 shows that the average (79.32) of the climate disclosure scores after the agreement is higher than the average before (72.77). The data presented a very strong correlation (> 0.9) indicating that the data are well adjusted for the paired samples test since this test requires that the data be strongly correlated for better matching. Finally, Table 6 presents the results of the t-test that tested the differences of climate disclosure scores three years before and after the Paris agreement.

Table 6 - Test results of paired samples

Paired Differences Test between:	Mean	SD	SE	95% Confidence		t	df	Sig.
				Inferior	Superior			
(1) Disclosure scores (average 2016-2018)								
(2) Disclosure scores (average 2013-2015)	6.55	8.68	0.99	4.58	8.52	6.62	76.00	0.000*

SD=Standard deviation, SE=Standard error of the mean, Confidence=Difference confidence interval, *P<0,01

Table 6 shows that Brazilian companies in the sample increased their climate scores after the Paris agreement with a significance level of 1% confidence. This result shows that after the agreement in 2015, there was an increase in awareness and the urgent need for the companies analyzed to be more transparent with regard to climate management. Therefore, after the Paris agreement, there was a 6.55% increase in the average of the climatic score compared to the score before the agreement. This leads to the acceptance of the first research hypothesis that, *ceteris paribus*, a statistically significant increase in the level of climate information disclosure happened after the PCA.

4.2.2 Climate performance score

The same procedure adopted in the previous section was also used for the carbon performance variable. In Table 7, we present the statistics of the variable.

Table 7 - Paired sample statistics and correlation

	Paired sample statistics				Correlation	
	N	Mean	SD	SE	Coefficient	Sig.
Performance scores (average 2016-2018)	66	60.25	25.54	3.14	0.86	0.000
Performance scores (average 2013-2015)	66	52.73	22.05	2.71		

SD = Standard deviation, SE = Standard error of the mean

It is noted that, contrary to the results of the climatic disclosure score presented in Table 5, where the number of observations was 77, the performance results, in turn, presented $n = 66$. This difference is because the CDP has a minimum score required to obtain the climate performance score, that is to obtain the performance score, the company should reach a minimum score of 50% in the climate disclosure score. So, it's common a company when being evaluated by CDP can get a score of the climate disclosure but will not get the climate performance score. The results show that the mean scores after the Paris agreement are higher than the score before the agreement ($60.25 > 52.73$), and the two samples before and after the agreement are strongly correlated (coef. = 86). We present the final results of the paired T-test in Table 5:

Table 8 - Test results of paired samples

Paired Differences Test between:	Mean	SD	SE	95% Confidence		t	df	Sig.
				Inferior	Superior			
(1) Performance scores (2016-2018)	7.53	12.97	1.60	4.34	10.71	4.71	65	0.00
(2) Performance scores (2013-2015)								

SD=Standard deviation, SE=Standard error of the mean, Confidence=Difference confidence interval

On average (see Table 1 and Table 2), the climatic performance score in the three years preceding the Paris agreement (Mean = 52.73; SE = 2.71) was lower than the climatic performance score in the three years after the agreement = 60.25, SE = 3.14), $t(66) = 4.71$, $p < 0.01$. Thus, the sample companies increased their climate performance in response to the agreement. In fact, after the agreement, there was an increase in the level of involvement in climate issues resulting in an increase in climate mitigation and adaptation actions, policies and projects of the companies analyzed. Therefore, the second hypothesis of this study is accepted. In fact, *ceteris paribus*, a statistically significant increase in the level of carbon performance happened after the PCA.

In view of the results, we made a more in-depth analysis of the possible variables that can influence the level of climate disclosure in order to isolate the effects of these variables. For

example, previous research suggests that the level of corporate climate disclosure is related to firm size, origin, financial performance (see Kouloukoui et al., 2019, Kouloukoui et al., 2018), corporate resources and affiliations (see Kolk and Pinkse, 2005) and the intensity of emissions (see Sprengel and Busch, 2011)).

