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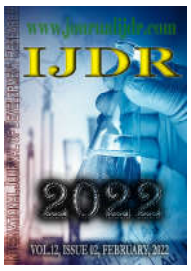

RESEARCH ARTICLE OPEN ACCESS

ECO-INNOVATION IN BRAZILIAN COMPANIES

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ABSTRACT

The objective of this study was to analyse eco-innovation from the perspective of publicly traded Brazilian companies, components of the B3's Corporate Sustainability Index (ISE B3). In the last decades, the discussion about sustainable business practices has developed towards a socio-environmental evolution to meet an increased demand for a more sustainable global society. As a result, researchers and managers are increasingly interested in eco-innovation. This study is a descriptive, comparative, and longitudinal analysis between ISE B3 and IBOVESPA (Brazil Stock Market Index) in the last ten years to understand the performance of publicly traded Brazilian companies, components of the ISE B3. The results show large concentration of sectors participating in the ISE B3. Superior results were found for ISE B3 in comparison with IBOVESPA. Pearson's correlation coefficient was strong, positive, and significant at 1% between the indexes. However, analysing the individual performance, superior results were not evident if the company participates or not in the ISE B3 index.

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INTRODUCTION

The objective of this study was to analyse eco-innovation from the perspective of publicly traded Brazilian companies, components of the B3's Corporate Sustainability Index (ISE B3). A comparative and longitudinal analysis was applied to ISE B3 and IBOVESPA to understand the performance of companies participating in these indexes. The term eco-innovation (EI) derivates from sustainability, therefore, it is fair to demonstrate its synonyms. The literature explains that innovation with a focus on sustainability can be called sustainable innovation, environmental innovation, green innovation, clean innovation, as well as eco-innovation (Aloise; Macke, 2017; De Marchi, 2012; Veugelers, 2012; Bernauer *et al*., 2006). Among the various concepts of innovation already enshrined in the literature, this work uses that of Kemp and Pearson (2007), presented in the next section. Growing discussions about sustainable practices in recent decades have sparked a social evolution that has increased the demand for a sustainable global society, while questions arise about rampant economies that lead to environmental degradation.In this scenario, researchers and managers have recognized the fundamental importance of eco-innovation (Rennings, 2000). Studies have shown that the eco-innovation represents significant improvements in processes and products that generate benefits for society (Barbieri *et al*., 2016; Berrone *et al*., 2013). On this way, eco-innovation is an inevitable choice for companies obtaining competitive advantage.

Under growing socioenvironmental pressure, it represents the search for sustainability (Cai; Li, 2018). Its adoption alsoallows reducing environmental risks and negative impacts relative to the use of resources (Vieira de Souza *et al*., 2018), as well as social and economic impacts. Sustainable organizations have targeted eco-innovation to reduce negative environmental externalities, obtain green certifications and, thus, meet the demands of stakeholders and end clients (Garcia-Granero *et al*., 2018; Kuo e Smith, 2018). As a result, eco-innovation allows environmental, economic, and social benefits, creating win-win situations (Hojnik *et al*., 2018; Lee *et al*., 2018). Many authors have approached eco-innovation under different perspectives, such as: relationship between eco-innovation and business competitiveness (Lee *et al*., 2018; Rennings, 2000), business performance (Bach *et al*., 2019; Oncioiu *et al*., 2018; Chen *et al*., 2006), social dimension (Cao; Chen ,2019; Bendell, 2017; Nicolai; Faucheux, 2015), environmental impacts (Oncioiu *et al*. 2018; Cui, 2017). Studies relating eco-innovation to business performance have been relevant for diverse organizations (Archibugi; Filippetti, 2018, Stek; Van Geenhuizen, 2016). Studies evidence that innovative companies achieve the best results (Tsai *et al*. 2020; Bach *et al*., 2019; Lee *et al*., 2018; Taalbi, 2017). However, most of these studies illustrate an international reality and few were done in Brazil. For these studies, ISE was the *proxy* to understand the characteristics of publicly traded Brazilian companies and their relationship with eco-innovation. Thus, the research question that guided this study was: *Does the stock portfolio of the companies that make up the ISE index*

perform better than the stock portfolio of the companies that make up the IBOVESPA?

This work analysed publicly traded Brazilian companies listed in the Brasil, Bolsa, Balcão (B3) to compare the stock portfolio performance of the companies that compose the ISE index with the performance ofIBOVESPA and, thus, understand the influence of eco-innovation on the performance of stock portfolios. It is worth to highlight that B3 has two sustainability indexes in force, the Corporate Sustainability Index (ISE) and the Carbon Efficient Index (ICO2). This work considers ISE, the fourth sustainability index created in the world and relevant enough to provide several quality information.

