

**POLITECNICO DI MILANO**  
School of Industrial and Information Engineering  
MSc in Management Engineering

**DETERMINANTS OF CARBON INFORMATION AND SOCIAL SDGs  
DISLCLOSURE:**

**Evidence based on Italian and Brazilian companies**

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**MILANO**

2021



*To my parents and close friends,  
that have been the greatest supporters of  
my study path and the pursuit  
of a career of impact.*



## ACKNOWLEDGEMENTS

The completion of this thesis, and not only it but the whole journey this final work represents, has been only possible with the support of many people. It started with the ones who helped me to get to enter in the university and the few who backed me when I decided to become an engineer, giving up from the possible chemist career. It involved many colleagues and professors from the University of Sao Paulo and the Politecnico di Milano, that, throughout these eight years in university, provided me with many valuable opportunities and learnings.

During this whole path, I have received a close support from my parents, who were always there for me and from whom I have learned how to be strong, resilient, determined and purposeful. I also recognize the crucial importance of my friends' support, those that made part of my daily routine and that shared with me the challenges this period has brought us: Fernando Ferri, Luiza Velloso, Erica Marques, André Zanella, Karen Kobayashi and a big list of other good friends I'm lucky to have met.

This achievement was only possible, as well, with the help of the ones who made part of my experience in Milan, that have become my family in Italy. I would like to specially thank Tiago Vicentini, Julia Kawamoto, Carolina Chapuis and Federica Baroni for the direct support on the development of this thesis. I am also grateful for the support of my friends that lived with me during this period, Thais Miky Kuroda, Julia Freixedelo and Daniela Pegaz, that have always encouraged me and made it feels like home; and my amazing Italian flat mates. I also thank the very special friends Yovita Skolastika, Bruna Nuncio and many other people that made part of such an important period of my life.

I am also very thankful for the help of my work colleagues: Filippo Gambardella, Vittoria Minunno and Blanca Moreno for the relevant insights regarding climate change. Finally, I would like to thank my supervisor Leonardo Boni for the close support and Prof. Roberta de Souza Castro Pião and Prof. Irene Bengo for the relevant insights.



## EXECUTIVE SUMMARY

With the emergence of a series of societal problems due to anthropogenic impact, the concept of sustainable development is ever more emphasized within the international agenda. The adaptation or even transformation of companies to this new context have been made them change their strategies from a purely economic perspective to also mitigating negative impacts generated, seeking for the creation of shared value or even solving social problems. Such phenomenon is interpreted through the lens of Corporate Social Responsibility (CSR) and its evolution towards the concept of hybrid organizations. As a result, companies have been put into pressure to disclose CSR information, incentivized by some aspects present on the organizational and institutional contexts, which is explained by the legitimacy, stakeholder and institutional theories.

This study aims at assessing the influence of a set of determinants (country of operation, company size, industry sector and CSR engagement) on the level of disclosure of carbon and social information, scored by the Carbon Disclosure Project (CDP) and revealed in the form of social pillar SDGs (SDGs 1 to 6) mentioned on sustainability reports, respectively. It also focuses at making a comparison between the different realities faced by Italian and Brazilian companies and at analyzing a possible correlation among the level of carbon and social disclosure. The methodology used consisted in the Fractional Logistic Model and the universe of analysis corresponded to the set of Brazilian and Italian companies assessed by the CDP in 2020, comprising a total of 226 companies.

The results, at a minimum confidence level of 95%, demonstrated that Italian companies disclosed more carbon information while Brazilian companies, more social aspects; enterprises making part of highly polluting sectors reported more carbon but less social information; company size positively influenced both the level of carbon and social disclosure, while the presence on a sustainability index did not provide any influence; and companies with a high level of carbon disclosure have also a high level of social disclosure. In addition, the average level of social reporting was lower than the one of carbon disclosure and companies reported less than half of the level they could have reach.

Key Words: *Carbon disclosure, Social disclosure, Determinants, CDP, SDG, Brazil, Italy*





## SOMMARIO

Con l'emergenza di una serie di problemi sociali dovuti all'impatto antropico, il concetto di sviluppo sostenibile assume maggiore rilevanza all'interno dei programmi delle istituzioni internazionali. L'adattamento o addirittura la trasformazione delle aziende a questo nuovo contesto ha permesso loro di cambiare le proprie strategie da una prospettiva puramente economica oltretutto attenuando gli impatti negativi generati, ricercando una condivisione di valore, oltre alla risoluzione dei problemi sociali. Tale fenomeno viene interpretato grazie alla Corporate Social Responsibility (CSR) e alla sua evoluzione verso il concetto di organizzazione ibrida. Di conseguenza, le aziende sono state sollecitate a rendicontare informazioni sulla CSR, incentivate da alcuni aspetti riguardanti i contesti organizzativi e istituzionali, che trovano spiegazione nelle teorie di legittimità, stakeholder e istituzionali.

Questo studio mira a valutare l'influenza di un insieme di determinanti (paese di attività, dimensione dell'azienda, settore industriale e impegno sulla CSR) sul livello di divulgazione delle informazioni sul carbonio e sociali, valutate rispettivamente dal Carbon Disclosure Project (CDP) e rivelate nella forma degli SDG del pilastro sociale (SDG da 1 a 6) menzionati nei rapporti di sostenibilità. Si concentra inoltre sul confronto tra le diverse realtà che caratterizzano le aziende italiane e brasiliane e sull'analisi di una possibile correlazione tra il livello di rendicontazione del carbonio e sociale. La metodologia utilizzata consisteva nel Fractional Logistic Model e l'universo di analisi corrispondeva all'insieme delle imprese brasiliane e italiane valutate dal CDP nel 2020, per un totale di 226 imprese.

I risultati, al minimo livello di confidenza di 95%, hanno dimostrato che le aziende italiane hanno rendicontato più informazioni sul carbonio mentre le aziende brasiliane, più aspetti sociali; le imprese che fanno parte di settori altamente inquinanti hanno riportato più informazioni associati al carbonio ma meno sociali; la dimensione aziendale ha influenzato positivamente sia il livello rendicontazione di carbonio che sociale, mentre la presenza su un indice di sostenibilità non ha fornito alcuna influenza; e le aziende con un alto livello di rendicontazione del carbonio hanno anche un alto livello di rendicontazione sociale. Inoltre, il livello medio di rendicontazione sociale era inferiore a quello relativo al di carbonio e le aziende segnalavano meno della metà del livello che potevano raggiungere.

*Key Words: Rendicontazione del carbonio, Rendicontazione sociale, Determinanti, CDP, SDG, Brasile, Italia*





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## LIST OF ABBREVIATIONS AND SYMBOLS

GHG	Greenhouse gas
UNFCCC COP	United Nations Framework Convention on Climate Change Conference of Parties
IPCC	Intergovernmental Panel on Climate Change
WCED	World Commission on the Environment and Development
SDGs	Sustainable Development Goals
ESG	Environmental, social and governance
CSR	Corporate Social Responsibility
CSP	Corporate Social Performance
CDP	Carbon Disclosure Project
FPO	For-profit organization
SB	Social business
GRI	Global Reporting Initiative
CSP-D	Corporate Social Disclosure
UNGC	United Nations Global Compact
UK	United Kingdom
EU	European Union
BRICS	Brazil, Russia, India, China, and South Africa
MINT	Mexico, Indonesia, Nigeria, Turkey
EU ETS	European Emission Trading System
ISE	Índice de Sustentabilidade Empresarial
GLM	Generalized linear model
DJSI	Dow Jones Sustainability Index





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## 1. INTRODUCTION

Since the 1950s, with the emergence of the industrial revolution, human population and its activities have grown in a way that the global systems have been negatively affected, for example, through the emission of greenhouse gases (GHGs), deforestation, and freshwater use (Rekker et al., 2021). Human-induced global warming has caused changes in the global climate, in relation to the pre-industrial period, in a rate of 0.2°C per decade, impacting both human health and ecosystems (IPCC, 2019).

In this context, it was internationally agreed, at the 2015 United Nations Framework Convention on Climate Change Conference of Parties, a maximum increase of 2°C in the global average temperature compared to pre-industrial levels and preferably a scenario of 1.5°C rise (UNFCCC COP, 2015). Risks for the human and natural systems are expected to be lower with the decrease of global warming, for example with the substantial reduction of the probability of extreme drought, precipitation deficits and lack of water availability (IPCC, 2019).

According to the Intergovernmental Panel on Climate Change (2019), the impacts of global warming fall disproportionately on the most vulnerable people, through the regionally differentiated climate-related risks to food security, water availability, heat exposure and coastal submergence, for example. Therefore, the IPCC (2019) affirms that limiting warming can facilitate the achievement of other aspects of sustainable development and the reduction of inequality. Climate mitigation and adaptation actions should be carried out to limit warming and they can have synergies with other sustainable development dimensions (poverty, hunger, health, water and sanitation, cities and ecosystems) or even trade-offs, which highlight the importance of adopting a systemic perspective when addressing such issues (IPCC, 2019).

As defined by the World Commission on the Environment and Development (WCED, 1987), sustainable development is the advancement that allows meeting the needs of the present without compromising the ability of future generations to meet their own needs. If in the past environmental quality and economic growth was considered a trade-off, currently there are increasingly being set mutual targets for growth, environmental sustainability and societal development (Doyle & Perez Alaniz, 2020). Associated to it, there is the emergent concept of ESG, that refers to environmental, social and governance factors largely approached in the selection processes of sustainability investing (Dorfleitner et al., 2015).

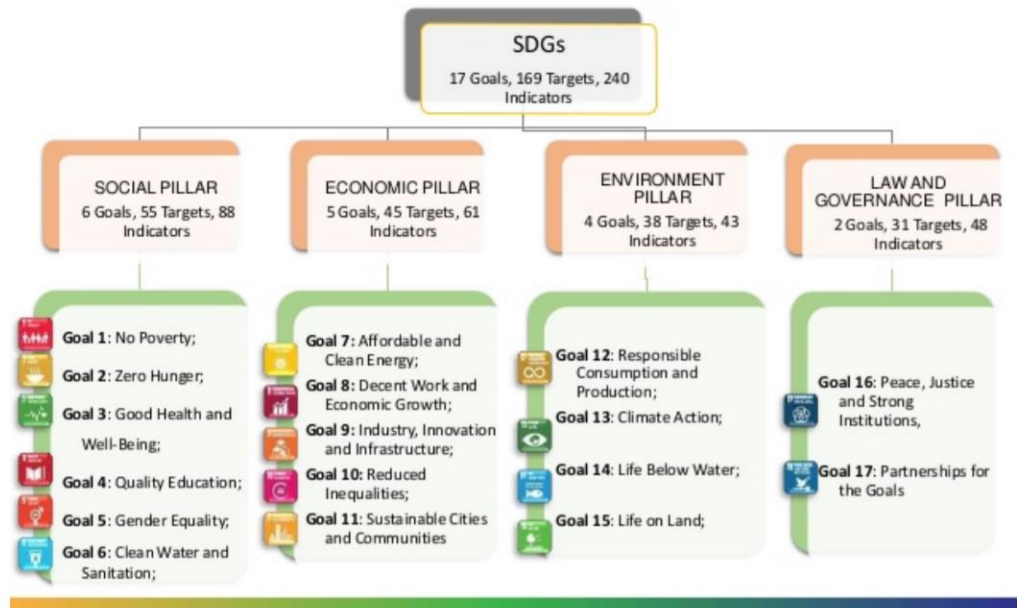
Some recent public policies have addressed the concept of sustainable development, being the main one the United Nations 2030 Agenda for Sustainable Development, that stated the requirement of a balanced progress in the environmental, social and economic dimensions to achieve sustainable development. The 2030 Agenda proposed 17 Sustainable Development Goals (SDGs) (Figure 1) and presented three main features: universality, integration and transformation; that reinforced the necessity of a worldwide engagement of both public and private entities to pursue all goals concomitantly by implementing transformative changes. The UN 17 SDGs can be segmented in four different pillars: social (SDGs 1 to 6), economic (SDGs 7 to 11), environment (SDGs 12 to 15) and law and governance (SDGs 16 to 17) pillars (Figure 2) (UN, 2015).

Figure 1 - Sustainable Development Goals



Source: UN (2021)

Figure 2 - Sustainable Development Goals Pillars



Source: UN (2021)

According to the UN 2030 Agenda, organizations play a critical role in the achievement of the SDGs (Agarwal & Gneiting & Mhlanga, 2017) and long-term sustainable development balance (Bebbington & Unerman, 2018; Scheyvens et al., 2016). The business sector, which in the past was considered to have as solely purpose the maximization of profits and shareholder value (Friedman, 1970), has been increasingly expected to promote not only economic but also social value (Rodriguez-Gomez et al., 2020). According to Izzo et al. (2020), modern companies ought to begin aligning their business models, missions and strategies with the social context in which they operate and, thus, with the SDGs. Correspondingly, there are currently increasing pressures on companies regarding their new role within society, focused on local communities and on the environment, and regarding the corporate contribution to solutions for social problems (Ferri, 2017).

These phenomena can be interpreted through the lens of the theoretical frameworks of Corporate Social Responsibility (CSR) and its evolution towards what is called hybrid organizations. CSR reflects the need to conduct business in a new way, that integrates purposely the social, environmental and economic dimensions into business strategies (Sánchez-Infante Hernández et al., 2020). However, there is an absence of consensus regarding its definition, main aspects and measurement (Rodriguez-Gomez et al., 2020). CSR was originated in the mid-1950s (Carroll, 1999) as a response to the labor conflicts emerged with the industrial revolution

(Jenkins, 2009; as cited in Rodriguez-Gomez et al., 2020) and, according to Porter and Kramer (2006), it has evolved from a responsive to a strategic approach, reaching the idea of “shared value”.

According to Defourny and Nyssens (2017), for-profit organizations can evolve towards social businesses, a type of hybrid organization, by orienting themselves from the capital to the general interest, through a path driven by the evolution of CSR. Baudot et al. (2020) have stated that a broader responsibility as regards society has consolidated with the emergence of hybrid arrangements.

Certain kinds of hybrid organizations are characterized by the practice of stakeholder accountability (Alter, 2007). Similarly, the practice of disclosure of Corporate Social Performance (CSP) has been observed as resulting from the adoption of CSR and has been interpreted mainly through the lens of the legitimacy theory, stakeholder theory, agency theory and institutional theory (Garcia et al., 2020). Such theories have been intensively used in past research as a basis to the investigation of the determinants of CSP disclosure.

Considering some identified gaps on the literature, this study aims at assessing the influence of a set of determinants (country of operation, company size, industry sector and CSR engagement) on the level of disclosure of carbon and social information, scored respectively by the Carbon Disclosure Project (CDP) and revealed as the form of social pillar SDGs (SDGs 1 to 6) mentioned on sustainability reports. It also focuses at comparing the carbon and social disclosure levels within the different realities faced by Italian and Brazilian companies and at analyzing a possible correlation among the level of carbon and social disclosure.

## **2. THEORETICAL BACKGROUND, LITERATURE REVIEW AND HYPOTHESIS DEFINITION**

### **2.1 HYBRID ORGANIZATIONS AND FOR-PROFIT COMPANIES EVOLUTION**

Grossi and Thomasson (2015) have defined hybrid organizations as entities that have two or more mixed modes, such as the case of pursuing both private and public objectives. Alter (2007) has provided a more specific definition by comparing hybrid organizations with purely philanthropic and purely commercial ones, into the dimensions of motives, methods, goals and

destination of profit. According to Alter (2007), a hybrid organization have mixed motives, pursue both social and economic value creation, reinvest partially or fully its income in its mission activities and utilize market and mission-driven methods (Figure 3).

