

REVIEW

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Changes in the climate-related disclosure of German listed companies during the first years of the new reporting standard

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Abstract

The relevance of climate or environment-related reporting has been increasing over the years. Since 2017, the Non-Financial Statement (NFS) has been part of the German reporting of listed companies. In this context, this academic paper examines the development of climate-related disclosure within the NFS. The research design involves a developed disclosure index concerning climate-related reporting within the NFS and a t-Test with dependent variables. The descriptive content analysis is the basis of the study to obtain the input data for the t-Test. The study is based on the NFS of the German Share Index, Mid-Cap-DAX, and Small-Cap-DAX companies. The financial years of the companies are the basis of the observation period 2018–2020. Companies whose financial year differs from the calendar year are also part of the sample. The analysis results show an improvement in climate-related reporting in the NFS across the three periods under review. The length of the NFS increased over the three observation periods. It is possible to deduce that the amount of climate-related topics disclosed in the NFS also increased. Furthermore, the number of disclosed environmental goals increased in the observation periods. This also indicates that companies put climate-related topics more on their reporting over the observation period. It is possible to conclude that the relevance of climate-related reporting has increased over the last three years and may increase in the future.

Keywords: Climate-related reporting, CSR-reporting, Non-financial statement, Sustainability reporting

JEL Classification: M41, Q56

Introduction

The importance of reporting non-financial information is steadily increasing. Before the Corona pandemic, climate change and its consequences for nature and the economy were the most critical topics for corporate stakeholders [1, 2]. Climate activists and associations such as Fridays for Future exert increasing pressure on companies [3]. However, also political actors see companies as obliged to act and are introducing more and more regulations in this regard [4]. Numerous companies are trying to meet these requirements by producing sustainability reports.

The non-financial information reporting is nowadays a norm for capital market-oriented companies of specific sizes since the introduction of the “Corporate Social Responsibility” (CSR) based on the Directive Implementation Act in 2017 [5]. The ruling of 29 Apr 2021 by the Federal Constitutional Court regarding the German government’s climate protection law [6] and current rulings against companies like Shell show political and judicial levels for climate change containment [7]. This is also demonstrated by the two “Green Deals” of the “European Union” (EU) [8] and the “United States of America” (USA) [9], which are initiating the transformation of future energy production with their large investment programs. Therefore, companies are under increasing pressure to make their handling of climate-relevant issues transparent to outsiders and explain how

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management implements measures in this regard [10]. The consequence is a steady increase in published corporate sustainability reports [11], as well as in Germany, the legal obligation “CSR-Richtlinie-Umsetzungsgesetz” (CSR-RUG) of large capital market-oriented companies for sustainability reporting.

This study contributes to the literature in many ways. First, the study contributes to the accounting literature by examining the evolution of sustainability reporting in more detail. In addition, the study provides evidence that sustainability reporting is increasingly changing. Furthermore, the results are of interest to regulators and policymakers who have mandated sustainability reporting in Germany and are considering expanding the scope of companies’ obligations. Therefore, this paper aims to make an up-to-date assessment of the progress of this reporting and to answer how climate-related reporting has developed within the first three years of the “Non-Financial Statement” (NFS). This study consists of various sections. The study starts with an introduction concerning the relevance of the topic. There is a description of the legislative context of the NFS in Europe in the second section. The third section provides an overview of the literature and the state of research on the development of sustainability reporting since it became a legal requirement. The fourth section explains the hypotheses, design, and research methodology. The fifth section provides insights from the analysis. The fifth section presents conclusions and opportunities for further research in turn.

Non-financial reporting in Europe

The European Commission, institutions and professionals have emphasised an update of the European non-financial statement. The foundations of today’s legislation on non-financial disclosure of company information stem from three different points. First on the Accounting Modernization Directive (Directive 2003/51/EC), second on the Non-Financial Information Directive (Directive 2014/95/EU), and third on individual national requirements of each EU member state. The Directive 2003/51/EU was an important initiative of the EU, as it introduced CSR policy by introducing measures on management commentary on financial statements [12]. Nevertheless, it did not lead to the expected success, as disclosing non-financial aspects was regulated without reporting standards and guidelines [13]. Therefore, the EU has revised its CSR strategy and defined the non-financial reporting of EU companies through specific regulations. The EU aims to develop a globally sustainable economy through the Directive 2014/95/EU. Long-term profitability needs to interconnect with environmental protection and social justice to achieve this goal. In doing so, the EU emphasises the NFS, which is intended to measure and monitor