LITERATURE REVIEW

To best understand eco-innovation, it is helpful to verify its origin and meaning. Fussler and James (1996) were the first to concept eco-innovation as "new products and processes that add value to clients and companies reducing environmental impacts". Other authors brought contributions on the topic and, naturally, the concept evolved with the awareness of society. Bocken *et al*. (2014) define eco-innovation as "management and investment processes facilitating the achievement of goals that promote business sustainability". Succinctly, it is observed in the first concept a nitid environmental and economic concern. Twenty years later, a most recent definition also includes the social issue, strengthening sustainability goals. Today, eco-innovation is not only addressing environmental issues but business competitiveness (Esty; Winston, 2009). Companies are implementing new strategies to increase productivity and competitive advantages, reduce costs and access new markets (Peiro-Signes *et al*., 2013) in addition to promote social and environmental responsibility together with society (Buhl *et al*., 2016). This research used the concept of Kemp and Pearson (2007):

"Eco-innovation is the production, assimilation or exploitation of a product, production process, service or management or business method that it is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives". (Kemp and Pearson, 2007). Renewable energy technologies, systems of air and water purification, organic agriculture, green investment funds, low carbon technologies and advanced recycling systems are examples of eco-innovation (Bammens; Hünermund, 2020; Ekins, 2010; Arundel; Kemp, 2009; Kemp, 2009). Multiple studies address eco-innovation to several areas of knowledge and the number of scientific publications on the topic has significantly increased. A search on the *Web of Science* on the topic of eco-innovation returned 9 and 82 articles for the years 2010 and 2019, respectively. Likewise, a search on *Scopus* returned 33 and 180 articles for the years 2010 and 2019, respectively. Specific areas of knowledge show a broad spectrum for eco-innovation application. A study by Daddi and De Giacomo (2012) showed that Italian companies that invested in technologies, opportunities, jobs, and services to manage eco-innovative activities obtained competitive advantages and operational efficiency in their production processes. On the same way, Hojnik and Ruzzier (2016) showed that 223 Slovenian companies that strategically adjusted eco-innovative actions into their business obtained more profit, positive sustainability image, growth, and competitive advantages. Orji and Liu (2020) developed a study in Spain that analysed 3.200 manufacturing companies.

The authors observed that public regulations and investments in research and development (R&D) are the triggers for implementing eco-innovative activities, while government and market subsidies are not key factors. Cheng and Shiu (2012) also developed a research in Spain and found that 222 construction sector companies that invest in R&D obtained more success with environmental innovation. Jové-Llopis and Segarra-Blasco (2018) investigated the factors promoting eco-innovation and their effects on the performance of 442 Chinese manufacturing companies. The study demonstrated that some organizational skills and tools to measure the level of eco-innovation can contribute to business development, since eco-innovation improves the economic performance and environmental efficiency of companies. However, Cai and Li (2018) and Esty and Winston (2009) observed that environmental regulations or competitive pressure are not enough for companies to implement eco-innovation in their businesses. Analysing and planning internal resources is essential.The study suggests improvements in the environment and policies of companies to adapt their resources and internal facilities for the benefit of not only business, but also society. A globalized industrial policy with economic and environmental efficiency is one of the main European strategies for 2020. Thus, the role of eco-innovation is to improve sustainable policies to dynamize markets and their globalization (Smol; Kulczycka, 2017; Vence; Pereira, 2019). Therefore, it is important to identify key factors to promote eco-innovative activities. Nowadays, few studies have proposed a model of eco-innovation to potentialize sustainable economies. Studies related to eco-innovation and its applications differ according to the objectives and specificities of each country or sector (Kemp *et al*. 2013).

MATERIALS AND METHODS

A thorough analysis was carried out of the publicly traded Brazilian companies listed in B3, especially those that make up the Corporate Sustainability Index (ISE). We opted for the analysis of time series with long-distance data. According to Reis and Reis (2002), time or historical series are a set of observations of the same quantitative variable, discrete or continuous, carried out over time. The period analysed was from 2012 to 2021. Secondary data were collected between the months of January and March 2021 in public domain documents, found on the pages of B3 and the companies surveyed. The ISE consists of the result of a theoretical portfolio of assets, carefully developed by the Center for Sustainability Studies (GVces) at the School of Business Administration of São Paulo, Getúlio Vargas Foundation (FGV-EAESP). ISE's objective is to indicate the average performance of quotations of the assets of companies that have a recognized commitment to sustainable development, practices, and strategic alignment with corporate sustainability, in addition to acting as an inducer of good practices in the Brazilian business environment (ISE B3, 2021). As of 2016, ISE started to mention the Sustainable Development Goals (SDGs) in its analysis methodology, thus incorporating the challenges brought by the 2030 Agenda. In this line, the criteria for inclusion of companies in the ISE are based on a comprehensive and objective questionnaire that assesses the sustainable performance of the 200 most traded shares of B3 - those with the highest market liquidity (ISE B3, 2021).