In addition, according to Matisoff, Noonan, & O'Brien (2013), several researchers have investigated the motives that drive companies to disclose their climate coping policies (see for example, Halkos & Skouloudis). As a result, research shows as factors: the pressures of the investment industry (see Reid and Toffel, 2009), growth rates and shareholder value growth (see Blacconiere and Patten, 1994), improved terms of trade with suppliers and customers (Lev, 1992), reducing regulatory intervention (Lev, 1992, Walker and Salt, 2006) and reducing cost and increasing access to cheaper capital (Blacconiere and Patten 1994, Botosan, 1997).

However, it is important to note that in this study we performed a t-test for dependent samples, that is, the same companies that were tested before the agreement were the same ones that were tested afterward. Consequently, considering the purpose of this study in specific, none of the variables mentioned above can influence the mean before or after. Therefore, the objective of this study is not to investigate which variables influence the level of climate management, but to verify if there was an increase in the level of climate management of the analyzed companies, maintaining the normal influence of these variables, both before and after the agreement.

In addition, we considered the average of the scores three years before and three years later which implies that the small possible variations that can occur in these variables would have reflected in the average of the scores in the interval of three years in both parts. Therefore, the result observed is the reflection of the Paris agreement? Also, the research of Kouloukoui et al. (2018) investigated the disclosure of climate risks by the world's 100 largest companies in terms of market capitalization and found that the level of disclosure of this information is not related to the size of the company. In addition, Kouloukoui et al. (2019) investigated the factors that explain the level of disclosure of climate risk information by Brazilian companies and found that the level of indebtedness of a company does not influence the level of disclosure.

In this way, the company's internal characteristics (for example Size, level of involvement, financial performance etc.) are not always influenced by the company's involvement in climate issues. Sometimes it depends simply on the decision of the company itself to get involved in climate issues or an external variable mainly regulation that has the power to lead all companies to get involved in climate management once there is a force of law.

Thus, to raise the level of corporate involvement in climate issues, previous research suggests that firms should increase women's participation in the Board of Directors, as well as use the strength of institutional investors and government regulation to pressure companies to increase their commitment with climate issues (Kouloukoui et al., 2019; Kouloukoui et al., 2018). In this way, companies have reacted proactively in response to possible imminent regulations that may emerge after the Paris agreement.

On the other hand, we believe that a variable potential that can influence climate scores three years after the agreement in relation to the three years before may be national economic growth. In this way, we believe that perhaps the increase in scores can be attributed to the growth of global activity in Brazil from 2016 to 2018 independently of the agreement since the involvement in climate issues in part requires considerable investments. Because of this, we conducted a parallel study to verify Brazil's GDP growth three years before and three years later. GDP growth was 3%, 0.5%, -3.5%, -3.5% and 1% respectively in 2013, 2014, 2015, 2016 and 2017 (IBGE, 2018). We

found that contrary to expectations, there was no increase in the Brazilian GDP in the years 2016 and 2017 compared to the years 2013, 2014 and 2015, on the contrary, there was a decrease in GDP in the years preceding the agreement demonstrating that the increase in the scores cannot be attributed to economic growth - GDP (GDP 2018 are not yet available).

Finally, after the Paris agreement there was a significant improvement in the level of corporate commitment to climate management. Due in particular to Brazil's targets for reducing emissions, notably Brazil's commitment to the Paris agreement to reduce its emissions by 37% below 2005 levels by 2025, and a 43% reduction by 2030. Companies can interpret that there is a possible regulatory climate risk imminent to this commitment. As a result, companies have become increasingly involved in climate issues and this has reflected in the scores obtained in the three years after the Paris agreement. The practical implication of this result is that the most effective strategy to involve all companies in climate management is government intervention through climate regulation. As there will be a force of law that will force all companies to develop concrete policies and actions to reduce their emissions through the transition to low carbon economy through the use of clean and renewable energies, as well as strive to seek energy efficiency.

