Swiss Journal of Business

Established 1947 as *Die Unternehmung*

Published on behalf of the Schweizerische Gesellschaft für Betriebswirtschaft (SGB)

Editors

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Research Articles

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Jörg Müller
The Energy Crisis as a Game Changer for Sustainable Investing?

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Contents

Editorial 361

Articles

Anna Eifert, Christian Julmi
Unlocking Organizational Atmospheres: Utilizing Employer Reviews and Dictionary-Based Analysis 363

Jörg Müller
The Energy Crisis as a Game Changer for Sustainable Investing? 387

Patricia Ruffing-Straube, Saverio Olivito
Value Creation Reporting for Sustainable Development – Is Sustainability Information Integrated with Financial Information? 418

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Editorial

As this year is coming to a close, I look back with great joy and gratitude on a successful first year for the *Swiss Journal of Business (SJB)*. With the support of our long-standing publishing partner *Nomos*, we have not only successfully transitioned to open access, but also significantly increased the number of submissions, published articles and article views to over 100,000. This encourages us to continue on this path in the future.
This last issue takes up three current topics in organization and sustainability research and practice:

- *Anna Eifert* and *Christian Julmi* investigate in their mixed-method design research study organizational atmospheres by combining quantitative frequency and dimensional analyses with qualitative content analysis to uncover the drivers behind specific atmospheres. By using the validated text analysis tool GANAiO and an exploratory approach, they analyze through dictionary-based content analysis online employer reviews of three major parcel delivery companies in Germany. As a result *Eifert* and *Julmi* empirically identify recurring patterns, atmosphere types, and affective dimensions. Their findings reveal distinct differences in atmosphere types across organizations and over time, offering theoretical and practical insights into how employees perceive and describe organizational atmospheres and how these can be systematically studied.
- In the second paper of this open issue *Jörg Müller* examines the financial outcomes of investments in stocks with varying degrees of ESG-rated sustainability before and after the energy crisis that began to unfold in 2021. His paper analyses whether the energy crisis has caused improvements or deteriorations in the performance of more-sustainable compared to less-sustainable stock investments. *Müller* addresses an apparent gap in the existing literature, where interdependencies among the risk–return profiles of stocks and the ESG ratings of their issuers have so far garnered little attention in the context of the energy crisis. His results suggest that the energy crisis has triggered significant changes in the risk-return profile of securities issued by companies deemed sustainable versus those classified as less sustainable. Compared to previous crises with other economic backgrounds, more-sustainable stocks showed similar behavior relative to less-sustainable ones. *Müller's* findings carry implications for asset managers and economic policymakers in terms of their decision-making with regard to the configuration of subsidies
- The transition to more sustainable economic development is at the heart of the Agenda 2030 for Sustainable Development by the United Nations. This leads to a broader definition of value that integrates social and environmental aspects alongside economic value. In the third paper of this open issue *Patricia Ruffing-Straube* and *Saverio Olivito* derive a structure for the analysis of reporting on sustainable value creation based on actual reporting decisions. Structuring the disclosures on sustainable value creation focuses on presentation, integration, measurement and aggregation. *Ruffing-Straube* and *Olivito* further provide descriptive evidence on firms' reporting decisions on sustainable value creation by manually analysing the reports of the 20 largest Swiss companies from 2013–2022 and the 2022 reports of the 50 largest EU listed companies. Their

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analysis suggests a substantial increase in reporting on sustainable value creation over time with slightly more than 50 % of firms reporting on sustainable value creation in 2022. Firms tend to report in visual form and focus on prior year realizations of measures in the environmental and social areas. Firms' impacts and dependencies on people and planet are vaguely integrated with financial considerations and dependencies are rarely addressed. Aggregated or forward-looking measures are largely missing.

We hope that this issue will provide you at the closing of this year with more inspiring insights into current topics in business and management as well as surprising and revealing „aha" moments for further research. We would like to thank all the authors involved in this issue for their insightful contributions. A special thanks go to our dedicated reviewers, who again have made a significant contribution to the quality of this issue. We hope you enjoy reading this final issue of the *Swiss Journal of Business* for 2025 and wish you all the best for the upcoming holiday season and the start of the New Year, which will open the doors to our 80th volume of the *Swiss Journal of Business (*Established 1947 as *Die Unternehmung)*.

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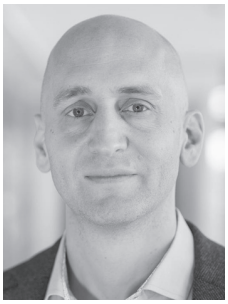
Unlocking Organizational Atmospheres: Utilizing Employer Reviews and Dictionary-Based Analysis



Anna Eifert, Christian Julmi

Abstract: This study investigates organizational atmospheres through dictionary-based content analysis of online employer reviews. Using the validated text analysis tool GANAiO and an exploratory approach, we analyze reviews of three major parcel delivery companies in Germany. We empirically identify recurring patterns, atmosphere types, and affective dimensions. Our mixed-method design combines quantitative frequency and dimensional analyses with qualitative content analysis to uncover the drivers behind specific atmospheres. The findings reveal distinct differences in atmosphere types across organizations and over time, offering theoretical and practical insights into how employees perceive and describe organizational atmospheres and how these can be systematically studied.

Keywords: heuristic methods, organizational psychology, business development, organizational atmospheres

Organisationale Atmosphären entschlüsseln: Eine Analyse von Arbeitgeberbewertungen mit diktionärsbasierten Verfahren

Zusammenfassung: Diese Studie untersucht organisationale Atmosphären mittels diktionärsbasierter Verfahren von Online-Arbeitgeberbewertungen. Unter Verwendung des validierten Textanalysetools GANAiO und eines explorativen Ansatzes analysieren wir Bewertungen von drei großen Paketzustellern in Deutschland. Empirisch identifizieren wir wiederkehrende Muster, Atmosphärentypen und affektive Dimensionen. Unser Mixed-Methods-Design kombiniert quantitative Häufigkeits- und Dimensionsanalysen mit einer qualitativen Inhaltsanalyse, um die Treiber spezifischer Atmosphären aufzudecken. Die Ergebnisse zeigen deutliche Unterschiede in den Atmosphärentypen zwischen Organisationen und über die Zeit hinweg auf und bieten theoretische wie praktische Einblicke darin, wie Mitarbeiter organisatorische Atmosphären wahrnehmen und beschreiben und wie diese systematisch untersucht werden können.

Stichwörter: Heuristische Verfahren, Organisationspsychologie, Unternehmensentwicklung, Organisationale Atmosphären

1. Introduction

Recently, organizational atmospheres are receiving growing scholarly attention (Jørgensen & Beyes, 2023; Julmi, 2017b). Generally, the work atmosphere can be defined as the affectively perceived quality of the immediate work environment. It constitutes a perva-

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sive yet intangible phenomenon that surrounds individuals in a given space and shapes their experiences and behaviors (Julmi et al., 2024, p. 1). In organizational settings, they manifest in various ways—whether it is the uneasy tension during a performance review or the uplifting mood of a team celebration. These atmospheres are often instantly perceptible and can profoundly shape interactions, decisions, and overall experiences within the workplace. This stands in contrast to organizational culture, which refers to a set of established norms, values, and behaviors within an organization that are conveyed to new members through a socialization process (Schein & Schein, 2017). While organizational culture is an abstract, cognitive construct that is both challenging to grasp and resistant to change, the work atmosphere is an affective phenomenon that is intuitively accessible, situational, can shift rapidly and may coexist in diverse, even conflicting forms (Julmi, 2017c). Accordingly, atmospheric patterns capture not uniformity but the affective polyphony of organizational life. Despite their critical role in shaping employee satisfaction, productivity, well-being, and employer choice (Ashraf, 2019; Julmi et al., 2024; Radermacher & Herdejürgen, 2022), work atmospheres have so far received little attention in empirical organizational research—unlike the extensively studied concepts of organizational culture and climate (Ehrhart & Schneider, 2016; Giorgi et al., 2015).

The concept of atmospheres has only recently gained traction in organizational research, emerging prominently over the last decade (Jørgensen & Beyes, 2023). While their importance is widely recognized, much of the existing research has concentrated on practices aimed at deliberately shaping atmospheres. For example, De Molli et al. (2020) explore how the atmosphere of a film festival was intentionally crafted, while Leclair (2023) examines how atmospheres contribute to enhancing creativity processes. Additionally, researchers have investigated the role of atmospheres in facilitating learning (Elmholdt et al., 2018; Michels & Beyes, 2016; Michels et al., 2020; Thedvall, 2017; Wolf, 2019) and sensemaking processes (Knight et al., 2025; Vitry et al., 2020).

However, despite these advances, a critical research gap remains: Due to the lack of systematic empirical investigations into how organizational atmospheres manifest, differ, and exert influence, we still know relatively little about the types of atmospheres that emerge in organizational contexts. Without empirically grounded insights, it is difficult to develop a coherent theoretical framework. As a result, both academic theorizing and practical applications risk being built on vague assumptions rather than robust evidence.

In an initial attempt to address this gap, Eifert and Julmi (2025) developed the German Affective Norms for Atmospheres in Organizations (GANAiO)—a dictionary-based tool for computer-aided text analysis. They propose eleven distinct categories of organizational atmospheres. GANAiO offers considerable potential for theory development, particularly when applied to large-scale textual data (Hannigan et al., 2019; McKenny et al., 2018; Short et al., 2018). In this context, the employer review platform kununu serves as a valuable data source: unlike general review platforms, it explicitly prompts users to reflect on the work atmosphere in their organization (kununu, 2023). These reviews provide rich, naturalistic descriptions of employees' lived experiences of organizational atmospheres.

Recognizing the theoretical potential of combining a validated text analysis tool like GANAiO with a large corpus of atmosphere-related employee narratives, this study aims to take a first step toward empirically identifying typical organizational atmospheres and discovering how they change over time by applying GANAiO to kununu reviews. Given the novelty of applying GANAiO to analyze organizational atmospheres, our study adopts

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an exploratory approach rather than a confirmatory or hypothesis-driven one. The primary objective is to uncover underlying patterns and dimensions within the data, particularly as the use of this dictionary in the context of organizational atmosphere has not been tested in prior research. By focusing on discovery, we aim to identify relevant trends and relationships that can serve as the foundation for future, more focused hypothesis testing. This approach allows for a more open-ended exploration of the complexities of organizational atmospheres, where predefined hypotheses may limit the identification of unexpected or nuanced findings.

This article is structured as follows: Firstly, we look at the theoretical background of atmospheres in organizations and the research concerning typical atmospheres and their relationships. Next, we describe the methodology employed in this study. The results section presents the key findings of our analysis, followed by a discussion of their implications. We then address the limitations of our study before concluding our paper.

2. Theoretical background

To situate our study theoretically, we begin by examining how atmospheres have been conceptualized in terms of affect and emotional experience. Schmitz et al. (2011) think of atmospheres as affective phenomena. Meanwhile, Russell and Pratt (1980, p. 311) try to grasp the meaning of affect and define it "as emotion expressed in language". They investigate the affective quality of environments, which they describe as "the emotion-inducing quality that persons verbally attribute to that place" (Russell & Pratt, 1980, pp. 311–312). To analyze these qualities, they propose a framework based on two dimensions: pleasure-displeasure and arousal-sleepiness. For instance, an environment that combines sleepiness and pleasantness is characterized as relaxing, while one that is both unpleasant and arousing is described as distressing.

While Russell and Pratt's (1980) framework adopts a dualistic perspective—strictly separating the environmental stimulus from its affective response—Julmi (2022) proposes a non-dualistic understanding of atmospheres. In this view, atmospheres and their effects are intertwined: for example, an atmosphere of sadness both evokes sadness in individuals and simultaneously renders the environment itself gloomy. Nonetheless, Julmi (2015, 2017a, 2022, 2024) builds on Russell and Pratt's (1980) model and introduces the circumplex model of affective atmospheres (figure 1), offering a refined framework for analyzing and understanding affective atmospheres. He conceptualizes atmospheres along the dimensions of inviting and repellent atmospheres, corresponding to pleasure and displeasure (valence dimension), and narrowing and widening atmospheres, corresponding to arousing and sleepy (arousal dimension) (for a discussion see Julmi, 2022). Inviting atmospheres draw individuals in, fostering engagement, while repellent atmospheres create an urge to leave. Narrowing atmospheres concentrate attention inward, emphasizing the spatially felt "here", whereas widening atmospheres promote a sense of expansiveness, detachment, or openness to the surrounding space. Combining these dimensions yields four ideal atmosphere types: repellent-narrowing, inviting-narrowing, repellent-widening, and inviting-widening. As is common in circumplex models, the specific arrangement of axes (i.e., which dimension is placed on which axis) is arbitrary and does not affect the conceptual interpretation of the model.

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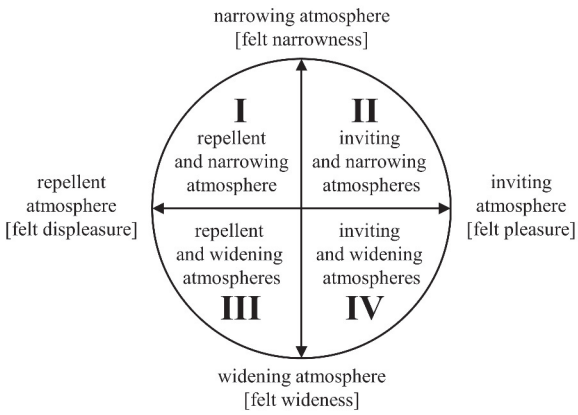

Figure 1: The circumplex model of affective atmospheres (Julmi, 2022)

Building on this model, recent research has begun to explore the concrete forms that organizational atmospheres can take. Notably, Eifert and Julmi (2025) identify eleven distinct atmosphere types within organizational contexts: feel-good, family, trust, team, start-up, open-plan-office, competitive, pressure-laden, surveillance, anxiety, and toxic. These atmosphere types can be tentatively grouped along the dimensions proposed in the circumplex model of affective atmospheres: while feel-good, family, trust, team, and start-up atmospheres tend to be inviting and widening, competitive, pressure-laden, surveillance, anxiety, and toxic atmospheres are more often repellent and narrowing. The open-plan-office atmosphere, in contrast, appears more ambivalent, comprising both inviting and repellent elements depending on contextual factors.

Furthermore, each atmosphere type is characterized by a specific vocabulary. For instance, a trust atmosphere is typically associated with terms such as honesty, sincerity, and sympathy, whereas a surveillance atmosphere is marked by notions of control and suspicion. These lexical markers not only help to distinguish different atmosphere types but also suggest that atmospheres can be identified and analyzed through the language used to describe them.

However, the categorization of atmospheres remains at an early stage. While initial findings indicate distinct patterns, possible overlaps between categories—for example between toxic and anxiety atmospheres—highlight the need for further conceptual refinement. By identifying typical atmospheres described on kununu and uncovering underlying patterns and dimensions within the data, hypotheses about the relationships between different atmosphere types (e.g., anxiety and toxic) can be developed. This contributes to advancing the empirical and theoretical understanding of work atmospheres.

The following section outlines the methodological approach used to gain deeper insight into these typical organizational atmospheres.

3. Methodology

3.1 Analytical approach

To research types of organizational atmospheres, we applied a computer-assisted text analysis approach to employer reviews. Our methodology builds on GANAiO, a dictionary

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specifically developed for analyzing verbal descriptions of work atmospheres (Eifert & Julmi, 2025). In this study, we use GANAiO to classify large volumes of unstructured text data by identifying recurring patterns of how different atmospheres are described. The analysis combines a categorical perspective—assigning reviews to one or more of eleven distinct atmosphere types (e.g., toxic, start-up)—with a dimensional perspective that captures how pleasant or unpleasant (valence: -4 to +4) and how calming or activating (arousal: 1 to 9) an atmosphere is perceived. These scale ranges reflect the scoring system of the GANAiO dictionary, which uses a centered valence scale (to indicate polarity) and a unidirectional arousal scale (to indicate intensity).

To gain insight into the factors underlying these patterns, we complemented the dictionary-based analysis with qualitative methods. GANAiO's categorical approach allowed us to filter out reviews relevant to particularly salient developments. Building on this, we conducted an inductive analysis using MAXQDA, following the coding principles outlined by Gioia (2021). This enabled us to identify the drivers behind specific atmosphere types and to better understand the potential organizational, contextual, and experiential factors associated with their emergence and transformation. The integration of both quantitative and qualitative approaches thus offers a richer understanding of how employees experience and interpret the atmosphere in their organizations.

3.2 Data source and case selection

To empirically identify typical organizational atmospheres using GANAiO, we aimed to access a data source that would enable large-scale, naturalistic insight into employees' subjective experiences. Employer reviews offered a promising foundation for this purpose, as they capture firsthand reflections on workplace culture (Höllig, 2021, 2022) and atmosphere. We chose kununu —a major employer review platform in German-speaking countries—because it systematically collects structured feedback from current and former employees as well as applicants. This platform provides both qualitative narratives and quantitative ratings across multiple organizational dimensions, including corporate culture, diversity, working environment, and career & salary. Within the corporate culture section, reviewers are explicitly asked to describe the work atmosphere, leadership behavior, team spirit, communication, work-life balance, and the presence of interesting tasks. Each of these dimensions is also rated on a scale from 1 to 5, offering both qualitative and quantitative insights into organizational dynamics. Since GANAiO is specifically designed for German-language analysis, kununu's German-language reviews offered the ideal linguistic basis for our study.

To generate meaningful and comparable insights, we selected three major German parcel delivery companies—DHL, Hermes, and DPD—as case studies. These organizations were chosen for several reasons: First, parcel carriers are among the largest employers in Germany. Their large workforce is reflected in a substantial volume of employer reviews on kununu, providing a robust and empirically relevant dataset from which reliable insights into typical atmospheres within each organization can be derived. Second, selecting companies from the same industry sector ensures a high degree of contextual comparability. All three organizations operate under similar external conditions, including time pressure, tight delivery schedules, frequent customer interaction, and physically demanding tasks. Third, given these shared contextual factors, differences in the perceived work atmospheres are likely to result from internal organizational factors—such as leadership

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behavior and management practices—rather than sector-specific conditions. This enhances the validity of cross-case comparisons and strengthens the explanatory power of the findings. Thus, we collected employer reviews of these three parcel carriers from the kununu platform, spanning from 2013 to 2022. Our dataset comprises comments on various aspects including the work atmosphere, communication, team spirit, leadership behavior, work-life balance, and interesting tasks, as research shows the relevance of these aspects for work atmospheres (Radermacher & Herdejürgen, 2022).

3.3 Data processing and analysis

Before applying the dictionary and analyzing the kununu data, we prioritized text preprocessing as a critical step in our research. This step is essential for ensuring high data quality and enhancing the reliability and validity of our results. The goal of preprocessing is to eliminate irrelevant text passages that may obscure meaningful patterns and consequently compromise the quality of text classification (Chai, 2023; Hickman et al., 2022; Kobayashi et al., 2018; Nandwani & Verma, 2021).

We closely followed the recommendations outlined by Hickman et al. (2022), derived from a systematic literature review in organizational research. Our preprocessing steps included tokenization, converting all letters to lowercase, and handling negations to avoid misinterpretation of results. Unlike the traditional approach of removing stop words, we opted not to include this step, as Hickman et al. (2022) suggest that the choice of dictionary determines whether stop words are considered in the analysis. Finally, we lemmatized all words —that is, we reduced words to their base or dictionary form (e.g., *running* → *run*)— to maintain consistency with the lemmatized corpus of our dictionary (Hickman et al., 2022). These preprocessing steps were implemented using Python version 3.11.5 to ensure efficiency and accuracy in our analysis (Reid et al., 2023).

After preprocessing our data, we proceeded to apply both categorical and dimensional models. Using the categorical dictionary, we analyzed how frequently employees of the parcel carriers described specific types of atmospheres. The frequency was calculated by counting how often each word appeared in the comments for a company and adjusting for the number of words in each dictionary category. Simultaneously, employing the dimensional model, we positioned the employer reviews within the valence-arousal space, enabling us to quantify the described atmosphere. In addition, we calculated the average atmosphere ratings for each type per company. We applied the categorical dictionary to identify all comments containing at least one word from a given atmosphere type. For these matched comments, we extracted the corresponding atmosphere ratings from kununu (1–5 scale) and computed the arithmetic mean.

To allow for meaningful comparisons across atmosphere types and companies, we calculated the normalized frequency of atmosphere-related words (NFARW, per 100,000 words). This measure reflects how frequently employees used words from a specific atmosphere category in their reviews for a given company, relative to the size of the category and the total word count. To avoid extremely small decimal values and improve readability, the resulting score was multiplied by 100,000. The normalization itself—ensuring comparability—was achieved by dividing the number of matching words by both the number of words in the respective category and the total number of words in all comments for the company (i.e., NFARW = number of word matches in company comments / category word size / total word count × 100,000).

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In our analysis, we compared the atmospheres of the three German parcel carriers. Next, we conducted an in-depth analysis of DHL to gain more insights as to, e.g., how an atmosphere changes over time. To this end, we conducted a time series analysis from 2013 to 2022. On one hand, we examined how frequently the atmosphere types at DHL were described on kununu over time. In that regard, we focused on comments with a rate of at least 0.02, meaning that at least 1 in 50 words was used to describe a specific atmosphere type (see figures 8 and 9). On the other hand, we also calculated the average atmosphere ratings without applying a quota, as there were often no hits with a quota, resulting in a rating of 0 (see figures 10 and 11). In addition, using the categorical approach, we subjected comments to a qualitative inductive content analysis to identify themes contributing to the prevailing work atmosphere. We also conducted word frequency analyses to further support our findings.

4. Results

4.1 Comparative analysis of DHL, Hermes and DPD

We used bar charts and scatter plots to depict the results of our analysis. Figures 2 and 3 illustrate the NFARW values across companies and atmosphere types. In line with the results of Julmi et al.'s (2024) empirical study, we divided the results into categories of supposedly pleasant and unpleasant atmospheres (see section 2). As their study further revealed that the open-plan office atmosphere cannot be distinctly categorized as either positive or negative but rather lies somewhere in between, we have excluded it from our analysis.

The bar charts reveal that multiple types of atmospheres, both positive and negative, can coexist within a single organization. Notably, differences between the three parcel carriers are evident. Deutsche Post & DHL (hereinafter DHL) have relatively fewer descriptions of good atmospheres and more of bad atmospheres.

Compared to DHL and DPD, Hermes stands out for its notably positive organizational atmosphere, achieving the highest scores in four out of five categories of good atmospheres. The most pronounced difference appears in the trust atmosphere: Hermes reaches a NFARW score of 4.52, markedly higher than DPD's 3.49 and DHL's 2.57. This indicates that a trust atmosphere is described considerably more frequently at Hermes than at its competitors. Interestingly, start-up atmospheres are rarely reported in the parcel industry, and team atmospheres are less frequently described compared to feel-good atmospheres.

Regarding negative atmospheres, it is apparent that Hermes and DPD show similar scores, while DHL exhibits higher scores across all types of bad atmospheres. DHL, in particular, scores higher in fear, pressure, and surveillance atmospheres. Despite the lower frequency of team atmospheres, one might argue that competitive atmospheres are more prominent. However, this is not the case in any of the three companies.