management’s social and environmental results. The main focus was on an essential harmonisation of reporting. The directive requires large companies with more than 500 employees to show information regarding environmental, ethical and social policies. Also regulated are presentation and approach while still leaving much flexibility in the formulation and use of frameworks. The directive was transposed into German national law in March 2017 with the CSR Directive Implementation Act (§289b “German Commercial Code” (HGB)). However, while this should bring initial improvements in comparability, it was found that no significant improvement in transparency occurred due to a lack of standards [14]. Furthermore, different national regulations lead to differences that further complicate comparability [12].

Literature review

Most EU countries have required listed companies to disclose non-financial information in recent years. This information is part of their financial reports or sustainability reports.

This change in non-financial accounting has been perceived in different ways. For example, some authors believe companies should be obliged by law to disclose their information. Because voluntary disclosure often leads to intransparent and not complete data [15–20]. Other authors believe that stand-alone CSR reports tracking sustainable business have not been successful because managers have inadequately interpreted them [21–29]. In order to avoid management’s self-interpretation of CSR meaning, the researchers in the field of social and environmental accounting propose to introduce regulation for more comprehensive and better quality reporting in the interest of society [26, 28, 30]. Authors Gray and Laughlin reiterate this requirement to achieve a minimum set of rules that promote the required CSR behaviour of companies [31]. Mandatory reporting is expected to lead to institutional reforms [28] and allows stakeholders to become part of the process of reporting and decision-making [32]. Based on the presented observations, numerous empirical studies have been carried out. The research topic is whether the introduced rules are an effective instrument for improving the transparency of CSR reporting. In the first instance, the results are unsatisfactory or confusing concerning compliance with various national regulations [33–35]. Also, international studies concerning the efficiency of the EU policies to improve the transparency of management commentaries conclude similarly [13, 36, 37]. However, improvements were noted, with more CSR activities and better reporting quality [38, 39]. Nevertheless, more selective reporting also complies exclusively with the regulations [40]. Many studies are seeing still potential for development

in terms of comparability [41–44] and criticise the "one-size-fits-all" approach towards sustainable practices [45]. The best practice seems to focus on one of the different specific standards [10, 42, 46], which the EU is working on in the European Financial Reporting Advisory Group [47].

Although increasing regulatory and political attention has raised public awareness of climate-related reporting requirements, comparatively less systematic research has been done on this topic [48]. For years, investors and financial analysts have been sceptical and critical of the corporate "environment, social and governance" (ESG) information. In their opinion, it lacks qualitative aspects such as value relevance, comparability, and credibility, and as a result, no financial decision can be made [49–51]. Further, little standardisation exists to date, and few metrics are reported [52–54]. The few studies to date on the impact of the EU Directive provide mixed findings. While ESG information has little relevance even under the new EU Directive [55], some positive impacts on sustainability reporting are evident [56, 57]. Despite the many problems with ESG reporting, institutions, investors, and analysts are demanding more information about a company's sustainability [58]. Many companies are therefore changing their reporting practices based on new guidance and frameworks, such as the EU Directive [59], the EU Regulation [60] and the "Task Force on Climate-Related Financial Disclosures" (TCFD) [61] to improve sustainability disclosures. Companies are, therefore, mainly concerned with increasing information quality and relevance in addition to more information [58]. The assumption is that the quantity of disclosure also affects the quality or transparency of disclosure [62]. Nevertheless, this is not the case, as quantitative measures are often used to proxy disclosure quality [63]. The "Sustainability Accounting Standards Board", "International Integrated Reporting Council" (IIRC) and "Global Reporting Initiative" (GRI) share the same view of increasing the quantity and quality of reporting through reporting frameworks. In this context, this paper aims to provide initial evidence on the potential of the EU Directive as a change agent for the climate-related disclosure of German listed companies. The analysis focuses in particular on the question of whether companies show any further development in the disclosure of climate-related topics since the introduction of the law.

Methodology and data

The law on publishing an NFS has been in force in Germany since the 2017 business year. An analysis of the NFS of listed German companies takes place to achieve the research objective, the change in the NFS regarding climate-related reporting, since the laws' introduction.