Figure 3 – Comparison between purely philanthropic, purely commercial and hybrid organizations

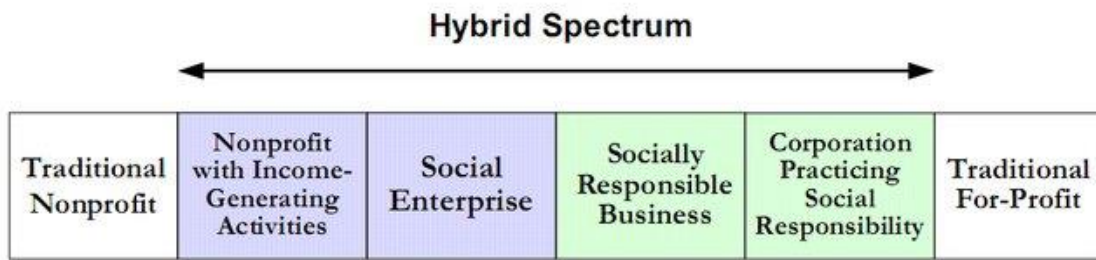
	Purely Philanthropic	<b>Hybrid</b> <sup>Op.14</sup>	Purely commercial
<b>Motives</b>	Appeal to goodwill	<b>Mixed motives</b>	Appeal to self-interest
<b>Methods</b>	Mission-driven	<b>Balance of mission and market</b>	Market-driven
<b>Goals</b>	Social value creation	<b>Social and economic value creation</b>	Economic value creation
<b>Destination of Income/Profit</b>	Directed toward mission activities of nonprofit organization (required by law or organizational policy)	<b>Reinvested in mission activities or operational expenses, and/or retained for business growth and development (for-profits may redistribute a portion)</b>	Distributed to shareholders and owners

Source: Alter (2007)

Recently, the boundaries between private, non-profit and public sectors have become increasingly blurred, and this phenomenon allowed the emergence of the arenas where the hybrid organizations operate (Battilana & Lee, 2014). Consequently, these organizations can simultaneously display features of public, private and non-profit organizations (Doherty & Kittipanya-Ngam, 2021) and bear conflicting goals, institutional pressures and responsibilities (Kastberg & Lagström, 2019).

Alter (2007) has also proposed a framework called “Hybrid Spectrum” (Figure 4) that categorizes hybrid organizations considering their proximity to purely philanthropic or purely commercial entities, and then to the prevalence of social value creation or economic value creation, respectively. The organizations classified as “Non-profit with income generating activities” and “Social Enterprise” have a primacy of the mission motive, reinvest the income in its social programs and perform stakeholder accountability. On the other hand, “Socially Responsible Business” and “Corporation Practicing Social Responsibility” prioritize the profit-making motive, redistribute profit as dividends and perform a shareholder accountability (Alter, 2007).

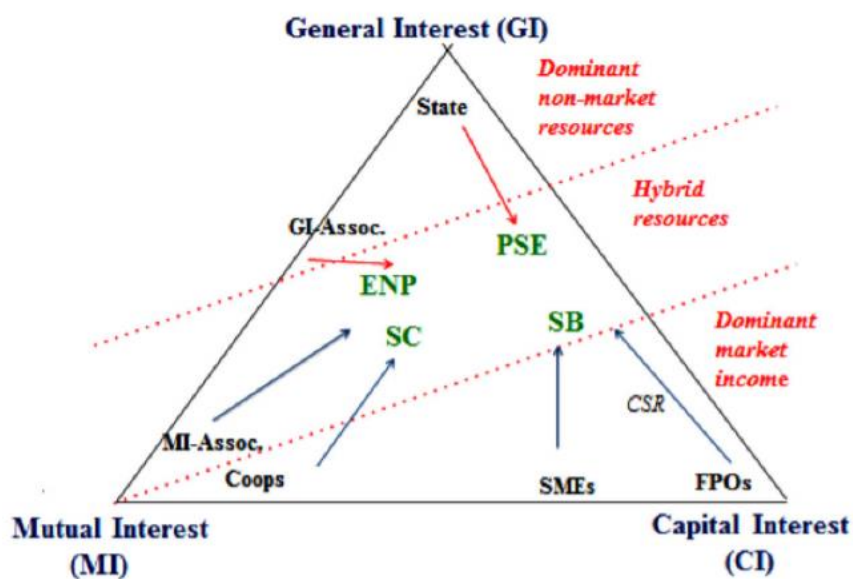
Figure 4 – Hybrid Spectrum



Source: Alter (2007)

Despite the affirmation made by Alter (2007) that organizations rarely evolve along the whole spectrum, Defourny and Nyssens (2017) have proposed a framework (Figure 5) in which initial organizational types can advance through institutional trajectories and become different social enterprise models. Such framework allows (re)positioning organizations based on the principles of interest (general, mutual and capital) and resources mixes (market, non-market and hybrid). This way, cooperatives, associations, the state, for-profit organizations and small and medium enterprises can evolve to social cooperative, social business, entrepreneurial non-profit and public-sector social enterprise models (Defourny & Nyssens, 2017).

Figure 5 – Institutional trajectories generating social enterprise models



Source: Defourny & Nyssens (2017)



A particular case consists in the institutional trajectory through which a for-profit organization (FPO) is transformed into a social business (SB). This pathway consists in a move from the capital towards the general interest, which can be understood as the creation of blended value (Defourny & Nyssens, 2017), a concept of “total value” that includes the economic, social and environmental dimensions (Alter 2007). The social business can be also characterized by a hybrid economic model, with the possible introduction of non-market resources into the resource pool (Defourny & Nyssens, 2017).

According to Yunus (2010), social businesses are market-based organizations specifically designed to address a social objective and that do not perform profit distribution and, therefore, all profits are reinvested to support the social mission. However, other authors are less demanding and consider for-profit organizations that undertake Corporate Social Responsibility (CSR) as part of social entrepreneurship (Defourny & Nyssens, 2017). By highlighting the risk of associating social enterprises to “social washing” and diluting its concept, Defourny and Nyssens (2017) left organizations involved in CSR activities out of the social business category, affirming though the importance of Corporate Social Responsibility (CSR) as a driver for the evolution towards social business.

## 2.2 EVOLUTION OF CORPORATE SOCIAL RESPONSIBILITY

According to Kraus et al. (2020), literature has emphasized that Corporate Social Responsibility (CSR) activities as well-recognized globally and that its boundaries are expanding. CSR is now worldwide rooted in the business agenda as an umbrella term, comprising a range of activities from donations to complex business-community partnerships integrated into the strategy (Kowszyk & Vanclay, 2020) and adjacent areas such as corporate governance and corporate financial performance, that influence social-environmental activities in a robust manner (Fiandrino et al., 2019). The significance around the concept of CSR has pointed out to the need to conduct business in a new way, that integrates purposely the social, environmental and economic dimensions into business strategies (Sánchez-Infante Hernández et al., 2020).

Rodriguez-Gomez et al. (2020) have described the three dimensions contemplated by CSR. As regards the economic aspect, CSR has evolved from the pure maximization of profit (Friedman, 1970) to comprising also the generation of jobs, innovation and technological

advancement (Jamali, 2008; as cited in Rodriguez-Gomez et al. (2020)). The social area refers to the organization's responsibility towards employees and the society (Jamali, 2018; as cited in Rodriguez-Gomez et al. (2020)) and aims at satisfying in a balanced way the interest of stakeholders (Maclagan, 2008; as cited in Rodriguez-Gomez et al. (2020)). Finally, the environmental aspect considers the company's responsibility towards the environment for a sustainable development (Taliento et al., 2019s; as cited in Rodriguez-Gomez et al. (2020)).

These organizations need to manage some trade-offs, such as between profit and sustainable value (Preghenella & Battistella, 2021), but many studies have affirmed the positive relationship among the social, environmental and economic performances and that joint action promotes long-term sustainability (Rodriguez-Gomez et al., 2020).

The CSR research shows an absence of consensus regarding its definition, main aspects and measurement (Rodriguez-Gomez et al., 2020), given the multiplicity of theories and approaches, like those more than 25 different definitions reviewed and discussed by Carroll (1999). In addition, its concept did not remain unchanged since its emergence (Rodriguez-Gomez et al., 2020), but adapted when facing changes in the society's economic, philanthropic and ethical expectations towards business (B. Carroll, 2015; Carroll, 2015).

Rodriguez-Gomez et al. (2020) have provided a consolidated study on the evolution of CSR. Accordingly, CSR was originated in the mid-1950s (Carroll, 1999) as a response to the labor conflicts emerged with the industrial revolution (Jenkins, 2009; as cited in Rodriguez-Gomez et al. 2020), and in the 1980s it was understood as an area of the company that needed to be managed (Rodriguez-Gomez et al., 2020). The objective of CSR was focused on the improvement of the image and reputation of companies (Carroll, 2009) to obtain a "social license" to operate (Syn, 2014; as cited in Rodriguez-Gomez et al., 2020). With the globalization, CSR was integrated into the business strategy (Arco-Castro et al. 2020; as cited in Rodriguez-Gomez et al., 2020). Two more objectives for implementing CSR were also identified in Rodriguez-Gomez et al. (2020): reducing the business risks and associated costs and managing demands and improving relations with stakeholders. Consequently, the practice of sharing information on CSR gained importance, as it allowed the communication with different stakeholders (Bae et al. 2018; as cited in Rodriguez-Gomez et al., 2020).

Porter and Kramer (2006) have also theorized the advancement of CSR and developed a CSR maturity model (Figure 6). Such model highlighted the need for understanding the interrelationships between business and society to promote simultaneously the most significant

social impact and the greatest business benefits, by evolving from a responsive to a strategic approach. Responsive CSR involved two aspects: acting as a good corporate citizen, by responding to changes in stakeholders' concerns; and mitigating existing or potential adverse impacts from companies' activities, which could be practiced by using standardized sets of environmental and social risks, for example, provided by the Global Reporting Initiative (GRI). Contrastingly, a Strategic CSR approached the specific social impacts derived from their value chain (inside-out linkages) and social aspects of the competitive context (outside-in linkages) to unlock shared value, that is, to tackle selectively social impacts that can profoundly benefit the society and offer competitive advantage at the same time. The most strategic CSR involved the integration of a social dimension into the business model's value proposition or even building it around the social issue (Porter and Kramer, 2006).

At this step, it is relevant to point out that the notion of "shared value" approached by Porter and Kramer (2006) approximates to the one of "blended value" mentioned by Alter (2007), when characterizing hybrid organizations, and by Defourny and Nyssens (2017) when describing social businesses. This latter observation supports Defourny and Nyssens (2017) affirmation that adopting CSR could lead a for-profit organization into the path towards a social business.

Figure 6 – Corporate Social Responsibility maturity model



Source: Porter and Kramer (2006)

## 2.3 DISCLOSURE OF SUSTAINABILITY ASPECTS

As beforementioned, hybrid organizations located closer to the purely philanthropic pole in the hybrid spectrum perform stakeholder accountability (Alter, 2007). These organizations should provide accurate, timely and understandable information (Dillard, 2011) to supply accountability systems of a more horizontal nature, that represent their performance regarding employees, customers or future generations (Messner, 2009; as cited in Baudot et al., 2020). According to Córdova Román et al. (2021), ethic of accountability allows demonstrating that one is fulfilling their responsibility by giving an account and, similarly, accountability is considered as a prerequisite to evaluate at which level an organization facilitates the long-term viability of the community (Dillard and Brown, 2015).

Likewise, as regards CSR, Corporate Social Performance (CSP) was defined as the ability of an organization to meet and manage the expectations of their stakeholders: the environment, human resources, community, governance (Cassely et al., 2020). The practice of corporate disclosure helps providing information in a timely and transparent way about the companies' operations, performance and governance (Dawkins & Fraas, 2008) and CSR reports aim to show that related social, environmental and economic impacts are aligned with the society values (Beske-Janssen et al., 2019).

Accordingly, Garcia et al. (2020) have gathered a set of theories to justify the practices of voluntary Corporate Social Disclosure (CSP-D): legitimacy theory, stakeholder theory, agency theory and institutional theory. Besides the theory of voluntary disclosure, which states that the disclosure is carried out to allow the reduction of information asymmetry (Verrecchia, 2001; as cited in Garcia et al., 2020), those theories are presented as an influence to the set of determinants of CSP-D, that will be further explored in this work. The legitimacy theory affirms that, through voluntary corporate transparency, companies seek to appear as socially responsible and acquire legitimacy, in order to maintain a social contract and guarantee the survival of their activities (Guthrie & Parker, 1989; Haji, 2012; as cited in Garcia et al., 2020). To achieve it, companies' actions should be seen as appropriate and desirable considering the social system of values, beliefs and norms (Suchman, 1995; as cited in Garcia et al., 2020). The stakeholder theory postulates that organizations disclose socially responsible information with the objective of showing their accomplishments to stakeholders, as a result of stakeholder management (Boesso and Kumar, 2007; as cited in Garcia et al., 2020). These two theories are

interconnected in a way that disclosures are carried out to achieve or maintain legitimacy among stakeholders (Coetzee & van Staden, 2011; as cited in Garcia et al., 2020).

Still according to Garcia et al. (2020), the agency theory states that the disclosure is carried out to reduce the information asymmetry among companies' owners – principals – and administrators – agents. Finally, the institutional theory poses that organizations disclose in order to be compliant with practices and procedures present on the institutional environment and with external norms and rules (DiMaggio and Powell, 1983, as cited in Garcia et al., 2020).

Complementary, Ferri (2017) has assessed the reporting behavior of companies through the lens of the institutional theory, arguing that this approach is under-investigated and has presented mixed results. According to her, such theory states that corporations perform similar behaviors based on the pressures of the surrounding environment and, therefore, CSR is also shaped by the specific accepted values, norms and rules. Differences regarding CSR on developed and developing countries are also considered as a result of different rules and norms and also responsibilities expected from companies (Ferri, 2017).

Additionally, sustainability disclosure can be considered a differentiator in competitive industries, a signal of management quality and efficiency and a facilitator of a better access to capital (EY, 2013).

When it comes specifically to the disclosure of carbon emissions, it is becoming a widespread practice, together with its integration within companies' CSR, given the fact that climate change has been considered globally as one of the most important topics at the social, political and business levels (Qian & Schaltegger, 2017). Carbon management have been used to combat climate change, and the first step required to it consists in the carbon disclosure (Córdova Román et al., 2021). Therefore, it is crucial to measure how companies are reducing greenhouse gas emissions (Rekker et al., 2021). Companies are also being pressured to report their strategies for climate change and the referent risks and opportunities (Kouloukoui et al., 2018a), either physical or transition (Caldecott, 2018), given that these risks can harm the return over investment and the organizational performance (Labatt & White, 2007). Such carbon reporting allow stakeholders to use this information into their decision-making processes (Luo et al., 2013).

Analog to the case of CSP, Mateo-Márquez et al. (2019) have identified some theories to justify the practice of disclosure of GHG emissions: the socio-political, the economic and the institutional theories of disclosure. The group of socio-political theories includes the

stakeholder theory and the legitimacy theory (Clarkson et al., 2008; as cited in Mateo-Márquez et al., 2019). Economic theories are those based on a cost-benefit analysis (Verrecchia, 1983; as cited in Mateo-Márquez et al., 2019) and the institutional theory considers the pressure from the institutional context (Bansal and Roth, 2000; Hahn et al., 2015; as cited in Mateo-Márquez et al., 2019). Conclusively, despite the influence of institutional factors, the climate disclosure practices are observed even in the absence of any normative requirement (Kouloukoui et al., 2018a).

### **2.3.1 Disclosure standards**

According to Baudot et al. (2020) accountability systems, such as standards and possible respective certifications, pressure companies to account for their actions in defined ways, and are utilized to compare organizational performance, which requires standardization. The standards facilitate companies to define and redefine their responsibility, identify relevant relationships and do benchmarking among themselves (Baudot et al., 2020).

Sustainability report is a document used by companies to present in a transparent and voluntary way their environmental, social and economic performance (Murillo-Avalos et al., 2021), with the objective of addressing stakeholders' demands and obtaining legitimacy, to secure positioning or create competitive advantage (Rosati & Faria, 2019). This way, companies choose strategically the content to be present in their reports and the level of sustainability commitment (Rosati & Faria, 2019).

Sustainability reporting has not yet well-established standards (Rekker et al., 2021). However, the volume of reports prepared according to the Global Reporting Initiative (GRI), a worldwide reference for elaborating such document, has increased expressively (Murillo-Avalos et al., 2021). Global Reporting Initiative is a non-profit institution whose purpose is to achieve a sustainable global economy (Rocha de Souza et al., 2014), in which companies would manage in a responsible way their performance in the environmental, social and economic aspects (Murillo-Avalos et al., 2021).