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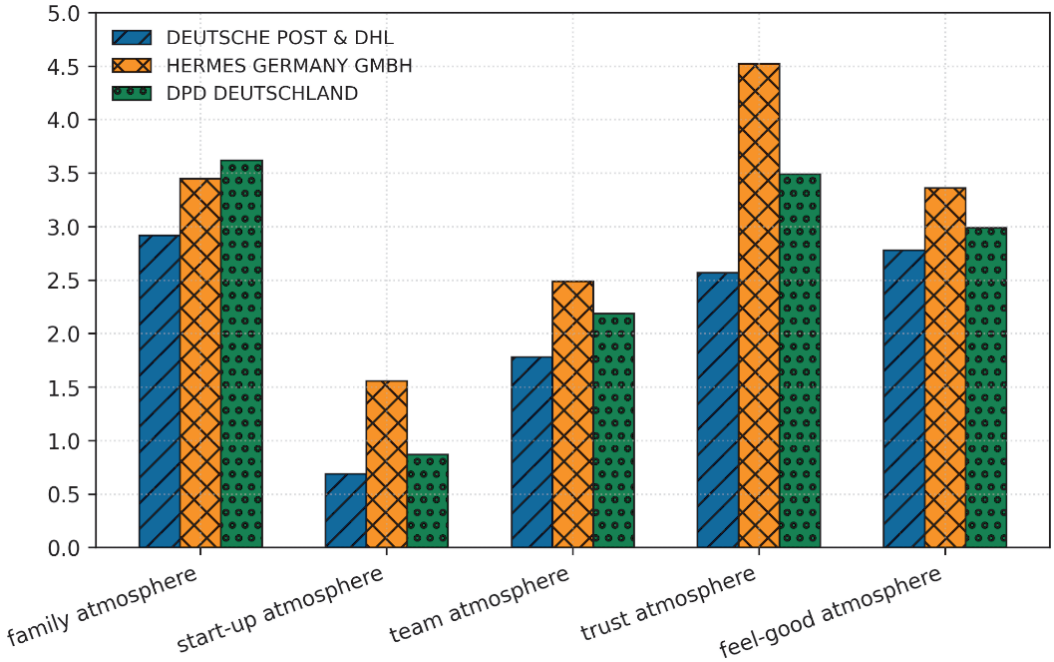

Figure 2: NFARWs of positive atmospheres of parcel carriers in Germany

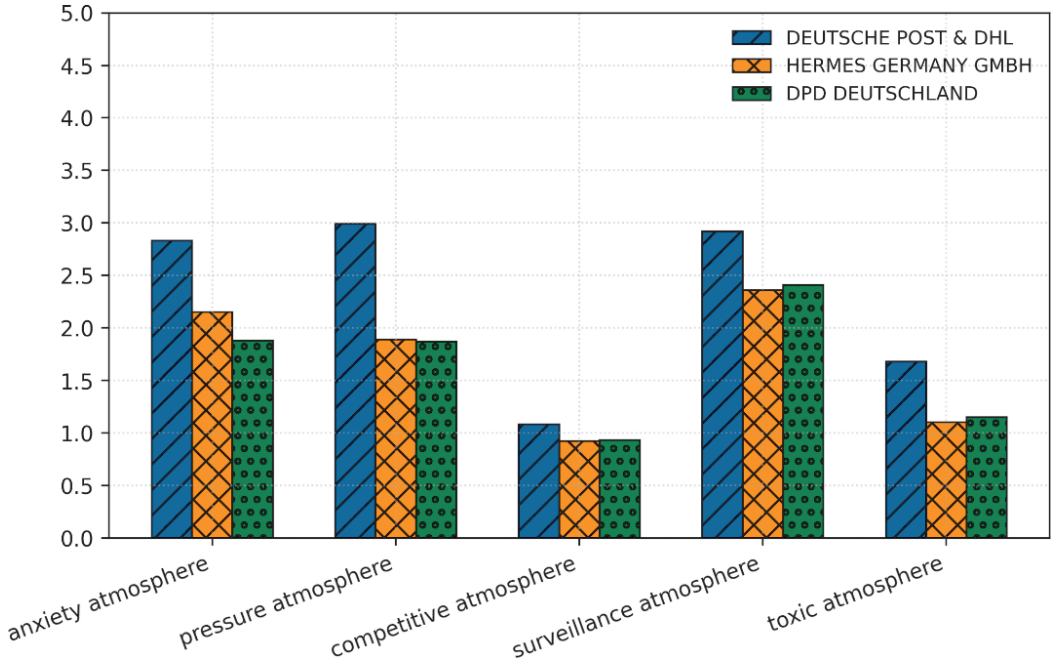

Figure 3: NFARWs of negative atmospheres of parcel carriers in Germany

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In addition to the categorial approach, we applied the dimensional approach of our dictionary. The results are shown in scatter plots in figure 4, 5 and 6. In each plot, every point represents a single employer review, positioned according to its average valence and arousal score. Taken together, the scatter plots illustrate how the reviews for each company are distributed within the valence-arousal space, offering a visual overview of the emotional tone and intensity of the described atmospheres.

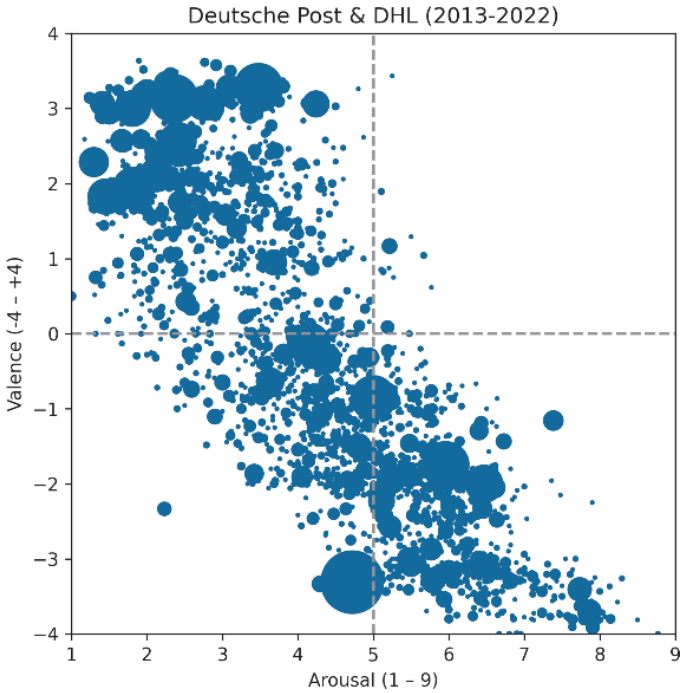

Figure 4: kununu comments on DHL in the valence-arousal-space

Notably, for all three parcel carriers, the ratings scatter predominantly in every quadrant except the upper right. This pattern indicates that a variety of typical atmospheres—ranging from pleasant and relaxed to unpleasant and tense—can coexist within a single organization. There is a tendency for more strongly centered points in the upper left quadrant, suggesting that positive, relaxed atmospheres slightly outweigh negative, tense ones in the parcel industry.

The condensed scatter plot for DHL can be attributed to its status as the largest delivery company with the most employees in Germany, resulting in a higher volume of ratings from DHL employees on kununu. Similar to the categorical analysis, Hermes and DPD exhibit more similarities to each other compared to DHL, further highlighting distinct differences of the organizational atmospheres within these companies.

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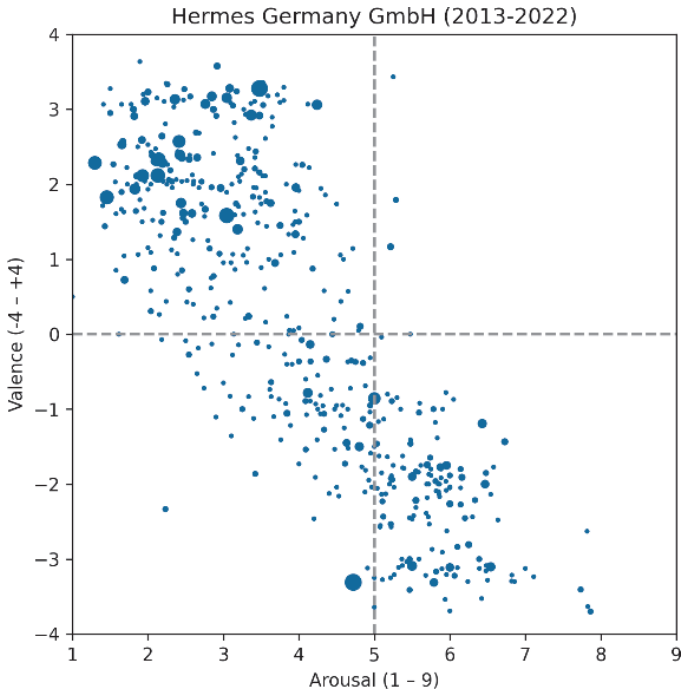

Figure 5: kununu comments on Hermes in the valence-arousal-space

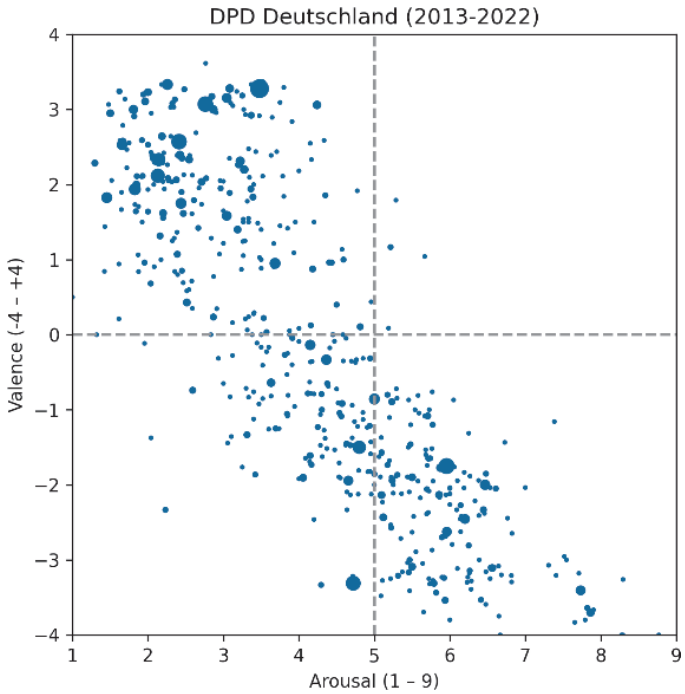

Figure 6: kununu comments on DPD Deutschland in the valance-arousal-space

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To gain further insights into how atmospheres are perceived within these three companies, we calculated the average atmosphere ratings for each type (see section 3). The results are illustrated in figures 7 and 8, indicating that the qualitative perception of a particular "good" or "bad" atmosphere can vary between companies.

In alignment with the results shown in Figure 2, it is not surprising that Hermes achieves the highest average ratings for the feel-good, trust, and team atmosphere. Conversely, the start-up atmosphere scores best at DHL, while DPD has the highest-rated family atmosphere.

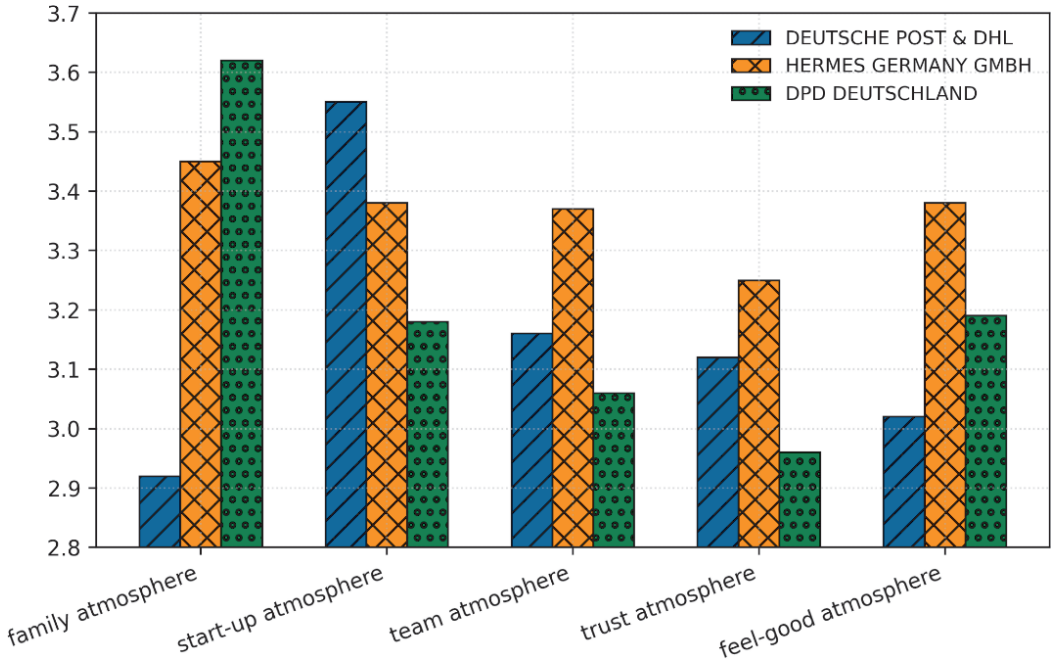

Figure 7: Average ratings per type and company for positive atmospheres

Taking a closer look at the average ratings for supposedly negative atmospheres, it comes as a surprise that DHL outperforms Hermes in each type but the pressure atmosphere. It is also unexpected that DPD achieves higher ratings than Hermes, despite the similar relative distribution of atmosphere types between these two companies. This suggests that the relative prevalence of certain atmosphere types in an organization must be separated from their qualitative assessment. For example, the surveillance atmosphere may be relatively more common at DHL than at Hermes, while it is perceived as particularly negative where it occurs at Hermes. As Hermes scores only 1.18 for surveillance atmospheres, this indicates that surveillance, supervision, and control create a very unpleasant atmosphere for employees.

Nonetheless, these results highlight areas for improvement within each company. While they provide an overview of potential issues, a more in-depth analysis is required to identify underlying causes and inform targeted interventions.

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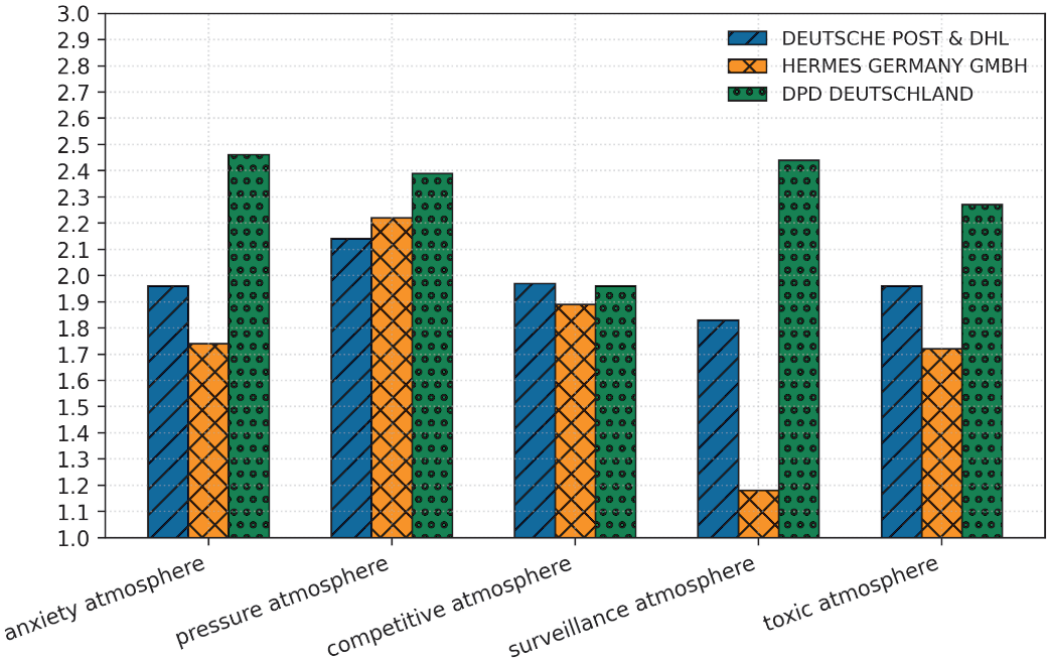

Figure 8: Average ratings per type and company for negative atmospheres

4.2 In-depth analysis of DHL

The application of the categorical and dimensional components of the GANAiO dictionary to the kununu data provides an overview of (1) the relative distribution of typical atmosphere types within an organization and (2) their perceived quality, based on user ratings on a five-point scale. However, this analysis does not yet reveal how organizational atmospheres evolve over time, nor does it identify the specific factors contributing to the perception of a given atmosphere.

To explore these questions in greater depth, we conducted a detailed case analysis of DHL. Compared to Hermes and DPD, DHL has a substantially larger number of reviews, offering a more robust empirical basis for longitudinal investigation. We applied the same categorical analysis to DHL's reviews on a year-by-year basis. By examining the annual development of atmosphere types and their associated ratings, we aimed to uncover temporal trends and shifts in the perceived work atmosphere. Figures 9 and 10 present the NFARW values for DHL across both positive and negative atmospheres over the period from 2013 to 2022.

This longitudinal approach allows us to identify potential drivers of change within the organization and gain deeper insight into the dynamics of employee perception and satisfaction. The findings may offer valuable implications for organizational development, leadership practices, and workplace atmosphere interventions.

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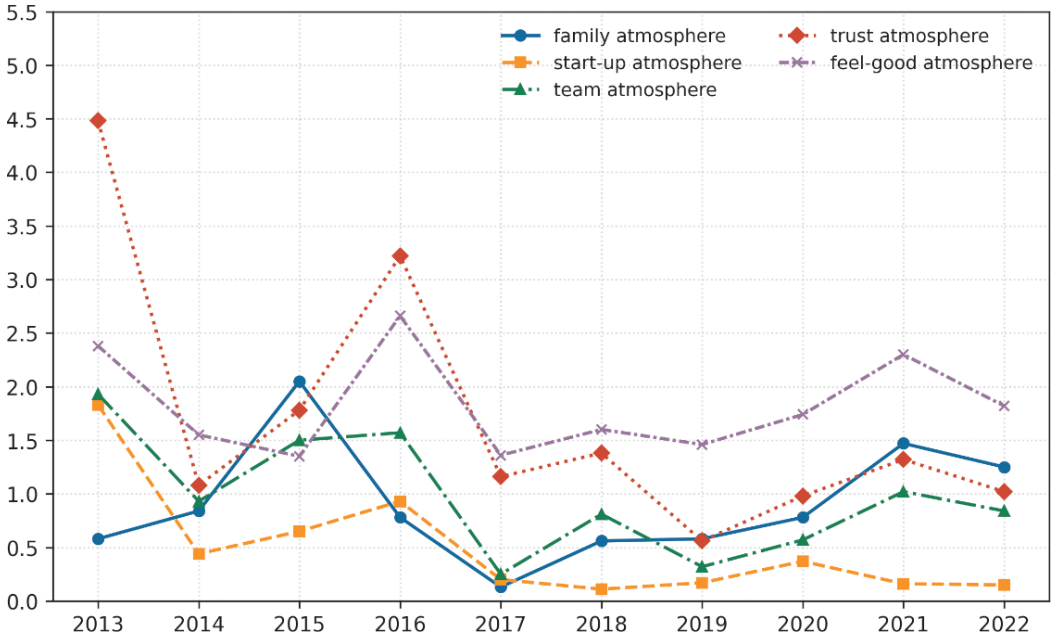

Figure 9: NFARWs of positive atmospheres at DHL from 2013 to 2022

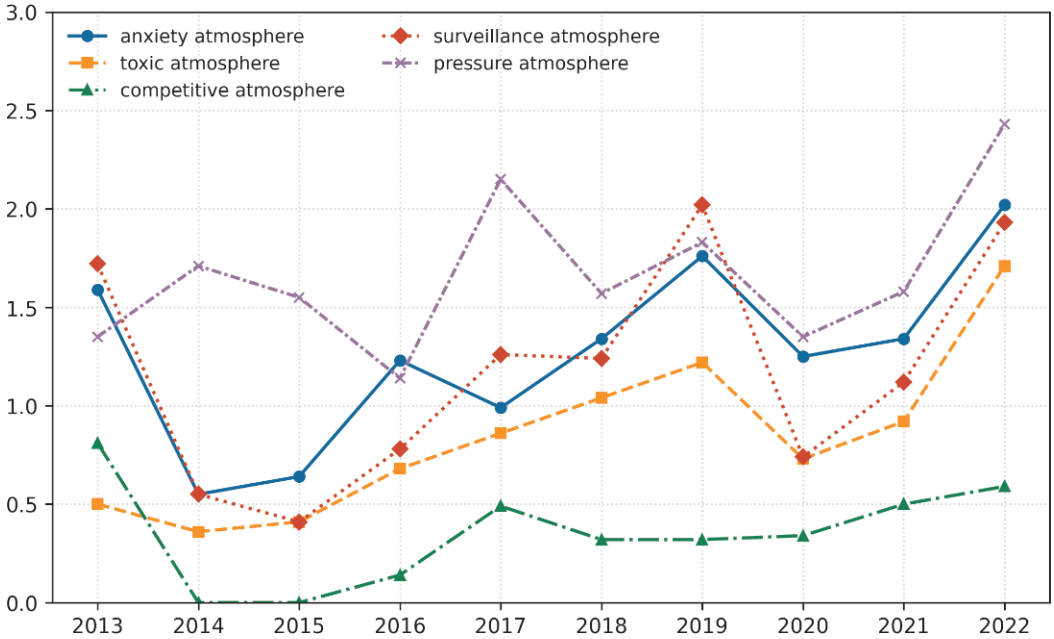

Figure 10: NFARWs of negative atmospheres at DHL from 2013 to 2022

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When examining the diagrams showing the distribution of typical positive and negative atmospheres over time at DHL, it becomes clear that these atmospheres are subject to fluctuations, exhibiting wave-like movements. Notably, the positive atmospheres, particularly trust and feel-good, peak in 2016. In contrast, the pressure atmosphere reaches its peak in 2017 and the surveillance atmosphere in 2019 among the negative atmospheres.

Interestingly, there seems to be an inverse relationship between positive and negative atmospheres. For example, there is a noticeable deterioration in positive atmospheres at two points: from 2016 to 2017 and from 2021 to 2022. Conversely, the scores for negative atmospheres increase from 2016 and again from 2020 onward. Specifically, opposite trends between the trust and surveillance atmosphere become evident. Consistent with previous findings, the competitive atmosphere shows a relatively constant and low score demonstrating fewer fluctuations compared to other types.

From 2021 onwards, the distribution of positive atmospheres decreases across all types, while descriptions of negative atmospheres increase, as evidenced by a noticeable kink in the graphs. This trend indicates a deterioration in the overall atmosphere at DHL starting around 2021, which is also visible in figures 11 and 12. These figures show parallels in the quantitative evaluation of atmosphere types at DHL, with some graphs running almost parallel.

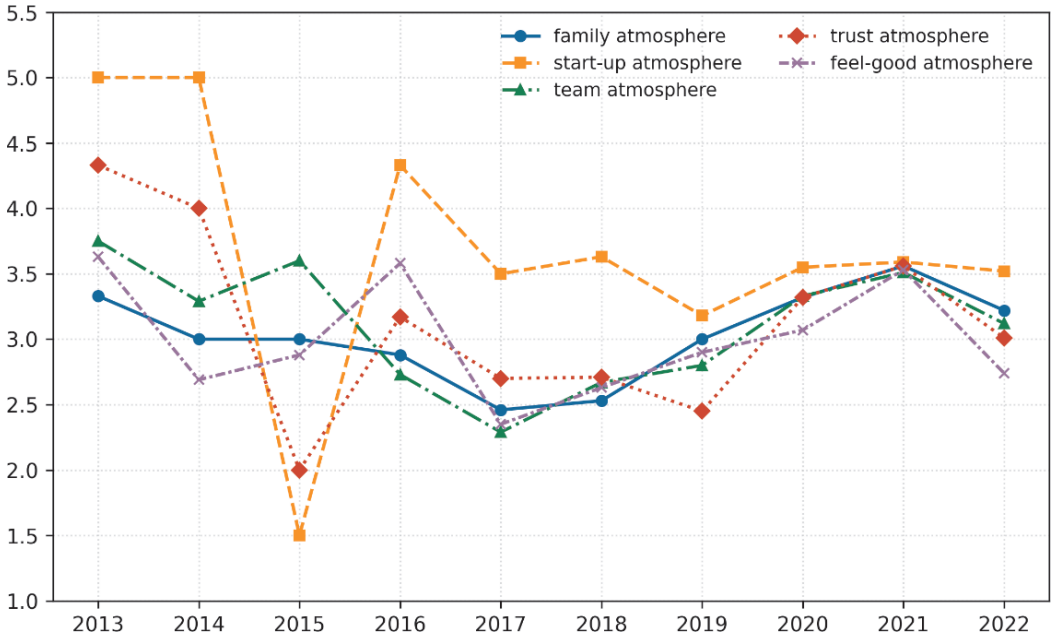

Figure 11: Average ratings for positive atmospheres per type and year at DHL

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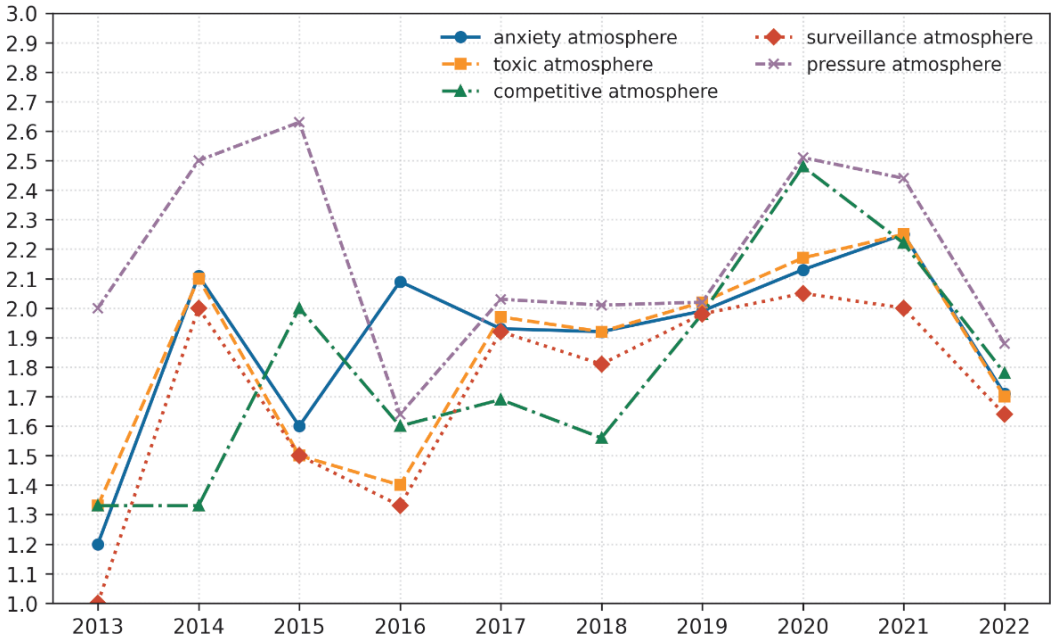

Figure 12: Average ratings for negative atmospheres per type and year at DHL

Concerning the pressure atmosphere in 2017, comments derived from 23 employer ratings provide revealing insights. Employees specifically denounced a high workload, largely attributed to the increasing volume of parcel deliveries. This surge in workload was compounded by a strong emphasis on profit and cost efficiency, leading to high stress, significant pressure, and extensive (unpaid) overtime. Moreover, poor communication was frequently criticized, both from managers and among team members. This lack of effective communication fostered an environment where cooperation was scarce. Instead of supporting one another, employees engaged in monitoring and reporting on each other and their managers, creating a competitive and distrustful atmosphere. As a consequence of these factors, employees reported a lack of work-life balance, feelings of exhaustion, anxiety, and pervasive bad moods. Ultimately, these conditions posed a significant risk to employees' health, as first, in the comments, employees speak of high sickness rates, and second, the negative impact of work-related stress on physical and psychological health is a well-researched subject (Ganster & Rosen, 2013; Ganster & Schaubroeck, 1991). This highlights the detrimental impact of a pressurized atmosphere on overall well-being, which is also confirmed in a recent study on the work atmosphere in Germany (Julmi et al., 2024).