The analysis focuses on the one hand on a descriptive content analysis of the NFS concerning climate-related reporting. On the other hand, on a t-Test with dependent variables. The descriptive content analysis is the basis of the study to obtain the input data for the t-Test. Other studies also use descriptive analysis to develop a CSR disclosure index [43, 64]. Therefore, the research design involves a developed "NFS Disclosure Index" (NFSDI) concerning climate-related reporting.

To analyse the development of climate-related reporting in the NFS, the NFSDI builds on the analysis of the following points. Firstly, there is an analysis of the number of words in the NFS. Through this, it should be possible to deduce a development in the detail of the NFS. A challenging aspect is that companies have the option, according to § 315c of the HGB, to integrate the NFS disclosure into another section of the consolidated report. Consequently, the correct allocation of a section to the NFS is not always entirely clear; therefore, detailed content analysis is necessary. Secondly, an analysis of the frameworks in use for the publication of the NFS takes place. In order to be able to establish a connection to climate. Third, an evaluation of the number of disclosed key non-financial performance indicators related to climate occurs. The purpose of this analysis is to determine if there is a change in climate-related reporting over time. Companies take numerous performance indicators into account in reporting. Therefore, a consistent "most significant" classification is counted as a key performance indicator. If the performance indicators are not labelled as "most significant" or as a key performance indicator, the forecast report is useable as a supplement to the analysis. Performance indicators included and forecasted in the business performance analysis and the chapter "Group situation" are counted as "most significant" performance indicators. Fourthly, an analysis of the number of disclosed goals with environmental relevance occurs. The collection of this parameter should also identify development in climate-related reporting. It is necessary to note that companies often do not clearly define whether the published target is a goal or a performance indicator.

The basis of the data collection concerning the NFSDI is three years. This represents the period since the law's introduction. A comparative analysis concerning environmental disclosure before and after the law is not part of this paper, as there was no law to disclose environmental issues. Consequently, the basis of this analysis is the observation period 2018–2020. This observation period separates into the following financial years:

- Observation Period I: 2018 | 2017/2018
- Observation Period II: 2019 | 2018/2019
- Observation Period III: 2020 | 2019/2020

Companies with a differing business year from the calendar year are part of the analysis as well. Therefore, the period under review refers to the years 2017–2020.

According to Thomson Reuters Eikon, the analysis population represents the four German performance indices listed. The four indices are “German Share Index” (DAX), “Mid-Cap-DAX” (MDAX), “Small-Cap-DAX” (SDAX), and “German Share Index Technology DAX” (TecDAX). In total, 190 companies belong to the four German indices. The 30 companies of the TecDAX are part of the MDAX and SDAX, which minimises the sample size of this scientific work to 160 different companies. As the companies in the indices change due to stock market ascents and descents, the companies listed on the cut-off date of 13 Dec 2020 are the basis of the analysis. The adjustment of the population of the 160 companies (DAX, MDAX, SDAX) belongs to the following aspects. Companies that use the right of option § 315b para. 2 HGB are not part of the sample. Furthermore, companies that prepare to deviate consolidated financial statements according to another standard than HGB are not part of the sample. Companies that do not publish consolidated financial statements or have a short financial year in the observation period are not part of the population. In addition, companies that voluntarily publish an NFS despite one of the exemptions mentioned are not part of the population. Based on the listed exemptions and special regulations, the population minimises by 30 companies to a new population of 130 companies. The population divides among the three indices as follows. Twenty-nine companies belong to DAX, 49 are part of the MDAX and 52 are the SDAX.

The collected data of the NFSDI represent the input data for the t-Test with dependent variables. There is a comparison of the mean values of two dependent. The dependent variable in this analysis is the number of companies from all three indices (population). The independent variable represents the respective reporting period. Comparison of the first and second observation periods build the first step of the t-Test. The second step compares the first and third observation periods. The following hypotheses are tested concerning their significance with a t-Test:

- H0: There is no change over the observation periods.
- H1: There is a change in the number of words in the NFS over the observation periods.
- H2: There is a change in framework usage over the observation periods.
- H3: There is a change in the number of environmental goals disclosed over the observation periods.

- H4: There is a change in the number of disclosed non-financial key performance indicators with environmental relevance over the observation periods.