The questionnaire considers the performance of companies in seven dimensions: general, nature of the product, corporate governance, economic-financial, environmental, social and climate change. These dimensions assess, in an integrated way, environmental, social, and economic aspects. After voluntary submission of the questionnaire, companies must also send their corporate documents proving the answers indicated in the questionnaire (ISE B3, 2021). After analysing the information, companies that performed satisfactorily in all dimensions are considered eligible. ISE is made up of a portfolio of 40 companies at most, with a 12-month term. A new portfolio starts on the first Monday in January and ends on the day before the entry of the next portfolio, always in January (ISE B3, 2021). *Statistical Package for the Social Sciences (SPSS) v.26* was used to perform descriptive analysis of data and identify possible relationships and standards. Central tendency measurement tests were also used to calculate simple arithmetic means, thus summarizing the collected data. The simple arithmetic mean was calculated for the results of the companies that make up the ISE and for the individual results of each company, year by year, for the last ten years. Finally, Pearson's correlation coefficient was applied to measure the degree (high or low) and the direction (positive or negative) of the correlations between the average annual returns of the studied indexes. Then, the major results were plotted into graphs and tables

for interpretation. A comparative analysis between ISE and IBOVESPA helped us to understand the effects of eco-innovation on the performance of publicly traded Brazilian companies.

RESULTS AND DISCUSSION

ISE component companies: When analysing the database, information about the ISE was found from 2005, the year of its creation. A filter was made for the last 10 years (2012 to 2021). This search returned a sample of 57 companies, among which 4 major acquisitions were observed in the last decade: Anhanguera was acquired by Cogna, Tractebel by Engie, Telemar by OI and Fibria by Suzano. Throughout the decade studied, participation in the index varied. However, some companies participated in the index in all the years analysed and deserve mention: AES TIETE, BCO do BRASIL, BRADESCO, CCR, CEMIG, COPEL, DURATEX, ECORODOVIAS, EDP, ENGIE, ITAÚ, ITAUSA, LIGHT, NATURA, SANTANDER, and TIM. Table 1 shows the participation of companies in the ISE over the past decade. It is observed that 61.4% of the companies made up the index between 5 and 10 times (years), while 17.54% of the companies made up the index only once.

Table 1. ISE participants in the last decade

Period (years)	Companies	(%)
10	AES TIETE, BCO BRASIL, BRADESCO, CCR, CEMIG, COPEL, DURATEX, ECORODOVIAS, EDP, ENGIE, ITAU, ITAUSA, LIGHT, NATURA, SANTANDER, TIM.	28,07
9	AES ELETROPAULO, BRASKEM, BRF, CIELO, CPFL, ELETROBRAS, FLEURY, KLABIN, TELEFONICA.	15,79
8	SUZANO, WEG.	3,51
7	B2W, LOJAS AMERICANAS, LOJAS RENNER.	5,26
6	SUL AMERICA.	1,75
5	EMBRAER, EVEN, MRV, VALE.	7,02
4	CESP, COELCE, GERDAU, METALÚRGICA GERDAU, SABESP.	8,77
3	BIC BANCO, COPASA, OI.	5,26
2	CELESC, MOVIDA, PETROBRAS DISTRIBUIDORA, ULTRAPAR.	7,02
1	ANHANGUERA, BTG PACTUAL, CIA BRASILEIRA DE DISTRIBUIÇÃO, COSAN, JSL, M. DIAS BRANCO, MARFRIG, MINERVA, NEO ENERGIA, PETROBRAS.	17,54
TOTAL		100,00