Recently, a joint initiative was established by GRI and the United Nations Global Compact (UNGC) with the aim of allowing companies to incorporate SDG reporting into their processes (GRI, 2018; UNGC, 2018). Accordingly, sustainability reporting is considered one of the most important drivers of SDG integration into corporate strategy and actions (Adams,

2020). Izzo et al. (2020) have stated that SDG reporting is not an alternative but a complementary approach to other currently used disclosure frameworks, and that when it is associated with these frameworks, it enhances its credibility and profoundly embed it into the business models and strategy. Still according to Izzo et al. (2020), despite SDGs being at early stages, there have been an increase on the research related to it, as regards the analysis of corporate responsibility, corporate disclosure, competitive advantage, business models and investment opportunities.

Additionally, to generate visibility on the emission reduction strategies and targets, companies have made use of voluntary or mandatory carbon reporting (Borie & Decq, 2015). The Carbon Disclosure Project (CDP) is being worldwide used as the main standard for voluntary carbon disclosure to increase company's legitimacy. CDP is an organization founded by institutional investors that has the objective to support better informed decision-making. It provides an annual voluntary questionnaire to companies and, based on the gathered data, evaluates and attributes scores according to the emission reduction initiatives (Mateo-Márquez et al., 2019). The analysis involves four different sets of information: corporate climate-related risks; emissions inventory control; corporate actions to reduce harm on the environment; and management of effects derived from the environment-related strategic decisions (Rocha de Souza et al., 2014). Data from CDP has already been used in past research to analyze the determinants of voluntary carbon disclosure (Mateo-Márquez et al., 2019).

Rocha de Souza et al. (2014) have evidenced the use of international initiatives, such the GRI and CDP, as tools to develop and implement actions to mitigate climate change and, for Amaral (2012) and Ziegler, Busch e Hoffmann (2011) as cited in Rocha de Souza et al. (2014), the participation into market initiatives such as GRI, CDP and sustainability indexes helps increasing the company's market value, thanks to the improvement in organizational performance, that is explained by the implementation of sustainable management and emission mitigation strategies by the participant companies (Rocha de Souza et al., 2014)

## 2.4 DETERMINANTS OF DISCLOSURE

Garcia et al. (2020) have done a literature review on the determinants of CSP disclosure, at the basis of the legitimacy theory, stakeholder theory, agency theory and institutional theory presented in the section 2.3. Their work captured the evolution from studies describing disclosure practices to the assessment of the factors that influence such disclosure. The

maturation and increase of studies in CSP-D may be attributed to the rise in the CSP-D agenda in both developed and developing countries, given the influence of social, political and cultural aspects, according to the authors. The term “determinants of disclosure” on quantitative studies was identified as referring to the independent variables, which involved aspects as size, industry, financial performance, CSP, external pressure and institutional macro system, that impacted the chosen dependent variable. On the other hand, the dependent variables were based on a series of different proxies: disclosure indexes, number of words per theme, level of GRI reporting, frequency of presenting reports, richness and quality of disclosure, etc. The authors pointed out to a lack of consensus on the determinants that influence CSP disclosure and to the fact that they do not compete with but complement each other, resulting in multivariate effects. It was also emphasized the complexity of managerial requirements to address multifaceted factors when defining the level of disclosure to be performed and if it would create value for the organization (Garcia et al., 2020).

Similarly, Rodriguez-Gomez et al. (2020) noted studies on the factors that influence the ethical conduct in an organization, such as the sector, industry competitiveness, presence of a system of sanctions, incentives or codes of conduct, company size and country factor; Cassely et al. (2020) have identified the influence of macro, meso and microeconomic factors in CSP and its components; and Ferramosca and Verona (2020) have pointed out to the consideration of organizational features on CSR research.

However, in spite of an increase in the research on the factors influencing CSP and environmental disclosure, Kouloukoui et al. (2018a) evidenced the almost absence of studies on climate risks. In addition, Córdova Román et al. (2021) have revealed that, given an initial lack of data, literature on the factors influencing carbon reporting focused on developed countries and only started approaching developing economies recently. Accordingly, Kouloukoui et al. (2018a) stated that few studies considered developing countries when assessing environmental disclosure and especially carbon disclosure and climate risk disclosure.

Additionally, despite the existence of the study made by Rosati and Faria (2019), Izzo et al. (2020) have suggested the necessity of future research on the determinants of SDG disclosure, by recognizing some lack on literature with this regard. Furthermore, literature has not covered the study of the drivers that influence the disclosure of social aspects isolated from the umbrella concept of CSR, CSP or SDGs. The correlation among the level of disclosure of environmental or carbon information and the social disclosure level has not been profoundly



contemplated as well, in spite of the finding that the presence of external assurance, e.g. CDP, drives the disclosure of SDGs in general (Rosati & Faria, 2019).

Considering the revealed gaps, as well as some contradictions identified in past research, that will be further explored, this study will analyze the influence on the level of carbon and social disclosure of the following factors: country of operation, company size, industry sector and CSR engagement. Furthermore, the correlation among carbon and social disclosure will be also investigated.

#### **2.4.1 Country of operation**

Recent research has assessed the influence of the country aspect on CSP and carbon disclosures through many different approaches. Kouloukoui et al. (2018a) have analyzed how the country of origin of the companies listed in the Brazilian stock exchange influence the carbon risk disclosure, and found out that foreign companies disclosed more than national counterparts, given their easier tendency to be subject to public scrutiny. Cassely et al. (2020) have studied the impact of the national economic systems on the CSP of companies in different countries. Córdova Román et al. (2021) have used the United Nations Human Development Index (HDI) to assess how the level of development of the country where a firm is located affects the carbon reporting and management; and discovered that companies established in developing countries reported less carbon emissions, but that the development did not improved the emissions management. Contrastingly, Ali et al. (2017) have approached the development level and pointed out that in developing countries there was a higher influence of external forces, such as foreign investors and customers and international regulatory bodies, on CSR disclosure.

Other authors have studied the influence of the countries' regulatory context in CSP and carbon disclosures. Mateo-Márquez et al. (2019) have stated that the climate change-related regulatory context impacts positively the companies' participation in the CDP questionnaires and the score obtained, arguing that the social expectations generated with the regulations influence corporate behavior towards climate change, that act to avoid scrutiny; what also includes companies that are not subject to such regulations, emphasizing the increase in the practice of voluntary carbon disclosure.

Considering that recently many countries have enlarged their climate-related regulations (Mateo-Márquez et al., 2019), some authors have also studied the correspondent implications. Venturelli et al. (2019) have assessed the state of art of CSP-D in Italy and United Kingdom (UK) before the introduction of the 2014/95 European Union directive on the disclosure non-financial information; and have highlighted the lower quality in the disclosure of environmental and social indicators in Italy compared to the UK, but their improvement in relation to the situation in 2009, the first adoption year of another regulation, the EU Directive 2005/51. Accordingly, Fontana et al. (2015) stated that Italian listed companies had their voluntary environmental disclosure increased with the introduction of the national legislative decree n. 32/2007 that regulated this type of disclosure.

When it comes to SDG reporting, van der Waal and Thijssens (2020) have found out that countries pertaining to the BRICS (Brazil, Russia, India, China, and South Africa) and MINT (Mexico, Indonesia, Nigeria, Turkey), besides the United States, have a considerably lower likelihood to disclose when compared to other groups of countries, like the Continental European ones; which was attributed to the weaker public pressure to promote CSR disclosure, despite the relevance of the sustainable development goals in emerging countries. The Continental Europe presented also the highest level of SDG disclosure in relation to all other analyzed countries (van der Waal & Thijssens, 2020). Contrastingly, Elalfy et al. (2020) have found that companies in Europe and in the Latin America have the highest and equivalent likelihood of including SDG disclosure in their reports. Italian large-capitalized companies have been shown to promote SDG disclosure in a lower level, merely citing the term SDG or generically describing the related actions, without linking them to indicators; in a study of 2018 reports carried out by Izzo, Ciaburri, et al. (2020).

Ferri (2017) studied the influence of the institutional context on sustainability reporting comparing the realities of Italy, Brazil and the United States and argued that, despite companies build their sustainability reports based on international initiatives, they emphasize aspects related to the local institutional pressures. In the case of Italy, CSR is considered to work according to the “Agora model”, in which it is promoted through governmental actions and requires the involvement of political, social and corporate actors; therefore, CSR becomes a manner to be compliant to the regulatory system and aligned with national social requests. This context impacts the information disclosed, that focused on topics associated to specific stakeholders and on human resources, given the important historical role of labor unions. Contrastingly, in the case of Brazil, it is emphasized that some regulations have been

historically promoted, but that they focused mainly on the environmental aspect (e.g. Brazilian National Policy on natural environment and law n. 9,605/98 on environmental crimes), despite the criticality of the societal needs and inequality (education, health and poverty). It is also evidenced that the discourse in Brazil is still under construction, since the responsibility to societal issues was not traditionally approached by companies, but ever more the organizations are being expected to contribute to solutions for societal problems. Considering this evolving institutional context, Brazilian companies are more and more disclosing widespread societal issues, which emphasizes the CSR commitment to societal advancement, especially on environmental conservation and education, given the local scarcity of literacy and the country high-energy profile (Ferri, 2017).

Considering all the beforementioned aspects that can justify the differences on CSP and carbon disclosures among companies operating in different countries, the first set of hypotheses is presented:

H1: The level of carbon disclosure of Brazilian companies is lower than of Italian companies.

H2: The level of social disclosure of Brazilian companies is lower than of Italian companies.

#### **2.4.2 Company size**

Garcia et al. (2020) have identified company size as one of the most important determinants of CSP-D, in a way that large organizations disclosure more CSP information to improve brand visibility and reputation and reduce the probability of attacks from external groups, given their higher vulnerability to speculation and harmful false stories. As explained by the legitimacy theory, big firms have to fulfill the social expectations of a large set of stakeholders and, therefore, disclose more information (Fontana et al., 2015). Accordingly, Rosati and Faria (2019) have found out that large companies have more resources and sensitive brands, so they are more interested in showing their commitment to sustainability frameworks and, more specifically, to the SDGs. Furthermore, according to Fontana et al. (2015), mainstream literature has mentioned company size as one of the main variables that positively influence disclosure, especially regarding environmental aspects; both in developed and developing economies (Córdova Román et al., 2021).

When it comes to carbon disclosure, the larger the company size, the higher the quantity of climate risks present on sustainability reports, the greater the probability of disclosing total carbon emissions, Scope 1 and Scope 2 (Córdova Román et al., 2021) and the higher the participation in CDP and the score obtained (Mateo-Márquez et al., 2019). These results are supported by the socio-political theories and, more specifically, the legitimacy theory (Mateo-Márquez et al., 2019). However, according to Kouloukoui et al. (2018a) some studies have shown a positive relationship and others, a negative relationship among firm size and carbon disclosures.

As regards the disclosure of SDGs, van der Waal and Thijssens (2020) have stated that company size determines the likelihood of disclosing SDGs, but that did not influence the level of such disclosure. Accordingly, Elalfy et al. (2020) have discovered an influence of the size on the probability of the inclusion of SDG in the company's reporting.

Venturelli et al. (2019) have evidenced a correlation among firm size and the quality of non-financial disclosures in Italy. Similarly, Fontana et al. (2015) have found out that large Italian listed companies disclose more environmental information than smaller ones. Furthermore, Jaggi et al. (2018) have demonstrated a positive influence of size and the level of voluntary carbon disclosure in the case of Italian listed companies, which was attributed to the fact that large companies usually perform more activities that can harm the environment and then can be subject to public scrutiny; and can also bear higher costs and allot more resources to the disclosure of carbon information and the reduction of GHG emissions. Accordingly, in the case of Brazil, climate risk disclosure was considered as positively influenced by firm size, in the sense that large companies publicize more information to meet the public expectations (Kouloukoui et al., 2018a).

According to Kouloukoui et al. (2018a), size was contemplated in past studies by measuring the companies' total assets and, in some others, the revenues or the number of employees. In this study, size was proxied by the sales revenue. To test the influence of the size determinant, the following hypotheses were formulated:

H3: Large companies disclose more carbon information than smaller ones.

H4: Large companies disclose more social information than smaller ones.

### **2.4.3 Industry sector**

Cassely et al. (2020) have postulated that, as companies belonging to the same sector face similar challenges, models of CSR and regulations may emerge within it, which put pressure on companies to comply with sectorized standards and to promote convergent CSR practices inside an industry. Accordingly, the industry context has been seen as a determinant of the opportunities for socially responsible behavior and, then, of the particular responses to these opportunities (Rowley & Berman, 2000; as cited in Godfrey et al. 2010). According to Godfrey et al. (2010), industry has been identified as the variable that most explained the different approaches of CSR.

Studies have also stated that there is a relationship among sector of activity and the level of environmental disclosures (Kouloukoui et al., 2018a). High-profile industries, that are those with high regulatory risk, high customer visibility or concentrated and intense competition, usually disclose more social responsibility information (Roberts, 1992; as cited in Kouloukoui et al., 2018a), as well as do companies which operate in socially or environmental sensitive industries (Fontana et al., 2015; Garcia et al., 2020) and those with potentially polluting economic activities (Dierkes & Preston, 1977; as cited in Kouloukoui et al., 2018a). These industries disclose this type of information with the objective of avoiding pressure and criticism (Kouloukoui et al., 2018a), justifying their operations and maintaining legitimacy (Garcia et al., 2020).

Kouloukoui et al. (2018b), in a study of the world's largest companies, found out that corporations in high environmental impact sectors disclose more information on environmental aspects and, consequently, more climate risks. Controversially, Córdova Román et al. (2021) presented contrasting evidence from the literature: carbon-intensive sectors have, to some authors, a positive influence on carbon disclosure and, to others, a negative; and in their own study they have found out that belonging to heavy polluting sectors did not significantly influence carbon reporting.

Regarding SDG disclosure, Elalfy et al. (2020) have stated that industries with higher sustainability impact are more likely to address SDG in their reporting, when compared to those with lower impacts. Contrastingly, Izzo et al. (2020) have discovered no significant effect of industry sector on the SDG disclosure among European companies.

When it comes to Brazil, a study from Kouloukoui et al. (2018a) have evidenced that companies in high impact sectors do not show expressive difference in the level of disclosure of climate risks, when compared to firms in low impact sectors. Contrastingly, as a result of the study of Jaggi et al. (2018), Italian firms belonging to heavy polluting sectors had higher incentives to report carbon information. Regarding environmental information, Fontana et al. (2015) discovered a positive relationship among environmental sensitivity of sectors and disclosure in Italy; and as regards non-financial reporting, Venturelli et al. (2019) evidenced a non-relationship among sector and disclosure practiced by Italian companies.

For testing the impact on the level of disclosure of pertaining or not to highly polluting industries, it was considered both the European Emission Trading System (EU ETS) (Jaggi et al., 2018) and the Brazilian law no. 10.165/2000 (Kouloukoui et al., 2018a). The EU ETS defines as highly polluting industries the ones which generate heat and electricity, commercial aviation industries and energy-intensive industry sectors such as oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals. Such sectors are obliged to report their GHG emissions to the National Authority and the EU Commission (European Commission, 2005). On the other hand, the Brazilian law no. 10.165/2000 defines as highly polluting industries the mining, metal, paper, leather, chemical and transport industries; which are also required to report their activities that are subjected to control and inspection (Presidência da República, 2000). To generalize the definition of highly polluting industries to the whole universe of analysis, and then isolate the industry sector from the country of operation factor, the union of the industry sets provided by the law no. 10.165/2000 and by the EU ETS was considered to classify both Italian and Brazilian companies. Finally, the following hypotheses were also formulated:

H5: Belonging to highly polluting industry sector influence positively the level of carbon disclosure.

H6: Belonging to highly polluting industry sector influence positively the level of social disclosure.

#### 2.4.4 CSR engagement

Some authors have assessed the influence of the engagement of companies with CSR practices on the carbon disclosure and CSP by attributing different proxies. Córdova Román et al. (2021) have utilized the presence of a sustainable committee, the publication of sustainability reports and the external CSR assurance as an approximation for the companies' engagement with CSR, to analyze its influence in the carbon disclosure and management; and discovered positive correlations. Similarly, Orazalin (2020) has assessed the impact of the presence of a sustainability committee on the environmental and social performance of UK listed companies, which was also confirmed and found out to be mediated by CSR strategies.