The significance level of the analysis remains at 5% ($\alpha = 0.05$). There is a rejection of H0 if the t-Test firstly shows a “t-value (t Stat)” less than zero. Second, H0 is rejected if the “P-value ($P(T \leq t)$ one-tail)” is greater than standard deviation “ $\alpha = 0.05$ ”. Third, H0 is rejected if “|t-value|” is smaller than the “t Critical one-tail” value. The focus of the rejection of H0 is on the one-tail because it can be assumed that the mean value increases in observation periods II and III. Consequently, there is a change between the observation periods. Furthermore, this implies that development in climate-related reporting throughout observation is recognisable.

The data belongs to different sources. On the one hand, there is the data from Thomson Reuters Eikon regarding the listed companies. On the other hand, there is the data for the NFSDI published by the companies in the NFS, group reports or another separate group report. The reports are downloaded from the companies’ websites. There was a manual data collection for the analysis. The calculation of the t-Test is based on Microsoft Excel.

Results

The results of the t-Test regarding the different hypotheses will be presented and interpreted in the following.

The t-Test results show that H0 for both studies can be rejected, and the counter hypothesis H1: *There is a change in the number of words in the NFS over the observation periods* is confirmed (cf. Fig. 1).

Confirmation of hypothesis H1 suggests that the number of words in the NFS increases across the three observation periods. This further suggests that companies are publishing more content within the NFS and that the disclosure would be required to be detailed. The result does not directly suggest that a higher level of detail is also present for climate-related topics, as only the number of words of the entire NFS was analysed. Nevertheless, it can be assumed that if the total number of words in the NFS increases, the climate-related part of the NFS will also increase. Furthermore, it cannot be deduced from the result whether only the proportion of prose text has increased over the periods under consideration.

The results (cf. Appendix A) of the t-Test concerning framework usage show development towards using specific frameworks over the three observation periods. However, the results are not statistically significant. Therefore the counter hypothesis H2: *There is a change in framework usage over the observation periods* is rejected for all observation periods except one. Only for the GRI

	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	10413,63846	11648,58462	10413,63846	13256,66923
Variance	67271175,72	78428239,08	67271175,72	98774610,87
Observations	130	130	130	130
Pearson Correlation	0,931552457		0,844408688	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	-4,372232353		-6,084600978	
P(T<=t) one-tail	1,2544E-05		6,19493E-09	
t Critical one-tail	1,656751594		1,656751594	
P(T<=t) two-tail	2,5088E-05		1,23899E-08	
t Critical two-tail	1,978524491		1,978524491	

Fig. 1 t-Test Results of a Paired Two Sample for Means—Number of Words of the NFS

framework and comparing the first and second observation periods can H0 be rejected (cf. Appendix A).

The results show that frameworks like the “Eco-Management and Audit Scheme” (EMAS) and TCFD, which have a climate focus, are not used to prepare NFS or are only used once by a few companies. On this basis, it is possible to conclude that companies do not use different frameworks for climate reporting and the other topics with a reporting focus. The absence of the TCFD framework may be that this framework focuses on the combination of financial and non-financial indicators. The implementation of this approach can be challenging for companies as it requires the identification of the climate impact in the company processes and the establishment of the data collection. Furthermore, it indicates that mainly frameworks are used, which are already used by other companies. This conclusion finds confirmation in the results of the statistical analysis of the GRI

framework (cf. Appendix A). Furthermore, the increasing mean values for the “United Nations Global Compact” (UNGC) framework allow this conclusion even if there is no statistical significance (cf. Appendix A). Furthermore, the results show that companies switch from other frameworks to the GRI framework, especially when comparing the first and second observation periods. This assumption seems to be supported by the statistical significance. In addition, this assumption reflects in Fig. 2 for the “German Sustainability Code” (DNK), IIRC and “Sustainable Development Goals” (SDG) frameworks. One possible reason companies primarily use GRI may be that it is an international framework. Because the analysed companies are mainly internationally operating, an internationally accepted framework can be advantageous for international comparisons. Comparing results between the first and third observation periods suggests that companies change their decision regarding using