The comments derived from 28 employer ratings describing a surveillance atmosphere in 2019 reveal similarities to the pressure atmosphere. Employees frequently lamented a lack of work-life balance, extensive overtime, and high workloads. Additionally, communication, leadership behavior, working conditions, overall atmosphere, and team cohesion were consistently described as poor. Team cohesion issues manifested in a lack of mutual respect, selfishness, gossip, arguments, and a tendency to play colleagues off against each other. Bullying, both by superiors and peers, was reported as a common occurrence. The

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treatment of employees was often described as inhumane, with a noticeable lack of empathy. Instances of insults, humiliation, and sexism were frequently mentioned. Furthermore, employees felt that their ability to act independently was restricted by stringent guidelines and specifications, leading to a sense of constant surveillance. As a result, many employees reported going to work with stomach aches. Moreover, the surveillance atmosphere was described as chilly and as leading to a high sickness rate.

In addition to analyzing the pressure and surveillance atmospheres at DHL, we sought to understand the apparent deterioration of DHL's atmosphere in 2021. To do this, we gathered all comments from 2020 and 2021 and conducted a word frequency analysis for both years, comparing the results. Compared to 2021, the word "bad" was used 382 times more often to describe the work atmosphere at DHL. Conversely, the word "good" was used 229 fewer times than in 2020 to elaborate on the atmosphere. Additionally, mentions of "pressure" nearly doubled, and references to "bullying" more than doubled, indicating increasing issues with high workload and workplace harassment. Complaints about "overtime" also became more frequent, further implying that employees struggled with excessive workloads. This trend is underscored by the frequent use of terms like "stress" and "catastrophe". The increased occurrence of words such as "disrespectful", "blaspheme", and "anxiety" suggests that interpersonal relationships were deteriorating, leading to a perception of a toxic overall atmosphere at DHL. Moreover, the significantly higher mentions of "sick" gives the impression that DHL faced high sickness rates, which not only indicated poor employee health but also contributed to high operational costs and exacerbate the workload issue.

We suspect that the increase in workload was related to the COVID-19 pandemic, which triggered a boom in parcel deliveries due to lockdowns and business closures (McKinsey, 2022). To support our assumption, we closely examined word frequencies, particularly those related to the pandemic. The word "corona" was mentioned 145 times in 2021, compared to 40 times in 2022. Additionally, terms such as "corona measures" and "corona madness" further indicate that the pandemic significantly contributed to the increase in workload and stress. A closer analysis of the comments mentioning "corona" confirms this assumption. Employees reported working six days a week to manage the increased workload, similar to the Christmas holiday season rush. They also mentioned that some employees came to work while sick with COVID-19, driven by fear of being laid off and the overwhelming demand. This highlights the severe impact of the pandemic on working conditions.

The word frequency analysis and the inductive analysis of the comments reveal a consistent trend: DHL has faced significant problems with an excessive workload and stress. These issues correlate with a deterioration in the work atmosphere, posing health risks for employees and leading to high sickness rates. Viewed from the perspective of 2022, these findings indicate an urgent need for action at DHL to address these challenges and improve the work atmosphere.

In summary, our qualitative analysis of DHL's employer reviews, based on the NFARWs of negative atmospheres, revealed recurring elements of a pressure, a surveillance, and a toxic atmosphere. These findings align with the atmosphere types described by Eifert (forthcoming) but also illustrate their concrete manifestation in an organizational setting. Table 1 provides an overview of the three atmosphere types, including their general definition and the specific forms they took at DHL.

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Atmosphere type	General description	Manifestation at DHL
Pressure atmosphere	Characterized by stress, excessive workload, strong performance pressure, and frequent overtime.	Rising parcel volumes during the pandemic; strict emphasis on profit and efficiency; extensive (often unpaid) overtime; high stress levels; reduced work-life balance.
Surveillance atmosphere	Marked by control, mistrust, micromanagement, and mutual monitoring among employees.	Poor communication; frequent monitoring and reporting of colleagues; lack of trust; selfish behavior and absence of mutual support.
Toxic atmosphere	Shaped by bullying, exclusion, disparagement, discrimination, and destructive communication.	Bullying by managers and colleagues; insults and humiliation; sexist remarks; gossip; inhumane treatment; lack of respect and empathy.

Table 1: Pressure, surveillance and toxic atmospheres at DHL

Taken together, these findings illustrate how abstract atmosphere types such as pressure, surveillance, and toxicity materialize in concrete organizational contexts, highlighting both the explanatory power of the GANAiO dictionary and the practical relevance of atmosphere analysis for understanding employee experiences.

5. Discussion

Based on the results presented in Section 4, we identify three central implications for researching organizational atmospheres: first, the importance of analyzing atmospheres at multiple organizational levels rather than solely at the company level; second, the need to investigate the relationships between different atmosphere types as well as their connection to structural and contextual factors; and third, the relevance of exploring how the dimensions of valence and arousal interact in the context of work atmospheres.

Given the diverse range of atmosphere types identified within a single company, it is likely that organizational atmospheres vary significantly across different locations, departments, and even teams. This variability underscores the complexity of organizational atmospheres and suggests that they should not be examined solely at the company level but also with attention to more localized contexts. While a company-wide analysis can reveal overarching trends, a more granular examination—focused on specific units or departments—may provide a more accurate and nuanced understanding of the prevailing atmosphere. Such a targeted approach can help uncover the root causes of unpleasant atmospheres and enable the development of more tailored management strategies that address the unique needs and conditions of different parts of the organization.

Furthermore, our results offer a promising foundation for developing propositions about the relationships between different types of organizational atmospheres. Understanding these relationships is crucial for advancing theoretical models of how work atmospheres emerge and interact, as well as for identifying potential trade-offs or reinforcing dynamics between different atmosphere types. By exploring such interconnections, researchers and practitioners can gain deeper insights into how certain atmospheres coexist, compete, or evolve in response to structural conditions and management practices.

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One particularly striking finding is the apparent inverse relationship between trust and surveillance atmospheres. As the prevalence of one increases, the other tends to decline—suggesting that these two atmosphere types may be conceptual opposites. This observation invites further investigation into whether organizational trust and surveillance function as mutually exclusive dimensions, potentially shaped by leadership styles, monitoring practices, and internal communication norms.

Beyond the specific interplay between trust and surveillance, our findings also suggest a more general inverse relationship between positive and negative atmospheres over time. Periods marked by a decline in positive atmospheres tend to coincide with an increase in negative atmospheres, and vice versa. This pattern indicates that organizational atmospheres may not only vary independently but also evolve in systematic opposition, reflecting broader shifts in organizational atmospheres. One possible explanation is that external shocks such as the mentioned COVID-19-pandemic or internal organizational changes (e.g., restructuring, changes in leadership) simultaneously erode positive qualities such as trust, support, and appreciation, while amplifying negative experiences such as stress, pressure, or surveillance (Julmi et al., 2024).

At the same time, the distinctiveness of the atmosphere categories highlights that these shifts are not simply a matter of "positive replaced by negative". Instead, specific constellations of atmospheres may emerge, where certain negative atmospheres become more salient as positive ones recede. This dynamic interplay underscores the value of studying atmospheres as relational phenomena, whose prevalence and intensity are shaped by organizational conditions, leadership practices, and external context. Future research could investigate whether these inverse dynamics reflect a structural trade-off between fostering positive and curbing negative atmospheres, or whether they are driven by shared contextual triggers that simultaneously suppress positive qualities and activate negative ones.

In addition, our longitudinal results reveal an asymmetry in how positive and negative atmospheres evolve over time. As shown in the average ratings of positive atmospheres (Figure 11), steep downward shifts are often observed, e.g. in 2015 and 2017, whereas improvements tend to occur only gradually over longer periods. In contrast, the average ratings of negative atmospheres (Figure 12) appear more stable. This suggests that exogenous shocks or intraorganizational changes can rapidly erode positive atmospheres by undermining perceived support and trust. However, recovering from such breaches of trust and re-establishing a positive atmosphere seems to require considerably more time. This finding highlights the fragility of positive organizational atmospheres and the difficulty of rebuilding them once they have been disrupted.

The data also highlight differences in how frequently certain atmospheres might occur across organizations. For instance, pressure and toxic atmospheres appear more frequently than competitive atmospheres, particularly within the parcel delivery industry, indicating that structural stressors and hierarchical control may foster certain negative atmospheres more than others.

Conversely, the absence of a start-up atmosphere might be attributed to the clearly structured work processes in this industry, which leave little room for entrepreneurial activities. Similarly, the lack of a team atmosphere could be because work is generally conducted with minimal group interaction. This raises important questions about the organizational and environmental factors that enable or inhibit specific atmosphere types.

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Building on these findings, future research can test propositions such as:

- A high prevalence of a trust atmosphere is negatively associated with the prevalence of a surveillance atmosphere.
- Periods of decline in positive atmospheres are associated with subsequent increases in negative atmospheres, suggesting that organizational atmospheres may shift in systematic opposition rather than independently.
- Positive atmospheres deteriorate more rapidly in response to organizational shocks than they recover afterward, whereas negative atmospheres remain comparatively stable over time.
- Pressure and toxic atmospheres are more prevalent in high-demand, operationally intense environments than competitive atmospheres.
- The start-up atmosphere is significantly less likely to be found in traditional environments compared to innovation-driven environments.

Finally, as shown in Figures 4, 5, and 6, the data points predominantly cluster in the upper left and lower right quadrants of the scatter plots. This distribution suggests a potential tendency for positive work atmospheres to be associated with low arousal (i.e., calm or relaxed settings), while negative atmospheres may correspond to higher arousal levels, such as stress or agitation. This observation aligns with findings by Eifert and Julmi (2025), who argue that in organizational settings, positive experiences are often linked to stability and routine rather than excitement, which may explain why high-arousal positive atmospheres (e.g., enthusiastic or euphoric) appear less frequently in this context. Importantly, the negative correlation observed between valence and arousal in our data should not be taken as a universal principle but rather as a context-specific pattern that merits further investigation. While psychological research has debated whether valence and arousal are orthogonal or correlated dimensions (Kuppens et al., 2017; Yik et al., 2023), our exploratory findings suggest that, in work atmospheres, they may interact systematically.

6. Limitations

Our study comes with several limitations that need to be discussed. First, as stated in the introduction, atmospheres are affective phenomena that can shift rapidly—even from moment to moment—in response to social interactions, leadership behavior, or situational triggers. This inherent fluidity presents a fundamental challenge for empirical analysis. Since our study relies on employer reviews, which are retrospective and often reflect generalized impressions over extended periods of employment, momentary fluctuations in atmosphere are unlikely to be captured. Instead, the reviews are more likely to reflect recurring affective patterns that accumulate and persist in employees' perceptions over time. As such, our findings offer insights into more stable or dominant affective tones rather than short-lived moods. To better understand the dynamic nature of atmospheres, future research should incorporate methods that allow for the collection of more time-sensitive data.

Second, a further limitation arises from the nature of kununu data and the anonymity of its contributors. On kununu, both current and former employees, as well as applicants, can submit reviews—often without verifiable context regarding their role, tenure, or specific department within the organization. As such, it remains unclear whose perspective is

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being captured and whether it is representative of the broader workforce. This introduces a potential self-selection bias. Research shows that individuals with particularly positive or negative experiences are more inclined to leave reviews on employer platforms, which may skew the overall sentiment (Marinescu et al., 2021). Therefore, the atmospheres distilled from such reviews might overrepresent extreme viewpoints while underrepresenting more moderate or ambivalent experiences. Moreover, the design of the platform itself can influence the type and tone of responses. For example, Cloos (2021) highlights how review structure and prompts can affect the informativeness and focus of user contributions. Accordingly, the extent to which our findings on the atmospheres at DHL, Hermes, and DPD can be generalized remains limited.

Third, it is important to acknowledge the inherent limitations of exploratory research. As Swaraj (2019) points out, exploratory research is typically conducted in fields where limited prior knowledge exists, with the aim of generating initial insights and identifying promising directions for future investigation. Its purpose is to detect relevant patterns, refine problem definitions, and develop theoretical propositions that can later be tested more rigorously. However, this approach does not allow for the robust testing of causal relationships or the formulation of generalizable conclusions. In our study, exploratory analysis served as a foundation for mapping the landscape of organizational atmospheres and highlighting areas of particular interest. Building on these findings, future research should pursue hypothesis-driven approaches to systematically examine the relationships between different types of atmospheres and organizational contexts. For example, the first proposition suggested in section 5 could form the basis of a longitudinal study aimed at examining whether inverse trends in the prevalence of trust and surveillance atmospheres can be observed over time. Therefore, exploratory research often serves as a crucial first step in hypothesis development, laying the groundwork for subsequent investigations into potential causal relationships.

Finally, our exploratory design does not allow for robust testing of causal relationships. Trend data, as we used, cannot establish causality between atmosphere types or their antecedents. While such analyses are valuable for detecting associations and temporal patterns, they fall short of identifying underlying mechanisms. Stronger causal insights could in principle be gained through experiments or controlled interventions (Shadish et al., 2002). Although GANAiO is primarily suited for naturalistic, large-scale text data, it could also be applied to experimental contexts if participants produce written responses (e.g., in vignette studies simulating organizational scenarios). Combining exploratory dictionary-based analyses with experimental or longitudinal designs would therefore provide a stronger basis for testing the propositions developed in this study.

7. Conclusion

This study used GANAiO, a validated dictionary-based text analysis tool, to explore and better understand organizational atmospheres. By applying an exploratory approach to a large corpus of German-language employer reviews, we were able to identify typical atmosphere types, detect patterns in their prevalence, and observe their distribution across companies and over time. These insights underscore that organizational atmospheres are diverse, dynamic, and context-sensitive—often varying significantly within a single organization.

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Rather than aiming for generalizable conclusions, this research offers an initial empirical foundation for future studies. The propositions derived from our findings—such as the inverse relationship between trust and surveillance atmospheres—can guide more targeted, confirmatory research into the causes and consequences of specific atmosphere types.

As interest in employee well-being and the quality of workplace experience continues to grow, the study of organizational atmospheres provides a promising path forward. Tools like GANAiO can help uncover how atmospheres are perceived and experienced, laying the groundwork for both academic inquiry and practical reflection on how to create better organizational environments.

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The Energy Crisis as a Game Changer for Sustainable Investing?

*Jörg Müller**

Abstract: This paper examines the financial outcomes of investments in stocks with varying degrees of ESG-rated sustainability before and after the energy crisis that began to unfold in 2021. It was analysed whether the energy crisis has caused improvements or deteriorations in the performance of more-sustainable compared to less-sustainable stock investments. The paper addresses an apparent gap in the existing literature, where interdependencies among the risk–return profiles of stocks and the ESG ratings of their issuers have so far garnered little attention in the context of the energy crisis. The results suggest that the energy crisis has triggered significant changes in the risk-return profile of securities issued by companies deemed sustainable versus those classified as less sustainable. Compared to previous crises with other economic backgrounds, more-sustainable stocks showed similar behavior relative to less-sustainable ones. The findings carry implications for asset managers and economic policymakers in terms of their decision-making with regard to the configuration of subsidies.

Keywords: investment, shares, ESG, sustainability, exogenous shock, stock performance, risk and return

Die Energiekrise als Game-Changer für nachhaltiges Investieren?

Zusammenfassung: Der vorliegende Beitrag untersucht die finanzielle Performance von Investitionen in Aktien mit unterschiedlichen ESG-Nachhaltigkeitsratings vor und nach der ab 2021 aufkeimenden Energiekrise. Es wird analysiert, ob die Energiekrise zu einer Verbesserung oder Verschlechterung der Performance von nachhaltigeren Aktieninvestitionen im Vergleich zu weniger nachhaltigen Aktieninvestitionen geführt hat. Die bestehende Literatur hat sich bislang noch nicht adäquat mit der Beziehung zwischen dem Risiko-Rendite-Profil von Aktien und dem ESG-Rating ihrer Emittenten vor dem Hintergrund der Energiekrise auseinandergesetzt. Die Ergebnisse deuten darauf hin, dass die Energiekrise erhebliche Veränderungen im Risiko-Rendite-Profil von Aktien nachhaltiger Unternehmen im Vergleich zu Titeln weniger nachhaltiger Unternehmen ausgelöst hat. In früheren Krisen mit anderen ökonomischen Hintergründen zeigten nachhaltige im Vergleich zu weniger nachhaltigen Aktien ein ähnliches Verhalten. Die Analyseergebnisse liefern Entscheidungshilfen für Asset-Manager sowie für wirtschaftspolitische Entscheidungsträger bei der Gestaltung von Subventionen.

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Stichwörter: Investition, Aktien, ESG, Nachhaltigkeit, Exogener Schock, Aktienperformance, Risiko und Rendite

1. Introduction

There is evidence in the literature that the sustainability practices of publicly traded companies have a measurable impact on risk and return indicators for equity investments in these share-issuing firms. Broadly speaking, a useful definition of sustainability as a desirable goal for society emerges in the much-cited report *Our Common Future* by the World Commission on Environment and Development (1987), which states that sustainable development should „[…] ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability thus defined comprises the three ESG dimensions of environment/ecology („E"), social/society („S") and responsible corporate governance/transparency („G") (Tober, 2016, p. 66).

In a financial context, it is worth exploring whether the links between the risk–return indicators of stocks and the sustainability scores of stock-issuing companies are sensitive to extraordinary economic events. History has recorded several such system shocks, and one recent example is the energy supply crisis that lasted for an extended period from 2021[1]. Triggered (among other things) by a rapid economic recovery after the coronavirus pandemic and exacerbated by Russia's war against Ukraine (International Energy Agency, 2024), literature variously describes it as either a European[2] or a global[3] crisis. It caused a dramatic spike in the price of natural gas, accompanied by an increase in electricity costs in some countries, and raised the price of oil to its highest level since 2008 (International Energy Agency, 2024). Then by late 2023, a growing number of analysts concluded that the energy crisis had subsided (Moore, 2024, DWS Investment GmbH, 2024, Stagg, 2024, and Kemp, 2023). At this point, one could question whether the events described were actually of such great significance that they warrant being labeled a „crisis" and require more in-depth consideration. Meier and Slembeck introduce the term „crisis problem" in the context of economic policy (Meier/Slembeck, 1998, p. 74). Typical characteristics of crisis problems are, among other things, that their widespread perception attracts considerable media interest and that the government is under strong pressure from the public to take action (Meier/Slembeck, 1998, p. 78). Both factors were observable in connection with the events described above: Strong media interest is evident, for example, from the internet search engine of Google Ireland Limited: For the period from January 2021 to December 2024, the number of web pages displayed for the term „energy crisis" was approximately 236 million, more than three times higher than in the same period before (around 75 million for January 2017 to December 2020). As proof of the pressure on political leaders to act, we can point for example to the laws on the introduction of energy price brakes („Erdgas-Wärme-Preisbremsengesetz" and „Strompreisbremsegesetz") passed at the end of 2022[4] in the Federal Republic of Germany. The foregoing arguments justify

1 Concerning increasing tension on energy markets beginning in 2021, see International Energy Agency (2024), for a timeline of the energy crisis see Emiliozzi et al. (2023), p. 7.
2 See Emiliozzi et al., 2023, p. 3 and Erkan et al. (2023), pp. 145–146.
3 See International Energy Agency (2024) and Ozili/Ozen (2023), p. 1.
4 See Deutscher Bundestag (2022), Bundesrepublik Deutschland (2025a), and Bundesrepublik Deutschland (2025b).

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the understanding of the scenario emerging from 2021 onwards as an economic crisis and thus its closer examination.

Looking back through the lens of stock markets, this article fills a crucial knowledge gap by examining the characteristics of risk and return indicators for stock investments along a spectrum from „least sustainable“ to „highly sustainable“ issuers before and after the outbreak of the energy crisis. The aim is to answer the question whether the performance of more-sustainable compared to less-sustainable stock investments has improved or deteriorated since the onset of the energy crisis. To this end, the analysis correlates the ESG ratings of publicly traded companies with the risk–return indicators of their shares for representative periods before and after the onset of the crisis.

The existing literature already contains various studies on the links between share-value risk–return indicators and issuers' ESG performance, including in the context of economic crises. It is therefore all the more surprising to find a shortage of studies exploring the 2021 energy crisis in this regard. Further contributions to the literature seem warranted, given its potential impact.

Indeed, the energy crisis may have acted as a fundamental disruption—the proverbial game changer—in two respects: First, there are indications that its onset changed the patterns of risk-and-return indicators for ESG-weak and ESG-strong stock issuers; and second, this time around the indicators may have shifted in ways that deviate from other recent crises.

The research findings documented here are relevant for capital market participants as well as less directly involved market actors. Among all market participants, one group worth noting are the managers of third-party assets who acquire their mandates through commitments to sustainable investment strategies. For them, the impact of sustainability metrics on the risk–return investment profile is an essential piece of information, including for communication with their customers. As for the group of indirect capital market actors, the research may be germane to political decision-makers. If, for example, the risk–return behavior of sustainable investments turns out to be consistently deteriorating compared to less sustainable investments, policymakers may choose to increase state subsidies in a bid to steer capital in socially desirable directions.

This paper examines the stated research question in six chapters. Chapter II considers theoretical foundations and provides an overview of the relevant literature. Chapter III describes the study's design with a particular view towards the construction of observational periods, sourcing of raw data, and application of analytical methods. Chapter IV documents the results of these analyses in comprehensive detail and answers the research question. The final two chapters offer a discussion of the findings and a concluding review of the research process.

As its subject of investigation, this work uses the companies in the STOXX Europe 600 (Gross Return) share index. That particular focus precludes any of the aforementioned debate on whether the energy crisis was of a European or global dimension—either way, the analysis rests on the stock market of a region that was affected by the event under review.

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2. Theoretical Background and Literature Review

2.1 Sustainability and General Stock Performance

Why do ESG scores have the potential to influence the risks and returns of equity investments? ESG scores are intended to reflect the sustainability performance of companies (Diebecker et al., 2021, pp. 12–13 and p. 17), which in turn is an important factor for the investment decisions of capital market participants (PricewaterhouseCoopers International Limited, 2023, pp. 3–5; Diebecker et al., 2021, p. 15[5]). As a result, the sustainability behaviour of companies—as expressed in ESG scores—could influence price dynamics on the stock market and thus the risk–return performance for investors. Principle scenarios are, for example:

a) Investors may assume that companies' increased sustainability efforts are associated with rising costs for them (Hartzmark/Sussman, 2019, p. 1). Amid expected declines in profits, shareholders could feel pressured to sell their holdings in companies with high ESG ratings and/or potential new investors would refrain from outset. This could trigger price fluctuations on the stock market: Securities issued by companies with low ESG ratings could benefit by generating outsized returns compared to high-ESG issuers.
b) Investors may be inclined to enhance their social image by acquiring sustainable securities (Riedl/Smeets, 2017, p. 2506). Due to the growing importance of social image in public communications, institutional investors may increasingly decide to focus on shares of top ESG performers. Increased demand for such shares could lead to higher returns compared to weak ESG performers.

Concerning the impact of issuers' sustainability performance on the risk–return metrics of their capital market shares, empirical studies abound. For instance, a meta-study by Whelan et al. (2021) offers a comprehensive summary of published results from 2015 to 2020. The analysis reveals that 59 % of studies find an equal or better performance of sustainable investments compared to conventional approaches. Another study focused on US securities finds that the shares of companies with stronger sustainability scores engender less idiosyncratic risk than those of firms with weaker sustainability performance (Horn, 2023, pp. 418, 421 and 426). Lopez-Prol and Kim (2022) examined return- and risk-optimized stock portfolios, finding that shares in companies with higher sustainability ratings were more likely to produce lower returns but also less volatility and a lower Sharpe ratio than shares in low-ESG issuers.

2.2 Stock Performance, Sustainability and Energy Prices

Rising energy prices generally weaken the profitability of companies. Empirical evidence to this effect, and specifically in the case of rising oil prices, is found in studies by Xu et al. (2022, pp. 4–8 and p. 12) or Rentschler and Kornejew (2017, pp. 244–250). However, the impact on profitability may vary depending on the degree of ESG implementation. For example, less sustainable companies may primarily cover their energy needs through fossil fuels. An increase in crude oil prices could thus have a greater impact on their profits in relation to highly sustainable companies who are more likely to source their energy

5 Sources cite other authors.

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from renewables and are therefore less vulnerable to volatility in the price of crude oil. This could neutralize outsized gains for low-ESG securities described in scenario (a) under section 2.1, prompting shareholders to divest from them in favor of more sustainable alternatives. This could, in turn, affect the returns on their respective shares, with the share price of ESG-performant companies rising while lower-rated companies lose value. This assumption is at least partially supported by empirical evidence in Maraqa and Bein, who find statistically significant positive correlations between the returns on crude oil prices and the indices of high-ESG stocks in their analysis of volatility spillover effects (Maraqa and Bein, 2020, p. 7).

In relation to the present research question, the chain of effects just described would suggest that in the wake of the energy crisis, the financial performance of sustainable stocks, expressed in terms of their returns, has improved compared to less sustainable equity.