Additionally, Jaggi et al. (2018) have evidenced the presence of an environmental committee as a positive influence on the disclosure of carbon information by Italian listed companies. Furthermore, as regards developing countries, Córdova et al. (2018) revealed that the presence of sustainability report and sustainability committee impact positively the carbon performance.

Contrastingly, Kouloukoui et al. (2019) have made use of a different approach: the companies' participation in a sustainability index. It was discovered a positive influence of participating in a national sustainability index named ISE (in Portuguese: Índice de Sustentabilidade Empresarial) on the Brazilian companies' climate change management, which demonstrates its relevance as a key instrument to make companies increase their actions towards social, environmental and, more specifically, climate issues. This conclusion reflects the relevance of capital markets' role on climate mitigation and adaptation by creating ISE-like instruments (Kouloukoui et al., 2019).

Adopting a similar approach to this study, the ECPI Emerging Markets ESG Equity Index and the ECPI Euro ESG Equity Index were utilized as a proxy of CSR engagement of Brazilian and Italian companies, respectively; in order to study its influence on the carbon and social disclosures. Therefore, the following hypotheses were formulated:

H7: The participation in a ECPI ESG index influence positively the level of carbon disclosure.

H8: The participation in a ECPI ESG index influence positively the level of social disclosure.

#### **2.4.5 Influence of carbon disclosure in social disclosure**

According to the Intergovernmental Panel on Climate Change (2019), the impacts of global warming fall disproportionately on the most vulnerable people, through the regionally differentiated climate-related risks to food security, water availability, heat exposure and coastal submergence, for example. Therefore, the IPCC (2019) affirms that limiting warming can facilitate the achievement of other aspects of sustainable development and the reduction of inequality. Climate mitigation and adaptation actions that should be carried out to limit warming can have synergies with other sustainable development dimensions – poverty, hunger, health, water and sanitation, cities and ecosystems – or even trade-offs, which highlight the requirement of adopting a systems perspective (IPCC, 2019).

Despite the IPCC (2019) statement on possible synergies among low-carbon attitude and social aspects of sustainable development, the correlation among the level of disclosure of environmental or carbon information on the level of reporting social aspects has not been explored by past research. However, Rosati and Faria (2019) have approached the relation among the CDP and SDGs, pointing out that the presence of external assurance – like CDP – increases the likelihood of the disclosure of SDGs in general. Additionally, Godfrey et al. (2010), by highlighting the possibility of offsetting companies’ “community weaknesses” both through community investments, like philanthropy, or through adopting positive behaviors regarding the natural environment; have suggested this latter relation to be further studied. To test this possible correlation, the final hypothesis was defined as follows:

H9: The companies’ carbon disclosure level influence positively the level of social disclosure.

### **3. OBJECTIVES AND METHODOLOGY**

#### **3.1 OBJECTIVES**

For defining the objectives of this research, it was taken into account the following conclusions from the literature review:



- a) the lack of substantial past research on the determinants of carbon disclosure (Kouloukoui et al., 2018a), especially regarding developing countries (Kouloukoui et al., 2018a; Cordova Román, Zorio-Grima & Merello, 2020); of SDG disclosure (Izzo, Strologo, et al., 2020), of social aspects disclosure decoupled from the umbrella concepts of CSR, CSP or SDG; and on the possible correlation among the level of carbon and social disclosure;
- b) the lack of substantial past research considering the participation in a sustainability index as a proxy for the CSR engagement as a determinant of the level of social or carbon disclosure;
- c) the presence of contradictions on findings associated with some relevant drivers, such as company size and industry sector, on determining the level of social and carbon disclosure.

Therefore, the objectives of this work were defined as:

- a) the investigation of the influence of **country of operation, company size, industry sector and CSR engagement** on the level of **carbon** disclosure;
- b) the investigation of the influence of **country of operation, company size, industry sector and CSR engagement** on the level of **social** disclosure;
- c) the investigation of the influence of the level of **carbon** disclosure on the level of **social** disclosure.

The determinants chosen reflect the interest in studying the influence of both internal or organizational and external or institutional factors on the disclosure levels.

The abovementioned objectives were constrained by the following boundary conditions:

- a) the universe of analysis consisted of the companies that were analyzed by CDP in 2020;
- b) the countries contemplated corresponded to Italy and Brazil;
- c) the sustainability indexes considered were the ECPI Emerging Markets ESG Equity Index and the ECPI Euro ESG Equity Index.

## 3.2 METHODOLOGY

### 3.2.1 Theoretical model

According to Garcia et al. (2020) the vast majority of past research on the determinants of CSP disclosure have made use of multiple regression (73%) and logistic regression (16%) models. Accordingly, on recent research the multivariate linear regression has been largely used to identify the determinants of environmental, carbon and SDG disclosure (Jaggi et al., 2018; Kouloukoui et al., 2018a, 2019; Rosati & Faria, 2018; Fontana et al, 2015; Hossain & Farooque, 2017; Mateo-Márquez, González-González & Zamora-Ramírez, 2019; Pizzi, 2018).

However, the Ordinary Least Squares regression cannot guarantee that its values fall into the unit interval, so it is not appropriate in the case the dependent variable represents a percentage or a proportion, bounded between 0 and 1; which is the case of the disclosure levels. On the other hand, the Logit (logistic regression) method fits the data into the (0,1) interval, but it is required to perform an adjustment in the case the dependent variable assumes the values 0 or 1, since the log-odds ratio is not defined to these values; therefore, it could be problematic if a considerable large percent of data is at the extremes. Such argumentation was put in place in Papke and Wooldridge (1996), with the objective to present a more appropriate method to tackle fractional dependent variables: the Fractional Logistic Model, a robust method with basis on the generalized linear model (GLM) literature from statistics and the quasi-likelihood literature from econometrics.

The Fractional Logistic Model can be applied regardless the distribution assumed by the dependent variable and implies no difficulty to recover the regression function, that are the expected values for the fractional dependent variable, when compared to log-odds type procedures (Papke & Wooldridge, 1996). Papke and Wooldridge (1996) also justify the better suitability of their method compared to the Berkson's minimum chi-square method and the beta distribution approach, in the case there is a considerable amount of data assuming the value 0 or 1. The model has been utilized on recent research of diverse areas, such as environmental science and sociology (Duchanois et al., 2019; Sousa et al., 2020; Wolfe, 2021).

The Papke and Wooldridge (1996) model present as the functional form the following equation:

$$E(y_i | \mathbf{x}_i) = G(\mathbf{x}_i \boldsymbol{\beta}) \quad (\text{Equation 1})$$

that determines the expected value of the dependent variable  $y_i$  conditional to the vector of observations  $\mathbf{x}_i$  that contains the set of independent variables; mediated by the function  $G$  applied to the linear combination  $\mathbf{x}_i \boldsymbol{\beta}$ , in which  $\boldsymbol{\beta}$  is the vector of parameters.

Such equation is usually accompanied by the assumption that  $G$  corresponds to the logistic function, therefore:

$$E(y_i | \mathbf{x}_i) = 1 / [1 + \exp(-\mathbf{x}_i \boldsymbol{\beta})] \quad (\text{Equation 2})$$

To determine the vector of parameters  $\boldsymbol{\beta}$ , the quasi-likelihood function (Equation 3) is maximized (Equation 4), as follows:

$$l_i(\boldsymbol{\beta}) = y_i \log [G(\mathbf{x}_i \boldsymbol{\beta})] + (1 - y_i) \log [1 - G(\mathbf{x}_i \boldsymbol{\beta})] \quad (\text{Equation 3})$$

$$\max_{\boldsymbol{\beta}} \sum_{i=1}^N l_i(\boldsymbol{\beta}) \quad (\text{Equation 4})$$

Under the assumption in Equation 2, it is possible to estimate the parameters in the same manner as in the case of binary logistic regression by maximizing the likelihood function (Liu et al., 2014).

### 3.2.2 Dependent variables

The dependent variables comprised in this study consisted of the level of carbon disclosure and the level of social disclosure. To define the former, it was utilized the CDP Climate Change score obtained by a company, which could assume the values “A”, “A-”, “B”, “B-”, “C”, “C-”, “D”, “D-”, “F”, “Not requested”, “See another”, “Not scored”, “Not available” and “Forthcoming” (CDP, 2021).

In order to determine the level of carbon disclosure (CDL), the scores were transformed into percentages of the highest possible category (“A”), similarly to the procedure used in Kouloukoui et al. (2019). Therefore, “A” was considered as 1, “A-” as 0.875 and so on, thus “D-” represented 0.125 and “F”, zero; as it can be seen on Table 1. Receiving a “F” means that the company failed to provide sufficient information to be evaluated or even did not disclose any information, in the case it was requested to do so, for example, by investors (CDP, 2021).

The companies categorized as “Not requested”, “See another”, “Not scored”, “Not available” and “Forthcoming” were excluded from the analysis since this classification did not fairly represent a zero score.

Table 1 - Correspondence between the CDP Climate Change score, CDP classification and CDL

CDP Climate Change score	CDP Classification	CDL
A	Leadership level	1
A-	Leadership level	0.875
B	Management level	0.750
B-	Management level	0.625
C	Awareness level	0.500
C-	Awareness level	0.375
D	Disclosure level	0.250
D-	Disclosure level	0.125
F	Failure to provide sufficient information	0

Source: the author (2021)

Despite being the scores “D” and “D-” classified as “Disclosure level”, they represented a basic level of disclosure, for example, regarding the reporting of carbon emissions; so higher scores were accompanied by higher-level disclosures. In the case of a company taking the “Awareness level” classification, it must disclose the impacts it generates on the environment and how the environment affects their business activities, which influence the degree of business climate risks. For taking the classification of “Management level”, companies must also report their actions, processes and procedures taken to address these negative impacts, such as efforts to mitigate risks, the implementation of environmental policy and the integration of environmental issues into strategy. Finally, for being classified as in a “Leadership level”, companies must disclose actions considered as the best practices that mark them as leaders. To advance to a higher-level score, companies must also achieve a minimum threshold on the previous levels (CDP, 2021).

As regards the other dependent variable, the level of social disclosure, it was obtained through the assessment of the SDG reporting with focus on the SDGs pertaining to the social pillar (SDGs 1 to 6), as in seen on Figure 2 and discriminated on Table 2.

Table 2 - SDGs pertaining to the social pillar

<b>Social pillar SDGs</b>
SDG 1: No poverty
SDG 2: Zero hunger
SDG 3: Good health and well-being
SDG 4: Quality education
SDG 5: Gender equality
SDG 6: Clean water and sanitation

Source: UN (2021)

The information on the SDGs' disclosure and the correspondent level of detail was obtained through content analysis, the technique most largely utilized to detect information in a text and to analyze CSP and environmental disclosure (Izzo, Strologo, et al., 2020). The content analysis was carried out manually and visually, given that the information on the SDGs could not always be processed by a content analysis software, as stated by Cosma et al. (2020), because it appears in a high frequency in the form of icons instead of words.

The social disclosure level (SDL) was then obtained through the following formula:

$$SDL_i = \sum_{j=1}^6 \frac{SDG_j}{6} \mu_i \quad (\text{Equation 5})$$

$$i = 1, \dots, 226; \mu \in [0.2, 0.4, 0.6, 0.8, 1]$$

where  $\sum_{j=1}^6 \frac{SDG_j}{6}$  corresponded to the fraction between the number of SDGs belonging to the social pillar that were disclosed and the total number of social pillar SDGs; similarly to the procedure adopted by Fontana et al. (2015), Venturelli et al. (2019) and Cosma et al. (2020); and

$\mu_i$  represented the level of social pillar SDGs disclosure, assuming values according to the coding system determined by Beattie et al. (2004) and Beck et al. (2010): 1 - generic/narrative, 2 - narrative with details, 3 - quantitative only, 4 - quantitative/narrative, 5 -

quantitative/narrative/comparative). Therefore, if the disclosure level corresponded to 1,  $\mu_i$  assumed the value of 0.2, meaning 20% of the highest possible level; and so on, thus, when the disclosure level was 5,  $\mu_i$  was 1. The level of disclosure was determined as an average to the whole set of social pillar SDGs and not specifically to each one. The comparative aspect was considered as the report of an information along a time horizon, such as the evolution of an indicator in two consecutive years.

### **3.2.3 Independent variables**

As regards the independent or explanatory variables, they corresponded to the potential determinants of disclosure comprised in the hypotheses presented in the section 2.4: country of operation, company size, industry sector, CSR engagement and carbon disclosure level itself (in the case of the social disclosure level was the dependent variable).

The country of operation and the industry sector were transformed into binary variables assuming the values of (Brazil=0, Italy=1) and (Not highly polluting=0, Highly polluting=1), respectively. Likewise, the CSR engagement variable already presented a binary nature as (Not present on ECPI ESG Index=0, Present on ECPI ESG Index=1), which was maintained in the model. On the other hand, the company size, as it was proxied by the sales revenue, presented a continuous nature, which was also kept in the model. However, given that the magnitude of the values assumed was considerably higher in comparison with the other variables (that were binary), the company size variable was normalized to the range [0,1], which facilitated the implementation and interpretation of the regression model. Finally, as beforementioned, the level of carbon disclosure assumed values inside the interval [0,1]. Such variable played the role of both dependent and independent variable in the present study.

### **3.2.4 Model formulation**

Given that in this study there were two dependent variables to be assessed, the carbon disclosure level and social disclosure level, two different fractional regression models were developed. Model 1 described how the independent variables influenced the disclosure of carbon information and Model 2, of social information.

Therefore, Model 1 contained as independent variables: country of operation (Country), company size (Size), industry sector (Sector) and the CSR engagement (ESG Index); and as dependent variable, the level of carbon disclosure (CDL). On the other hand, Model 2 contained the same explanatory variables as Model 1 and it was also added the carbon disclosure level (CDL) as independent variable; to assess their impact on the level of social disclosure (SDL). Tables 3 and 4 describe all the variables present on the Models 1 and 2, respectively, as well as the expected sign for their correspondent parameters.

Table 3 - Model 1 variables characterization

Variables	Symbol	Sign	Type	Definition
<i>Dependent variable</i>				
<b>Carbon disclosure level</b>	<b>CDL</b>		Fractional	Carbon disclosure level, values from 0 to 1
<i>Independent variables</i>				
<b>Country of operation</b>	<b>Country</b>	+	Binary	If Brazil '0' and if Italy '1'
<b>Company size</b>	<b>Size</b>	+	Continuous	Sales revenue in million euros normalized to [0,1]
<b>Industry sector</b>	<b>Sector</b>	+	Binary	If highly polluting sector '1', otherwise '0'
<b>CSR engagement</b>	<b>ESG Index</b>	+	Binary	If pertain to ECPI ESG Index '1', otherwise '0'

Source: the author (2021)

Table 4 - Model 2 variables characterization

Variables	Symbol	Sign	Type	Definition
<i>Dependent variable</i>				
<b>Social disclosure level</b>	<b>SDL</b>		Fractional	Social disclosure level, values from 0 to 1
<i>Independent variables</i>				
<b>Country of operation</b>	<b>Country</b>	+	Binary	If Brazil '0' and if Italy '1'
<b>Company size</b>	<b>Size</b>	+	Continuous	Sales revenue in million euros normalized to [0,1]
<b>Industry sector</b>	<b>Sector</b>	+	Binary	If highly polluting sector '1', otherwise '0'
<b>CSR engagement</b>	<b>ESG Index</b>	+	Binary	If pertain to ECPI ESG Index '1', otherwise '0'
<b>Carbon disclosure level</b>	<b>CDL</b>		Fractional	Carbon disclosure level, values from 0 to 1

Source: the author (2021)

The linear combination of independent variables  $x_i \beta$  for each model can be written as follows:

$$x_i \beta_{Model 1} = \alpha_1 + \beta_1 Country + \beta_2 Size + \beta_3 Sector + \beta_4 ESG Index \quad (\text{Equation 6})$$

$$x_i \beta_{Model 2} = \alpha_2 + \beta_5 Country + \beta_6 Size + \beta_7 Sector + \beta_8 ESG Index + \beta_9 CDL \quad (\text{Equation 7})$$

### 3.3 DATA COLLECTION AND SAMPLE DEFINITION AND DESCRIPTION

Since the universe of analysis consisted of the set of Brazilian and Italian companies assessed by the CDP in the year of 2020, a database containing the correspondent list of companies, as well as their CDP Climate Change score, industry sector and country of operation, was extracted from the CDP website, accessed on March 3<sup>rd</sup>, 2021. The database contained 282 companies, being 114 Italian and 168 Brazilian. The 18 Italian and 36 Brazilian companies with a score “Not available”, “Not requested”, “Not provided” and “See another” were excluded from the sample.