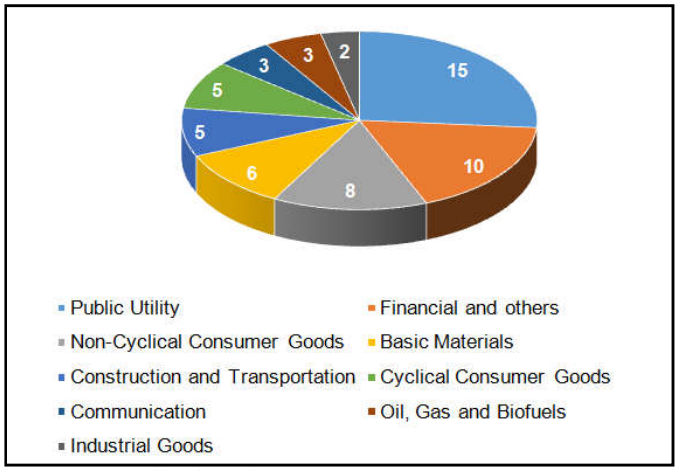
Source: Prepared by the authors

Source: Prepared by the authors

Figure 1. Word cloud.

Above is the word cloud (Figure 1) containing the name of all the companies that made up the index, with emphasis on those that participated in the ISE in the last 10 years.

Of the nine sectors classified in B3, as shown in Graph 1, Public Utility was the most representative in ISE (26.32%), followed by Financial and Others (17.54%), Non-Cyclical Consumer Goods (14.04%), Basic Materials (10.53%), and others (<8%). Industrial Goods was the least representative sector (3.51%).



Source: Prepared by the authors

Graph 1. Number of companies participating in the ISE by sector

In the last decade, the four predominant sectors were Public Utilities, Finance and Others, Non-Cyclic Consumer Goods and Basic Materials, which together represented 68.42% of the companies participating in the ISE. Within Public Utilities, the Electric Energy Subsector was the most important, representing 22.8% of the sector.

These results differ from the results found in previous studies. Beato *et al*. (2009) and Machado *et al*. (2009) analysed the profitability of the ISE between 2005 and 2008. The authors observed that the Financial and Electric Energy sectors predominated in 2008. For Beato *et al*. (2009) more than 70% of the ISE was concentrated in these 2 sectors during this period. The results of this study show a more varied distribution of sectors, but not yet ideally diversified. The concentration of sectors can positively or negatively influence the index, especially in the case of sudden fluctuations.

Comparative analysis between ISE and IBOVESPA: When analysing the closing indexes for the year, as shown in Table 2, it is possible to see that the volatility of the ISE is much lower when compared to the IBOVESPA. The lowest score of the ISE index was 2.118 in 2015 and its highest was 4.153 in 2020,corresponding to a 96% variation between its minimum and maximum, considering a mean score of 3.006 in the last 10 years.In the same line, the lowest score of the IBOVESPA index was 43.349,also in 2015 and its highest was 19.017, also in 2020, corresponding to a 174.5% variation between its extreme scores, considering a mean score of 77.977 in the last 10 years.

Table 2. Comparison of ISE and IBOVESPA closing indexes

Year	ISE	IBOVESPA
2012	2.432,53	60.952,08
2013	2.479,61	51.507,16
2014	2.431,59	50.007,41
2015	2.118,01	43.349,96
2016	2.410,05	60.227,28
2017	2.829,50	76.402,08
2018	3.108,65	87.887,27
2019	4.140,26	115.645,34
2020	4.153,31	119.017,24
2021*	3.965,14	114.780,62
Average	3.006,87	77.977,64

* Results for the first quarter of 2021. Source: Prepared by the authors based on information obtained from B3 (2021).

A descriptive analysis of the indexes compared the values with those of previous years. There was an average variation of 7.74% for ISEand 8.66% for IBOVESPA over the period evaluated.

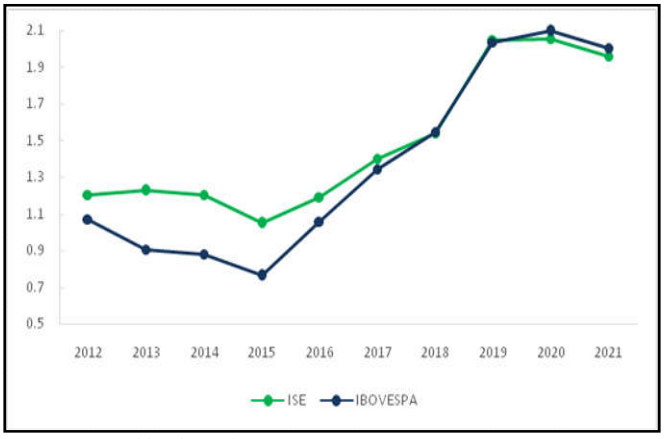
The positive variation of ISE was higher than IBOVESPA only in 2012 (20.49%), 2013 (1.94%) and 2019 (33.19%). In addition, the negative variation of ISEwas slightly lower than IBOVESPA, which

was also negative, in 2014 (-1.94%) and 2015 (-12.90%).In the other years, ISEpresented variations below the IBOVESPA. Such variations are shown in Graph 2.