2.3 Stock Performance and Sustainability in Crisis Situations

The onset of the energy crisis brought about an exogenous shock to the economy and, in this context, to the stock market. The International Monetary Fund defines an exogenous shock as „[…] a sudden event beyond the control of the authorities that has a significant negative impact on the economy […]“ (International Monetary Fund, 2003, p. 4). Besides the influence of an issuer's ESG performance on the risk–return profile of its shares in general (see 2.1), the scientific literature also addresses the question of how sustainable and non-sustainable shares behave specifically in moments of economic crisis. In this domain, studies have focused mainly on the financial crisis (end of the noughties) and the more recent COVID-19 pandemic. In each of these two crisis moments, evidence suggests that shares backed by higher ESG ratings have proven more resilient than their less sustainable counterparts chiefly because:

- they achieved higher returns (Gianfrate et al., 2021, p. 26; Lins et al., 2017, pp. 1797–1802; Albuquerque et al., 2020, pp. 10–12 and 14–18); and
- the returns were less volatile (Albuquerque et al., 2020, pp. 12–13; Engelhardt et al., 2021, p. 8).

The authors elaborate on several possible reasons for this:

1. Companies that invest in sustainability can expect increased loyalty from their customers. Demand for these companies' products is less price-elastic, enabling higher overall margins (Gianfrate et al., 2021, p. 26; Albuquerque et al., 2020, p. 2; Albuquerque et al., 2019).
2. Stocks of companies with higher ESG ratings are more frequently held by socially conscientious shareholders who are more resilient to shocks and less likely to participate in sell-offs (Gianfrate et al., 2021, p. 26; Renneboog et al., 2011, pp. 575–579).
3. Sustainable companies invest in social capital (Gianfrate et al., 2021, p. 26), which has the effect of strengthening shareholder trust and causes a better performance of such companies' shares in times of crises (Gianfrate et al., 2021, p. 26; Lins et al., 2017, pp. 1797–1802).

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In contrast to the studies by Gianfrate et al. (2021) and Engelhardt et al. (2021), the work of Albuquerque et al. (2020) and Lins et al. (2017) analyzes differences in stock performance both within and beyond the actual crisis. It becomes apparent that:

- higher returns on ESG-strong versus ESG-weak stocks occurred mainly during the crisis scenario and tended not to occur outside of it (Albuquerque et al., 2020, pp. 11–12 and p. 25; Lins et al., 2017, pp. 1805–1806); and
- lower volatility of ESG-strong versus ESG-weak stocks also occurred beyond the crisis scenario, although the difference was more pronounced throughout the crisis itself (Albuquerque et al., 2020, pp. 12–13 and p. 27).

If the findings of Albuquerque et al. and Lins et al. are transferable to the energy crisis, in the context of the research question one could expect the performance of sustainable versus non-sustainable stocks to improve with the onset of the crisis, analogous to the scenario described in section 2.2. Specifically, one might assume that a pre-crisis return disadvantage of ESG-strong stocks compared to ESG-weak stocks would decrease – or that, conversely, a return advantage of ESG-strong stocks compared to ESG-weak stocks would increase. The same logic would reasonably apply to risk assessment: If ESG-strong shares had lower risks than ESG-weak shares before the crisis, we should expect the gap to have widened further, while risk-related disadvantages of ESG-strong versus ESG-weak stocks that existed before the crisis should have been reduced.[6]

2.4 Progression of the Energy Crisis and Comparison to Previous Crises

Figure 1 shows the course of the energy crisis over time, taking into account particularly significant events. The unfolding crisis is viewed through the lens of the Brent Crude Oil Benchmark Index due to the role of oil as an important energy source and thus a useful indicator for the intensity of this crisis over time.

6 In addition to the influences described in this section, the constructed causal chain could have been additionally supported by salience effects. In behavioral finance theory, the concept of „salience“ is linked with the phenomenon of availability heuristics, in the context of which people tend among others to make decisions on associations that are easy to recall (Sulphey, 2014, p. 63; da Silva Rosa/Durand, 2008; Gigerenzer et al., 1999, pp. 213–214; Tversky/Kahneman, 1974, pp. 1127–1128; and Tversky/Kahneman, 1973). The strong focus on the energy crisis in the media (see section 1) may have heightened investors' awareness of the problem and motivated them to focus more on ESG-strong shares, as their issuers are less dependent on fossil fuels (see explanations in section 2.2). This may have favored improved returns and reduced volatility of ESG-strong versus ESG-weak stocks during the energy crisis.

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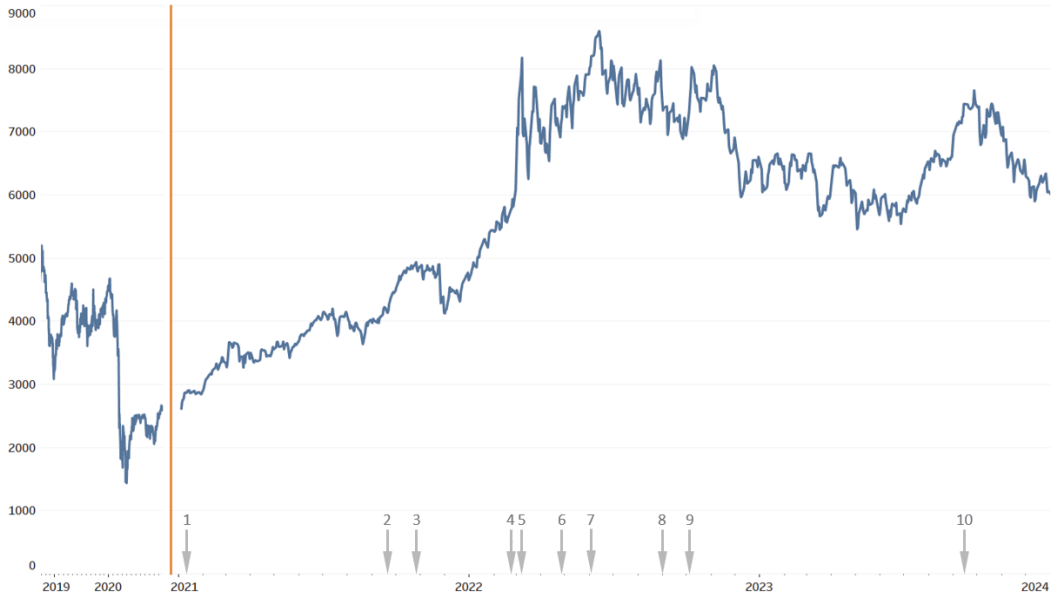
Progression of the energy crisis illustrated through price trends in the Brent Crude Oil Benchmark Index



No.	Date	Incident
1	Beginning of 2021	Energy prices climb steadily in 2021 due to factors such as rapid economic recovery from the pandemic-induced recession and enduring under-investment policies in fossil fuels.
2	21/9/2021	International Energy Agency urges Russia to ramp up gas supplies to Europe.
3	27/10/2021	Russian President Putin orders Gazprom to fill Europe's gas storage only after Russia completely refills its own reserves.
4	24/2/2022	Russia invades Ukraine.
5	8–10/3/2022	Canada, Great Britain, and the United States announce a ban on oil and petroleum products from Russia.
6	27/4/2022	Poland and Bulgaria are the first European nations cut off from Russian gas supplies.
7	3/6/2022	The European Union announces an import ban on Russian seaborne crude oil and petroleum products.
8	1/9/2022	Gazprom announces an indefinite shutdown of the Nord Stream 1 pipeline; 25 days later, explosions along the Nord Stream 1 and 2 pipelines and gas leaks.
9	5/10/2022	The Organization of Petroleum Exporting Countries Plus (OPEC+) announces production cut of two million barrels per day.
10	September 2023	After a decline, crude oil price begins to rise again following production cuts by Saudi Arabia and Russia as well as supply concerns resulting from the conflict in the Middle East.

Figure 1: Progression of the energy crisis (data sourced from LSEG Group, 2025; Emiliozzi et al., 2023, pp. 6–7; International Energy Agency, 2022, pp. 87–88; and Deutsche Bundesbank, 2023, p. 7).

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The energy crisis began to unfold at the start of 2021, slowly at first, as seen in the chart after the orange vertical line. From this point on, the price of crude oil began a steady ascent, among other reasons due to rising economic output after COVID-19. The crisis escalated significantly in February 2022 with Russia's invasion of Ukraine, whereupon oil prices rose sharply and peaked in June 2022. The situation did not ease until the end of 2022, although prices never fully recovered to their pre-2022 levels. From mid-2023, prices began to rise again, although this trend levelled off again by the beginning of 2024.

A comparison of the energy crisis with the 2008 financial crisis and the 2020 pandemic reveals fundamental differences in the macroeconomic backdrop to each scenario. For this reason, insights gleaned from previous crises (cf. section 2.3) are not necessarily transferable to the energy crisis. In general, with regard to macroeconomic triggers for a crisis, we can distinguish between demand shocks and supply shocks. The 2008 financial crisis was predominantly characterized by demand-side shock, whereas the COVID-19 pandemic brought about demand- and supply-side shock simultaneously (*Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung*, 2008, p. 9; Bofinger et al., 2020). In contrast, the most recent energy crisis represents a pure supply shock (Dullien, 2024; Zhao et al., 2023; Kilian/Plante, 2022). While negative demand shocks to the market generally lead to a decline in overall demand with corresponding reductions in price and sales volume—as was the case during the financial crisis and COVID-19 pandemic—a negative supply shock—as during the energy crisis—leads to rising market prices with falling sales volumes (for the aforementioned shock effects, see Mankiw, 2022, p. 271 and Mishkin, 2015, pp. 351–361).

Regarding stock investments with different sustainability ratings, it is questionable whether the effects identified in the financial crisis (demand-side crises) and the COVID-19 pandemic (simultaneous demand- and supply-side shock) occurred analogously in the exclusively supply-side energy crisis. It is reasonable to assume that certain impact channels only occur in the context of demand shocks and therefore had no influence in the case of the energy crisis. Moreover, an exclusive supply shock could create impact channels that exist neither in the case of simultaneous demand and supply shocks nor in exclusive demand shocks. Possible scenarios include:

- Increased energy prices lead to higher costs for companies. As there is only a supply shock and no change in demand, sustainable and non-sustainable companies can pass on the increased costs to supply-side market prices in equal measure. Any lower price elasticity of demand in sustainable companies becomes irrelevant. The energy crisis does not cause any deviations in the margins of sustainable and non-sustainable companies as reflected in unchanging share price trends.
- Supply-shock–induced inflationary tendencies force sustainable and non-sustainable investors alike to liquidate their stock holdings due to declining real incomes. The greater resilience of sustainable investors to falling prices is no longer a given, as they also face pressure to sell their investments due to economic necessities.

As outlined above, previous analyses of variously sustainable stocks under exogenous shock have focused primarily on the financial crisis and the COVID-19 pandemic. Given the macroeconomic scenarios associated with these events, the existing literature provides ample treatment of demand-side shock as well as simultaneous demand-and-supply shock. However, the supply-side has been largely ignored to date. By looking at ESG-strong

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and ESG-weak stocks in the context of an exclusive supply shock, this paper offers an important contribution to the academic discourse on ESG equity ratings in times of macroeconomic crises.

2.5 Stock Indicators Included for Analysis

A set of risk and return indicators can help answer the question of whether stock investments have performed better or worse along the ESG sustainability spectrum since the start of the energy crisis. The parallel consideration of return and risk follows the Markowitz maxim (1952), which states that investment decisions should take into account the expected return and its variance. The indicators used in this analysis are:

- Stock return
- Volatility of Stock returns
- Beta factor
- Sharpe ratio
- Treynor measure
- Jensen measure

In addition to the volatility of stock returns, beta serves as a measure of risk. In contrast to volatility, this is not an indicator of the overall risk of an investment, but reflects its sensitivity to market fluctuations. With the Sharpe ratio (Sharpe, 1966), the Treynor measure (Treynor, 1965), and the Jensen measure (Jensen, 1968[7]), this analysis includes three indicators that ensure a synthesis of return and risk variables.

2.6 Systematization of the research basis

Figure 2 shows the theoretical outline of the problem, the research question, and the research contribution in a systematized form.

7 On the Jensen measure, see also Söhnholz et al. (2010), p. 126; Heidorn and Schäffler (2017), p. 152; and Stahlhut (2002), p. 51.

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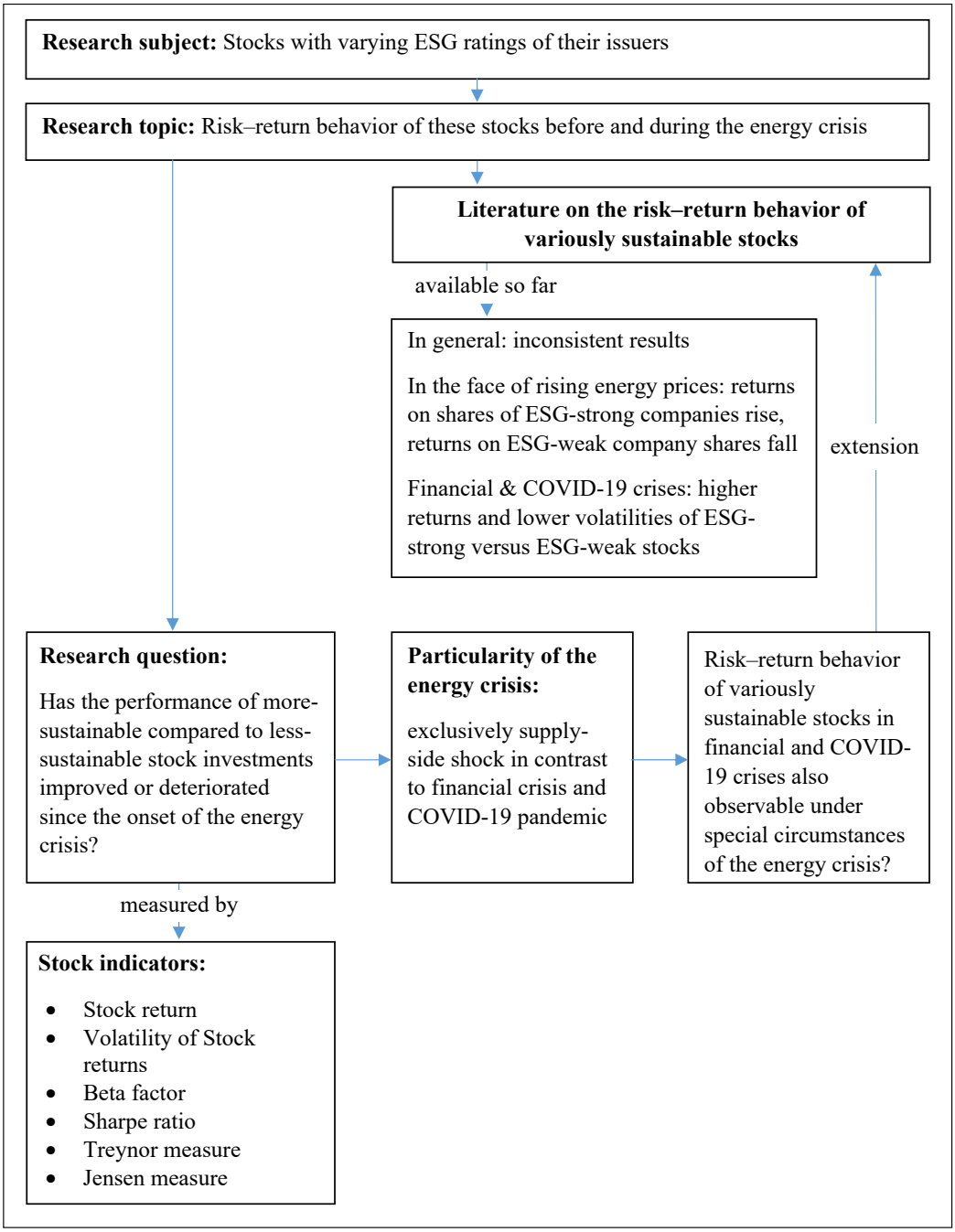

Figure 2: Theoretical problem outline, research question, and research contribution

As previously noted, all analyses relate to European stock markets.

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3. Research Design

3.1 Observation Periods

The analysis requires a definition of the periods under consideration. In particular, it is necessary to clarify which periods should represent the *time before the onset of the crisis* and the *time after the onset of the crisis*. In order to enable the comparability and traceability of these investigations, the observational periods are designed to be of equal duration and to cover as many complete calendar years as possible.

The observation periods are defined as follows:

1. Observation Period 1 (before the onset of the energy crisis): 1 January 2017 to 31 December 2020
2. Observation Period 2 (after the onset of the energy crisis): 1 January 2021 to 31 December 2024

1 January 2021 serves as the start date for the energy crisis and thus for the start of Observation Period 2 because the energy crisis began to unfold at this time, as explained in section 2.4. We can assume that from this point on, the crisis gradually began to impact the stock markets.

The term *total investigation period* denotes cases in which the analytical context demands a view of the complete timeframe by aggregating both observational periods (1 January 2017 through 31 December 2024).

3.2 Data Set

The analytical basis constitutes all companies listed on 5 August 2024 in the EUR-quoted STOXX Europe 600 (Gross Return) share index. For these companies, the available daily total return values for the period from 1 January 2017 to 31 December 2024 were collected from the LSEG Eikon information system.[8]

Moreover, the available yearly ESG scores of the companies included in the index for the total investigation period were extracted from the information system. LSEG Eikon publishes ESG scores for the end of the fiscal year of these companies. In constructing the data set, ESG scores were classified as belonging to a specific year when the end of the fiscal year of a given company falls between 1 July of the previous year and 30 June of the year in question.[9]

To analyze the relationships between stock performance indicators and the ESG ratings of stock-issuing companies, the ESG scores were not used per se; rather, the companies in question are classified into deciles as a function of their ESG scores for each year under review. Each decile generally comprises 10 % of the companies to be analyzed.[10] Organizations with the lowest ESG scores are assigned to decile 1, companies with the

8 The calculation of total returns takes into account both share-price changes and dividends, see LSEG Group (2024).

9 If, for example, a company's fiscal year ends on 31 December 2021, the ESG score for 2021 is first available in 2022. As a result, when stock indicators from 2022 are examined for their ESG susceptibility as in this analysis, ESG scores that were known to investors in 2022 should serve as the analytical basis. In that instance, the ESG score for 31 December 2021 is used for the investigation year 2022.

10 The number of companies per decile follows this formula:
Number of analyzed companies ÷ 10 = X, where X is the number of companies per decile.

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next-best ESG scores to decile 2, and so on. Companies with the highest ESG scores thus form decile 10. In this model, membership of a particular decile reflects the sustainability performance of respective companies for the purposes of analysis.[11]

This data set excludes index members with major data gaps. For example, not included in the set are companies for which no total return values were available in LSEG Eikon for more than two complete years in the period from 1 January 2017 to 31 December 2020 and/or from 1 January 2021 to 31 December 2024. The same procedure applies to companies for which no ESG scores were available for more than two of the years 2016–2019 and/or 2020–2023.[12] All other companies (561 of the 600 listed in the index) form part of the data set as research subjects.

In addition to the subject-related characteristics (total return values and ESG scores), the data set includes general market data relevant to the calculation of stock indicators; specifically:

- discrete returns[13] derived from changes in the STOXX Europe 600 (Gross Return) index on each trading day (source: LSEG Eikon); and
- current yields (German: *Umlaufsrenditen*) on public bonds of the Federal Republic of Germany with outstanding maturities of more than nine to ten years (source: Deutsche Bundesbank, 2024).

These values were collected for the individual trading days in the period from 1 January 2017 to 31 December 2024.

3.3 Analytical Content and Procedures

From the data set, first the annual values for the stock indicators to be observed were calculated separately for each of the 561 objects under investigation for 2017 to 2024. If a company's stock returns, volatilities, or ESG scores are absent for individual years due to a lack of data, the arithmetic mean of existing values for the relevant period serves as a substitute; for example, if an ESG score is missing for 2017, the arithmetic mean of scores from 2018 to 2020 takes its place.[14]

Annual stock returns for the various titles are calculated as arithmetic averages of daily total returns[15] (end of day) for the year in question, and annual volatilities as standard deviations of these daily returns. To determine the beta factor (covariance of market and

If X does not return an integer, the following procedure applies:
X rounds down to the nearest lower integer and the size of each decile initially corresponds to this rounded X. Starting with the first decile, each decile receives one more company up to the point where the sum of companies in all deciles = the number of analyzed companies.

11 The categorization of companies into deciles already features in other studies on the influence of sustainability on stock investments (cf. Teti et al., 2023; Lopez Prol/Kim, 2022).

12 Larger data gaps, which require the exclusion of relevant STOXX Europe 600 members from the data set, result for example from the fact that the companies in question did not exist throughout the total investigation period, as their founding occurred during this period. One example is Siemens Energy AG (founded and entered in the commercial register in 2019, see Amtsgericht München, 2025).

13 On the concept of ‚discrete return' see Auer/Rottmann (2020), p. 40.

14 This so-called *mean imputation* is common practice for dealing with missing values in data analyses. In this regard, see also Toutenburg et al. (2004), p. 16. It is safe to assume that this procedure has not caused any significant biases in the present data analyses, as only a small number of values found their way into the data set by this method (2.1 % of observed ESG scores and 0.2 % of stock returns and volatilities in the data set).

15 The daily total return values are discrete returns in financial mathematical terms.

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stock returns divided by variance of market return), the market returns are represented by the daily returns of the STOXX Europe 600 (Gross Return). The three integrated indicators (Sharpe Ratio, Treynor measure, Jensen measure) require a determination of the risk-free interest rates modeled as annual arithmetic means of current yields (*Umlaufsrenditen*).

A panel regression for each stock indicator addresses the research question.[16] Each regression is based on a fixed-effects model, thereby eliminating both subject- and time-specific effects.

Each of the six defined stock indicators requires a corresponding regression equation to control for:

- the effect of increasing ESG levels on stock indicators across the total investigation period from 1 January 2017 to 31 December 2024; and
- the change between Observation Periods 1 and 2 in the rate of growth or decline for stock indicators with rising ESG levels.

In each of the regression equations, the stock indicators act as dependent variables.

Independent variables include:

- ESG deciles, shown below with the formula symbol E; and
- an interaction variable consisting of:
  - a dummy variable („Dummy") to characterize the two observation periods; and
  - the ESG deciles.

The interaction variable takes the form of *Dummy* × *ESG decile*[17] and is represented below with the formula symbol R. The dummy variable uses the values 0 (for the first observation period) and 1 (for the second observation period). The interaction term aims to detect structural breaks induced by the energy crisis in the relationship between a company's ESG performance and its respective stock indicator. If the estimate of the slope parameter belonging to the interaction term is significant, we may assume the presence of a structural break; otherwise, we may reject this assumption.

All six regression equations are based on the following formula:

$$S_{it} - \overline{S}_{i.} - \overline{S}_{.t} + \overline{S}_{..} = \left(E_{it} - \overline{E}_{i.} - \overline{E}_{.t} + \overline{E}_{..}\right) * \beta_1 + \left(R_{it} - \overline{R}_{i.} - \overline{R}_{.t} + \overline{R}_{..}\right) * \beta_2 + \upsilon_{it} - \overline{\upsilon}_{i.} - \overline{\upsilon}_{.t} + \overline{\upsilon}_{..}$$

where S_{it} is the stock indicator of share i in year t; $\overline{S}_{i.}$ is the mean value of S_{it} in the case of subject-specific but no time-specific effects; $\overline{S}_{.t}$ is the mean value of S_{it} in the case of time-specific but no subject-specific effects; and $\overline{S}_{..}$ is the mean value of S_{it} across all observations. The variable E_{it} expresses the ESG decile to which company i belongs in year t. $\overline{E}_{i.}$ then stands for the mean value of E_{it} in the case of subject-specific but no time-specific effects; $\overline{E}_{.t}$ for the mean value of E_{it} in the case of time-specific but no subject-specific effects; and $\overline{E}_{..}$ for the mean value of E_{it} across all observations. In analogous continuation of this nomenclature, R_{it} represents the interaction variable of Dummy and ESG decile that company i belongs to in year t. $\overline{R}_{i.}$, $\overline{R}_{.t}$, and $\overline{R}_{..}$ express the corresponding mean values of R_{it} (mean value in the case of subject-specific but no time-specific effects,

16 The following descriptions of the regression analyses are based on the explanations in Baltagi (2021), pp. 15, 17 and 47–48; Brooks (2008), p. 487 and 490–494; Gehrke (2022), pp. 107, 110–112 and 115; Giesselmann/Winzio (2021), pp. 33–47; Greene (2020), pp. 415–416; Gujarati/Porter (2009), pp. 593–605; von Auer (2023), pp. 1–17 and 22–23.

17 Use of the interaction variable and realisation described here based among others on Urban/Mayerl (2011), pp. 286–290.

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mean value in the case of time-specific but no subject-specific effects, and mean value across all observations). The characters β_1 and β_2 represent the two slope parameters to be estimated by the regression: β_1 is the slope parameter for the independent variable ESG decile and β_2 for the (independent) interaction variable Dummy × ESG decile. On the right-hand side of the above regression equation, we find the error term v_{it}, which reflects unobserved effects of share i in year t, supplemented by the respective mean value variables ($\overline{v}_{i.}$: mean value of v_{it} in the case of subject-specific but no time-specific effects; $\overline{v}_{.t}$: mean value of v_{it} in the case of time-specific but no subject-specific effects; and $\overline{v}_{..}$: mean value of v_{it} across all observations).