As the company size was determined with sales revenue as the proxy, this information was collected either from the Milan or the Sao Paulo stock exchange websites, in the case of listed companies and when such information was available; otherwise, from the enterprises’ annual report obtained on their correspondent website. Both the stock exchange and the companies’ websites were accessed in April, 2021. The majority of the sales revenue data was referred to the fiscal year of 2020, otherwise from the closest year with available financial information. Given the presence of different currencies, Real was converted to Euro according to the average exchange rate for 2020: 5.89. Two Brazilian companies had to be eliminated from the set, given the impossibility of obtaining their corresponding sales revenue. Therefore, the final dataset contained 226 companies: 96 Italian and 130 Brazilian.

Despite the CDP database provided the industry sector the companies operate in, it contained a very representative number of generalized values (Table 5), therefore it was necessary to collect data from another source. Being 88% of the Italian companies listed in the Milan stock exchange and 94% of the Brazilian companies, in the Sao Paulo stock exchange, such information was obtained directly from the respective stock exchanges’ websites as the correspondent sub-sectors. To the small number of non-listed companies, the data on the industry sector was obtained from the CDP database itself.



Table 5 - Sample sector distribution according to CDP classification

Industry sector	Brazilian companies		Italian companies	
	Number of companies	Percentage	Number of companies	Percentage
General	45	34.6%	47	49.0%
Financial services	18	13.8%	19	19.8%
Electric utilities	19	14.6%	6	6.3%
Transport OEMS	3	2.3%	6	6.3%
Transport services	6	4.6%	2	2.1%
Real estate	7	5.4%	1	1.0%
Food, beverage & tobacco	6	4.6%	2	2.1%
Capital goods	0	0.0%	7	7.3%
Agricultural commodities	4	3.1%	1	1.0%
Oil & gas	4	3.1%	1	1.0%
Paper & forestry	4	3.1%	1	1.0%
Metals & mining	4	3.1%	0	0.0%
Steel	4	3.1%	0	0.0%
Construction	3	2.3%	0	0.0%
Cement	1	0.8%	2	2.1%
Chemicals	2	1.5%	1	1.0%
total	130	100%	96	100%

Source: the author (2021)

The industry sectors were classified as highly polluting and not highly polluting (Table 6) as explained in the section 2.4.3, according to the definitions provided by the law no. 10.165/2000 and the EU ETS, obtained from their respective websites. Among the Brazilian companies, 48 were classified as highly polluting (36.9%) and 16 Italian companies (29.2%) took this classification, so 29.2% of the whole dataset pertained to highly polluting sectors. Such sectors were in the majority from the electric energy and utilities (48.5%), transport (16.7%) and metal and mining (13.6%) sectors, but also from oil and gas (7.6%), paper (7.6%), chemicals (4.5%) and cement (1.5%) industries (Table 7).

Table 6 - Sample sector distribution according to pollution level

Industry sector	Brazilian companies		Italian companies		Total	
	Number of companies	Percentage	Number of companies	Percentage	Number of companies	Percentage
Highly polluting	48	36.9%	18	18.8%	66	29.2%
Not highly polluting	82	63.1%	78	81.2%	160	70.8%
total	130	100.0%	96	100.0%	226	100.0%

Source: the author (2021)

Table 7 - Sample highly polluting sectors distribution

Industry sector	Number of companies	Percentage
Electric energy and utilities	32	48.5%
Transport	11	16.7%
Metal and mining	9	13.6%
Oil and gas	5	7.6%
Paper	5	7.6%
Chemicals	3	4.5%
Cement	1	1.5%
total	66	100%

Source: the author (2021)

Additionally, the lists of companies participating in the sustainability indexes ECPI Euro ESG Equity and ECPI Emerging Markets ESG Equity were obtained from the ECPI website. Despite being the Dow Jones Sustainability Index (DJSI) considered as one of the best indices to measure sustainability performance of businesses (Beloe, Scherer, & Knoepfel, 2004; López, Garcia, & Rodriguez, 2007; Miska, Szocs, & Schiffinger, 2018, as cited in Murillo-Avalos et al., 2021), the sample of Brazilian (7) and Italian (15) companies contemplated by it was insufficient. On the other side, other global sustainability indexes, like the FTSE4Good All-World contained a larger set (23 Italian and 57 Brazilian companies for the case of FTSE4Good All-World), but the list of companies which make part of it was not disclosed publicly. Therefore, it was utilized a composition of two different indexes, one for the case of Brazilian and the other for Italian companies. However, to guarantee the highest possible homogeneity in the factors considered to determine such indexes, it was selected indexes from the same provider, ECPI. Among the Italian companies, 28 participated in the ECPI Euro ESG Equity index (29.2%) and among the Brazilian ones, 70 were present on the and ECPI Emerging Markets ESG Equity index (53.9%), as it can be seen on Table 8.

Table 8 - Percentage of companies in the sample constituent of ECPI ESG Indexes

Index	Number of companies in the sample	Percentage
ECPI Euro ESG Equity	28	29.2% (out of Italian companies)
ECPI Emerging Markets ESG Equity	70	53.9% (out of Brazilian companies)

Source: the author (2021)

Finally, in order to calculate the level of disclosure of SDGs, it was collected the companies' GRI reports from the GRI database and, when not available, their sustainability reports, non-financial statements or integrated reports on companies' own websites. In the case

it was already released by the company, the correspondent 2020 report was collected, otherwise, it was utilized the 2019 version. The access to the GRI and the companies' websites was done on March 26<sup>th</sup>, 2021.

The GRI database did not contain any report for 2020 and only less than 20% for 2019 (Table 9), besides, 38.5% of Brazilian and 43.8% of Italian companies were not even present on it. On the contrary, the companies' websites provided more updated reports (Table 10), so 70% of Brazilian and 88.5% of Italian companies published a sustainability report or equivalent for the years of 2020 or 2019. Therefore, around 17% of Brazilian and of Italian companies were analyzed according to a report published on the GRI database; 52.3% of Brazilian and 73% of Italian companies, based on a report published on their respective websites; and 30.8% of Brazilian and 10.4% of Italian companies could not be analyzed in terms of social disclosure, since they did not provide any sustainability report or equivalent for the years of 2019 or 2020 (Table 11).

Table 9 - Statistics on the reports collected from GRI database

Year	Brazilian companies		Italian companies	
	Number of companies	Percentage	Number of companies	Percentage
2019	24	17.7%	19	19.8%
2018	36	27.7%	7	7.3%
2017	6	4.6%	15	15.6%
2016	8	6.2%	11	11.5%
2015 or before	6	4.6%	2	2.1%
Not present	50	38.5%	42	43.8%
total	130	100%	96	100%

Source: the author (2021)

Table 10 - Statistics on the reports collected from companies' websites

Year	Brazilian companies		Italian companies	
	Number of companies	Percentage	Number of companies	Percentage
2020	6	4.6%	10	10.4%
2019	85	65.4%	75	78.1%
2018 or before	14	10.8%	3	3.1%
Not present	26	20%	8	8.3%
total	130	100%	96	100%

Source: the author (2021)

Table 11 - Sample distribution of reports according to the source

Source of report	Brazilian companies		Italian companies	
	Number of companies	Percentage	Number of companies	Percentage
GRI database	22	16.9%	16	16.7%
Company website	68	52.3%	70	72.9%
Not available	40	30.8%	10	10.4%
total	130	100%	96	100%

Source: the author (2021)

### 3.4 DATA ANALYSIS

The data collected was primarily analyzed through descriptive statistics and, afterwards, it was performed a univariate analysis by using the Pearson correlation method followed by the determination of the Variance Inflation Factor. Then, as aforementioned, the influence of the determinants of disclosure was assessed through the Papke and Wooldridge (1996) Fractional Logistic Regression method. Within this analysis, it was performed a t-student hypothesis test on the significance of the coefficients and a sensitivity analysis through marginal effects. It was utilized different confidence levels of 90%, 95% and 99%; and the minimum acceptable confidence level was determined as 95%.

Such analyses were carried out using both the SAS software and the Pandas package of Python programming language, in order to validate the results obtained. The implementation of Fractional Logistic Model on SAS was based on the paper developed by Liu et al. (2014) and on the content provided by the SAS support online platform.

## 4. RESULTS AND DISCUSSION

### 4.1 DESCRIPTIVE STATISTICS RESULTS

In addition to the final dataset characterization already presented in the section 3.3, the independent and dependent variables were assessed through descriptive statistics. Initially, it was calculated the mean, standard deviation, median, minimum and maximum values and skewness for the whole set of variables (Table 12).

Table 12 - Variables descriptive statistics

Variables	Mean	Std. Dev.	Min	Median	Max	Skewness
Country	0.42	0.50	0	0	1	0.31
Size	0.04	0.11	0	0.01	1	5.74
Sector	0.29	0.46	0	0	1	0.92
ESG Index	0.43	0.50	0	0	1	0.27
CDL	0.36	0.38	0	0.25	1	0.32
SDL	0.26	0.33	0	0.10	1	1.06

Source: the author (2021)

As regards the binary variables, the medians were all equal to zero, which showed that the companies were in majority Brazilian (Country=0), from not highly polluting sectors (Sector=0) and not present on an ECPI ESG Index (ESG Index=0), which is in line with the sample characterization provided in section 3.3. The mean demonstrated the distribution of 0s and 1s and allowed understanding how much the companies taking a 0 exceed the ones taking a 1. Therefore, the variables Country (0.42) and ESG Index (0.43) were more balanced, while the Sector showed a higher number of companies pertaining to not highly polluting sectors (0.29). Accordingly, the skewness confirmed this behavior, since for Country (0.31) and ESG Index (0.27) it assumed a value closer to zero in comparison to Sector, which presented a higher value (0.92).

In the case of the numerical variable Size, the median assumed the value of 0.01 and the mean, 0.04, showing that the majority of values were situated very near zero. The significantly high skewness (5.74) showed that the curve was very asymmetric, right-skewed with a long tail to the right. This means that few companies had a considerably higher revenue in comparison to the others, being the latter concentrated near zero. This can be explained by the presence of heterogeneous companies in terms of size (proxied by the revenues) in the set analyzed by the CDP: some of them were listed in indexes of large-capitalization companies (for example the FTSE MIB Index of the Milan stock exchange), while others were not even listed.

Regarding the dependent variables, the carbon disclosure level (CDL) assumed an overall average of 0.36 and the social disclosure level (SDL), the value of 0.26; **which means that the average company disclosed less than half of the maximum it could have disclosed both in terms of carbon and social aspects.** However, since the standard deviations were considerably high (0.38 for the CDL and 0.26 for the SDL), it reflected the CDL and SDL values attributed to different companies varied expressively. In both cases the median assumed a value that is lower than the average and a positive skewness, showing that the curves were right-skewed. However, given the smaller value for the average and the median and the

considerably higher for the skewness, the SDL presented a curve more concentrated on the left with a longer tail to the right, in comparison to the CDL. Therefore, it can be concluded that **the overall level of carbon disclosure was higher than the level of disclosure of social aspects.**

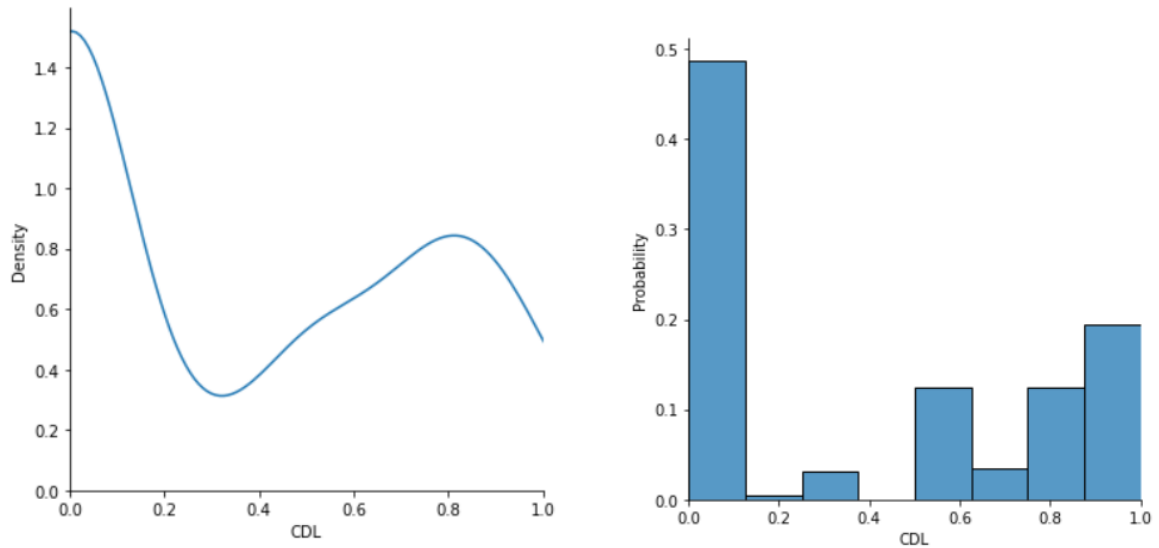
To better understand the distribution of the variable CDL, it was also determined the number and the percentage of companies that took each Climate Change score on the CDP assessment (Table 13). The presence of a considerably **high number of companies with a CDP score “F” (48.7%)**, and then a CDL equal to zero, reinforces the importance of the choice of a method (Fractional Logistic Method) that comprehended the extreme values, zero and one, assumed by the dependent variable. It can be seen that almost half of the sample, both in the case of Italian and Brazilian companies, took a “F” score and the other **half presented at least a minimum level of carbon information disclosure** (at least a “D-” score). Contrastingly, the other extreme, that corresponds to the **maximum score “A”, comprises very few companies (5.3% overall), which make part of the CDP A List** (CDP, 2021). Furthermore, it is possible to observe that the distribution contained two different modes or peaks: the first one around the “A-” and “B” score and the second, on the “F” score. This bimodal character of the distribution can be better illustrated on the graph and the histogram presented on Figure 7, representing, respectively, probability density and the probability of CDL. Finally, it can also be concluded, from Table 13, that **the Brazilian companies presented a relatively lower carbon disclosure level than the Italian ones.**

Table 13 - Sample distribution of CDP Climate Change score

CDP Climate Change score	Brazilian companies		Italian companies		Total	
	Number of companies	Percentage	Number of companies	Percentage	Number of companies	Percentage
A	4	3.1%	8	8.3%	12	5.3%
A-	15	11.5%	17	17.7%	32	14.2%
B	15	11.5%	13	13.5%	28	12.4%
B-	5	3.9%	3	3.1%	8	3.5%
C	22	16.9%	6	6.3%	28	12.4%
C-	0	0%	0	0%	0	0%
D	3	2.3%	4	4.2%	7	3.1%
D-	1	0.7%	0	0%	1	0.4%
F	65	50.0%	45	46.9%	110	48.7%

Source: the author (2021)

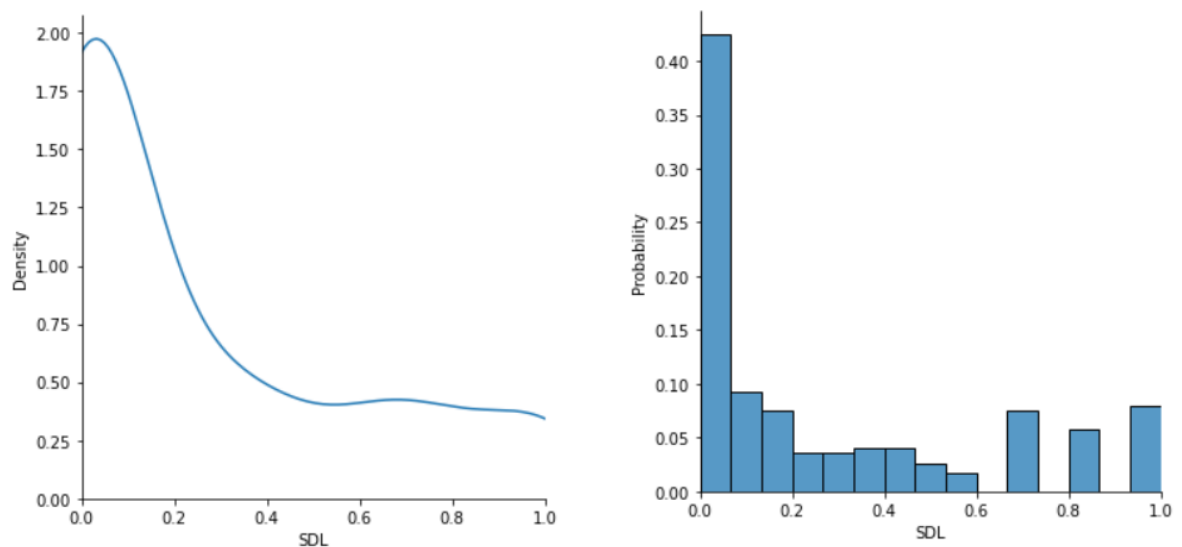
Figure 7 – Distribution of CDL



Source: the author (2021)

Additionally, the probability density and the probability distributions for the dependent variable SDL was also plotted, as presented on Figure 8. Such distribution can be understood as an exponential decay until the value 0.5, from which it becomes approximately flat. As expected with the beforementioned analysis, the vast majority of companies presented a low level of social aspects disclosure.