5. CONCLUSIONS

The main objective of this study is to examine whether companies have improved their climate management actions, policies and strategies after the Paris agreement. To do so, we used the data from the Carbon Disclosure Project (CDP), from 2013 to 2018. We tested whether the mean of the climate disclosure and climate performance scores three years after the Paris agreement is higher than the average of the scores three years before the agreement. The sample consisted of 77 companies (420 observations) that responded consistently to the CDP questionnaire, scored and publicly provided their answers.

This article shows that the climate management scores obtained by the companies after the agreement are higher than the scores obtained before the agreement, indicating that the companies interpreted the agreement signed in Paris as a potential regulatory risk that could strongly affect their business through a climate regulation. Thus, Brazilian companies reacted proactively by increasing their climate management disclosures after the Paris agreement and consequently their level of commitment as a way of demonstrating to competent bodies and other stakeholders that they are prepared to meet the challenges of climate change.

Thus, in line with the literature on the orientation of strategies that may lead companies to become involved in climate management, the fact that the companies analyzed in this study feel exposed to the probable regulatory risks resulting from the Paris agreement and reacted positively and proactively by developing more policies and mitigation actions demonstrates that the most effective strategy for involving all companies in climate management may be regulation. Thus, the lack of regulation may lead companies to ignore or underestimate the risks of climate change, at least in the short term.

However, it is important to note that the fact that post-agreement scores are greater than pre-agreement does not necessarily mean that the agreement necessarily influences the concrete actions on climate change of the companies. It is well known that companies make "creative writing" in sustainability reports to promote themselves. In this way, it may simply be that companies have improved their way of presenting and disclosing such information to improve scores.

The present study contributes to the literature that deals with corporate social and environmental disclosure, especially climate disclosure. The analysis in this study provided some insight into how companies have behaving after the Paris agreement on reducing GHG emissions.

It is known that the climate changes as they were put in the agenda during the Paris conference require immediate and urgent action. The corporate sector is one of the main emitters due to the production process and therefore is identified as a major contributor to climate change (Sakhel, 2017, Kolk et al., 2008).

In fact, the study by The Carbon Majors of CDP (2017) found that only 100 companies accounted for 71 percent of global emissions over the past few decades. Thus, a study that investigates the impact of the Paris agreement on climate management in the corporate context is relevant not only to academics but also to climate policy makers, governments and other stakeholders.

The findings of this study need to be interpreted considering several limitations that also open the way for future studies. First, the composition of the sample may limit the generalization of this study in different ways, since the results of this work are based on a relatively small sample ($n = 77$, 420 observations) composed of Brazilian companies that respond to the CDP questionnaire and make available publicly their answers. We verified that all 77 companies were listed on the São Paulo Stock Exchange. As a consequence of this sample selection, the article does not provide information on the behavior of companies not listed also of small businesses. Therefore, future research can extend this study incorporating small businesses and companies not listed on the stock exchange.

Second, the observations and findings are restricted to the Brazilian context. In this way, business responses to the agreement may vary across countries due to national differences, the current legal system, current climate policies, government rigor and its commitment to climate issues beyond culture, other formal and informal variables of each country. Therefore, future studies should, therefore, examine the impact of the agreement on the climate management of companies in other geographical contexts. Alternatively, other studies could verify the difference in the average of the climatic scores before and after the agreement considering other means of dissemination such as the GRI, annual reports and other means of communication.

Finally, although this study presents an overview of the behavior of Brazilian companies with regard to climate management after the Paris agreement and shows that after the agreement, Brazilian companies have increased their actions to combat climate change, it does not reveal relations or causalities in relation to the variables that may explain the level of climate management, that is, regardless of the agreement the companies answered the questionnaire. Thus, future research should therefore be based on the findings of this study and raise hypotheses that can be tested empirically. To do this, it must select potential variables that can lead companies to become involved in climate management and test them using regression analysis. This may help advance our understanding of different factors that inhibit or drive business responses in order to identify certain triggers of climate action beyond regulation.