The analyzed stock indicators were tested for the simultaneous presence of subject-specific and time-specific fixed effects (using an F test for two-way effects). Such effects emerge in five of the six indicators, with only the Treynor measure yielding no significant outcome. These results suggest that the fixed-effects model for both subject- and time-specific issues is a suitable method for the intended analysis.

All regressions were tested for the presence of possible limitations on the validity of results with a particular focus on signs of:

- heteroscedasticity (Test method: Breusch-Pagan test),
- autocorrelation (Test method: Wooldridge test) and
- cross-sectional correlation (Test method: Pesaran-CD test).[18]

All three limitations can be addressed using the Driscoll-Kraay estimator, which was used to adjust the results whenever at least one of these problems occurred in a regression.[19]

For the analyses, the statistical software R (RStudio 2024.09.1+394) was used, with the packages dplyr (Wickham et al., 2023), tidyr (Wickham et al., 2024), lmtest (Hothorn et al., 2022), sandwich (Zeileis et al., 2024), plm (Croissant et al., 2025), moments (Komsta/Novomestky, 2022), rms (Harrell, 2025), Hmisc (Harell et al., 2025), tseries (Trapletti et al., 2024) and rugarch (Galanos, 2025) (partly in earlier versions).

4. Analysis

4.1 Descriptive Statistics

Figure 3 initially shows the medians of dependent variables for individual years of the total investigation period, wherein the ESG performance of underlying shares is not yet accounted for. The vertical lines in the graphs between 2020 and 2021 symbolize the separation between Observation Periods 1 (pre-crisis) and 2 (crisis period). It is apparent that the risk-adjusted earnings indicators (Sharpe ratio, Treynor measure, and Jensen measure) change over time in a similar way to stock returns. Risk-adjusted profit indicators therefore appear to be influenced primarily by the returns included in their calculation and less by their inherent risk components. Risk indicators (volatility and beta factor) show similar trends over the total investigation period in terms of directional change—but not in terms of the strength of the changes.

18 Regarding the definitions of the three problems mentioned and possible tests see Gehrke (2022), pp. 123–129.

19 The use of the Driscoll-Kraay estimator (Driscoll/Kraay, 1998) follows the interpretation of Gehrke. Gehrke describes the Driscoll-Kraay estimator as a further development of the Arellano estimators (Arellano, 1987), with which by means of different procedures either cross-sectional correlation or both heteroskedasticity and autocorrelation can be corrected (Gehrke, 2024; Gehrke, 2022, pp. 126–129).

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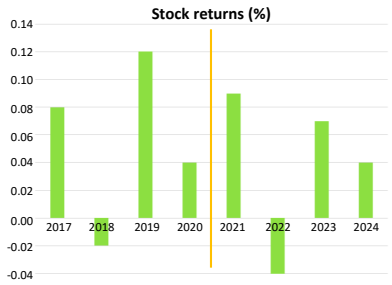
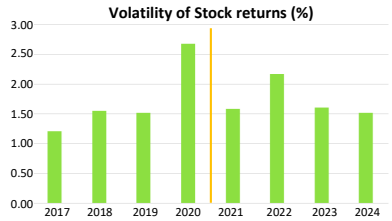
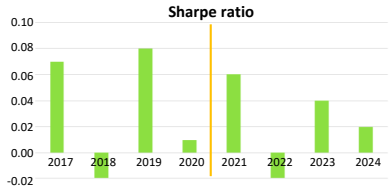


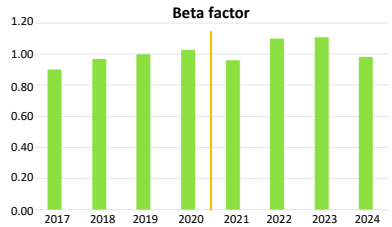
Medians							
2017	2018	2019	2020	2021	2022	2023	2024
0.08	-0.02	0.12	0.04	0.09	-0.04	0.07	0.04



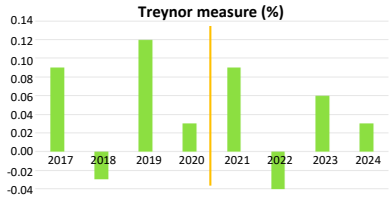
Medians							
2017	2018	2019	2020	2021	2022	2023	2024
1.21	1.55	1.52	2.68	1.58	2.17	1.61	1.52



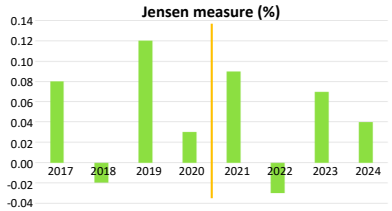
Medians							
2017	2018	2019	2020	2021	2022	2023	2024
0.07	-0.02	0.08	0.01	0.06	-0.02	0.04	0.02



Medians							
2017	2018	2019	2020	2021	2022	2023	2024
0.90	0.97	1.00	1.03	0.96	1.10	1.11	0.98



Medians							
2017	2018	2019	2020	2021	2022	2023	2024
0.09	-0.03	0.12	0.03	0.09	-0.04	0.06	0.03



Medians							
2017	2018	2019	2020	2021	2022	2023	2024
0.08	-0.02	0.12	0.03	0.09	-0.03	0.07	0.04

Figure 3: Medians of dependent variables, disregarding ESG performance of underlying shares

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Figure 4 also shows the medians of dependent variables over the total investigation period but differentiates according to the ESG performance of stock issuers. Here, too, the boundary between Observation Periods 1 (pre-crisis) and 2 (crisis period) is shown as a line between 2020 and 2021. It is noteworthy that the values for stock returns and related variables (Sharpe ratio, Treynor measure, and Jensen measure) tend to deteriorate with improved ESG performance before the crisis. After the onset of the crisis, however, the disadvantages of ESG-strong stocks appear to largely erode. In terms of volatility, no systematic changes are apparent in the comparison of values for Observation Periods 1 and 2. The beta factor shows a tendency toward higher values with better ESG performance in the years preceding the crisis, but this tendency is no longer observable after its outbreak. The following section shows, within the framework of the central analysis, to what extent these initial data impressions are confirmed.

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Figure 4: Medians of dependent variables, including ESG performance of underlying shares

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4.2 Results of the Regression Analysis

The following table shows the slope parameters of regressions for single stock indicators; the test results for heteroscedasticity; autocorrelation and cross-sectional correlation; and resulting necessary adjustments to the values of slope parameters („Driscoll-Kraay estimator“ column).

Stock indicator	Slope parameters ESG-decile variable	Slope parameters interaction variable	Test values: Breusch-Pagan (BP) Wooldridge (F) Pesaran-CD (Z)	Driscoll-Kraay estimator Slope parameters ESG-decile variable	Driscoll-Kraay estimator Slope parameters interaction variable
Stock return	-0.00782***	0.00743***	4.2 14.3*** -0.5	-0.00782***	0.00743***
Volatility of Stock returns	0.00961	-0.01045*	44.2*** 139.8*** 3.7***	0.00961	-0.01045*
Sharpe ratio	-0.00381***	0.00363***	12.9** 10.7** -0.9	-0.00381***	0.00363***
Beta factor	0.01459***	-0.02139***	2.7 343.3*** -0.4	0.01459*	-0.02139***
Treynor measure	0.01926	0.01499	4.0 2.2 123.3***	0.01926	0.01498*
Jensen measure	-0.00796***	0.00738***	4.0 20.9*** -0.9	-0.00796**	0.00738***

Notes:

*** estimation significant at a level ≤ 0.1 %

** estimation significant at a level > 0.1 % and ≤ 1 %

* estimation significant at a level > 1 % and ≤ 10 %

Table 1: Regression parameters, test values, and adjusted regression parameters

The stock return for the total investigation period indicates a significant correlation with the ESG performance of corresponding companies. An increase in ESG performance by one decile leads to a reduction in the stock return by almost 0.8 basis points (estimation significant at level ≤ 0.1 %). Sustainably-minded investors were forced to accept lower returns. The slope parameter for the interaction variable shows a change for the period after the onset of the energy crisis: The parameter is greater than 0 and the estimation is significant at the level ≤ 0.1 %. This means that the disadvantages in returns of sustainable

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compared to less sustainable investments has been noticeably reduced since the onset of the crisis. In contrast to the returns, the volatility analyses yields more ambiguous results. Looking at the total investigation period, there are signs of rising volatility with increasing ESG performance—nearly one full basis point per decile—but the estimate of the slope parameter is not significant. For the slope parameter of the interaction variable, the result is a value below 0, putting the estimate barely within the significant range. This indicates, albeit not especially strongly, that the volatility of returns on sustainable stocks has decreased relative to non-sustainable stocks since the onset of the energy crisis. The result for the second risk indicator, the beta factor, is somewhat clearer: Over the total investigation period, the factor increases for higher ESG values (slope parameter 0.01459, significant at levels between > 1 % and ≤ 10 %). Investors in more sustainable stocks therefore generally had to bear higher market risks. The negative slope parameter of the interaction variable (estimation significant at the level ≤ 0.1 %) shows that the difference narrowed in the second observation period (i.e., after the onset of the crisis). With rising ESG performance, we can expect a less pronounced increase in market risks compared to the previous period. Overall, the energy crisis can be understood as a systemic shock that affected the entire capital market. That the market sensitivity of ESG-strong stocks converged with the lower market sensitivity of ESG-weak stocks in Observation Period 2 could result from the fact that ESG-weak companies are more dependent on fossil fuels and were therefore more heavily affected by crisis-related market fluctuations than ESG-strong companies.

In conclusion, both risk indicators (volatility of stock returns and beta factor) show improvements for sustainability-oriented investors since the onset of the energy crisis, albeit to varying degrees. As already suggested in section 4.1, the results for the Sharpe ratio appear to be driven by stock returns: In other words, sustainably orientated investors were poorly compensated for their risk over the total investigation period compared to less sustainable investors (Sharpe ratio reduced by more than 0.003 per higher ESG decile). However, the shares of sustainable issuers caught up noticeably compared to those of less sustainable issuers after the onset of the crisis (slope parameter of the interaction variable higher than 0 with a highly significant estimation).

The Treynor measure, on the other hand, only reveals weak correlations between the analyzed variables. Over the total investigation period, the indicator increases in the case of a rising ESG performance of the stock issuers, however, the estimate is not significant. The slope parameter for the interaction variable is greater than 0 at the significance level between > 1 % and </= 10 %. This suggests that any advantages of sustainable over non-sustainable stocks that may have existed before the energy crisis could have increased after the onset of the crisis.

In contrast to the Treynor measure, the Jensen measure, like other indicators in this study, exhibits a more conclusive ESG sensitivity; i.e., the relevant values decrease as the ESG performance of stock issuers increases (slope parameter for the ESG-decile variable less than 0, estimation significant at a level between > 0.1 % and ≤ 1 %). ESG-weaker stocks were therefore generally better positioned than ESG-stronger stocks relative to the Capital Asset Pricing Model benchmark. However, the disadvantage of more sustainable stocks diminished after the onset of the crisis (slope parameter of the interaction variable greater than 0, estimation significant at the level ≤ 0.1 %).

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In answering the research question of this study, the overall result supports the idea that the performance of more-sustainable over less-sustainable stock investments has improved since the outbreak of the energy crisis, with improved values for more-sustainable stocks across all indicators. These findings further suggest that sustainable stock investments were more resilient to the effects of the energy crisis than non-sustainable ones.

Presumably, the causes described in sections 2.2 and 2.3 are simultaneously responsible for this; to wit:

a. Rising oil prices lead to rising share prices of ESG-strong companies, as they are less affected by cost increases due to the use of non-fossil energy sources (see 2.2).
b. Demand for products from sustainable companies is less price-elastic in times of crisis, which translates into higher margins compared to non-sustainable companies (see 2.3).
c. The stocks of companies with higher ESG ratings are more likely to be held by socially conscientious investors who are less likely to participate in sell-offs (see 2.3).
d. Sustainable companies invest in social capital, which builds trust with investors and leads to better performance for such companies in times of crisis (see 2.3).

These causes are of a two-fold nature: Some are fundamental (a and b), while others result from certain forms of investor behavior (c and d).

The results of this analysis align with the findings described in section 2.3 for the financial crisis and the COVID-19 pandemic (higher returns and lower volatility of ESG-strong stocks), warranting the assumption that effects on variously sustainable stock investments in crises associated with demand shocks occurred in similar ways in the energy crisis, which represented an exclusive supply-side shock.

In conclusion, we observed significant changes in terms of the risk–return behavior of stocks along the ESG spectrum before and after the outbreak of the energy crisis, but we cannot understand the crisis as a game changer with regard to the behavior of those stocks in relation to previous crises.

4.3 Robustness Checks

The regressions show, among other things, that the advantages of non-sustainable over sustainable stocks have diminished since the outbreak of the energy crisis in terms of stock returns and risk indicators (volatility, beta factor). The aim of the robustness checks is to examine whether these results also materialize within a different analytical methodology. Two portfolios were initially formed for this purpose:

- *ESG-strong* portfolio consisting of all shares in the highest ESG decile; and
- *ESG-weak* portfolio consisting of all shares in the lowest ESG decile.

The structure of these portfolios is adjusted annually as a result of the new composition of deciles due to changes in ESG scores. All securities in the portfolios receive the same proportional weighting. The regressions in section 4.2 apply to an analysis across all ESG deciles. The robustness test, which only considers the two most extreme deciles, should therefore at least confirm if not amplify any differences previously detected between sustainable and non-sustainable stocks.

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4.3.1 Robustness Analysis for Stock Returns

The robustness test for stock returns proceeds as follows: The first step is to calculate daily return differences between the ESG-strong and ESG-weak portfolios (expressed formulaically: $d_n = rl_n - rh_n$; i.e., return difference d of day n results from the daily return rl_n of the ESG-weak portfolio minus the daily return rh_n of the ESG-strong portfolio). Calculated return differences for Observation Period 1 were assigned to the *pre-crisis* analysis group, differences for Observation Period 2 to the *crisis* analysis group. In the next step, we compare the two analysis groups in a one-sided Mann–Whitney U test[20] to determine whether the differences changed significantly from Observation Period 1 to 2. At this stage, the comparison of mean values for both groups in a box plot (see Figure 5) offers an early indication that the differences are reduced from the first to the second observational period (mean value pre-crisis: 0.06802; mean value crisis: 0.00151).

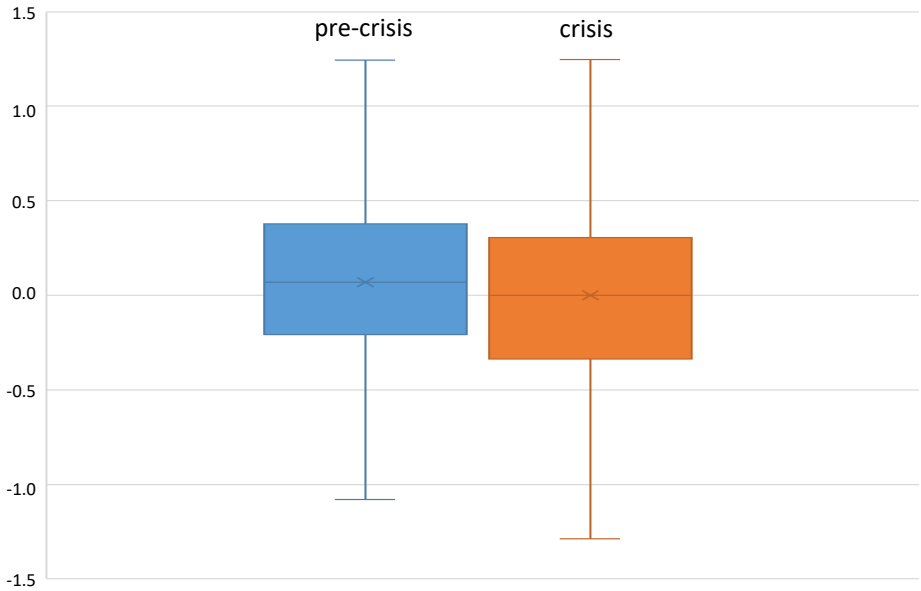

Figure 5: Return differences ESG decile 1 vs. ESG decile 10 compared between *pre-crisis* and *crisis* (without breakout points)

The one-sided Mann–Whitney *U* test is directed at confirming or rejecting the null hypothesis „differences in both groups are identical“ at the expense or in favor of the alternative hypothesis „differences in the *crisis* group are significantly lower than in the *pre-crisis* group“. A necessary precondition for the comparability of these two analysis groups is to determine whether the time series of the differences in the two groups exhibit the characteristic of stationarity. This check was performed through Augmented Dickey–Fuller tests[21]. The results of the two tests are shown in Table 2.

20 Regarding this test, see Black (2010), pp. 678–682.
21 Regarding this test, see Gehrke (2022), pp. 363–364.

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The Augmented Dickey–Fuller test provides evidence of the stationarity of the difference time series for both analysis groups. We can thus reject the null hypothesis on which the test is based („time series is not stationary") for both the *pre-crisis* and *crisis* analysis groups (significance level of both tests < 1 %). The subsequent one-sided Mann–Whitney U test reveals significant deviations among the differences contained in the two groups.

Group	***pre-crisis* (N=1026)**	***crisis* (N=1028)**
Augmented Dickey-Fuller test (Test value *DF* and significance *p*)	DF = -9.9104 p < 1 %	DF = -8.773 p < 1 %
Mean	0.06802	0.00151
Mann-Whitney U test (rank sum W and significance p)	W=577973 p < 0.1 %	

Table 2: Results robustness analysis for stock returns

The null hypothesis („both populations are identical") is rejected at a significance level below 0.1 %, meaning that the alternative hypothesis („significant difference between the two groups") is valid. In other words, the outbreak of the energy crisis has lessened the return advantages of the ESG-weak portfolio compared to the ESG-strong portfolio. This result confirms the corresponding findings from the regression analysis.

4.3.2 Robustness Analysis for Risk

The results concerning risk behavior of variously sustainable stocks before and after the onset of the energy crisis are verified using Generalized Autoregressive Conditional Heteroskedasticity (GARCH) modeling according to Bollerslev (1986).

The specific GARCH(1,1) variant used here follows this formula (Bollerslev, 1986, pp. 308–311; Hull, 2016, pp. 248–253):

$$\sigma_t^2 = \gamma V_L + \alpha u_{t-1}^2 + \beta \sigma_{t-1}^2$$

where σ_t^2 is the variance of the current day (dynamic variance); V_L is the long-term variance; u_{t-1} is the previous day's return (i.e., the return from day *t-2* to day *t-1*); and σ_{t-1}^2 is the volatility of the previous day. The characters γ, α, and β represent the weights assigned to V_L, u_{t-1}^2 and σ_{t-1}^2 when determining σ_t^2. The GARCH analyses are each based on an AR(1) process as a mean model.[22] Such a first-order autoregressive process can be formally represented as follows (Franke et al., 2004, pp. 143–144):

$$X_t = c + \rho X_{t-1} + \varepsilon_t$$

where X_t is the random variable to be estimated (here the return on day *t*); X_{t-1} is the value of X_t on the previous day; and ρ is the autoregression parameter on which the process is based. The character ε_t denotes a random variable in the sense of „white noise," and *c* acts as a constant that is inherent to the process. Table 3 shows the key parameter

22 The GARCH modelling with the AR(1) process as a mean model was realised using ‚R' software. This was done based on Becker et al. (2025) and Ghalanos (2025).

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characteristics of the separate GARCH models for the ESG-strong and ESG-weak portfolios. The calculations for the two portfolios were based on daily log returns[23] and a Students t distribution of the returns was assumed in each case.

Parameter	ESG-weak portfolio	ESG-strong portfolio
ρ	0.01717	-0.00259
γV_L	0.02716***	0.03974***
α	0.13833***	0.13831***
β	0.84093***	0.82700***
Shape parameters of the Student t-distribution	7.46933***	5.09240***

Notes:

*** estimation significant at a level ≤ 0.1 %

** estimation significant at a level > 0.1 % and ≤ 1 %

* estimation significant at a level > 1 % and ≤ 10 %

Table 3: GARCH model parameters for the ESG-weak and ESG-strong portfolios

Once the variances are in place, calculating the corresponding dynamic volatilities for returns on the two portfolios is a trivial matter of taking the square root. Figure 6 shows the trend in these volatilities over the two observational periods. While the volatilities of both portfolios exhibit fairly similar movements prior to the onset of the crisis, the ESG-strong portfolio afterward tends toward lower volatilities compared to the non-sustainable portfolio, especially from the beginning of 2022.

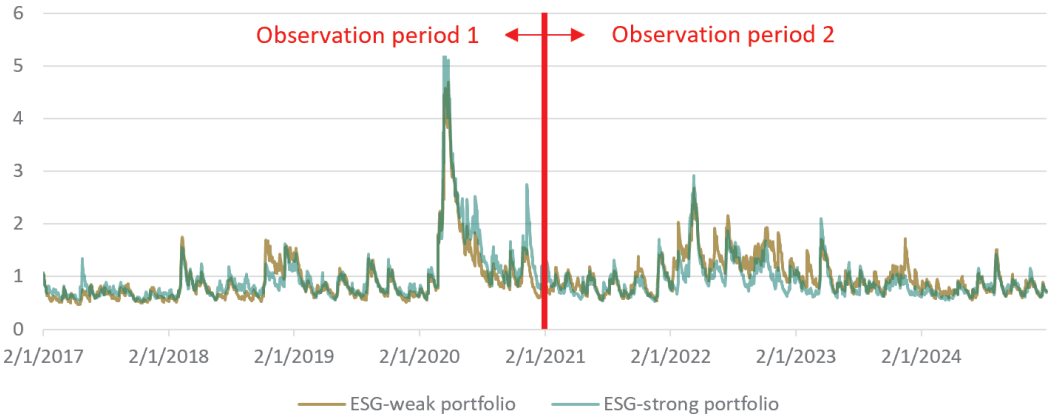

Figure 6: GARCH volatilities of the ESG-strong and ESG-weak portfolios

The described changes become even more significant once we subtract dynamic volatilities of the ESG-weak portfolio from those of the ESG-strong portfolio on a daily basis (see

23 Augmented Dickey–Fuller tests confirmed the stationarity of the two return time series.

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Figure 7): The 100-day average line of these differences largely approaches zero or above during Observation Period 1. At the start of Observation Period 2, this average line continually falls.

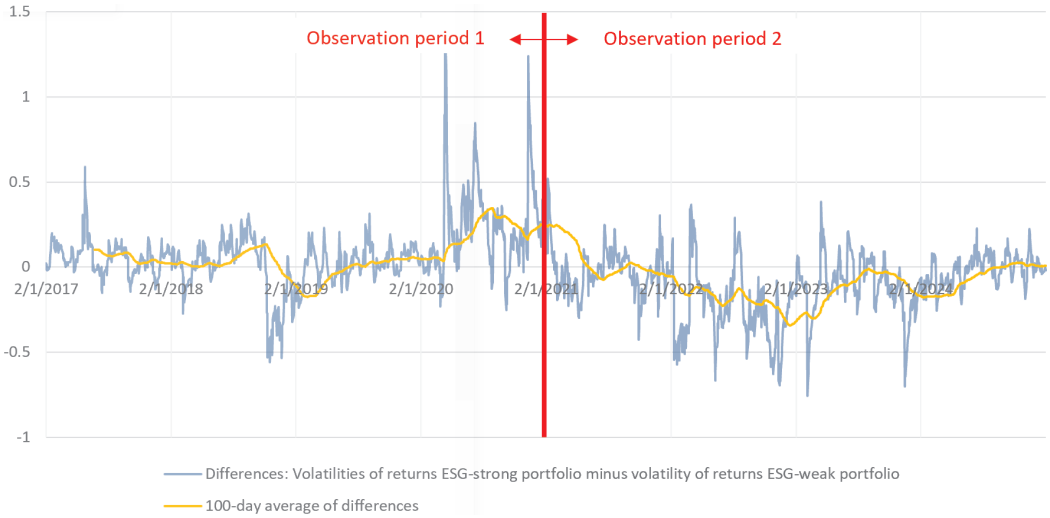

Figure 7: Differences in GARCH volatilities for the ESG-strong and ESG-weak portfolios

At the end of 2021, the line finally reaches negative territory, where it then remains for a longer period of time. The negative difference is an indication that the volatilities of the returns on the ESG-strong portfolio were lower than those on the ESG-weak portfolio. The results of the regression analysis with regard to risk exposure—diminishing advantages of non-sustainable compared to sustainable shares since the outbreak of the energy crisis—are therefore robust.

5. Discussion of the results

The gap in investment performance of more-sustainable versus less-sustainable shares, where present, depends on energy prices. This finding deserves greater scrutiny in practice and research. Rational investors will only favor more sustainable investments under the following incentive scheme:

Investment performance of more sustainable assets	+	**Monetary value of other benefits from sustainable investments**	>	**Investment performance of less sustainable assets**

Investment performance should be understood in this context as a risk-adjusted measure of return that takes into account all risks relevant to the investor—especially price, credit and liquidity risks—and also others that may not be measurable from historical data, such as regulatory changes or human error. „Other benefits“ of a sustainable investment could arise, among other factors, from investors communicating their sustainability efforts to their stakeholders and thereby achieving reputational gains. For example, investors could try to obtain higher sales prices from their clients on the basis of their enhanced reputation as a means of raising corporate profits. The results of the present analysis imply that

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the energy crises has augmented the chances of fulfilling the incentive condition: Insofar as sustainable stocks underperformed their less-sustainable counterparts, which was the case across four indicators, this gap has narrowed noticeably since the outbreak of the crisis. From an investor's perspective, this suggests that ESG-strong shares have become more attractive. Investors might now take them into greater consideration in their future decision-making. Regulatory initiatives such as the EU taxonomy already provided a path for investors to more reliably identify sustainable corporate behavior. This provides in combination with the outcomes described herein support for capital flows into sustainable securities, which could reduce overall capital costs for sustainable companies.