Figure 8 – Distribution of SDL



Source: the author (2021)

Since the social disclosure level (SDL) comprehended many aspects, the discrimination of the companies reporting on SDGs by each SDG, including also the ones that do not make part of the social pillar, was illustrated on Table 14. The SDG 8 “Decent work and economic growth” was the most reported one for both Italian (59.4%) and Brazilian (56.9%) companies and overall (58%) and was present in more than half of the reports. In addition, **the SDG 13 “Climate action” was the second most disclosed SDG, considering the whole sample (52.2%), and was also present on approximately half of the reports**, which goes in line with the fact that half of the companies took at least a “D-” CDP score.

When it comes to the SDGs pertaining to the social pillar (SDGs 1 to 6) and considering the whole sample, no one was present in more than 50% of the reports. **The most disclosed one was SDG 5 “Gender equality”, reported for 48.7% of the companies, followed by SDGs 3 “Good health and well-being” and 4 “Quality education”, both present in 46.9% of the reports. SDGs 6 “Clean water and sanitation” (30.5%), 1 “No poverty” (26.1%) and 2 “Zero hunger” (23%) were the least disclosed SDGs.** The same trend was observed when analyzing the Brazilian and Italian companies separately. However, a higher percentage of Brazilian companies reported the SDGs 1, 2 and 6 and a higher percentage of the Italian ones disclosed the SDGs 4 and 5. The SDG 3 was present in the same proportion among Italian and Brazilian companies.

Table 14 - Disclosure frequency of each SDG

SDG	Brazilian companies		Italian companies		Total	
	Number of companies	Percentage	Number of companies	Percentage	Number of companies	Percentage
SDG 1	41	31.5%	18	18.8%	59	26.1%
SDG 2	41	31.5%	11	11.5%	52	23.0%
SDG 3	61	46.9%	45	46.9%	106	46.9%
SDG 4	59	45.4%	47	49.0%	106	46.9%
SDG 5	61	46.9%	49	51.0%	110	48.7%
SDG 6	51	39.2%	18	18.8%	69	30.5%
SDG 7	60	46.2%	47	49.0%	107	47.3%
SDG 8	74	56.9%	57	59.4%	131	58.0%
SDG 9	59	45.4%	45	46.9%	104	46.0%
SDG 10	54	41.5%	28	29.2%	82	36.3%
SDG 11	53	40.8%	39	40.6%	92	40.7%
SDG 12	65	50.0%	51	53.1%	116	51.3%
SDG 13	64	49.2%	54	56.3%	118	52.2%
SDG 14	41	31.5%	12	12.5%	53	23.5%
SDG 15	49	37.7%	17	17.7%	66	29.2%
SDG 16	63	48.5%	26	27.1%	89	39.4%
SDG 17	39	30.0%	31	32.3%	70	31.0%

Source: the author (2021)



As regards the level of detail that also compounded the SDL, its distribution was determined as illustrated on Table 15. The companies that either did not provide a sustainability report (or equivalent) or did not disclose any SDG on their report took a zero level of detail, which corresponded to 38.1% of the cases. Among these, seven companies that took the zero score actually mentioned the term “Sustainable Development Goals” or “SDG”, but did not present which goals they were committed to.

**Among the ones that did report on SDGs, the majority surprisingly provided a full level of detail** (23.9% of the whole sample) presenting a narrative description, a quantification and a temporal comparative analysis. **Contrastingly, 16.8% of companies presented only a generic or narrative description** of the SDGs reported. Among these, more than half only stated the SDGs which they were committed to, without providing any further explanation or description. Almost the same percentage of companies provided a narrative with details (9.7%) or a narrative accompanied by a quantification (11.1%) and only one company presented just a quantification without any narrative. A similar distribution was obtained when analyzing separately the Brazilian and Italian companies.

Table 15 - Frequency of the level of detail of SDG disclosure

Level of detail	Brazilian companies		Italian companies		Total	
	Number of companies	Percentage	Number of companies	Percentage	Number of companies	Percentage
0 - No disclosure	54	41.5%	32	33.3%	86	38.1%
1 - Generic/narrative	19	14.6%	19	19.8%	38	16.8%
2 - Narrative with details	10	7.7%	12	12.5%	22	9.7%
3 - Quantitative only	0	0%	1	1.04%	1	0.4%
4 - Quantitative/narrative	13	10%	12	12.5%	25	11.1%
5 - Quantitative/narrative/comparative	34	26.2%	20	20.8%	54	23.9%

Source: the author (2021)

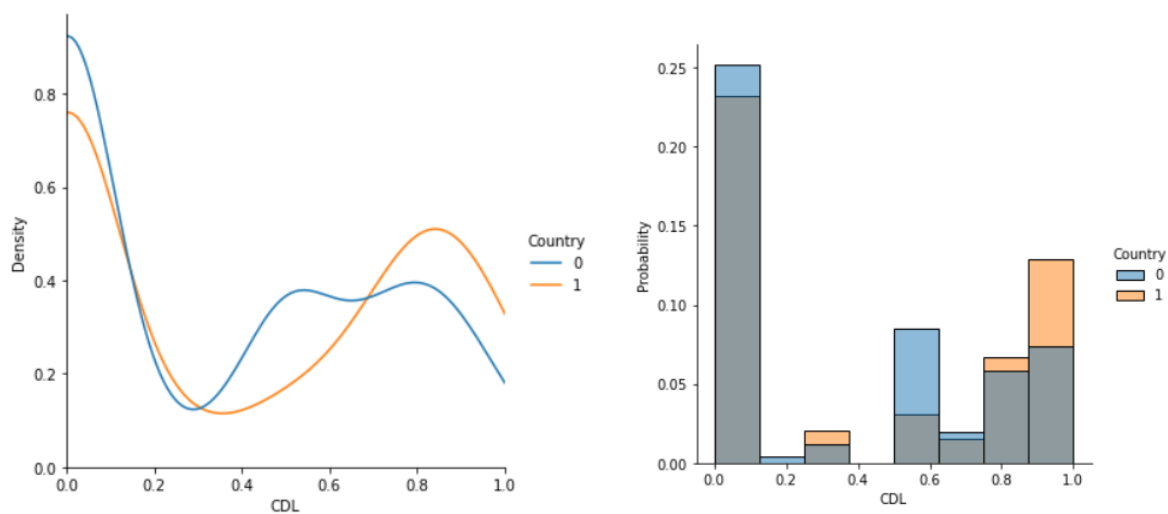
## 4.2 UNIVARIATE ANALYSIS RESULTS

An initial graphical analysis was carried out to help understanding the impact of the binary independent variables on the dependent ones. To perform each analysis, the original sample was segmented in two different subsamples: one for the companies to which the explanatory variable assumed the value 0 and the other, the value 1. With the objective of

carrying out a fair comparison, the imbalance present on the sample was compensated by replicating some observations, through the application of an oversampling procedure. In the case of the variable Country, for example, 130 companies were Brazilian and 96 Italian, so to provide a proper comparison the sub database of Italian companies was considered four times (384 observations) and the Brazilian, three times (390 observations) on the database utilized for the analysis. An analog procedure was done for the case of the variables Sector and ESG Index. Since the CDL variable assumed only a few values inside the interval [0,1], it was plotted both its probability, by extrapolating it to a continuous variable, and its probability density, to provide a better understanding of its distribution.

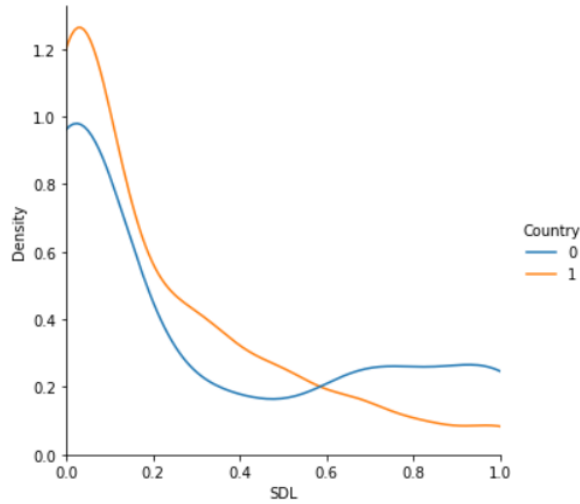
In the case of the variable Country, it could be seen that the distributions illustrated a relative divergence. While the Brazilian companies (Country=0) presented a higher probability of taking a value of CDL around 0.5 (CDP Climate Change score “C”) in relation to the Italian ones (Country=1), these showed a higher probability of having a CDL from 0.7 to 1 (Figure 9). For both countries the value of CDL with the highest probability was 0 (CDP Climate Change score “F”). On the other side, the Brazilian companies showed a higher level of disclosure of social aspects, since they presented a lower probability of having scores under than 0.6 and a higher probability of values up to this threshold, when compared with the Italian companies (Figure 10).

Figure 9 – Distribution of CDL by country



Source: the author (2021)

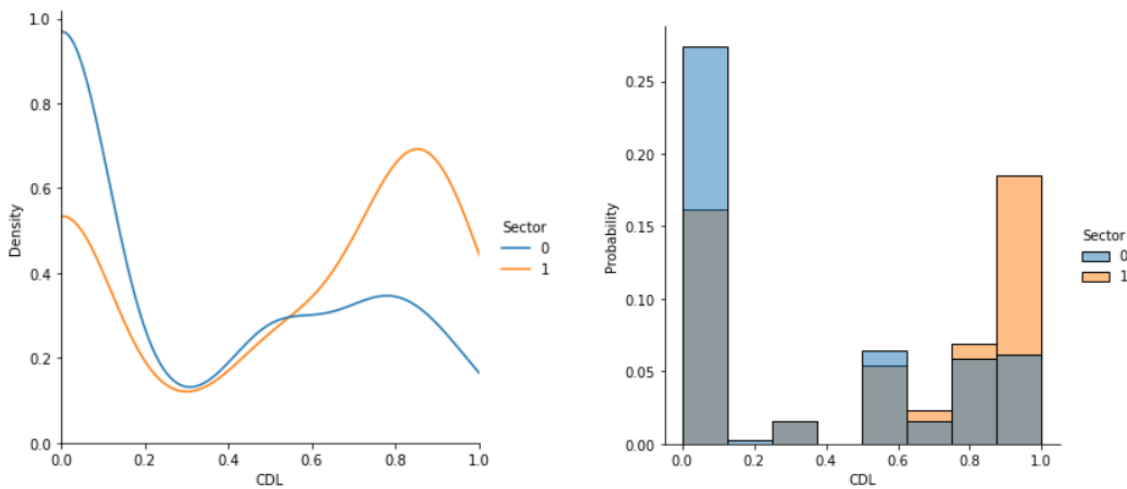
Figure 10 - Distribution of SDL by country



Source: the author (2021)

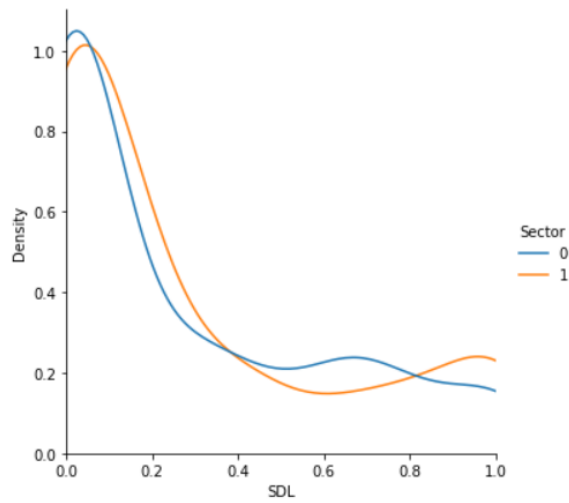
As regards the variable Sector, it could be identified an expressive difference among the distributions of the CDL (Figure 11). The companies that make part of highly polluting sectors (Sector=1) presented a considerably higher incidence for the upper values of CDL and a lower probability for values less than 0.6. When it comes to the SDL, the variable Sector did not seem to present a considerable influence, which can be concluded from the proximity of the curves and the presence of three intersection points (Figure 12).

Figure 11 – Distribution of CDL by sector



Source: the author (2021)

Figure 12 - Distribution of SDL by sector



Source: the author (2021)

An additional analysis was performed to capture the values assumed by the CDL for the different sectors classified as highly polluting (Table 16). It can be observed that the sector “Cement” provided the highest level of carbon disclosure (0.88), followed by “Paper” (0.68) and “Oil and gas” (0.60). The sectors “Electric energy and utilities” and “Transport” presented a value for the CDL near 50%. Finally, “Metals and mining” and “Chemicals” sectors showed the lowest values of CDL, 0.38 and 0.29, respectively. However, since the sample of companies pertaining to some sectors was relatively small, especially for “Cement” and “Chemicals”, the results could difficultly be generalized.

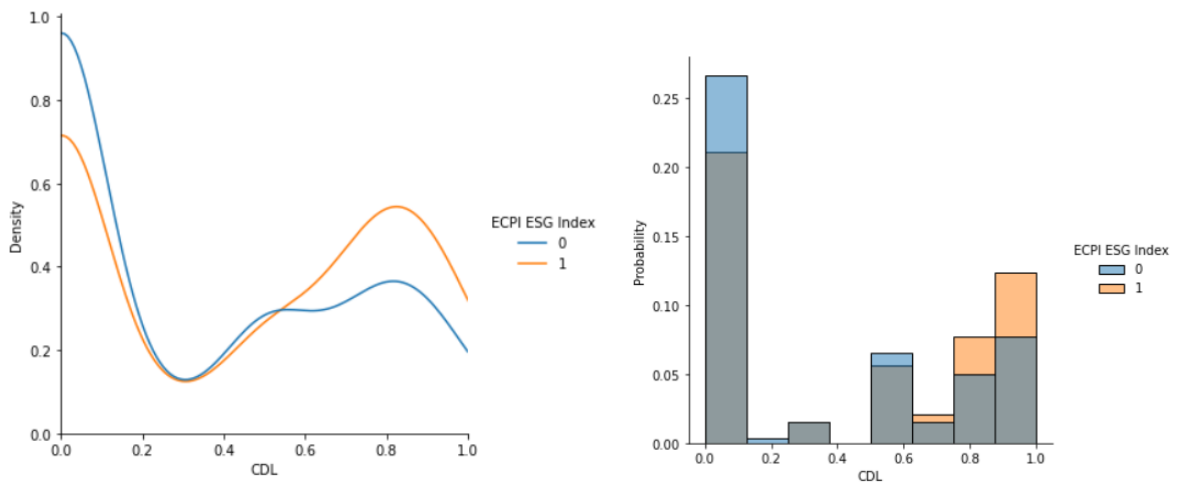
Table 16 - Average CDL by each highly polluting sector

Industry sector	Number of companies	Average CDL
Electric energy and utilities	32	0.54
Transport	11	0.52
Metal and mining	9	0.38
Oil and gas	5	0.60
Paper	5	0.68
Chemicals	3	0.29
Cement	1	0.88

Source: the author (2021)

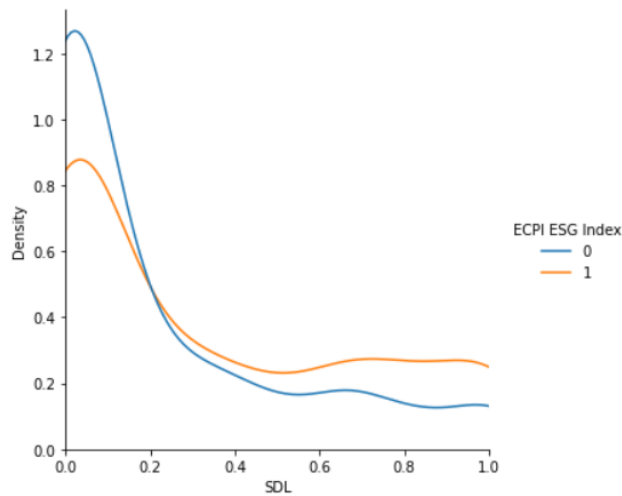
Finally, for the variable ESG Index, it could be perceived a relative difference on the CDL and SDL curves (Figures 13 and 14). The companies participating on such sustainability indexes (ESG Index=1) presented a higher level of disclosure of both carbon and social aspects, since their distribution surpassed the one for the companies that did not participate (ESG Index=0) for the highest levels of disclosure, and had a lower probability of taking smaller values of CDL and SDL.