* Results for the first quarter of 2021.
Source: Prepared by the authors based on information obtained from B3 (2021).

Graph 2. Comparison of the variation between ISE and IBOVESPA (%)

The results presented in Graph 2 were calculated using the simple arithmetic mean and do not include accumulation effects that are common in longitudinal studies. Therefore, the data was fitted for a fair comparison with a compound quantity mathematical model that used the equivalent annual performance rate (%), commonly applied in long-term performance analyses. Appendix I presents the calculations of the accumulated return on a compound basis and the annual equivalent. Graph 3 shows some difference in the accumulated return between the years 2012 and 2017. There is almost no difference from 2018.

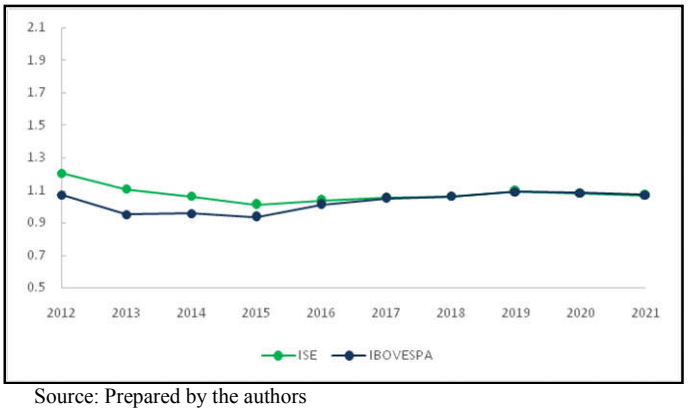


Source: Prepared by the authors

Graph 3. Accumulated performance of ISE compared to IBOVESPA

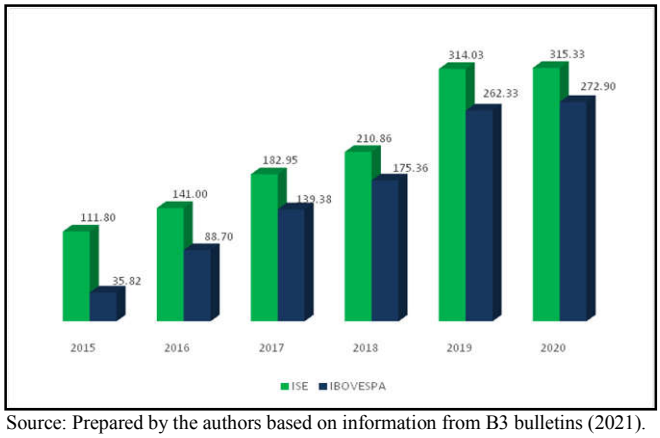
Graph 4 shows a small difference in the equivalent return between the years 2012 and 2015. There is almost no difference as of 2016. It is observed that the equivalent annual performance of ISE was 5.79% while that of IBOVESPA was 5.08% in the last ten years. A small advantage of 0.71% is observed for the ISE index. From the B3 bulletins that compare ISE and IBOVESPA, data were obtained and plotted in Graph 5, which shows the performance of the two indexes. Performance information was found only between 2015 and 2020 and collected in December of each year. It is observed that the performance of ISE was superior to IBOVESPA in the period examined.

The biggest discrepancy occurred in 2015, when ISE achieved a performance 212% higher than IBOVESPA. The smallest variation occurred in 2020, where ISE surpassed IBOVESPA by 15.5%.



Source: Prepared by the authors

Graph 4. Equivalent performance of ISE compared to IBOVESPA



Source: Prepared by the authors based on information from B3 bulletins (2021).

Graph 5. Comparison between ISE and IBOVESPA performance (%).

The results corroborate Souza *et al*. (2014) who showed superior performance of ISE when compared to IBOVESPA in the years 2006 to 2011 and with Beato *et al*. (2009), who found that ISE surpassed IBOVESPA between 2005 and 2008. According to Kruel (2011) ISE is a reference (benchmark) for investors to seek sustainable companies. Maehara (2013) demonstrates that ISE can add value through sustainable development and social responsibility, providing a safe investment for shareholders. Table 3 shows the Pearson correlation test between variations in the average annual returns of ISE and IBOVESPA.