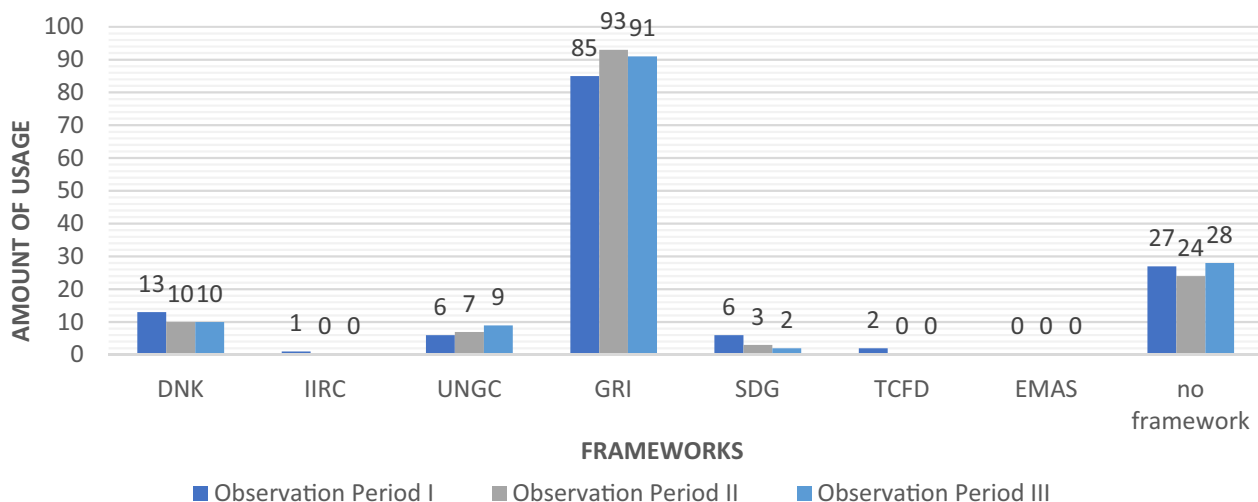


Fig. 2 Framework Usage in the three Observation Periods

the framework, especially after the first reporting year. The comparison of the first and third observation periods does not show statistical significance in any analysis (cf. Appendix A). Furthermore, even if there is no statistical significance, the results show that more companies do not use a framework for preparing the NFS over time in comparing mean values. The increased use of no framework in observation period III assumes that companies do not want to use NFS reporting requirements. This may be because companies do not want to report on every mandatory topic. Furthermore, this allows companies to create primarily prose text, meaning critical topics can be omitted or rewritten.

Figure 3 shows the t-Test results concerning the counter hypothesis H3: *There is a change in the number of environmental goals disclosed over the observation periods*. The results confirm H3 and a rejection of H0 for both analyses.

The results suggest that companies' environmental goals have increased since the NFS became mandatory. This allows the conclusion that the companies are increasingly addressing the issue of climate and are willing to contribute to climate protection. The increasing disclosure of climate-related goals can also respond to the stakeholders' requirements. Stakeholders are increasingly expecting companies to address climate change and the company's impact on the climate. Furthermore, investors are increasingly searching for companies that positively contribute to mitigating climate change. These results cannot deduce the extent to which the disclosed environmental goals are realisable. The effect of the targets on climate protection cannot be concluded from these results either.

The results (cf. Appendix B) of the t-Test analysis show a rejection of the counter hypothesis H4: *There is a change in the number of disclosed non-financial key performance indicators with environmental relevance over*

the observation periods. Consequently, the findings indicate the following. Since the law's introduction, companies have increasingly published environment-related key performance indicators. It is reasonable to assume that environmental indicators continue to be used more frequently. However, the development is too small for these assumptions to be statistically verifiable. However, the results show that the number of disclosed key climate-related performance indicators increases slightly. As these results do not show any statistical significance, this statement is not statistically verifiable. Consequently, it is reasonable to assume that the companies publish environmental goals, but these are not measured using non-financial performance indicators. This concludes that only the proportion of prose text in the NFS increases. At the same time, it is possible to conclude that the companies do not want to be measured against the published environmental goals, as the proportion of key figures has not grown in the same proportion as the disclosed environmental goals.

In conclusion, it is possible to state that the development of the NFS regarding climate-related topics since the introduction of the law is noticeable. This statement finds its basis primarily because the number of disclosed words of the NFS is increasing across all three observation periods. Furthermore, the number of disclosed environment-related goals is increasing. This also indicates the ongoing development regarding climate relevance. The development of framework usage and disclosed non-financial key performance indicators with environmental relevance also shows an NFS development. There is a change in framework usage, especially after the first reporting year. The implementation of the TCFD approach focuses on the combination of the financial and non-financial indicators, which can be challenging and can be a reason for less or no usage of this framework in the different observation periods. This