As this analysis omits any corresponding differentiation, it remains to be seen whether the findings are readily applicable to all sectors. For example, it is possible that the identified effects do not occur to the same extent in sectors that are not considered sustainable. Investigating this would be an approach for future research work. In addition, such efforts might examine whether the results found here for the European stock market are also valid in other regions of the world.

In addition to the previously described relevance for individual investors, these findings are important for the economy as a whole. If we assume from the overall social perspective that it is desirable for investor capital to flow into sustainable channels, the probability for that rises with dwindling performance disadvantages for sustainable over non-sustainable investments. With such disadvantages having diminished since the outbreak of the energy crisis, there is a greater chance that future investors will be motivated to spend money on sustainable projects. From an economic policy perspective this would allow for reduced subsidies concerning the promotion of sustainable investments. At the same time, policymakers must be wary of any abrupt changes to existing subsidy schemes, which could lead to a rapid decline in ESG levels for companies and thus erode the market-related financing advantages. A reduction in subsidies should therefore only proceed gradually and in combination with an impact analysis.

Eisenkopf et al. (2023) have shown that return advantages of ESG-strong stocks triggered by the COVID-19 shock diminished over time. The changes identified in the present analysis concerning the energy crisis also require careful monitoring for their stability over time. If the changes prove to be unstable, the reasons must be investigated. If the effects should disappear altogether, particularly in the case of decreasing energy prices, it would make sense for sustainability-oriented investors to hedge against an energy-price decline. The present investigation is based exclusively on market data, and these results should be verified using observational methods for the direct analysis of investor behaviour (e.g. laboratory experiments). This type of experimentation would also enable the search for specific triggers that motivate investors to engage with sustainable companies.

Finally, this analysis shows that the impact of the energy crisis as a pure supply shock is comparable to the effects of the financial crisis and the COVID-19 pandemic, which were accompanied by demand-side shocks. The fact that ESG-strong stocks also proved to be more resilient in the energy crisis than ESG-weak stocks indicates a particularly relevant contribution to the body of evidence: It supports the idea that the risk-reducing effects of ESG-strong stocks that occur during market crises can be generalized and applied to crises of many different types. In the scenario under consideration, sustainable stocks have once again proved their worth as hedges.

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6. Conclusion

The research presented here intends to clarify whether the performance of more-sustainable versus less-sustainable stock investments improved or deteriorated after the outbreak of the energy crisis. The analysis rests on shares data from the STOXX Europe 600 (Gross Return) index. Six typical stock indicators from portfolio management served as metrics in the panel regressions performed to answer the research question. Overall, these analyses lead to the conclusion that the performance of more-sustainable stock investments has improved since the onset of the energy crisis. Compared to previous crises with other economic backgrounds, more-sustainable stocks showed similar behavior relative to less-sustainable stocks in the energy crisis. In this respect, the energy crisis cannot be seen as a game changer. The results of this study may prove useful for considerations of capital allocation in ESG-strong areas, sustainable asset management, and the economic policy.

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Value Creation Reporting for Sustainable Development – Is Sustainability Information Integrated with Financial Information?

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Abstract: The transition to more sustainable economic development is at the heart of the Agenda 2030 for Sustainable Development by the United Nations. This leads to a broader definition of value that integrates social and environmental aspects alongside economic value. In this paper, we derive a structure for the analysis of reporting on sustainable value creation based on actual reporting decisions. Structuring the disclosures on sustainable value creation focuses on presentation, integration, measurement and aggregation. We further provide descriptive evidence on firms' reporting decisions on sustainable value creation by manually analysing the reports of the 20 largest Swiss companies from 2013–2022 and the 2022 reports of the 50 largest EU listed companies. The analysis suggests a substantial increase in reporting on sustainable value creation over time with slightly more than 50% of firms reporting on sustainable value creation in 2022. Firms tend to report in visual form and focus on prior year realizations of measures in the environmental and social areas. Firms' impacts and dependencies on people and planet are vaguely integrated with financial considerations and dependencies are rarely addressed. Aggregated or forward-looking measures are largely missing.

Keywords: Sustainable development, sustainable value creation, integration, measurement, aggregation, presentation

Nachhaltige Wertgenerierungsberichterstattung – Werden Nachhaltigkeitsinformationen und finanzielle Informationen integriert?

Zusammenfassung: Im Zentrum der Agenda 2030 für Nachhaltige Entwicklung der Vereinten Nationen steht der Übergang zu einer nachhaltigeren wirtschaftlichen Entwicklung. Dies führt zu einem umfassenderen Wertbegriff, der ökonomische, soziale und umweltbezogene Aspekte integriert. Im vorliegenden Beitrag entwickeln wir eine Struktur für die

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Analyse der Berichterstattung zur nachhaltigen Wertgenerierung, die auf der tatsächlichen Berichterstattung basiert. Die Strukturierung der Berichterstattung orientiert sich an den Aspekten Darstellung, Integration, Messung und Aggregation von Informationen. Darüber hinaus liefern wir deskriptive Ergebnisse zur Berichterstattung über nachhaltige Wertgenerierung, indem wir die Berichte der 20 grössten Schweizer Unternehmen im Zeitraum 2013–2022, sowie die Berichte des Jahres 2022 der 50 grössten börsennotierten EU-Unternehmen manuell analysieren. Die Ergebnisse zeigen einen deutlichen Anstieg der Berichterstattung zur nachhaltigen Wertgenerierung im Zeitverlauf. Im Jahr 2022 berichten etwas mehr als 50 % der Unternehmen über nachhaltige Wertgenerierung. Die Unternehmen berichten eher in einem visuellen Format und fokussieren auf soziale und umweltbezogene Informationen aus dem vorangegangenen Geschäftsjahr. Auswirkungen auf Gesellschaft und Umwelt und die entsprechenden Abhängigkeiten der Unternehmen sind nur vage in finanzielle Aspekte integriert, wobei insbesondere Abhängigkeiten kaum adressiert werden. Aggregierte oder zukunftsorientierte Informationen fehlen weitgehend.

Stichwörter: Nachhaltige Entwicklung, Nachhaltige Wertgenerierung, Integration, Messung, Aggregation, Darstellung

1. Introduction

Sustainable development is at the heart of international attempts to address both environmental and societal challenges around the world. In 2015, the General Assembly of the United Nations adopted the 2030 Agenda for Sustainable Development, which contains 17 sustainable development goals (SDGs) in the environmental, social and economic areas. Achieving the ambitious goal of sustainable development by 2030 requires actions by all players in the economy to reduce their impact on people and planet while ensuring economic stability.

With the overarching goal of sustainable development in mind, the notion of corporate value shifts from a mere focus on the cash flow potential of firms to a broader concept that additionally considers environmental and social value (see for instance Schoenmaker and Schamrade, 2019 or WEF, 2019). This concept of value focuses on the needs of all stakeholders and the value created or eroded for them through economic activities (Business Roundtable, 2019; WEF, 2019). To determine this value, stakeholders require considerable information in all areas of sustainable development and the respective valuation techniques for environmental and social value (IFVI, 2024; Schoenmaker, 2021; VBA, 2024). It also requires a new paradigm in reporting on value.

We understand sustainable value creation along the lines of prior literature and initiatives (Adams, 2017; IIRC, 2021; Schoenmaker and Schamrade, 2019; WEF, 2019) as any positive or negative value created or destroyed in economic, social or environmental areas. This definition of sustainable value creation translates into value created for all stakeholders (Freeman, 1984) and covers externalities and their internalization as part of the value creation or erosion process. Effectively communicating and reporting such a concept of value to outside stakeholders requires strong linkages across reporting elements.

Sustainability reporting standards such as the Global Reporting Initiative (GRI) standards, the International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards (IFRS S) or the European Sustainability Reporting Standards (ESRS) provide useful information on material topics and firm activities in the environmental and social

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domains. However, to date, few initiatives exist that discuss how this information can be integrated with financial information to develop a holistic view of the value created for sustainable development. In this paper, we analyse how firms report on sustainable value creation and derive a structure for the analysis of sustainable value creation reporting decisions. This structure focuses on key issues that are typically identified as challenges to improve the usefulness of sustainability reporting. They include presentation, integration, measurement and aggregation.

We analyse the reporting decisions of the 20 largest Swiss public firms (Swiss Market Index (SMI)) from 2013–2022. The focus on large firms rests on the assumption that they are subject to increased public scrutiny and therefore have stronger incentives to publicly disclose information on sustainable value creation. The Swiss setting is appealing because sustainability reporting as the informational basis for sustainable value creation reporting, was largely voluntary during that time. Voluntary disclosure settings offer firms a variety of reporting options and we exploit this fact for reporting decisions on sustainable value creation.[1] We also compare the most recent findings for Switzerland to the 2022 reports of the largest public European Union (EU) firms (Euro Stoxx 50 index) to assess systematic differences resulting from EU firms being subject to much stricter and mandatory sustainability reporting requirements.[2] However, reporting on sustainable value creation was neither mandatory in Switzerland nor in the EU during our sample period.

We structure the content analysis around two main steps. First, we assess which firms report on sustainable value creation and their presentation format. We allow for alternative ways to report on the integration of financial and sustainability aspects. Second, we focus on direct disclosures on sustainable value creation and analyse different reporting formats as well as measurement and aggregation. Our findings show that sustainable value creation reporting is increasing among SMI firms. By 2022 55% of Swiss firms (54% of Euro Stoxx 50 firms) report how they create value in economic, environmental and social terms. Firms mostly provide extensive visual illustrations that help in understanding the inputs and outputs to their value creation process. Our findings also highlight that firms reporting on sustainable value creation tend to align their purpose with sustainability and are more likely to have a separate sustainability strategy aligned with the overall strategy. In essence, the results suggest that the decision to report on sustainable value creation is strongly related to the integration of sustainability aspects into reporting on the financial considerations of companies. In terms of measurement and aggregation, the disclosures on sustainable value creation are merely qualitative in nature, and quantifications strongly focus on historical realizations of the data. Target setting and relations to SDGs or other wider goals rarely exist and, if so, only on a qualitative basis without any indication of whether current achievements are sufficient to reach broader goals. Although material topics are a core element of current sustainability reporting frameworks, our study shows that they are rarely used to link the business model with sustainability aspects as part of sustainable value creation reporting.

1 See Beyer *et al.* (2010) and Leuz and Wysocki (2016) for overviews on voluntary disclosure decisions in the financial reporting domain. Christensen *et al.* (2021) and Friedman and Ormazabal (2024) augment the literature with overviews on voluntary disclosure decisions in sustainability reporting.

2 See Hummel and Jobst (2024) for an overview of corporate sustainability reporting regulations in the EU.

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To the best of our knowledge, this is the first study to propose a structure for the analysis of reporting on sustainable value creation and to provide evidence on reporting decisions on sustainable value creation. This allows academics to capture the concept of sustainable value creation empirically based on existing guidance and effective reporting decisions. It is also important for corporate management wishing to understand how their firm contributes to sustainable development by equipping them with an analytical framework to guide information provision on sustainable value creation and respective disclosure decisions. Capital market participants and other stakeholders learn from this study how sustainable value creation can be described in corporate reports. The results further provide insights into the state of the art of disclosing information on sustainable value creation in Switzerland.

This paper contributes to various strands of literature. First, a true understanding of the value created for sustainable development is only possible if reporting integrates the impacts and dependencies of firms' activities on people and planet. In this respect, our paper expands the literature on integrated reporting and integrated thinking.[3] The literature in this area has largely focused on firms using the Integrated Reporting Framework (Barth *et al.*, 2017; Dimes *et al.*, 2023; Dimes and de Villiers, 2024; Lee and Yeo, 2016; Zhou *et al.*, 2017). Only a few papers rely on measures for integrated reporting and integrated thinking that are independent of firms actually using the Integrated Reporting Framework but are instead provided by international financial databases (Busco *et al.*, 2019; Malafronte and Pereira, 2020; Serafeim, 2015). Our approach is an alternative to measuring the integration of financial and sustainability aspects irrespective of the firms applying the Integrated Reporting Framework and allows us to assess key elements of integration within any corporate report.

Second, we contribute to the literature on the aggregation and measurement of sustainability information (Friedman and Ormazabal, 2024; Grewal and Serafeim, 2020; Wagenhofer, 2024). The literature stresses different informational needs for different stakeholders (Beyer *et al.*, 2023; Colonnelli *et al.*, 2024; Leonelli *et al.*, 2025; Roslender and Nielsen, 2021) and the role of comparability of sustainability information in decision-making (Greenstone *et al.*, 2023). Our findings show that disclosure by firms is highly diverse, most likely because firms have discretion in reporting on sustainable value creation. Furthermore, the measurement of information is sparse, and aggregation rarely occurs. Considering that we only analyse very large multinational companies, this result underscores the need for better measurement and aggregation to provide more comparable and decision-useful information.

Third, we also contribute to the debate on the presentation of accounting information (Beattie and Jones, 1992; Chen *et al.*, 2016; Christensen *et al.*, 2024; Davison, 2015; Friedman and Ormazabal, 2024). Our findings show that visual representations are commonly used for disclosing sustainable value creation. In this respect, we add to the findings of Busco *et al.* (2023), who show that managers may benefit from visual representations of sustainable value creation by highlighting that this may also apply to the case of external reporting. Therefore, we also confirm the findings of Lin *et al.* (2024) that sustainability information is often disclosed in a visual format. Other stakeholders, such as consumers, profit from easily accessible information regarding their consumption deci-

3 Integrated thinking is the management concept related to integrated reporting (IIRC, 2021).

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sions (Beyer et al, 2023, Jin and Leslie, 2003). Whether the representation in visual form is indeed more accessible rather than being used as an impression management device is left for future research (Cardinaels, 2008; Elliott *et al.*, 2017; Ronzani and Gatzweiler, 2022).

Finally, this study contributes to stakeholder-oriented views of the firm by showing how voluntary sustainability disclosures act as mechanisms for articulating value creation amid informational ambiguity and regulatory discretion.[4] About 50% of firms decide to prominently disclose key value drivers in their reports that provide insights into sustainable value creation and inform stakeholders.

2. Value creation for sustainable development

2.1 The concept of sustainable value creation

To address the world's environmental and societal challenges, countries have agreed on a global agenda to advance the transition to sustainable development. In 2015 the General Assembly of the United Nations adopted the 2030 Agenda for Sustainable Development (United Nations, 2015) that supports the worldwide transition to sustainable development and includes seventeen sustainable development goals – SDGs (United Nations, 2015). The SDGs cover environmental, societal and economic goals[5] and support a notion of value that places environmental and social considerations at the basis of any economic success (Laine *et al.*, 2022; Schoenmaker, 2020, 2021).

Alongside the political agenda for sustainable development, the role of businesses in society has changed. For instance, the Business Roundtable – an association of chief executive officers in the United States (U.S.) – changed its statement on the purpose of the firm to one that considers the needs of all stakeholders instead of only shareholders (Business Roundtable, 2019). Around the same time, the World Economic Forum (WEF) newly defined the purpose of a company as follows: „The purpose of a company is to engage all its stakeholders in shared and sustained value creation" (WEF, 2019). Hence, businesses are required to act as partners in society and to consider the needs of all stakeholders when doing business. This closely aligns with the triple bottom line approach (Elkington, 1997) or Freeman's stakeholder theory (Freeman, 1984) and contrasts with the longstanding focus on shareholder value maximization (see the discussions in Christensen *et al.* (2021) and in Laine *et al.* (2021)).

The definition of sustainable value creation in this paper, builds on the SDGs and stakeholder theory. We understand sustainable value creation as any positive or negative value created or destroyed in economic, social or environmental areas. This three-layer conception builds on existing approaches in Adams, (2017), Schoenmaker and Schamrade (2019) and WEF (2019). It also aligns with the concept of Accounting for Sustainability and Stakeholders that assumes the informational demands of stakeholders as the basis for corporate information provision (Hörisch et al., 2020). Our definition of sustainable value creation is broad and includes the impacts of firms on people and planet and the dependencies of firms on people and planet in line with the double-materiality approach. We emphasize in our definition that firms' impacts may fold back to financial performance

4 We thank an anonymous reviewer for suggesting this valuable sentence.
5 The Stockholm Resilience Center created an SDG wedding cake model with these three areas: https://www.stockholmresilience.org/research/research-news/2016-06-14-the-sdgs-wedding-cake.html.

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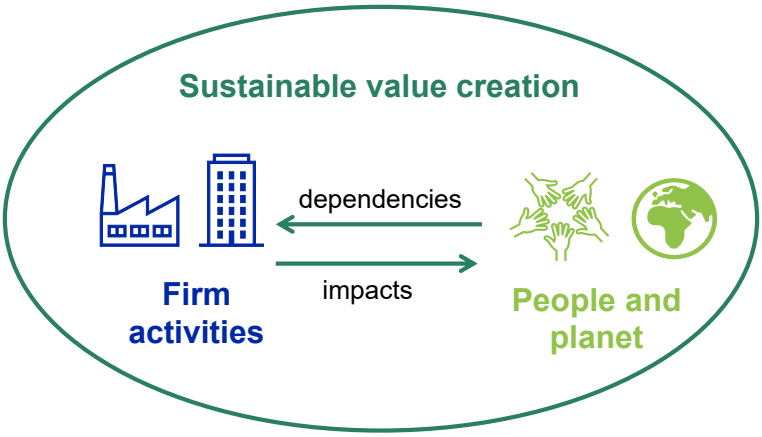
at some point in time because firms are dependent on people and planet. Hence, even small impacts by many firms may have large financial impacts due to firms' dependencies on natural resources or society (Schoenmaker, 2020, 2021; Schoenmaker and Schamrade, 2019, for similar arguments). Our definition of sustainable value creation is outlined in Figure 1.

Figure 1: Sustainable value creation



Own illustration of the concept of sustainable value creation. The Natural Capital Protocol contains a similar figure (Capitals Coalition, 2016, p. 15). The double materiality concept described in Article 29 of the CSRD (European Parliament and the Council, 2022) forms the basis for this illustration.

2.2 Academic literature on the role of sustainable value creation

From a theoretical perspective sustainable value creation considers the cash flow potential of firms and the internalization of externalities resulting from firms' activities (see Schoenmaker and Schamrade (2019) for similar arguments). In 1970 Friedman famously argued in the New York Times that externalities should be left to government, whereas companies should focus on maximizing shareholder value (Friedman 1970). However, the mounting pressure on the environment shows that leaving externalities to government is unlikely to result in ideal solutions (Hart and Zingales, 2017). Furthermore, externalities or ethical considerations are often not separate elements of firms' activities (Hart and Zingales, 2017). To account for such externalities, theoretical models in accounting, finance and economics change the objective functions for shareholders to consider aspects of social welfare (Friedman and Heinle, 2016; Hart and Zingales, 2017; Morgan and Tumlinson, 2019; Pástor *et al.*, 2021) or alternatively consider the needs of stakeholders in addition to those of shareholders (Magill *et al.*, 2015).

The empirical literature in this space shows that investors and other stakeholders increasingly require firms to act on environmental and social challenges and demand information (Dechow, 2023; Friedman and Ormazabal, 2024; Starks, 2023). Investors, for example, require disclosures and information on environmental and social issues (Chalmers and Picard, 2023; Ilhan *et al.*, 2023; Krueger *et al.*, 2020), and they appear to assign value to sustainability (Hartzmark and Sussman, 2019; Lins *et al.*, 2017). In some circumstances, investors may even drive sustainability within firms (Dyck *et al.*, 2019),

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although this may not translate to all types of investment strategies (Heath *et al.*, 2023). An important driver of changes in firm behaviour related to specific environmental or social considerations is engagement by large or active investors (Azar *et al.*, 2021; Dimson *et al.*, 2015). Other stakeholders such as customers, also use sustainability information on firms' activities but may rely on information sources other than annual or sustainability reports (Beyer *et al.*, 2023; Bradford *et al.*, 2017; Leonelli *et al.*, 2025). More importantly, these other stakeholders shape the demand for sustainable activities that in turn affect the sustainable value creation of firms and related reporting decisions.

However, existing literature largely neglects how cashflows and externalities relate to each other to form an interdependent system that cannot be considered in isolation. The case of natural resource depletion is an example of an externality that effectively emphasizes how corporate impacts and dependencies interact when firms extract resources that form the basis of future cashflows but simultaneously exploit the resources such that long-term cashflow potential is eroded. Hence, understanding impacts and dependencies on people and planet is a crucial aspect of sustainable decision-making. Providing such information is a demanding exercise and tools for reporting have only recently emerged. Most commonly, firms rely on sustainability reporting that may be complemented by approaches from organizations that cover sustainable value creation and its reporting more comprehensively.

2.3 Reporting concepts for sustainable value creation

Sustainability reporting

The largest amount of information on sustainability considerations is provided by sustainability reporting. In line with traditional valuation approaches that start with a thorough analysis of financial statements and derive cash flow projections from this analysis, sustainability reporting forms the basis for similar analyses of firms' activities in the environmental and social areas. Typically, sustainability information is based on a materiality assessment and includes a list of disclosures per material topic. Hence, sustainability reporting includes information on future externalities, and the risks and opportunities arising from the impact and dependencies of a firm on people and planet for each material topic. Sustainability reporting standards differ in the way material topics are assessed

The most widely used sustainability reporting standards are those of the Global Reporting Initiative (GRI) (McCalla-Leacy *et al.*, 2022). The GRI has chosen a stakeholder-oriented approach that targets disclosure of firms' impacts on people and planet (GSSB, 2022a). This focus on impact materiality provides accountability for firms' activities towards a diverse set of stakeholders. The IFRS Sustainability Disclosure Standards issued by the International Sustainability Standards Board (ISSB) take a financial materiality perspective that focuses on the informational needs of investors, whereas the EU considers double materiality. As neither the ESRS nor the IFRS Sustainability Disclosure Standards were mandatory when firms' disclosure decisions were taken in our sample period, they will be important guiding principles in the future.

For sustainability disclosure to provide information on value creation to all stakeholders, it needs to be related to financial information and integrated across material topics. Stakeholders who are interested in the sustainable value of the firm need to understand the impacts of the firm on people and planet as well as the risks and opportunities arising

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from the interrelation of all sustainability aspects with the business model and the firm's strategy. Recently, sustainability reporting standards have included requirements on the links among business models, strategies and sustainability aspects. The most recent version of the GRI standards includes a disclosure statement on the relevance of sustainable development and the firm's strategy for contributing to sustainable development by the highest governing body or the most senior executive (GSSB, 2022b, 2-22). The ESRS and IFRS S1 and S2 also require reporting on how sustainability issues are linked to business models and strategies. However, these requirements rest on strategic levels without requiring firms to integrate key performance indicators across various sustainability aspects. Furthermore, they were not mandatory when reporting decisions in this sample were taken.

Other initiatives

To address the integration of various value drivers and the rising demand for information on sustainable value creation, several attempts have been made to support firms in disclosing and measuring their sustainable value creation. One of the first attempts to disclose information on a broader concept of value has been made by the International Integrated Reporting Council (IIRC) with its Integrated Reporting Framework. The approach of the Integrated Reporting Framework requires an assessment of different capitals as inputs to and outputs of the value creation process (IIRC, 2021). The capitals in the Integrated Reporting Framework include traditional inputs to a firm's business activities, such as financial capital, manufactured capital, and intellectual and human capital. However, social capital, relationship capital and natural capital are also considered elements of the value creation process within firms (IIRC, 2021). Although it is primarily targeted towards investors, the Integrated Reporting Framework prominently considers sustainability aspects and their integration into the value creation process of the firm (Laine *et al.*, 2021). Today, the Integrated Reporting Framework has been consolidated within the ISSB but forms no part of the sustainability reporting standards issued by the ISSB.

While the Integrated Reporting Framework fosters integration, recent regulatory developments at the EFRAG and the ISSB have instead turned to the term connectivity (https://www.efrag.org/en/financial-reporting/about-connectivity and https://www.ifrs.org/connectivity/#about). Connectivity „supports the provision of a holistic and coherent set of information within and across the different AR [annual report] sections" (EFRAG, 2024, p. 11), but does not entail the strategic focus of value creation across different reports, which is the basis of integration (EFRAG, 2024). The ISSB described integration in its 2023 request for information as including „interdependencies, synergies and trade-offs between: a) the various resources and relationships reported on in general purpose financial reports, and b) how the value that an entity creates for itself and for its investors is inextricably linked to the value the entity creates for other stakeholders, society and the natural environment" (ISSB, 2023, A40). This definition resembles the approach taken in this paper although the project on integration has not been set as a strategic priority of the ISSB for the next two years as a response to market feedback (ISSB, 2024). Connectivity is likely to fall short in providing information on sustainable value creation. We therefore stick to the term integration in our analyses.

Apart from the Integrated Reporting Framework, other initiatives have started to consider the integration of financial and sustainability considerations for assessing firms' contributions to sustainable development. The focus of these initiatives is the provision of

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informative disclosures on sustainable development. One of these is the Capitals Coalition which also builds on a capitals approach within an input-output framework to support better decisions within companies on the interaction of businesses with natural, social and human capital (Capitals Coalition, 2016, 2019). Their protocols from 2016 and 2019 explicitly target decision-making within firms and highlight how value can be derived from interactions with natural, social and human capital. Essentially, they also build on input-output models that consider various capitals.