Table 3. Pearson correlation

		ISE	IBOVESPA
ISE	Correlation Coefficient	1	,789**
	Sig. (2-tailed)		0,0066
IBOVESPA	Correlation Coefficient	,789**	1
	Sig. (2-tailed)	0,0066	

** Correlation is significant at the 0.01 level (2-tailed).Source: Prepared by the author

Table 4. Descriptive statistics of the portfolio of companies making up the ISE index

Year	Minimum	Maximum	Average
2012	-57,85	126,45	27,89
2013	-54,78	87,4	4,10
2014	-74,72	147,38	2,49
2015	-81,94	148,84	-10,07
2016	-45,66	186,18	42,76
2017	-24,03	116,24	22,12
2018	-65,28	126,7	9,87
2019	-32,81	382,51	48,83
2020	-75,99	152,87	-3,33
2021	-90,29	48,32	-6,46

Source: Prepared by the authors

Table 5. Portfolio analysis: performance of shares of companies that make up the ISE index

COMPANIES	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average/company
AES TIETE					12,25	-9,15	-20,62	110,78	-22,09	4,18	12,56
ANHANGUERA	0,00	68,74	62,51	-36,91	43,82	36,40	-51,13	23,17	-59,91	-19,02	7,52
B2W	88,83	-12,79	62,51	-31,04	-32,77	116,24	110,52	47,04	20,26	-22,86	34,59
BCO BRASIL	14,89	1,65	3,80	-31,12	102,42	16,17	40,45	8,91	-27,27	-24,39	10,55
BRADESCO	39,13	5,23	11,77	-22,91	65,33	22,69	5,42	-4,30	-29,53	-2,12	9,07
BRASKEM	-15,71	65,50	-29,24	59,98	115,66	43,25	4,62	-31,15	-20,57	48,32	24,07
BRF	16,06	17,08	30,66	-10,05	-10,12	-24,03	-41,17	56,79	-37,63	9,86	0,75
BTG PACTUAL							-6,21	382,51	12,72	-5,10	95,98
CCR	66,15	-5,71	-8,98	-13,51	34,39	2,80	-32,37	58,17	-29,73	-11,29	5,99
CELESC	-57,85	87,40	147,38	0,00	0,00	36,74	53,33	4,33	25,03	-0,32	29,60
CEMIG	23,68	2,41	19,11	-52,04	36,24	-17,40	126,70	1,04	4,93	-5,94	13,87
CESP	-36,59	28,36	31,37	-42,21	25,68	-7,03	87,05	60,89	-13,66	17,86	15,17
CIA BRAS. DE DISTRIBUIÇÃO						84,76	0,02	4,55	-15,56	-58,15	3,12
CIELO	47,06	42,95	31,52	-1,08	3,40	5,95	-63,14	-13,08	-52,94	-11,17	-1,05
COELCE	55,72	4,18	12,47	-3,99	0,00	21,66	-21,89	36,84	39,62	-29,43	11,52
COPASA	36,36	-14,12	-30,46	-37,94	149,13	27,62	40,29	6,57	-75,99	-11,03	9,04
COPEL	-20,77	-4,69	22,41	-30,85	29,95	15,74	44,03	132,97	1,41	-90,29	9,99
COSAN	57,84	-4,25	-16,87	-9,94	64,16	12,19	-21,36	97,08	7,42	21,57	20,78
CPFL	-12,45	-8,09	2,02	-15,28	73,32	-22,69	47,95	23,91	-8,80	-8,30	7,16
DURATEX	71,41	-2,28	-30,30	-22,30	17,83	38,55	26,52	37,16	14,61	-2,19	14,90
ECORODOVIAS	27,65	-10,33	-19,15	-49,47	73,48	54,14	-23,93	67,70	-19,21	-16,89	8,40
EDP	-4,53	-6,13	-12,17	37,44	24,72	6,54	4,61	55,85	-10,68	-1,30	9,44