References

- Barnosky, A. D., Hadly, E. A., Bascompte, J., Berlow, E. L., Brown, J. H., Fortelius, M., ... & Martinez, N. D. (2012). Approaching a state shift in Earth's biosphere. *Nature*, 486(7401), 52-58.
- Bebbington, J., & Larrinaga-Gonzalez, C. (2008). Carbon trading: accounting and reporting issues. *European Accounting Review*, 17(4), 697-717.
- Blacconiere, W. G., & Patten, D. M. (1994). Environmental disclosures, regulatory costs, and changes in firm value. *Journal of accounting and economics*, 18(3), 357-377.
- BM&FBovespa, Bolsa de valores de São Paulo, available in http://www.bmfbovespa.com.br/pt_br/ (in portugues). Accessed in 14/ Oct/ 2017.

- Botosan, C. A. (1997). Disclosure level and the cost of equity capital. *Accounting review*, 323-349.
- CDP - carbon disclosure Project (2017), available in <http://www.cdpla.net/pt-br/quem-somos> (in portugues). Accessed in 03/ Oct/ 2017.
- CDP (carbon disclosure Project), available in <https://www.cdp.net/pt> (in portugues). Accessed in 07/ Sept/ 2017.
- COP21, United Nations Conference on Climate Change 2015, United Nations Framework Convention on Climate Change available in <http://www.cop21Paris.org/> (in portugues). Accessed in 01/ Oct/ 2017.
- Dovie, D. B. K., & Lwasa, S. (2017). Correlating negotiation hotspot issues, Paris climate agreement and the international climate policy regime. *Environmental Science & Policy*, 77, 1-8.
- EPE – Empresa de Pesquisa Energética (2016). Empresa de Pesquisa Energética do Ministério de Minas e Energia – MME, Balanço Energético Nacional Relatório Síntese | ano base 2015, Rio de Janeiro, RJ, Junho de 2016. (in portugues)
- Garnaut, R. (2011). Australia in the Global Response to Climate Change Summary. *Cambridge University Press*.
- Halkos, G., & Skouloudis, A. (2016). Exploring the current status and key determinants of corporate disclosure on climate change: Evidence from the Greek business sector. *Environmental Science & Policy*, 56, 22-31.
- Hansen, J., Sato, M., & Ruedy, R. (2012). Perception of climate change. *Proceedings of the National Academy of Sciences*, 109(37), E2415-E2423.
- Hilton, I., & Kerr, O. (2017). The Paris Agreement: China's 'New Normal' role in international climate negotiations. *Climate Policy*, 17(1), 48-58.
- Hoffman, A. J., & Woody, J. G. (2008). *Climate change: what's your business strategy?*. Harvard Business Press.
- iNDC Brasil, available in <http://simat.mma.gov.br/acomweb/Media/Documentos/987809fd-9fd3-4c94-b.pdf> (in portugues). Accessed in 12/ Oct/ 2017.
- Kim, Y. (2008). Corporate Responses to Climate Change: the Resource-Based View. *Recuperado em*, 15.
- Kinley, R. (2017). Climate change after Paris: from turning point to transformation. *Climate Policy*, 17(1), 9-15.
- Kolk, A., & Pinkse, J. (2005). Business responses to climate change: identifying emergent strategies. *California Management Review*, 47(3), 6-20.
- Kolk, A., Levy, D., & Pinkse, J. (2008). Corporate responses in an emerging climate regime: The institutionalization and commensuration of carbon disclosure. *European Accounting Review*, 17(4), 719-745.
- Kouloukoui, D. et al. Factors influencing the level of environmental disclosures in sustainability reports: Case of climate risk disclosure by Brazilian companies. *Corporate Social Responsibility and Environmental Management*. DOI: [10.1002/csr.1721](https://doi.org/10.1002/csr.1721)
- Kouloukoui, D., da Silva Gomes, S. M., de Oliveira Marinho, M. M., Torres, E. A., Kiperstok, A., & de Jong, P. (2018). Disclosure of climate risk information by the world's largest companies. *Mitigation and Adaptation Strategies for Global Change*, 1-29. DOI: [10.1007/s11027-018-9783-2](https://doi.org/10.1007/s11027-018-9783-2)
- Kouloukoui D. (2016). O disclosure de informações de riscos climáticos e o retorno anormal do preço das ações das empresas brasileiras. (dissertation, Universidade Federal da Bahia). (in portugues)
- Larkin, A., Kuriakose, J., Sharmina, M., & Anderson, K. (2017). What if negative emission technologies fail at scale? Implications of the Paris Agreement for big emitting nations. *Climate Policy*, 1-25.
- Lourenço, I. C., Branco, M. C., Curto, J. D., & Eugénio, T. (2012). How does the market value corporate sustainability performance?. *Journal of business ethics*, 108(4), 417-428.
- Matisoff, D. C., Noonan, D. S., & O'Brien, J. J. (2013). Convergence in Environmental Reporting: Assessing the Carbon Disclosure Project. *Business Strategy and the Environment*, 22(5), 285–305. doi:10.1002/bse.1741.
- MDIC - Ministério do Desenvolvimento, Indústria e Comércio Exterior (2013). Plano Setorial de Mitigação e Adaptação à Mudança do Clima para a Consolidação de uma Economia de Baixa