The World Economic Forum has proposed various metrics for reporting on sustainable value creation in their 2019 white paper on measuring stakeholder capitalism (WEF, 2020). The metrics build on existing frameworks and are newly arranged by the WEF into four core areas: governance, planet, people and prosperity. However, the metrics are not integrated.

The Value Balancing Alliance (VBA) provides one of the most recent approaches that aims at rethinking value creation by including not only economic aspects but also firms' impacts on nature and society (VBA, 2024).[6] Therefore, the VBA takes a double materiality approach and provides impact and dependency pathways that shall allow for monetarization of impacts. The International Foundation for Valuing Impacts (IFVI) operates in a similar domain but focuses on monetarised impact accounting to improve decision-making (IFVI, 2024). The IFVI and the VBA work closely together and have already released a conceptual framework for impact accounting (IFVI and VBA, 2024a) and a topic methodology on greenhouse gas emissions (IFVI and VBA, 2024b) with more topic methodologies to follow. We consider these approaches when developing the structure for our content analysis.

3. Empirical results

3.1 Research approach

Firms disclose information voluntarily once they perceive a benefit from providing this information to the public (Beyer *et al.*, 2010; Grossman, 1981; Grossman and Hart, 1980; Leuz and Wysocki, 2016; Milgrom, 1981). At the same time, disclosure may entail direct and indirect costs to firms such that they may decide to refrain from disclosure (Beyer et al., 2010; Leuz and Wysocki, 2016; Verrecchia, 1983; Wagenhofer, 1990). With this in mind, we analyse the reporting decisions of firms on sustainable value creation and describe the information that firms provide voluntarily. Any missing information may be an indicator for costs of disclosure exceeding their private benefits.

We structure our content analysis around two steps and use an inductive approach to assess the information. The main advantage of inductive approaches, as compared to deductive approaches, is the possibility to adjust the content analysis scheme according to decisions taken by firms such that we do not neglect important elements (Rimmel and Cordazzo, 2021). Our structural approach to the analysis is important because the information provided by firms is spread across different reports and not standardized. Hence, our structure supports a better understanding of how firms report on sustainable value creation. Future studies could use our approach as a basis for sophisticated automated textual analysis. However, in this study automated textual analysis could lead to blind

6 An early attempt in this respect was made in 2014 by KPMG with its True Value Concept (KPMG, 2014).

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spots on issues in the main interest of the analysis. Hence, we do not rely on automated textual analysis here.

To develop a structure for our analysis, we first screened reports for information on sustainable value creation. In the pilot phase, we focused on the 2022 reports of Swiss firms and resolved any ambiguous items to come up with our final content analysis scheme with detailed coding guidelines (see Appendix). We classify elements of the content analysis scheme as existing (assigned a 1) or not existing (assigned a 0) and refrain from qualitative assessments. During the pilot and the main coding phase, all firms were double checked by the team of authors or by one researcher of the team of authors and a junior researcher. The focus of the analysis is on easily accessible information that is typically provided at the outset of annual and sustainability reports because of the holistic nature of the sustainable value creation concept. Hence, missing information is not an unambiguous sign of informational absence. In sum, this approach gauges the reliability of the results as they are easily reproducible by any reader of the annual report.

This first step of our analysis was guided by the concept of sustainable value creation in Figure 1, that centres on the integration of firms' activities with people and planet. The content analysis was further informed by existing approaches to integrated reporting outlined in the previous section. Figure 1 shows that information may either be disclosed directly as sustainable value creation or indirectly by connecting firms' activities and people and planet. If we observe direct disclosures on sustainable value creation, we assess its presentation format, i.e. in tabular, visual or textual form. The indirect way of disclosing sustainable value creation involves information on firms' activities and their link to the business environment of the firm. We rely on purpose, strategy and sustainability strategy as proxies for firms' activities and on SDGs and the business environment as proxies for people and planet. The indirect link then results from an alignment of purpose with strategy, sustainability strategy with business strategy or any other link between the elements through material topics. The structure of this first part of our content analysis is summarized in Figure 2 Panel A.

In the second step, we focus on firms that prominently disclose sustainable value creation in their reports and seek to further describe their disclosures. The structure of this second part of the content analysis scheme in Figure 2, Panel B heavily focuses on input-output models that are commonly used by firms for disclosing sustainable value creation. Input-output models are a suitable way to integrate financial and sustainability aspects by focusing on capitals as inputs and outputs of the value creation process (PTF-RNFRO, 2021a, 2021b). In these models, inputs and outputs of the value creation cycle are often described as different capitals as in the International Integrated Reporting Framework (IIRC, 2021, p. 41) or the suggestions of the Capitals Coalition (Capitals Coalition, 2021). The value creation cycle is often described by a visual representation that illustrates how inputs are processed to create an output. For some firms this part corresponds to the business model. Input-output models may be augmented by impacts that clearly indicate how the environment, society and economy are impacted by the output generated by firms.

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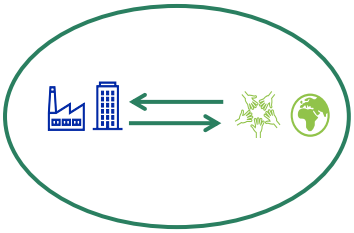
Figure 2: Main structure of the content analysis
Panel A: Direct vs. indirect approach to sustainable value creation disclosure



Direct sustainable value creation disclosure

- Separate chapter or section
- Table
- Graph

Indirect sustainable value creation disclosure

- Alignment of purpose and strategy
- Alignment of sustainability and business strategy
- Direct/indirect link via material topics

Panel B: Elements of the direct approach to sustainable value creation disclosure

Input	• Description • Measurement
Value creation cycle	• Description
Output	• Description • Measurement
Impact	• Description • Measurement
Links	• Material topics • SDGs • Business Environment
Aggregation	• ESG areas • Monetarization • Overall impact number

This figure describes the content analysis scheme for our main analysis. This scheme was established based on prior expectations on reporting on the double materiality concept for sustainability reporting and adjusted to observations from real-world data. For each element in our scheme, we assign a value of 1 if the item exists and 0 otherwise. The scheme in Panel A is applied to all firms in our sample. The scheme in Panel B is only applied to those firms directly reporting on sustainable value creation.

To gauge decision-usefulness, information on inputs and outputs needs to be assessed both in historical terms and in a forward-looking manner. Therefore, we also focus on measurement and analyse the time horizon of the information as well as the qualitative or quantitative nature of the information. In this respect, we build on classical approaches to the analysis of narrative reporting summarised in Michelon *et al.* (2022) and, in particular, on the classification of information developed in Beattie *et al.* (2004). We further determine whether firms set targets and report their achievements towards these targets.

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Finally, we also assess whether information is aggregated. Typically, this applies to firms disclosing information on sustainable value creation in a tabular format. The structure of the second part of our content analysis is summarized in Figure 2, Panel B.

For each item in our content analysis, we assign a 0 if the information is not available and a 1 if the information is available. We neither rank disclosures nor provide a summarized disclosure score, as the information in our content analysis scheme is often complementary and aggregating it would not indicate more decision-useful disclosures on sustainable value creation. The main aim of this paper is instead to come up with a suitable structure to guide content analysis of such disclosures. In Section 3.5, we relate our findings to common challenges identified concerning the usefulness of sustainability reporting.

3.2 Data

In our main analysis, we focus on the 20 largest public firms in Switzerland in terms of their market value – the SMI firms. The Swiss setting is particularly appealing, as the Swiss Code of Obligations (in German: Obligationenrecht (OR)) did not require formal sustainability reporting until 2022, with the first application for the reporting year 2023 (OR, 2024). During our sample period 2013–2022 firms were not subject to mandatory sustainability reporting requirements giving them more discretion to tailor disclosures to the specific needs of their stakeholders. This offers us the unique opportunity to analyse discretionary disclosures and inductively derive a content analysis scheme from observed disclosure decisions. However, SMI firms are large institutions with global operations that are under increased public scrutiny and subject to peer pressure with respect to sustainability reporting. Hence, we expect the reporting discretion with respect to sustainability reporting to decrease over the sample period – particularly because of the increasing tightness of EU sustainability reporting standards. Going back in time for ten years provides insights into the evolution of reporting decisions across time.

While reporting on sustainable value creation has not been mandatory in Switzerland nor in the EU, the EU has implemented mandatory sustainability reporting. We extend our analysis to Euro Stoxx 50 firms as the largest public EU firms that are comparable to SMI firms to assess whether mandatory reporting leads to different outcomes in terms of sustainable value creation reporting. We focus on their reporting decisions in the year 2022 to determine whether the outcome of the process on reporting on sustainable value creation differs to that of SMI firms. Any differences across these two types of firms could be an indicator of EU mandatory sustainability reporting also shaping reporting decisions for discretionary sustainability-related reporting items such as sustainable value creation.

We focus on the SMI composition as of January 2023 and consider their reporting over the last ten reporting years, starting in 2022.[7] Our focus on SMI firms as of January 2023 reduces our yearly sample size in the years prior to the reporting year 2022. This is due to Alcon being a spin-off of Novartis and the merger of Holcim and Lafarge. In addition, one firm did not have a sustainability report in 2015 but in all other years, such that we only excluded this single 2015 observation. Our SMI sample consists of 18 firms from

7 A firm with a fiscal year end on 31st of March was assigned to the previous reporting year for the analysis.

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2013–2015, 19 firms from 2016–2018 and 20 firms since 2019. We further include 50 observations from the Euro Stoxx 50 in 2022.

The firms in our sample primarily rely on the classic reporting format with separate annual and sustainability reports. Although the disclosure of explicitly labelled integrated reports has increased from no firm in 2013 to three firms in 2022 for the SMI (see Table 1, Panel A), the number of firms choosing the integrated reporting format is low. Most firms providing an integrated report offer an additional sustainability report, which contains more in-depth descriptions of sustainability-related topics. The data for the Euro Stoxx 50 firms in 2022 (table 1, panel B) are comparable to the 2022 SMI results.

Table 1: Report type and report length
Panel A: SMI time series analysis

SMI	N	Annual Report	Integrated Report	Mean Pages of Annual & Sustainability Report	Mean Pages of Integrated Report	Firms with More than 500 Pages
2013	18	18	0	228	0	1
2014	18	17	1	224	187	1
2015	18	17	1	234	200	1
2016	19	18	1	230	201	0
2017	19	18	1	228	199	1
2018	19	17	2	245	210	2
2019	20	17	3	241	192	2
2020	20	18	2	238	207	2
2021	20	18	2	259	363	3
2022	20	17	3	261	223	3

Panel B: Year 2022 cross-sectional analysis of SMI and Euro Stoxx 50 firms

2022	N	Annual Report	Integrated Report	Mean Pages of Annual & Sustainability Report	Mean Pages of Integrated Report	Firms with More than 500 Pages
SMI	20	17	3	261	223	3
Euro Stoxx	50	44	9	360	178	18
Total	70	61	12	333	189	21

The table presents information on the use of different types of reports and their length. The sample includes SMI and Euro Stoxx 50 firms. The SMI sample size increases from 18 firms in 2013 to 19 in

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2016 and 20 from 2019 onwards. The 2022 sample size is 20 for SMI firms and 50 for Euro Stoxx 50 firms. Panel A reports the results for the SMI time series analysis, and Panel B reports the results for the SMI and Euro Stoxx 50 cross-sections in 2022.

Over the years, the report length increased by approximately 30 pages on average from 2013 to 2022.[8] A comparison of the SMI and Euro Stoxx 50 shows that reports from EU firms are roughly 100 pages longer than the average SMI report. A potential reason for this effect could be tight regulations in the EU. The Euro Stoxx 50 sample also has more outliers than the SMI sample does (36 % vs. 15 % of firms have more than 500 pages). Among the Euro Stoxx 50 firms with long reports, the report length of four firms exceeds 900 pages. In essence, we observe a rather lengthy reporting format for all firms in our sample, with only a limited explicit use of the integrated reporting format.

Some firms offer a substantial amount of supplemental nonfinancial information on their webpages. As our definition of sustainable value creation includes value generated in the financial, environmental and social dimensions, this information is typically material to investors and needs to be included in corporate reports. Therefore, we do not consider information on webpages in our analyses. Still, we acknowledge that singular elements on sustainable value creation may be disclosed on webpages, in particular such pieces of information that are specifically targeted towards non-investor stakeholder groups (Boulland, et al., 2025). However, the holistic perspective of sustainable value creation includes financially material aspects that require the provision of the information in annual or sustainability reports if considered relevant by the firm. Furthermore, information on webpages is difficult to assign to each reporting year as information on prior years may not be available.

3.3 Status quo of reporting on sustainable value creation

As our first step of analysis, we search for information in companies' reports on how they create value in a sustainable way. Some firms label a chapter with terms that are related to sustainable value creation, such as „our value creation", „how we create value", or similar. Sustainable value creation may be communicated visually or in tabular or text formats. We differentiate across communication formats because presentation is a key issue with any emergent disclosure aspect. In line with existing research on the use of visual communications – in particular with respect to uncertainties – we deem visual representations more accessible than narrative formats (PTF-RNFRO, 2021a; Spiegelhalter *et al.*, 2011).

In our Swiss sample 11 firms (55%) report on sustainable value creation in 2022. This finding is the result of a positive trend among SMI firms, as outlined in Figure 3. In the Euro Stoxx 50 sample, 27 firms reported on sustainable value creation in 2022 (54% of the sample).

8 Untabulated results for the median show a similar pattern.

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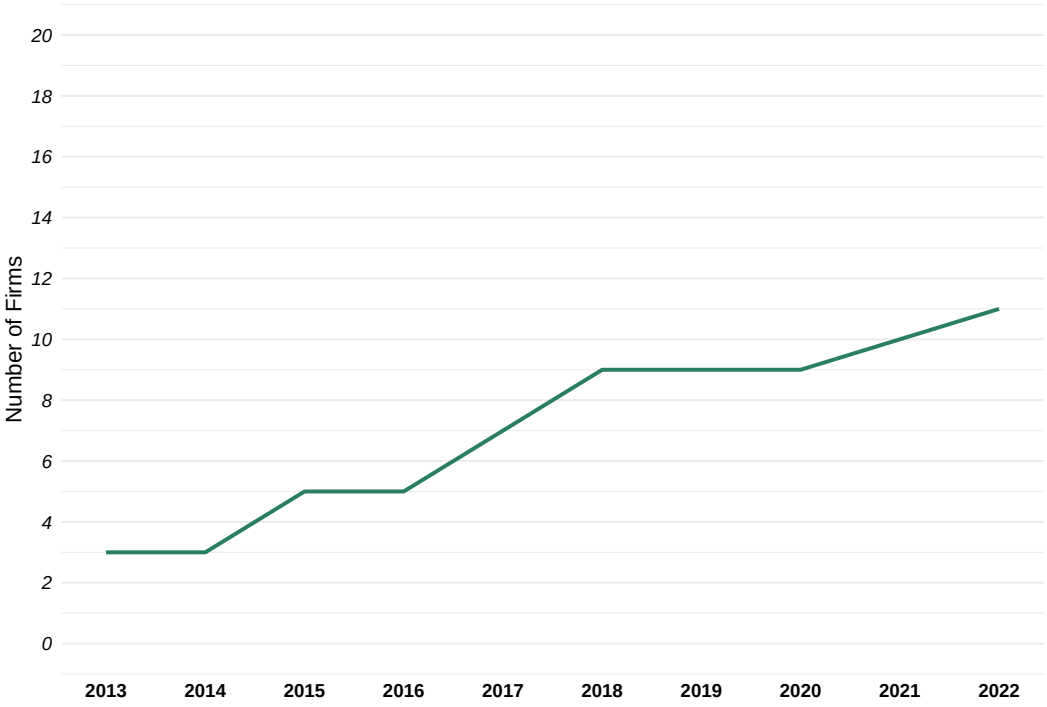
Figure 3: Sustainable value creation reporting by SMI firms



The figure displays the number of firms that explicitly disclose how they create sustainable value. The sample includes SMI firms. The sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2019 onwards. Data is hand-collected from annual, sustainability and integrated reports.

In terms of communication, all but one firm disclose their sustainable value creation in a separate chapter. The provision of the information in a separate chapter is helpful for the readers, as the information can be easily found and accessed. Firms typically illustrate their sustainable value creation either visually or tabularly or sometimes in both ways. As Figure 4, Panel A and B show, Swiss and EU firms prefer reporting their sustainable value creation in a visual way – mostly relying on some form of input-output model. Disclosure in tabular form is less prevalent but still used by several firms. Tabular formats include quantitative or qualitative indicators grouped across material topics or sustainability aspects.

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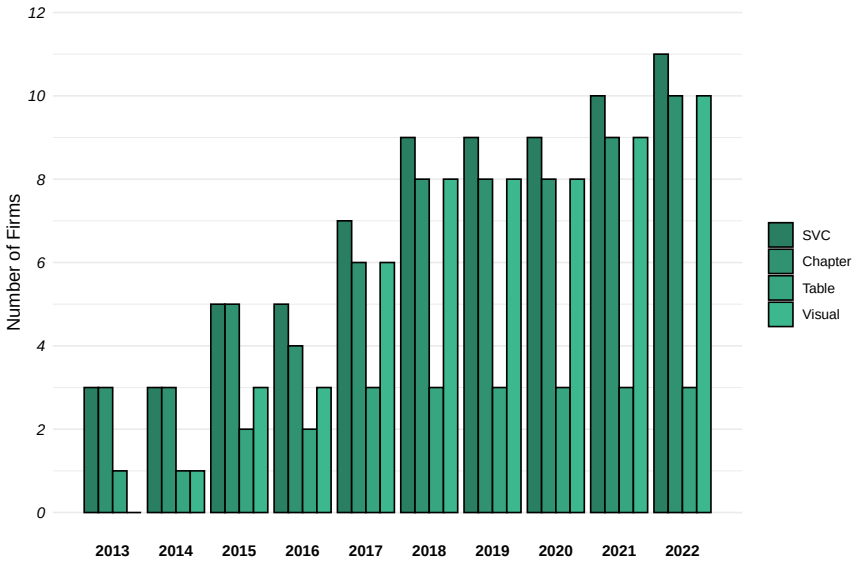
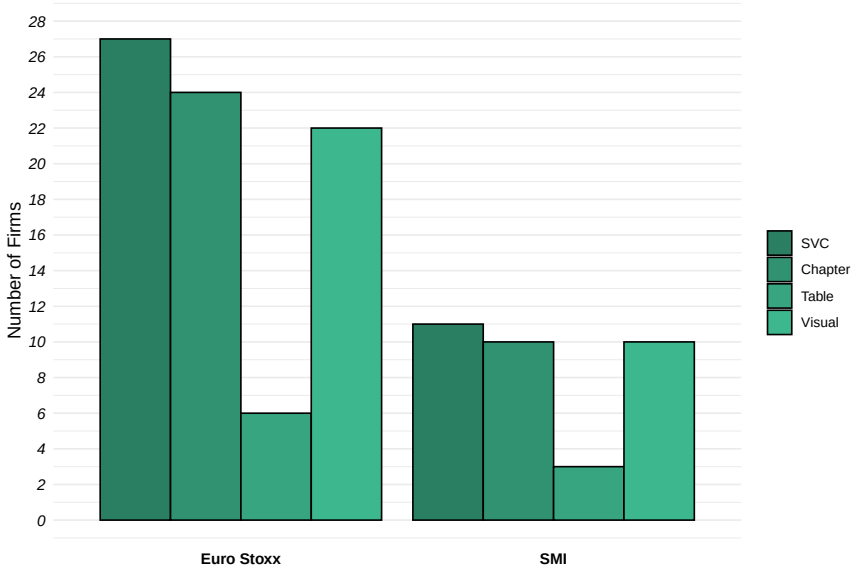
Figure 4: Reporting Format of Sustainable Value Creation

Panel A: SMI time series analysis



Panel B: Year 2022 cross-sectional analysis of SMI and Euro Stoxx 50 firms



The figure displays the reporting format chosen by firms that explicitly report on sustainable value creation (SVC). The sample includes SMI and Euro Stoxx 50 firms. The SMI sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2019 onwards. The 2022 sample size is 20 for SMI firms and 50 for Euro Stoxx 50 firms. Data is hand-collected from annual, sustainability and integrated reports. Chapter, table and visual refer to those firms that disclose information on sustainable value creation in a chapter, table or visual format. Panel A reports the results for the SMI time series analysis, and Panel B reports the results for the SMI and Euro Stoxx 50 cross-sections in 2022.

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Table 2: Implicit reporting about sustainable value creation
Panel A: SMI time series analysis

		Business			Environment		Materiality	
Year	N	Strategy	Sustainability Strategy	Purpose	SDG	Business Environment	Materiality Assessment	Material Topics Disclosure
2013	18	14	3	1	0	11	13	12
2014	18	13	5	1	0	11	13	13
2015	18	15	6	2	4	13	14	14
2016	19	17	6	3	8	14	16	15
2017	19	17	8	4	14	16	17	16
2018	19	17	7	6	15	13	19	19
2019	20	18	10	9	17	11	20	20
2020	20	18	11	13	18	12	20	18
2021	20	18	13	18	19	12	20	17
2022	20	18	11	17	18	12	20	19

Panel B: Year 2022 cross-sectional analysis of SMI and Euro Stoxx 50 firms

		Business			Environment		Materiality	
2022	N	Strategy	Sustainability Strategy	Purpose	SDG	Business Environment	Materiality Assessment	Material Topics Disclosure
SMI	20	18	11	17	18	12	20	19
Euro Stoxx	50	45	29	30	43	29	50	47
Total	70	63	40	47	61	41	70	66

The table presents information on different elements for capturing reporting on business, the environment and materiality. These elements could form the basis for a linkage between financial and sustainability considerations. The sample includes SMI and Euro Stoxx 50 firms. The SMI sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2019 onwards. The 2022 sample size is 20 for SMI firms and 50 for Euro Stoxx 50 firms. Panel A reports the results for the SMI time series analysis, and Panel B reports the results for the SMI and Euro Stoxx 50 cross-sections in 2022.

While around half of the firms choose the direct approach to reporting on sustainable value creation, we analyse whether the remaining firms choose a more indirect path of reporting on sustainable value creation. We observe a surge in firms reporting a purpose that starts in the years 2018 and 2019. In 2018, only 6 SMI firms reported a purpose,

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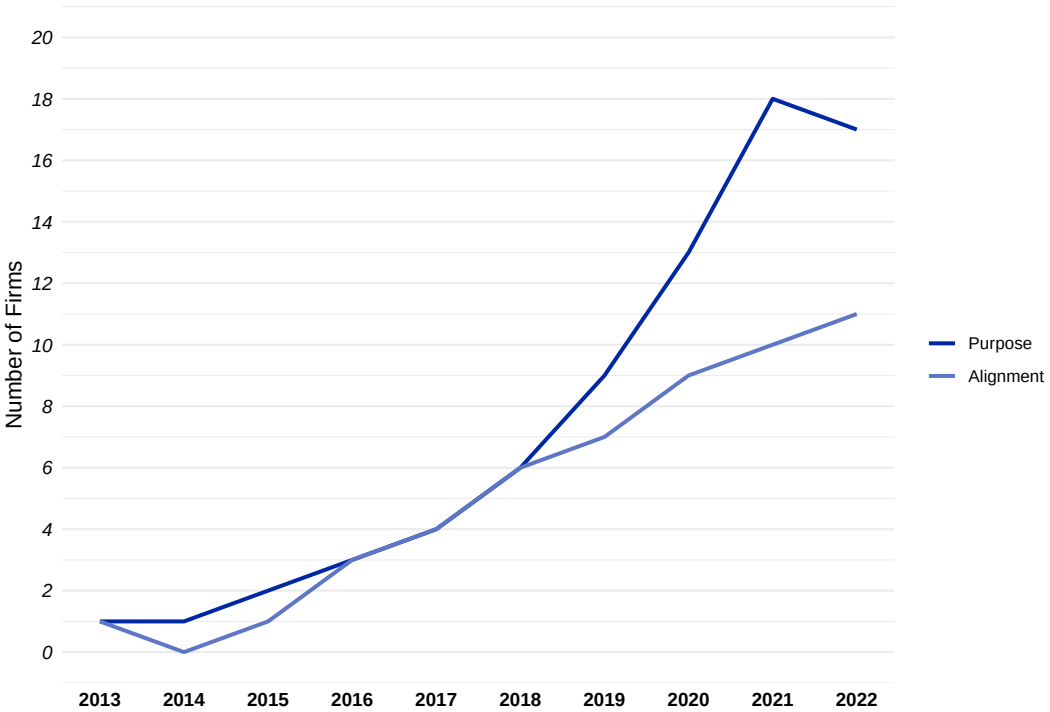
and in 2022, 17 firms disclosed a purpose in their reports (Table 2, Panel A). Given that a firm's purpose is considered an important internal and external commitment to sustainability (George *et al.*, 2023; Henderson and Van den Steen, 2015), this trend underlines the importance that sustainability has gained recently. Firms have also reported on their strategy since 2016, except for holding companies that describe separate strategies for each division without describing an overall strategy. We also observe a positive trend for separate sustainability strategies, although this trend appears to slightly reverse in 2022. Comparing EU and Swiss firms in 2022 (Table 2, Panel B) shows that fewer Euro Stoxx 50 firms disclose a purpose than SMI firms do (60% vs. 85% of firms). Nevertheless, this difference might also arise from the small sample sizes in this study. Results on business and sustainability strategy are comparable.