ELETROBRAS	7,05	1,12	4,54	-4,88	0,00	-4,18	5,76	29,66	5,05	-6,51	3,76
EMBRAER	22,98	31,57	30,07	24,37	-45,66	32,89	2,99	-8,23	-55,64	46,76	8,21
ENGIE BRASIL	18,83	14,96	-1,45	3,29	7,81	-0,34	-6,99	47,67	-13,84	-5,90	6,40
EVEN	58,91	-11,73	-30,29	-20,08	-5,14	55,56	3,27	158,04	-22,05	-15,47	17,10
FLEURY	6,92	-17,71	-3,94	0,70	142,54	71,75	-33,38	52,19	-13,09	-7,71	19,83
GERDAU	28,58	-3,00	-45,43	-54,29	128,57	28,02	11,27	39,11	17,70	14,34	16,49
GERDAU MET	20,31	5,04	-53,03	-81,94	186,18	20,05	39,25	15,18	10,81	11,12	17,30
ITAU	12,79	3,00	20,53	-14,47	35,41	27,56	18,73	6,59	-13,21	-11,61	8,53
ITAUSA	14,71	-0,11	-19,16	-15,37	36,35	29,24	22,13	2,41	-12,61	-9,39	4,82
JSL	52,26	14,12	-19,08	-41,65	40,73	-8,44	-11,88	267,22	-60,22	-24,89	20,82
KLABIN	65,89	-4,15	37,71	148,84	-38,20	-20,22	-15,41	-5,33	26,53	8,27	20,39
LIGHT	-14,14	3,42	-15,31	-38,56	82,90	-13,88	-2,54	42,96	1,84	-18,63	2,81
LOJAS AMERICANAS	83,39	-23,25	22,04	-3,60	23,87	6,32	19,57	30,81	4,50	2,10	16,58
LOJAS RENNER	70,37	-21,91	27,95	15,23	41,00	79,70	21,70	29,02	-23,24	-2,43	23,74
M. DIAS BRANCO	65,87	28,94	-8,03	-24,32	76,06	21,16	-15,33	-15,03	-10,72	-8,58	11,00
MARFRIG	-2,50	-53,33	50,38	3,37	4,76	16,38	-24,79	76,28	43,95	19,65	13,42
MINERVA	126,45	2,18	-13,75	34,27	-7,55	-6,41	-54,01	150,29	-20,96	-4,01	20,65
MOVIDA						0,00	16,85	111,27	7,66	-20,09	28,92
MRV	15,90	-25,42	-7,34	21,90	31,68	46,87	-17,82	70,76	-12,95	-5,33	11,83
NATURA	69,98	-27,02	-18,69	-21,81	0,00	47,72	39,75	66,61	35,03	-7,90	18,37
NEO ENERGIA								0,00	-29,09	-7,67	-18,38
OI	0,00	-54,78	-74,72	-74,53	11,61	43,48	-65,28	-32,81	152,87	-14,86	-10,90
PETROBRAS	-13,45	-19,16	-38,20	-10,45	103,77	2,36	47,33	20,08	-10,71	-19,35	6,22
PETROBRAS DISTRIBUIDORA						0,00	50,03	16,78	-26,84	-2,47	9,38
SABESP	74,90	-6,44	-32,58	12,28	56,46	21,48	-8,14	73,47	-26,68	-8,79	15,60
SANTANDER	31,56	17,34	20,68	42,14	143,27	-8,69	18,07	6,49	-18,88	-14,92	23,71
SUL AMERICA						0,00	106,54	124,25	-28,54	-21,81	45,11
SUZANO						0,00	103,64	3,04	46,17	22,48	43,83
TELEFONICA	-1,17	0,38	7,44	-3,87	16,15	19,28	-0,36	18,48	-4,28	-2,49	4,96
TIM	-8,67	54,91	-2,25	-40,30	18,52	68,38	-9,54	29,50	-6,33	-12,99	9,12
ULTRAPAR	47,93	23,63	-5,59	21,17	19,06	18,78	-30,31	-6,15	-6,83	-12,67	6,90
VALE	12,50	-12,42	-35,14	-36,98	106,67	60,85	21,92	4,92	62,00	8,98	19,33
WEG	45,81	17,37	29,09	-0,54	6,85	55,55	-29,56	92,56	117,02	-4,73	32,94