Figure 13 - Distribution of CDL according to the presence or not on ECPI ESG Index



Source: the author (2021)

Figure 14 - Distribution of SDL according to the presence or not on ECPI ESG Index



Source: the author (2021)

For all the considered CDL and SDL distribution plots, it was possible to recognize their similarity with the overall distribution curves presented on Figures 7 and 8, what made it evident that the divergence on the CDL and SDL distributions for different values assumed by the binary variables was not so abrupt.

Afterwards, the pairwise collinearity among the variables was calculated through the Pearson correlation method (Table 17), which is more recommended in the presence of both binary and numerical variables (Orazalin, 2020; Tibiletti et al., 2020). In the case of CDL as the dependent variable, the highest correlation among the independent variables assumed the value of 0.25 in module; and in the case of SDL, the biggest value was 0.33. These results mean that the independent variables were not strongly correlated and all of them could be comprised in the Functional Regression models without offering any risk to the analysis. Additionally, the Variance Inflation Factor was calculated to account for a potential multicollinearity among two or more explanatory variables. The results showed a value between one and two for all variables, except for the CDL, that presented a value between two and three. Since all values were lower than defined threshold of five, it could be concluded that there was no statistically significant multicollinearity among the independent variables.

As regards the pairwise correlation among the independent and dependent variables (Table 17), it presented a low to moderate effect. The variable Size demonstrated the highest correlation both with the CDL (0.33) and the SDL (0.34). Such correlation was positive, therefore, the higher the size, the higher the disclosure levels. In addition, Sector showed a considerable positive correlation with the CDL, but almost no correlation with the SDL, meaning that the companies pertaining to highly polluting sectors disclosed more carbon information but it did not seem to impact the level of disclosure of social aspects. Finally, the level of carbon disclosure showed to be significantly correlated with the level of disclosure of social aspects (0.32). The variables Country and ESG Index, however, did not show an expressive collinearity with the dependent variables.

Table 17 - Pairwise collinearity through Pearson correlation method

<b>Variables</b>	<b>Country</b>	<b>Size</b>	<b>Sector</b>	<b>ESG Index</b>	<b>CDL</b>	<b>SDL</b>
<b>Country</b>	1					
<b>Size</b>	0.08	1				
<b>Sector</b>	-0.2	0.15	1			
<b>ESG Index</b>	-0.25	0.14	0.09	1		
<b>CDL</b>	0.09	0.33	0.27	0.15	1	
<b>SDL</b>	-0.13	0.34	0.02	0.18	0.32	1

Source: the author (2021)

### 4.3 MULTIVARIATE ANALYSIS RESULTS

A multivariate analysis was performed by the application of the Fractional Logistic Method on the models previously described in the section 3. The results contained the regression parameters and the marginal effect obtained for each variable, as well as their robust standard error and statistical significance, determined through a test of hypothesis with confidence levels of 90%, 95% and 99%. It was utilized a standard error robust to heteroscedasticity, that consists of the non-constant behavior observed for the standard errors (White, 1980).

The hypothesis test on the significance of the parameters had as the null hypothesis the inclusion of zero inside their confidence interval for a determined confidence level. Therefore, if the interval included both negative and positive values, the null hypothesis was confirmed and it was not possible to take any conclusion on the positive or negative influence of an independent variable on a dependent one.

The concept of marginal effect utilized consisted of the partial derivative of a dependent variable in relation to an independent one, that is how much the dependent variable changes with an increment on the independent one, letting the other explanatory variables assume a constant value, usually their average. Marginal effect is computed differently for binary and continuous variables. In the case of binary variables, it refers to the discrete change, that is how much a dependent variable would change if the independent one changed from 0 to 1, which provides a right-away interpretation. For continuous variables, however, it constitutes the instantaneous rate of change, which does not involve the unitary change in the independent variable (Long & Freese, 2001). The application of this concept allowed carrying out a sensitivity analysis.

Table 18 illustrates the results obtained for the regression parameters and their correspondent robust standard error (on parenthesis) and statistical significance at different confidence levels, for both Model 1 and 2. The results for the Model 1 indicated that all the independent variables **Country, Size, Sector and ESG Index were positively correlated with the CDL**. However, while the variables Country, Size and Sector were proved to be statistically significant at a confidence level of 99%, the variable ESG Index was significant only at a confidence level of 90%.

This result means that **Italian companies (Country=1) disclosed more carbon information than Brazilian ones (Country=0), as expected by the hypothesis H1**, which is

confirmed. In addition, **larger companies disclosed more carbon information than those that are smaller, which made the hypothesis H3 accepted as well.** Finally, **companies that make part of highly polluting sectors (Sector=1) also disclosed more carbon information than the ones that belong to sectors that pollute less (Sector=0), confirming the hypothesis H5.** Contrastingly, since it was formerly established the acceptance of a minimum confidence level of 95%, the **hypothesis H7 regarding the positive influence of the ESG Index was not confirmed.**

In the case of the Model 2, **the variables Country, Sector, Size and CDL were proven to influence the dependent variable SDL.** With a confidence level of 99%, the variable **Country presented a negative correlation with the SDL and the variables Size and CDL, a positive correlation.** Additionally, **the variable Sector presented a negative correlation with SDL, with a level of confidence of 95%.**

This means that, opposingly to what was observed for the carbon disclosure, **Brazilian companies (Country=0) disclosed more social information than Italian ones (Country=1), which made the hypothesis H2 rejected.** As for the CDL, **larger companies disclosed more social information than smaller ones, confirming the hypothesis H4.** Surprisingly, **the companies' participation to highly polluting sectors proved to reduce the disclosure of social aspects in comparison to those that are less polluting, so the hypothesis H6 was rejected.** Furthermore, **the level of disclosure of carbon information influenced positively the disclosure of social aspects, so the final hypothesis H9 was also confirmed.**

Additionally, **the presence on a ECPI ESG Index could not be concluded to influence the level of disclosure of social information at any considered confidence level;** therefore, **the hypothesis H8 could not be accepted.**

Table 18 - Models 1 and 2 results for the regression parameters at different confidence levels

	Model 1	Model 2
Country	0.6473*** (0.245)	-0.7348*** (0.248)
Size	10.0731*** (2.777)	4.1688*** (1.157)
Sector	1.0558*** (0.254)	-0.5277** (0.252)
ESG Index	0.4577* (0.239)	0.2667 (0.241)
CDL	-	1.2895*** (0.328)

Note. \*Significant at 10% level; \*\*Significant at 5% level; \*\*\*Significant at 1% level.

Source: the author (2021)



Analog to the case of the regression parameters, Table 19 expresses the results obtained for the marginal effects of the binary variables, as well as their correspondent robust standard error (on parenthesis) and statistical significance at different confidence levels, for Models 1 and 2. Coherently with the previous results (Table 18), the confidence levels at which the variables achieved their significance was perfectly matched with those obtained for the marginal effects.

In the case of Model 1, it can be observed that changing the value of the binary variables Country and Sector from 0 to 1 promoted a positive increase in the value of the CDL, of respectively 0.15 and 0.25. As for the variable Size, the marginal effect assumed a value that is higher than one, which is plausible since the variable is not binary but continuous and the definition of marginal effect in this case is diverse. Therefore, a non-unitary change “x” in Size would promote a change in CDL of “x” times the marginal effect (or slope), which may result in a value lower than one. In addition, the expected value for the marginal effect did not correspond to the value assumed by the partial derivative at every point on the curve, since there is the presence of a standard error, which in the case is also considerably high.

When it comes to the Model 2, the variables Country and Sector presented a negative marginal effect of 0.14 and 0.10, respectively, which meant that when their value was changed from 0 to 1, the SDL had a decrement. Opposingly, since the variable CDL had positive marginal effect of 0.24, it promoted an increase in the value of SDL when its value changed from 0 to 1. In addition, the continuous variable Size also provided a positive marginal effect.

Lastly, despite the statistical influence proved for some independent variables on the value assumed by the dependent ones, the assessment of the marginal effects allowed to recognize that such impact presented a low magnitude.

Table 19 - Models 1 and 2 results for the marginal effects at different confidence levels

	<b>Model 1</b>	<b>Model 2</b>
<b>Country</b>	0.1515*** (0.057)	-0.1352*** (0.047)
<b>Size</b>	2.3570*** (0.678)	0.7671*** (0.219)
<b>Sector</b>	0.2470*** (0.060)	-0.0971** (0.047)
<b>ESG Index</b>	0.1071* (0.055)	0.0491 (0.044)
<b>CDL</b>	-	0.2373*** (0.059)

Note. \*Significant at 10% level; \*\*Significant at 5% level; \*\*\*Significant at 1% level.

Source: the author (2021)

#### 4.4 DISCUSSION

The first obtained result comprised the influence of the **country of operation** on the level of social and carbon disclosures. **On one hand, Italian companies presented a higher level of disclosure of carbon information than Brazilian ones. On the other, Brazilian companies showed a higher disclosure level of social SDGs in comparison with the Italian.** Therefore, the hypothesis H1 was confirmed and H2 was rejected. Such result for H1 is aligned with Córdova Román et al. (2021), that proved that companies located in developing countries disclosed less carbon emissions. It is also supported by the work of Mateo-Márquez et al. (2019), that showed that the climate change-related regulatory context acts to increase companies' participation and score on CDP questionnaires; and Venturelli et al. (2019) and Fontana et al. (2015), that observed an increase on the disclosure of environmental indicators in Italy after the implementation of the EU Directive 2005/51 and the national legislative decree n. 32/2007, respectively. In fact, Italy has ever more been involved in some national and supranational EU initiatives and policies, like the Europe 2020 strategy, that aimed at advancing the economy through a “smart, sustainable and inclusive growth” and included reducing GHG emissions in 20% until 2020, compared to 1990 levels (European Commission, 2010); the European Green Deal, that has the objective of making Europe the world's first climate-neutral continent by 2050 (European Commission, 2019); and the Taxonomy Regulation, that determined a new EU taxonomy for the classification of environmentally sustainable economic activities and promote finance for sustainable development (European Commission, 2020). Such a structured policy scenario is not observed in the case of Brazil, despite the participation of the country on the Kyoto Protocol, Copenhagen Agreement and Paris Agreement (Nexo, 2020).

This positive result for H1 evidences the relevance of external or institutional factors on the level of carbon disclosure, which is supported by the institutional theory, that poses that organizations disclose information in order to be compliant with practices and procedures present on the institutional environment (DiMaggio and Powell, 1983, as cited in Garcia et al., 2020), so differences regarding CSR on developed and developing countries can be considered as a result of different rules, norms and responsibilities expected from companies (Ferri, 2017).

When it comes to the hypothesis H2, its rejection does not strongly contradict the past research, since there is a gap on the literature regarding the disclosure of social pillar SDGs isolated from the other SDGs. Therefore, the result that Brazilian companies disclose more social pillar SDGs is not necessarily against but complementary to the findings of van der Waal and Thijssens (2020) regarding the lower overall SDG reporting of the BRICS (including Brazil) in comparison to Continental European (including Italy) countries. In fact, the result is aligned with the Izzo, Ciaburri, et al. (2020) study that showed that Italian large-capitalized companies promoted SDG disclosure in a low level, by merely citing SDG or generically describing the related actions, without linking them to indicators; given the small incidence of around 33% of Italian companies providing a quantitative information on social SDGs (Table 15).

Changing the focus to the **company size**, both hypothesis H3 and H4 were confirmed, so **larger companies (with higher sales revenue) reported more carbon and social information than smaller ones**. Such confirmation for H3 is aligned with the past research: for example, Córdova Román et al. (2021) concluded that larger companies reported more carbon emissions and Mateo-Márquez et al. (2019) observed big companies getting a higher CDP Climate Change score. Regarding the hypothesis H4, the result is aligned with the study of Elalfy et al. (2020) that discovered an influence of the company size on the probability of the inclusion of SDGs in the company's reporting. More generally, it is also aligned with the vast literature on the disclosure of CSP information (Córdova Román et al., 2021; Garcia et al., 2020; Rosati & Faria, 2019) in the case of Brazil (Kouloukoui et al., 2018a) and also of Italy (Fontana et al., 2015; Jaggi et al., 2018; Venturelli et al., 2019).

Large companies were, in fact, expected to disclose more CSP information to improve brand visibility and its reputation and reduce the probability of scrutiny, given their higher vulnerability to speculation (Garcia et al., 2020); aside from having more resources (Rosati & Faria, 2019). This result is, therefore, supported by the legitimacy theory.

As regards the **industry sector** which the company makes part of, the hypotheses H5 was confirmed and the H6 was rejected. Therefore, **companies pertaining to highly polluting sectors were found to disclose more carbon information but less social information in the form of social pillar SDGs**. Symmetrically, less polluting industries reported less carbon information but more social aspects. The result for H5 is aligned with the findings of Kouloukoui et al. (2018b), that confirmed that worldwide companies pertaining to high impact industries disclosed more information on carbon risks. Specific to the case of Italian companies, such result is also in line with the conclusions reached in Jaggi et al. (2018), in which Italian

companies making part of heavy polluting sectors had a higher incentive to disclose carbon information; and in Fontana et al. (2015), that showed that environmental sensitive sectors disclosed more environmental information. Additionally, the highest observed carbon disclosure levels of companies from the “Oil and gas” and “Paper” sectors were also obtained in Kouloukoui et al. (2018a). As for the hypothesis H6, the result cannot be said to contradict but also does not support the Elalfy et al. (2020) findings that industries with higher sustainability impact perform more SDG reporting.

Since highly polluting industries have a high regulatory risk and customer visibility (Roberts, 1992; as cited in Kouloukoui et al., 2018a), companies that make part of such sectors were, in fact, expected to disclose more carbon information to avoid pressure and criticism (Kouloukoui et al., 2018a), justify their operations and maintain their legitimacy (Garcia et al., 2020). Therefore, the result for H5 is also supported by the legitimacy theory. However, such behavior is not observed in the case of social reporting, so it can be said that highly polluting companies focus on the disclosure of carbon information, that is understood as being more critical to their business, and do not recognize the benefit of also disclosing social aspects, for example to establish their legitimacy.

Additionally, this higher exposure of larger companies and polluting industries incentivizes them to act to be seen as appropriate and desirable considering the social system of values, beliefs and norms (Suchman, 1995; as cited in Garcia et al., 2020). Therefore, the results for H3, H4 and H5 are explained by the stakeholder theory as well. Such theory also supports the fact that these companies were expected to show their accomplishments to stakeholders (Boesso & Kumar, 2007; as cited in Garcia et al., 2020) in order to seek, for example, for a better access to capital (EY, 2013). The proved influence of the company size as a determinant of carbon and social disclosures and the industry sector, of carbon disclosure, are, then, supported by the legitimacy and stakeholder theories. It must be noted, as a result, that large companies valorize the importance of disclosing both carbon and social information to maintain their legitimacy and perform stakeholder management, while highly polluting companies limit such importance only to carbon information reporting in detriment to social disclosure.