- Emissão de Carbono na Indústria de Transformação. BRASÍLIA / DF, June 2013 (in portugues). Accessed in 13/ Oct/ 2017.
- MMA, Ministério do Meio Ambiente, disponível em <http://www.mma.gov.br/clima> (in portugues). Accessed in 02/ Oct/ 2017.
- MMAB, Ministério do Meio Ambiente do Brasil available in <http://www.mma.gov.br/clima/convencao-das-nacoes-unidas/Acordo-de-Paris> (in portugues). Accessed in 012/ Oct/ 2017.
- Pinkse, J., & Kolk, A. (2009). *International business and global climate change*. Routledge.
- Pletsch, C. S., Brighenti, J., da Silva, A., & da Rosa, F. S. (2015). Perfil da Evidenciação Ambiental das Empresas Listadas no Índice de Sustentabilidade Empresarial. *Contabilidade Vista & Revista*, 25(3), 57-77.
- PNMC, Política Nacional sobre Mudança do Clima disponível em <http://www.mma.gov.br/clima/politica-nacional-sobre-mudanca-do-clima> (in portugues). Accessed in 14/ Oct/ 2017.
- Programa Brasileiro de GHG Protocol <<http://registropublicodeemissoes.com.br/participantes> (in portugues). Accessed in 12/ Oct/ 2017.
- Reid, E. M., & Toffel, M. W. (2009). Responding to public and private politics: Corporate disclosure of climate change strategies. *Strategic Management Journal*, 30(11), 1157-1178.
- Sharma, A. (2017). Precaution and post-caution in the Paris Agreement: adaptation, loss and damage and finance. *Climate Policy*, 17(1), 33-47.
- STERN, Nicholas H. et al. **Stern Review: The economics of climate change**. Cambridge: Cambridge University Press, 2006.
- Sullivan, R. (2010). An assessment of the climate change policies and performance of large European companies. *Climate Policy*, 10(1), 38-50.
- U. N. F. C. C. C. (2015). Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015. In *Addendum. Part Two: Action taken by the Conference of the Parties at its twenty-first session*.
- UNFCCC, disponível em http://unfccc.int/Paris_agreement/items/9485.php Accessed in 01/ Oct/ 2017.
- Viñuales, J. E., Depledge, J., Reiner, D. M., & Lees, E. (2017). Climate policy after the Paris 2015 climate conference.
- Ziegler, A., Busch, T., & Hoffmann, V. H. (2011). Disclosed corporate responses to climate change and stock performance: An international empirical analysis. *Energy Economics*, 33(6), 1283-1294.