Source: Prepared by the author from information obtained on the companies' webpages.

The annual variations of the ISE and IBOVESPA returns correlated strongly (> 0.7), positively and directly, that is, for each 1% variation in one of the indexes, the other follows in the same proportion. Finally, the last result of the correlation analysis showed that it is significant at the 1% level. The result indicates that the companies that make up IBOVESPA are positively and directly affected by the performance of ISE and vice versa, corroborating Gomes *et al.* (2017). The literature also shows divergent results when comparing ISE with IBOVESPA in the performance of companies. Studies carried out by Machado *et al.* (2009), Rezende *et al*. (2008), Crane *et al*. (2008) and McWilliams *et al*. (2006) show that there is no relationship between the indexes and no differences between companies' returns.These variations in result can be explained by the different ways in which these studies measured business performance (Madariaga; Cremades, 2010).

Analysis of portfolio performance (ISE) and individual company performance: The performance per year of the portfolio composed of the companies that made up the ISE index in the last decade was analysed. The companies AES Eletropaulo and BIC Banco, purchased by foreign companies and without accessible documentation proving their income, were excluded from the analysis.At this stage, 55 companies were analysed. Of these, not all companies actively participated in the 10 years surveyed. Table 4 shows a large variation in the portfolio in the period studied. The minimum value found was that of the company COPEL, a drop of 90.29% in 2021. Possibly, this significant drop was due to the troubled period of pandemic caused by COVID-19 that affects the world economy.On the other hand, the highest value found was that of BTG-Pactual, representing a growth of 382.51% in 2019.The result indicates breadth and fluctuation of the portfolio over the last decade.

The analysis of variations showed positive means in seven of the ten years analysed and negative means in the other three years. The highest average appeared in 2019, representing a growth of 48.83%, and the lowest appeared in 2015, representing a decrease of 10.07%. Table 5 shows the individual performance of each company participating in the ISE in the last 10 years. With the COVID-19 pandemic, which devastates the world economy, most companies had negative results in 2020 (61.81%) and in the first quarter of 2021 (73.36%). By the averages of each company in the period studied, it is noted that only three companies had negative results. Cielo, which participated in the ISE between 2014 and 2021, has decreased its performance in the last 5 years. Neo Energia has just entered the ISE in 2021 and has shown negative results in its last two years. Finally, OI, which participated between the years 2012 and 2014, has shown negative results because it is under judicial reorganization. In general, most companies showed positive results. BTG had an average above 95%, considering that it joined the ISE in 2021 and the 1st quarter result dropped just over 5%. This is a consequence of the performance of 2019 (382%), a period in which the company was not yet part of the index. Other companies, such as Movida, Petrobrás and Petrobrás Distribuidora, which participated in the ISE for 1 or 2 years, also had a positive average, even with their last negative results. Most companies had at certain times negative results or a drop in performance compared to previous years, even as ISE participants. When analysing the performance averages of these companies per year, it is possible to notice a negative performance (-10.07%) in 2015. Further on, the pattern is repeated in 2020 and 2021, which can be explained by the pandemic. The results demonstrate that there is a lot of volatility in the financial market, which is impacted by economic, political, sanitary facts and by the international scenario.

FINAL CONSIDERATIONS

The aim of this study was to analyse eco-innovation from the perspective of publicly traded Brazilian companies that are part of the Corporate Sustainability Index (ISE) of Brasil, Bolsa, Balcão (B3). There was a greater concentration of different sectors in the composition of the ISE index in the last decade. The predominant sectors, when suffering sharp fluctuations, can impact the index positively or negatively. When comparing the results of the ISE index with those of the IBOVESPA, ISE results are superior.An annual analysis of the indexes showed greater variations for ISE in the five years, and greater variations for IBOVESPA in the other five years. However, in 2012 and 2015 the difference was small. When analysing the accumulated performance, ISE presented six periods above, two periods below and two periods at the same level of IBOVESPA. When analysing the equivalent performance, ISE presented five periods above and the other five periods at the same level of IBOVESPA. Pearson's correlation test showed strong, direct, positive, and significant correlation (at the level of 1%) between the ISE and IBOVESPA indexes. When analysing the individual performance of companies, it cannot be said that companies listed on ISE provide better results than IBOVESPA. In addition, many companies listed on ISE also have their assets listed on IBOVESPA, which makes it difficult to compare results due to the overlap effect. Many factors can influence business performance. According to the literature, eco-innovation even brings financial benefits to companies that adopt it. However, it is difficult to measure eco-innovation when it is linked to financial performance and this was a limiting factor in this study, which was based on descriptive statistical analyses. To advance on the subject, the suggestion is to develop econometric studies with a greater number of variables that express the performance of companies. Thus, it would be possible to obtain greater accuracy in measuring eco-innovation.

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APPENDIX I

A1: Accumulated and equivalent performance per year

Year	Accumulated ISE	IBOVESPA	Equivalent ISE	IBOVESPA
2012	1,2049	1,0740	1,2049	1,0740
2013	1,2283	0,9075	1,1083	0,9526
2014	1,2044	0,8811	1,0640	0,9587
2015	1,0491	0,7638	1,0120	0,9349
2016	1,1937	1,0612	1,0361	1,0120
2017	1,4015	1,3462	1,0579	1,0508
2018	1,5398	1,5486	1,0636	1,0645
2019	2,0508	2,0376	1,0939	1,0931
2020	2,0574	2,0971	1,0835	1,0858
2021	1,9599	2,0042	1,0696	1,0720
Average			**1,0579**	**1,0508**

Source: Prepared by the authors

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