	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	3,315384615	3,707692308	3,315384615	3,738461538
Variance	5,023792487	6,394514013	5,023792487	6,101610018
Observations	130	130	130	130
Pearson Correlation	0,827437125		0,706684202	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	-3,132721821		-2,655329062	
P(T<=t) one-tail	0,001071878		0,004460955	
t Critical one-tail	1,656751594		1,656751594	
P(T<=t) two-tail	0,002143757		0,008921911	
t Critical two-tail	1,978524491		1,978524491	

Fig. 3 t-Test Results of a Paired Two Sample for Means—Number of Disclosed Environmental Goals

assumption also can be supported by the not statistically verifiable increase in non-financial climate-related key performance indicators. The results and their interpretation of this research can vary due to limitations. The data generated using the NFSDI for the t-test analysis can vary due to different reasons. One of these is the number of words in the NFS collected by hand. Furthermore, sections in other reports could not permanently be assigned to the NFS. Therefore, the number of words may vary depending on the observer. The number of environmental goals is a limitation as well. Companies do not continually clearly formulate the disclosed climate-related goals as objectives so the number may vary depending on the observer. Other limitations that affect the results of the t-test are the number of samples and the period of the analysis. Expanding the sample size could lead to different results. Furthermore, the study period of three years is short, which means that a change in the observation period could also lead to different results.

Conclusion

The literature review shows many studies dealing with CSR and ESG disclosure. Many studies deal with the analysis of voluntary and statutory disclosure and its effects on the company. Furthermore, the studies focus on the comparability and transparency of the reports for the addressees of the financial statements. The different analyses apply to listed German companies and other companies worldwide. However, the existing literature regarding NFS development in Germany is still limited. There are already some studies that examine one or two years of the NFS of German companies.

These analyses examine the entire NFS and not just individual topics such as climate. In general, it is possible to answer the research question as follows. The described results and their interpretation show that the NFS show development towards more climate relation in the NFS since the law's introduction. However, further development of the reporting is necessary. Firstly, the legal requirements need to be more detailed to provide clear guidance and expectations for preparers of financial statements and NFS. As a result, the transparency and comparability of reporting to users of financial statements increases. Furthermore, this minimises the possibility of reporting that does not meet the objectives. Secondly, reporting must also develop further in terms of measurable variables. On the one hand, this should regulate how the correlation of climate impacts on the financial key figures of the companies is to be reported in the future. On the other hand, statistically reliable results can be generated for future analyses. It should be noted that there is a need for further research, especially on the development of the NFS in Germany. Other topics such as labour and social issues could also be precisely analysed. Comparing sustainability reporting beyond the NFS in Germany is also possible to compare the development of climate awareness between German companies or other countries.

Appendix

Appendix A t-test results of a paired two sample for means—framework usage

German Sustainability Code (DNK) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.1	0.076923077	0.1	0.076923077
Variance	0.090697674	0.071556351	0.090697674	0.071556351
Observations	130	130	130	130
Pearson Correlation	0.769800359		0.673575314	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	1.345820363		1.135151205	
P(T ≤ t) one-tail	0.090360494		0.129208358	
t Critical one-tail	1.656751594		1.656751594	
P(T ≤ t) two-tail	0.180720988		0.258416715	
t Critical two-tail	1.978524491		1.978524491	
International Integrated Reporting Council (IIRC) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.007692308	0	0.007692308	0
Variance	0.007692308	0	0.007692308	0

International Integrated Reporting Council (IIRC) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Observations	130	130	130	130
Pearson Correlation	#DIV/0!		#DIV/0!	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	1		1	
P(T ≤ t) one-tail	0.159591305		0.159591305	
t Critical one-tail	1.656751594		1.656751594	
P(T ≤ t) two-tail	0.31918261		0.31918261	
t Critical two-tail	1.978524491		1.978524491	
United Nations Global Compact (UNGC) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.046153846	0.053846154	0.046153846	0.069230769
Variance	0.044364937	0.051341682	0.044364937	0.064937388
Observations	130	130	130	130
Pearson Correlation	0.922079397		0.662133944	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	−1		−1.345820363	
P(T ≤ t) one-tail	0.159591305		0.090360494	
t Critical one-tail	1.656751594		1.656751594	
P(T ≤ t) two-tail	0.31918261		0.180720988	
t Critical two-tail	1.978524491		1.978524491	
Global Reporting Initiative (GRI) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.653846154	0.715384615	0.653846154	0.7
Variance	0.228085868	0.205187835	0.228085868	0.211627907
Observations	130	130	130	130
Pearson Correlation	0.75938768		0.617465478	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	−2.168316059		−1.28237121	
P(T ≤ t) one-tail	0.015984748		0.101006041	
t Critical one-tail	1.656751594		1.656751594	
P(T ≤ t) two-tail	0.031969495		0.202012082	
t Critical two-tail	1.978524491		1.978524491	
Sustainable Development Goals (SDG) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.046153846	0.023076923	0.046153846	0.015384615
Variance	0.044364937	0.022719141	0.044364937	0.015265355
Observations	130	130	130	130
Pearson Correlation	0.698705214		0.568257571	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	1.745635728		2.023669463	
P(T ≤ t) one-tail	0.04162759		0.022534938	