When it comes to the **CSR engagement**, in contradiction to what was expected (so not confirming H7 and H8), the presence of a company in a sustainability index (ECPI ESG Index) did not prove to influence neither the level of carbon disclosure nor the level of social disclosure. **This means that companies that participate in such ESG indexes did not statistically take a higher CDP Climate Change score nor report in more detail the SDGs**

**pertaining to the social pillar.** Such a result diverged from the literature that made use of other proxies like the presence of a sustainability committee or the release of a sustainability report (Córdova et al., 2018; Córdova Román et al., 2021; Jaggi et al., 2018; Orazalin, 2020) and the solely source that used a similar approach (Kouloukoui et al., 2019). One possible reasoning that could justify such result is that ESG indexes consider a series of environmental, social and governance indicators, not only related to carbon risks or the social aspects covered by the social pillar SDGs. Thus, for example, a company that reported other environmental initiatives like waste management or product life cycle extension could take a high ESG score and be part of an ESG index without specifically disclosing carbon information. Therefore, the result obtained is plausible despite unexpected.

However, while the ESG Index was proved to significantly influence the level of carbon disclosure at a confidence level of 90% (lower than the minimum confidence level defined ex-ante in this study), such determinant did not impact the level of social disclosure, at the same confidence level. Therefore, it can be interpreted that the components that constitute such ESG indexes might be more aligned with the disclosure of carbon information than of social aspects.

In addition, literature points out to a lack of convergence among ESG ratings provided by different sustainability rating agencies, due to a divergence in the methodologies employed and dimensions considered (Rekker et al., 2021), which negatively impacts the decision-making processes of investors engaged in socially responsible investing (Dorfleitner et al., 2015). Such divergence is proved to be even higher in the case of the social dimension (Dorfleitner et al., 2015). This lack of robustness prevents the generalization of the results to other ESG or sustainability indexes available in the market and, then, the determination of the theoretical correlation among the company's participation in a sustainability index and its level of carbon and social disclosures.

Finally, it was also proven to be true the final hypothesis regarding a positive effect of the level disclosure of carbon information on the level of reporting of social aspects. Such result is coherent with the IPCC (2019) statement on the possible synergy between climate actions and the achievement of social sustainable dimensions. It is also in line with Rosati and Faria (2019) findings on the relationship among the presence of external assurance, like CDP, and the increase in the disclosure of SDGs.

Moreover, when it comes to the reporting of the specific social SDGs, independently from the influence of the determinants of disclosure, the results were also aligned with the findings of past research. In the Izzo, Ciaburri, et al. (2020) study on the SDG reporting of Italian listed companies in 2016, it already showed that the SDGs 3 “Good health and well-

being”, 4 “Quality education” and 5 “Gender equality” were more frequently disclosed than the other social pillar SDGs. Therefore, this current work, performed considering the 2019 and 2020 reports, confirms this trend for Italian companies. Additionally, in Izzo et al. (2020) the social SDGs that were mostly disclosed in 2018 by a set of European companies were SDGs 3, 4 and 5 as well. Furthermore, both in Izzo, Ciaburri, et al. (2020) and Izzo et al. (2020) it was evidenced the SDG 8 “Decent work and economic growth”, followed by the SDG 13 “Climate action”, as the most reported SDGs, which again is in line with the present study.

Lastly, it is important to point out that even in the presence of a statistical influence of some determinants on the disclosure level of carbon and social information, the average company reported less than half of the maximum it could have disclosed both in terms of carbon and social aspects. Additionally, the social disclosure level was even lower than the reporting level of carbon information, in average. Such overall achievement of low levels of disclosure is also highlighted by the limited impact on the dependent variables promoted with the change in the value of the independent ones, demonstrated through the marginal effect analysis.

## **5. CONCLUSION AND FUTURE STEPS**

Ever more there has been a worldwide concern about the negative impact of anthropogenic activities on environment and society. As a result, the discussion around this topic has increased with its inclusion in national and supranational agendas, such as the United Nations 2030 Agenda for Sustainable Development and the 2015 UNFCCC COP. Policies and initiatives, like the Paris Agreement and the European Green Deal, have also emerged to set the necessary conditions to achieve better projected future scenarios, including those with a reduced global warming. Therefore, the concept of sustainable development has been largely discussed on recent years and a purely economic perspective has been gradually replaced with the consideration of economic, environmental and social aspects together, that have both been treated as a trade-off but also as providing possible synergies.

Companies are ever more being requested to be accountable for externalities and to play additional roles apart from generating profit and shareholder value. The paramount adaptation or even transformation of companies to this new context have been made them change their business models, mission and strategies to mitigate the negative impacts generated by their activities, to seek for the creation of shared value or even to orient their business to solve societal challenges. Such phenomenon was interpreted in this study through the lens of the

theoretical frameworks of Corporate Social Responsibility (CSR) and its evolution towards a more strategic approach that approximates it to the concept of hybrid organizations.

Companies have been put into pressure to disclose social, environmental and, more specifically, carbon information as a manner to demonstrate their recognition of the importance of these themes and the respective adopted initiatives. Such practice is motivated by a series of factors like acquiring legitimacy, securing their positioning, showing their accomplishments to stakeholders, reducing information asymmetry and getting a better access to capital. Therefore, the disclosure of those sustainability aspects can, in turn, be interpreted through the legitimacy, stakeholder, agency and institutional theories. Such theories have been utilized as a basis to investigate the influence of some determinants of disclosure. Additionally, around this topic, sustainability disclosure standards have emerged to provide recommendations and the standardization of practices and, then, allow comparability. Some examples are the Global Reporting Initiative, the Carbon Disclosure Project and the SDG reporting.

The focus of this study is concentrated on the practice of disclosure of carbon information and social aspects by companies, that was interpreted as an analog but less evolved form of a fundamental feature of hybrid organizations, that consists of the stakeholder accountability. The present study aims at filling the gap regarding the lack of substantial past research on the determinants of carbon disclosure, especially regarding developing countries; on the determinants of SDG disclosure, principally decoupled from the umbrella concepts of CSR, CSP or SDG; and on a possible correlation among the carbon and the social disclosure. Additionally, it brings a proxy to evaluate the CSR engagement which is not commonly used: the participation in a sustainability index. Furthermore, this study is justified given the presence of contradictions on findings associated with the observed relevance of drivers such as company size and industry sector on determining the level of social and carbon disclosure; and given that such area of research is plenty recent.

Considering those identified gaps on the literature, this study aims at assessing the influence of a set of determinants (country of operation, company size, industry sector and CSR engagement) on the level of disclosure of carbon and social information, scored respectively by the Carbon Disclosure Project (CDP) and revealed in the form of social pillar SDGs (SDGs 1 to 6) mentioned on sustainability reports. It also focuses at comparing the carbon and social disclosure levels within the different realities faced by Italian and Brazilian companies and at analyzing a possible correlation among the level of carbon and social disclosure.

With the objective of filling these gaps, the following hypotheses were formulated:

H1: The level of carbon disclosure of Brazilian companies is lower than of Italian companies.

H2: The level of social disclosure of Brazilian companies is lower than of Italian companies.

H3: Large companies disclose more carbon information than smaller ones.

H4: Large companies disclose more social information than smaller ones.

H5: Belonging to highly polluting industry sector influence positively the level of carbon disclosure.

H6: Belonging to highly polluting industry sector influence positively the level of social disclosure.

H7: The participation in a ECPI ESG index influence positively the level of carbon disclosure.

H8: The participation in a ECPI ESG index influence positively the level of social disclosure.

H9: The companies' carbon disclosure level influence positively the level of social disclosure.

The methodology used to test the validity of such hypotheses consisted in the Papke and Wooldridge (1996) Fractional Logistic Model, different from the main one used in the literature (multivariate linear regression), given its best suitability for fractional bounded dependent variables. Such dependent variables consisted of the level of carbon disclosure and the level of social disclosure, calculated as a percentage of a maximum value and, thus, bounded between zero and one. The level of carbon disclosure was calculated through the 2020 CDP Climate Change score and the level of social disclosure, in turn, was determined by considering the number of social pillar SDGs reported and the level of detail of such disclosure. Such information on the SDGs was obtained through manual and visual content analysis by utilizing GRI reports, sustainability reports or equivalent documents. The independent variables consisted in either binary or numerical continuous variables: the country of operation assumed two possible values, Brazil (0) and Italy (1); the industry sector was clustered in highly polluting sectors (1) and less polluting sectors (0); the CSR engagement assumed the values of



participating (1) or not participating (0) in a ECPI ESG index; and, finally, the company size consisted in a normalized continuous variable proxied by the sales revenue. Therefore, two models were formulated: the first one with the carbon disclosure level as the dependent variable, and the other, with the social disclosure level. In the case the dependent variable was the level of social disclosure, the level of disclosure of carbon information also played the role of independent variable.

The universe of analysis of this study consisted of the set of Brazilian and Italian companies assessed by the CDP in the year of 2020, excluding the ones that did not receive a score or whose sales revenue could not be obtained, so the final dataset contained a total of 226 companies: 96 Italian and 130 Brazilian. As regards the data collection, it included different sources given the impossibility to have access to a more consolidated database: the CDP, GRI, Brazilian and Milan stock exchange's and companies' websites. Some critical issues emerged from this phase: the fact that the GRI database did not contain many reports from 2020 or 2019, so it was necessary to refer to each company' website and accept the risk of utilizing non-standardized reports; the considerably high number of companies without a defined sector in the CDP database, so it was required to take data from two different sources and lose the capability of properly compare and aggregate sectoral information; the impossibility to get access to data on the most recognized sustainability indexes; and, finally, the presence of data on sales revenues in different currencies, so it was necessary to apply exchange rates, that were inflated given the 2020 pandemics, economic and political crisis.

The descriptive statistics evidenced some important results, being the first one the fact that on average companies disclosed much less than half of the level they could have disclosed, both in terms of carbon and social information. This conveys the message that companies have much ground to increase their disclosure levels and that the targets are set on high values. Therefore, performing an assessment of this kind may put a pressure onto companies to improve their disclosure levels towards the highest achievable theoretical value or at least the benchmark, which in the case of the CDP score consists in the CDP A List.

Additionally, other results were that companies disclosed on average more carbon than social information; that the distribution of the level of social disclosure was highly concentrated at low scores; and that the distribution of carbon information disclosure level had two peaks, the highest at low scores and the other at high scores, being little the number of companies taking an average disclosure. Such results can possibly evidence that the presence of standardized disclosure frameworks, like in the case of the CDP questionnaire for carbon

information, promotes a higher engagement of companies to provide such a disclosure; and in the case companies are already engaged, they are properly oriented to seek for higher scores. In fact, in the case of the social disclosure, the SDGs do not consist of a disclosure framework by itself, so it was necessary to create a methodology for the assessment. In this scenario, companies are not so incentivized to provide such a disclosure practice or put on pressure to comply with standards. However, it was seen a great potential of companies that provided a disclosure of some social information that, at the moment, has not yet been connected with the SDGs.

Finally, the descriptive statistics also allowed concluding that the SDG 13 “Climate action” was the most disclosed one, confirming the primacy of the carbon disclosure. The social pillars SDGs that were the most disclosed, in turn, consisted in the ones related with gender equality and quality health and education (SDGs 3,4 and 5), in detriment of the fight against poverty, hunger and clean water and sanitation (SDGs 1,2 and 6). This showed that companies report more on subjects that are more easily applied to their own workforce, given the highly frequent presence of graphs and tables on the gender distribution and the working conditions at the workplace; than on topics that regards the community and society in general.

When it comes to the univariate analysis on the binary variables, which was made possible through balancing the database, it could be noted that Brazilian companies achieved a lower level of carbon disclosure but a higher level of social disclosure when compared with Italian companies. Belonging to highly polluting sectors also seemed to influence positively the level of carbon information despite did not apparently influence the level of social disclosure. These observations were confirmed, afterwards, through the regression results, except for the fact that belonging to highly polluting industry sectors actually negatively influenced the disclosure of social aspects. Therefore, these determinants proved to be statistically relevant for explaining the dependent variables. The graphical analysis for the case of CSR engagement, that showed a relative positive correlation with both the carbon and social disclosure levels, however, was not confirmed through the regression results. For the company size, the regression results were obtained directly and demonstrated a positive influence for both the social and carbon disclosure levels.

Therefore, the fractional logistic regression results on the significance of the coefficients and the marginal effects allowed to conclude, with a minimum confidence level of 95%, that: Italian companies disclosed more carbon information (confirming hypothesis H1), Brazilian companies disclosed more social information (rejecting hypothesis H2), large companies

disclosed more carbon (confirming hypothesis H3) and social information (confirming hypothesis H4), companies making part of highly polluting sectors reported more carbon information (confirming hypothesis H5) but less social information (rejecting hypothesis H6), companies present on an ECPI ESG index did not disclose more social or carbon information (not confirming neither hypothesis H7 nor H8) and companies with a high level of carbon disclosure had also a high level of social disclosure (confirming hypothesis H9).

These results are in general aligned with the existent literature. In the case of the determinants of the carbon disclosure level, the company size and industry sector results supported the past research that proved their positive influence; and the comparison among Brazilian and Italian companies added evidence on the primacy of developed countries on performing such a disclosure, justified through a raised discussion on the recent European carbon policy and agenda. The CSR engagement, however, innovatively proxied by the presence in a sustainability index, did not prove its influence, which diverged from the literature that made use of other proxies and the sole source that used a similar approach, highlighting the fact that such indexes approach many environmental, social and governance aspects and do not necessarily indicate a high disclosure of carbon and specific social issues. The important discussion on the lack of convergence among ESG ratings provided by different sustainability rating agencies, due to a divergence in the methodologies employed and dimensions considered, was also put into consideration as to justify such a result. In addition, at a lower level of confidence (90%), the proved influence of participating in a ESG Index on the carbon but not on the social disclosure level evidenced the higher alignment of such indexes to the carbon than to the social reporting.

Furthermore, the present study contributes to filling an important literature gap regarding the determinants of social disclosure level practiced by companies, through assessing the reporting of social pillar SDGs. For this reason, the findings are not directly comparable with other studies, but they were interpreted as supportive or complementary to the past research on SDG reporting in general.

The findings of this work also evidence the influence of both organizational (company size and industry sector) and institutional factors (country of operation) on the decision of what to disclose; explained by the legitimacy, stakeholder and institutional theories. Therefore, this poses that a series of factors that are present on the complex internal and external contexts must be considered when explaining the behavior of companies in such a matter.

This study provides added value for the academics, researchers, governments, policymakers and students. Some practical implications are that policymakers can play a major role on incentivizing the private action against climate change and towards a sustainable development, by exerting an influence from the external environment. In addition, company leaders are provided with findings that can help them orient their disclosure strategy as their peers (industry peers, companies operating in the same country, companies with a similar size) by allowing them to comprehend the current state of the market on the path towards a more sustainable future, the risks of staying behind and opportunities that can emerge from it.

As any scientific study, this work has some limitations, principally related to its boundary conditions. First, the results are limited to the Brazilian and Italian contexts, therefore, there is space for future research on a panel of developing and developed countries. Second, it was based on the companies that have been assessed by CDP in the year of 2020, so it can be extended to a more comprehensive set of companies, for example listed on stock exchanges, and utilized historical data. Third, it has been used the ECPI Emerging Markets ESG Equity and the ECPI Euro ESG Equity indexes as to evaluate the impact of participating in a sustainability index. Being aware of a lack of convergence of this kind of indexes, it would be of a great value the development of future studies comprehending more ESG indexes existent on the capital market. It is important to stress out that many of those choices on the boundary conditions were made based on the difficulty in accessing the required data coming from private entities (CDP, ESG rating agencies), so for delineating future research it is important to manage this matter. Additionally, the very recent stage of the practice of sustainability reporting brings some research difficulties, so a more proper study on this topic depends on the maturity to be reached regarding the standardization of sustainability reports, the definition of a structured framework for assessing the social aspects disclosure and the minimum convergence of methodologies and criteria to attribute ESG scorings.

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