Sustainable Development Goals (SDG) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
t Critical one-tail	1.656751594		1.656751594	
P(T < = t) two-tail	0.083255179		0.045069875	
t Critical two-tail	1.978524491		1.978524491	
Task Force on Climate-related Financial Disclosures (TCFD) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.015384615	0	0.015384615	0
Variance	0.015265355	0	0.015265355	0
Observations	130	130	130	130
Pearson Correlation	#DIV/0!		#DIV/0!	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	1.419727086		1.419727086	
P(T < = t) one-tail	0.079049619		0.079049619	
t Critical one-tail	1.656751594		1.656751594	
P(T < = t) two-tail	0.158099238		0.158099238	
t Critical two-tail	1.978524491		1.978524491	
Eco-Management and Audit Scheme (EMAS) framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0	0	0	0
Variance	0	0	0	0
Observations	130	130	130	130
Pearson Correlation	#DIV/0!		#DIV/0!	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	#DIV/0!		#DIV/0!	
P(T < = t) one-tail	#DIV/0!		#DIV/0!	
t Critical one-tail	#DIV/0!		#DIV/0!	
P(T < = t) two-tail	#DIV/0!		#DIV/0!	
t Critical two-tail	#DIV/0!		#DIV/0!	
No framework	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.207692308	0.184615385	0.207692308	0.215384615
Variance	0.165831843	0.151699463	0.165831843	0.170304114
Observations	130	130	130	130
Pearson Correlation	0.782747478		0.65430663	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	1		-0.257269875	
P(T < = t) one-tail	0.159591305		0.398690181	
t Critical one-tail	1.656751594		1.656751594	
P(T < = t) two-tail	0.31918261		0.797380362	
t Critical two-tail	1.978524491		1.978524491	

Appendix B t-Test Results of a Paired Two Sample for Means—Number of Disclosed non-financial Key Performance Indicators with Environmental Relevance

	Observation Period I	Observation Period II	Observation Period I	Observation Period III
Mean	0.092307692	0.107692308	0.092307692	0.146153846
Variance	0.17745975	0.18986285	0.17745975	0.218783542
Observations	130	130	130	130
Pearson Correlation	0.790060915		0.403101028	
Hypothesized Mean Difference	0		0	
df	129		129	
t Stat	−0.630989816		−1.260076193	
P(T ≤ t) one-tail	0.264581783		0.104958308	
t Critical one-tail	1.656751594		1.656751594	
P(T ≤ t) two-tail	0.529163565		0.209916616	
t Critical two-tail	1.978524491		1.978524491	

Abbreviations

CSR: Corporate Social Responsibility; CSR-RUG: CSR-Richtlinie-Umsetzungsgesetz; DAX: German Share Index; DNK: German Sustainability Code; ESG: Environment, Social, Governance; EMAS: Eco-Management and Audit Scheme; EU: European Union; GRI: Global Reporting Initiative; HGB: German Commercial Code; IIRC: International Integrated Reporting Council; MDAX: Mid-Cap-DAX; NFD: Non-Financial Disclosure; NFS: Non-Financial Statement; NFSDI: Non-Financial Statement Disclosure Index; SDAX: Small-Cap-DAX; SDG: Sustainable Development Goals; TCFD: Task Force on Climate-related Financial Disclosures; TecDAX: German Share Index Technology DAX; UNGC: United Nations Global Compact; USA: United States of America.

Authors' contributions

Both authors contributed to the completion of this article, from conceptualisation to the concluding remark. JBL: Methodology and Data, Results and Conclusion | ML: Introduction, Non-Financial and Literature Review. All authors read and approved the final manuscript.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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