In terms of business environment disclosures, the SDGs have evolved into a prevalent reporting item. Since their introduction in 2015, the SDGs have been considered in the reports of almost any firm by 2022. Interestingly, there is only a gradual adoption of the SDGs in reporting overtime, which aligns with the results of Hummel and Szekely (2022). The two Swiss firms that do not report on the SDGs report about the business environment instead. In line with sustainability reporting requirements, all SMI firms report on a materiality assessment since 2019. Reporting on materiality, the firms' environment and the SDGs is comparable across Euro Stoxx 50 and SMI firms in 2022.

Figure 5: Reporting on purpose and its alignment with business strategy



The figure displays the number of firms reporting on purpose and its alignment with business strategy. The sample includes SMI firms. The sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2019 onwards. Data is hand-collected from annual, sustainability and integrated reports.

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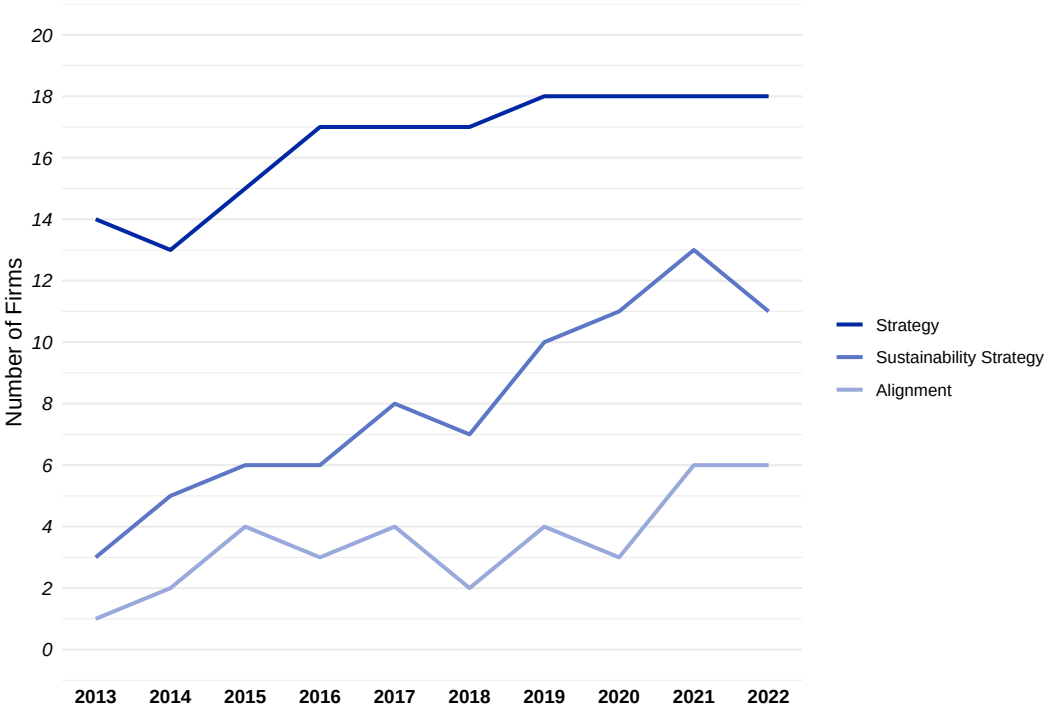
The results show that firms largely report both on their businesses and on sustainability. For the report readers interested in sustainable value creation, these elements require integration. One indicator of such an integration would be the alignment of the overall purposes of the firms with their business strategies. Figure 5 shows that 11 SMI firms (65%) align their purpose with their business strategy in 2022. A slightly lower degree of alignment is observable in the Euro Stoxx 50 sample, with 16 firms (53%) aligning purpose and business strategies. The time series analysis of the SMI firms reveals that the alignment between business strategy and purpose does not increase at the same rate as the number of firms disclosing a purpose. The differential increase starts in 2018, with some firms reporting a purpose but not aligning it with the business strategy. Hence, the gap between purpose reporting and alignment with the overall business strategy is driven by those firms that adopt a purpose in later reporting periods.

As a second indication of an integration of business and sustainability, we analyse whether a separate sustainability strategy is linked to the overall business strategy. Despite the increase in reporting separate sustainability strategies, no clear trend can be observed with respect to the integration of the two strategies (Figure 6). Instead, the integration of the two strategies is stable over time and applies to 6 SMI firms (55%) in 2022. The results for the Euro Stoxx 50 sample are similar, with 15 firms (52%) integrating the sustainability strategy with the business strategy. Finally, material topics could be used to

Figure 6: Reporting on sustainability strategy and its alignment with business strategy



The figure displays the number of firms reporting on their business and their sustainability strategies. It further highlights the number of firms that align the two strategies. The sample includes SMI firms. The sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2019 onwards. Data is hand-collected from annual, sustainability and integrated reports.

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integrate a firm's activities with people and planet. In 2022, only 4 SMI firms and 2 firms in the Euro Stoxx 50 sample provide this link (Table 6, Panel B).

The evidence presented so far shows that there are direct and indirect ways of integrating firms' activities and environmental and social aspects. We now assess whether these options are used individually or as complements to already existing disclosures on sustainable value creation reporting. Therefore, we run a correlation analysis and only display the results for the 2022 sample of SMI and Euro Stoxx 50 firms to reduce autocorrelation. Table 3 displays this Pearson's correlation matrix for the variables in our coding scheme with correlations greater than 0.3 highlighted in bold and italics. Only purpose and the alignment of purpose with business strategy as well as sustainability strategy and the integration of the sustainability strategy correlate. This is a correlation by design as firms need to have disclosures on purpose and sustainability strategy to be able to integrate this information. The results of the logistic regression analyses in Table 4 show a strong association between sustainable value reporting and the two indicators of integration (the alignment of purpose and business strategies and the alignment of business and sustainability strategies). This highlights that firms tend to disclose sustainable value creation both in a direct and an indirect way. If firms report on sustainable value creation, then

Table 3: Pearson correlations between reporting elements

	Business					
2022	**Purpose**	**Strategy**	**Sustainability Strategy**	**Alignment Purpose**	**Integration of Sustainability**	**SVC**
Purpose		0.07	0.07	***0.55***[1]	-0.01	0.09
Strategy			-0.1	0.26[2]	0.22[3]	-0.02
Sustainability Strategy				-0.14	***0.5***[1]	-0.04
Alignment Purpose					-0.01	0.14
Integration of Sustainability						0.04
SVC						

[1] Chi Square Test is statistically significant on a 1% niveau. A Fisher Test was conducted when there were less than 5 observations.

[2] Chi Square Test is statistically significant on a 5% niveau. A Fisher Test was conducted when there were less than 5 observations.

[3] Chi Square Test is statistically significant on a 10% niveau. A Fisher Test was conducted when there were less than 5 observations.

The table presents the Pearson correlation coefficients between the firm activities items of our main content analysis scheme (see Appendix) and sustainable value creation. The significance of the correlations is based on Chi Square tests or Fisher tests if there were fewer than five observations. The sample includes SMI and Euro Stoxx 50 firms in the reporting year 2022 to reduce autocorrelation concerns resulting from the SMI time series analysis.

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they also tend to align their purpose with their strategies and sustainability strategies with business strategies. Hence, the different measures for integration that we introduce in our content analysis scheme tend to be complementary elements of reporting on sustainable value creation.

Table 4: Logistic regression output of sustainable value creation reporting and firm activities items of the main content analysis

	SVC			
	(1)	(2)	(3)	(4)
Purpose	-1.134*	-2.218***	35.285***	12.818***
	(0.687)	(0.640)	(2.309)	(1.307)
Sep. Sus. Strategy	-2.815***	-3.336***	1.770	0.575
	(0.679)	(0.668)	(1.804)	(1.382)
Align. Purpose & Strategy	4.174***	4.624***	20.123***	26.717***
	(0.844)	(0.617)	(0.000)	(1.155)
Align. Sus. Strategy & Strategy	4.727***	5.027***	-0.167	19.207***
	(0.812)	(0.793)	(1.818)	(1.722)
Firm fixed effects	No	No	Yes	Yes
Year fixed effects	No	Yes	No	Yes
#Obs.	191	191	88	88
Pseudo R^2	0.286	0.253	0.356	0.481
Log-Likelihood	-85.9	-81.2	-26.5	-10.1
AIC	181.9	190.4	79.1	64.2
BIC	198.2	235.9	111.3	118.7

The table shows the logistic regression results of the dependent variable sustainable value creation reporting and the firm activities items of the main content analysis. The results are based on logistic regressions with robust standard errors (1), standard errors clustered by year (2) and standard errors clustered by firm (3) and (4). The dataset consists of 191 firm-year observations of the SMI from 2013 - 2022. Standard errors are shown in parenthesis. To account for the panel structure of our data with only a maximum of 20 firms per year, firm and year fixed effects were included. Intercepts are not reported. *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.

3.4 Design of sustainable value creation reporting

In this section, we focus exclusively on firms that report on sustainable value creation in a direct way. We differentiate between firms providing a visual or a tabular disclosure format.

Only a few firms provide their sustainable value creation in tabular format, as shown in Figure 5. Most of these firms choose to report a key performance indicator (KPI) table in a prominent place inside the report, which contains financial, environmental, and social results. In 2013, this approach was already used by one firm, but until today, only three firms have provided such a table. Two firms monetarised the KPIs, one from 2015 – 2018 and the other from 2015 – 2021. Neither of those two firms tried to aggregate the KPIs to a summary impact number. In the Euro Stoxx 50, the tabular format is again not the predominant choice, with only 6 firms using it in 2022. Among these, only one firm monetarises the KPIs but does not provide an overall impact number.

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Table 5: Details on sustainable value creation reporting for visual reporters
Panel A: SMI time series analysis

		Input Reporting				Output Reporting			
Year	**SVC**	**Inputs**	**Results**	**Targets**	**VCC**	**Outputs**	**Results**	**Targets**	**Imp. Results**
2013	3	0	0	0	0	0	0	0	0
2014	3	0	0	0	1	0	0	0	0
2015	5	1	0	0	2	2	2	1	1
2016	5	2	1	0	2	3	2	1	1
2017	7	4	2	0	4	7	6	2	1
2018	9	6	4	1	5	7	6	1	1
2019	9	7	4	1	6	7	7	1	2
2020	9	7	5	1	5	7	7	1	2
2021	10	7	5	2	6	7	6	2	3
2022	11	7	6	2	7	8	7	0	4

Panel B: Year 2022 cross-sectional analysis of SMI and Euro Stoxx 50 firms

		Input Reporting				Output Reporting			
2022	**SVC**	**Inputs**	**Results**	**Targets**	**VCC**	**Outputs**	**Results**	**Targets**	**Imp. Results**
SMI	11	7	6	2	7	8	7	0	4
Euro Stoxx	27	21	15	2	25	25	22	3	2
Total	38	28	21	4	32	33	29	3	6

The table presents information on the disclosure of sustainable value creation (SVC) for firms via an input-output based model. The sample includes SMI and Euro Stoxx 50 firms. The SMI sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2018 onwards. The 2022 sample size is 20 for SMI firms and 50 for Euro Stoxx 50 firms. Column SVC reports the number of firms reporting on sustainable value creation for a given year or subsample. Panel A reports the results for the SMI time series analysis, and Panel B reports the results for the SMI and Euro Stoxx 50 cross-sections in 2022. VCC refers to reporting on a value creation cycle and imp. abbreviates impact.

With respect to firms providing a comprehensive visual description of sustainable value creation, we find that most firms rely on the input-output based model for describing business models (PTF-RNFRO, 2021a, 2021b). This input-output approach is also suggested in the Integrated Reporting Framework (IIRC, 2021). These illustrations became more

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granular over time (Table 5, Panel A). The value creation cycle and the output reporting were disclosed earlier than the input reporting. The inputs and outputs often contain quantitative results from the current reporting year, but targets are rarely included. Only recently firms started to include an impact component in their sustainable value creation visual illustrations.

The results in Table 5, Panel B, for Euro Stoxx 50 firms are less comparable than those in previous analyses. Euro Stoxx 50 firms tend to be more forthcoming than SMI firms in terms of disclosing inputs (78% vs. 64%), the value creation cycle (93% vs. 64%), outputs (93% vs. 73%), output prior year realizations (81% vs. 64%), and output targets (11% vs. 0%), whereas SMI firms more often report about input targets (18% vs. 7%) and impacts (36% vs. 7%). Targets and their achievements are currently not disclosed in the impact section of the input-output model.

Finally, we look into links from sustainable value creation reporting to the SDGs and the business environment. We deem the link via material topics, a direct link to different SDGs or to the overall business environment as potential ways for such a linkage. As outlined above, firms merely use material topics to link the business of the firm to its impacts (see Table 6, Panel A). Only four SMI firms in 2022 provide this link via material topics, and two of these firms provide this link only in an indirect way by linking to the respective chapters in the report. Considering the SDGs as a potential framework for the impact of the firm delivers comparable results. Again, only four firms connect their graphical illustration of the process of sustainable value creation to the SDGs. The results for the Euro Stoxx 50 firms are comparable, with a slight tendency to contain even fewer links (see Table 6, Panel B).

In sum, reporting on sustainable value creation strongly relies on presentations in visual formats that focus on some kind of input-output model. Some firms even include impacts but merely as singular numbers and not as clear impact pathways. Dependencies are missing from the disclosures on sustainable value creation. Although information on dependencies may be difficult to gather, it is highly important to truly understand sustainable value creation because it allows us to assess the feedback of impacts on firms' activities.

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Table 6: Disclosure of sustainable value creation and its linkages to people and planet and material topics

Panel A: SMI time series analysis

		SDG Link			Business Environment Link			Materiality Link		
Year	SVC	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
2013	3	0	0	0	0	0	0	0	0	0
2014	3	0	0	0	0	0	0	0	0	0
2015	5	0	1	1	0	1	1	0	0	0
2016	5	2	0	2	0	0	0	0	0	0
2017	7	2	0	2	0	1	1	0	0	0
2018	9	2	0	2	0	2	2	0	1	1
2019	9	3	0	3	0	1	1	1	1	2
2020	9	4	0	4	0	2	2	1	1	2
2021	10	4	1	5	0	1	1	2	1	3
2022	11	4	0	4	0	1	1	2	2	4

Panel B: Year 2022 cross-sectional analysis of SMI and Euro Stoxx 50 firms

		SDG Link			Business Environment Link			Materiality Link		
2022	SVC	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
SMI	11	4	0	4	0	1	1	2	2	4
Euro Stoxx	27	6	0	6	1	0	1	2	0	2
Total	38	10	0	10	1	1	2	4	2	6

The table presents information on the disclosure of sustainable value creation and how these are linked to other disclosures on people and planet (SDGs and the business environment) and material topics. The sample includes SMI and Euro Stoxx 50 firms. The SMI sample size increases from 18 firms in 2013 to 19 in 2016 and 20 from 2019 onwards. The 2022 sample size is 20 for SMI firms and 50 for Euro Stoxx 50 firms. Panel A reports the results for the SMI time series analysis, and Panel B reports the results for the SMI and Euro Stoxx 50 cross-sections in 2022.

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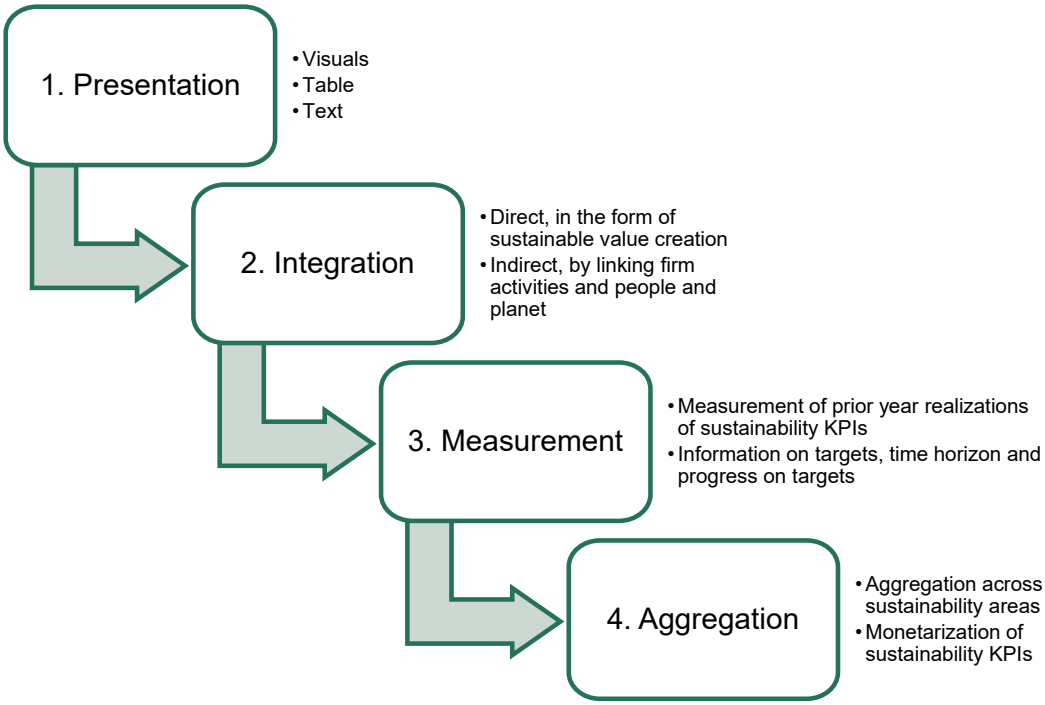
3.5 The usefulness of our structure for sustainable value creation reporting

Analysing and understanding disclosures on sustainable value creation requires a common structure. We have proposed such a common structure with our content analysis scheme. This structure links to issues that are typically raised with respect to the usefulness and comparability of sustainability reporting. These issues include the presentation of sustainability information, the integration of financial and sustainability considerations, and the measurement and aggregation of sustainability issues (Friedman and Ormazabal, 2024; Grewal and Serafeim, 2020; Wagenhofer, 2024). We discuss each of these issues in light of our analysis below.

Figure 7: Reporting on sustainable value creation and critical issues in sustainability reporting



The figure displays how our content analysis scheme for sustainable value creation reporting links to existing critical issues raised for sustainability reporting. It is based on our content analysis scheme in Figure 2 but adjusted for actual findings.

Presentation is a critical issue in sustainability reporting because there are no agreed-upon presentation formats, as in financial reporting with balance sheets, income statements etc. (Grewal and Serafeim, 2020; Wagenhofer, 1990). We also observe this presentation issue with respect to sustainable value creation reporting and find that firms tend to report in visual, tabular or textual format.

The most challenging part in this analysis is the integration of financial and sustainability considerations, and this information is crucial for stakeholders interested in the sustainable value created by a firm (Friedman and Ormazabal, 2024; Wagenhofer, 2024). Firms

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that integrate financial and sustainability considerations are likely to consider both aspects within their management accounting such that decisions are not only made in terms of financial but also sustainability considerations (Adams, 2017; Dimes *et al.*, 2023; Dimes and de Villiers, 2024). Ideally, reporting provides insights into the risks and opportunities arising from the environmental or social considerations of firms' activities and, at the same time, describes their impacts on people and the planet. Having a clear understanding of risks, opportunities and impacts would allow readers to assess how impacts may become financially material in the long run. Our observation is that firms typically do not connect the individual impacts and dependencies and particularly neglect dependencies. Instead, they rely on disaggregated disclosures of inputs and outputs of the value creation process and provide information on impacts and dependencies in a disaggregated way across reporting section on material topics.

Another commonly raised issue in sustainability reporting is measurement in qualitative and quantitative terms. Quantitative measures mostly have different units of measurement and monetarization is rarely observable (Barker, 2019; Grewal and Serafeim, 2020; Wagenhofer, 2024). For sustainable value creation reporting, stakeholders need information from the reporting year for each dimension. In the environmental area, these include, for example, measures for GHG emissions, water usage, waste generation or biodiversity. Such measures can be enriched by targets, the time horizon per target and progress made on targets.

Finally, aggregation is a crucial issue in sustainability reporting and in sustainable value creation reporting in particular. In the financial domain, information is aggregated to a single earnings number. In the environmental and social domains, such aggregation is currently not widely achievable; therefore, sustainability disclosures often lack the necessary level of aggregation to consider them in decision frameworks (Grewal and Serafeim, 2020; Serafeim *et al.*, 2019; Wagenhofer, 2024). This is primarily due to ethical concerns when trading off sustainability aspects against each other (Schoenmaker and Schamrade, 2019). Although we agree with this claim, we strongly encourage firms and stakeholders to consider appropriate ways to aggregate information that is important for decision-making on sustainable value creation.

4. Conclusion

Today's firms are increasingly required to operate in a way that supports sustainable development. This shifts the notion of value to sustainable value creation that integrates financial, environmental and social aspects of value creation. Understanding and measuring such a sustainable value creation is critical to assessing progress on sustainable development. In this paper, we develop a structure for the analysis of disclosures on sustainable value creation and provide descriptive evidence on the reporting decisions of large public Swiss firms with respect to sustainable value creation. Our findings suggest an increase in disclosures on sustainable value creation over the last ten years. Nevertheless, only 55% of Swiss firms reported on sustainable value creation in 2022. The disclosures made on this topic are not easily comparable and mostly lack clear targets and information on the progress on targets. We further compare the results for the SMI firms in 2022 with those for Euro Stoxx 50 firms and find that the results are largely comparable. Our findings emphasize the role of the presentation of information in corporate reporting as an essential feature for understanding interrelated aspects. They further highlight the important role of

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measuring and aggregating sustainability information to inform decision-makers. Finally, the integration of financial and sustainability information is crucial for understanding the dependencies of firms on people and planet and hence sustainable value creation. The aspects that we find important in structuring disclosures on sustainable value creation match with existing challenges raised with respect to the usefulness of sustainability reporting. Our paper highlights that reporting on sustainable value creation is only emerging and that clear guidelines and structures to this approach are needed to advance our understanding on how firms can contribute to sustainable development in a holistic way. Hence, we encourage all stakeholders to engage in the discussions and to support the development of solutions for this topic.

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We used Springer Nature's Curie assistant, ChatGPT, and Microsoft Copilot for language editing purposes. We thoroughly checked results and assume full responsibility for the published paper.

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Appendix

Detailed documentation of our content analysis scheme

Sustainable value creation disclosure, content analysis step 1			
Direct integration	A clear description about the sustainable value creation process of the firm, including economic, social, and environmental value, is disclosed.		
	Presentation Format	Separate chapter or section	The description can be found in a separate chapter or section.
		Table	The description is in a tabular format.
		Visual	The description is visualized. A visualization that contains only tables is not sufficient. It is not sufficient to show a visualization that only helps to understand the table.
Indirect integration	Firm Activities	Purpose	The firm boldly reports a purpose.
		Strategy and/or strategic priorities/activities	The firm reports a business strategy for the whole firm and not just for its subsidiaries.
		Separate sustainability strategy or framework	The sustainability strategy is clearly highlighted. A strategy containing only environmental aspects is not sufficient. At least two different dimensions must be considered within the sustainability strategy.
	SDG/Business Environment	SDG	(Relevant) SDGs must be integrated into the report. Merely showing a list with all SDGs is not sufficient.
		Business Environment	Information about markets, mega trends or current business environment is disclosed.
	Materiality	Materiality Assessment	A materiality assessment was conducted by the firm.
		Material topics disclosure	The mere presence of a materiality assessment is not sufficient. Material topics must be disclosed in the report.
	Links	Alignment of purpose and strategy	The firm aligns purpose and business strategy clearly. There has to be an obvious connection between the two.
		Sustainability strategy is part of the overall strategy	The sustainability strategy is clearly connected to the overall strategy.
		Material topics link firm activities and business environment	Material topics are used to link firms' activities and their impact and dependencies on people and planet.

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Sustainable value creation disclosure details, content analysis step 2			
Input-output models – Inputs	Inputs to the sustainable value creation process or the business model are described.		
	Measurement	Results of fiscal year	The inputs are quantified as results of fiscal year activities.
		Targets	The quantification of the inputs includes a target number that was to be achieved in the current fiscal year or is to be achieved in the future.
		Link to other sections for quantification	There is a link to other sections of the report where the inputs are further described and quantified. In case the quantification is already visualized this item might still apply if there are further refinements available in other sections of the report. Links need to be very explicit.
Input-output models – Value creation/business model	The graphical illustration or the chapter includes a part that describes how the firm operates with the inputs to create an output.		
Input-output models – Outputs	Outputs of the sustainable value creation process or the business model are described.		
	Measurement	Results of fiscal year	The outputs are quantified as results of fiscal year activities.
		Targets	The quantification of the outputs includes a target number that was to be achieved in the current fiscal year or is to be achieved in the future.
		Target achievement	Target achievement status is available.
		Link to other sections for quantification	There is a link to other sections of the report where the outputs are further described and quantified. In case the quantification is already visualized this item might still apply if there are further refinements available in other sections of the report. Links need to be very explicit.
Input-output models – Impacts	Impacts of the sustainable value creation process or the business model are described.		
	Measurement	Results of fiscal year end	The impacts are quantified as results of fiscal year activities.
		Targets	The quantification of the impacts includes a target number that was to be achieved in the current fiscal year or is to be achieved in the future.
		Target achievement	Target achievement status is available.
		Link to other sections for quantification	There is a link to other sections of the report where the impacts are further described and quantified. In case the quantification is already visualized this item might still apply if there are further refinements available in other sections of the report. Links need to be very explicit.

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Sustainable value creation disclosure details, content analysis step 2 (continued from previous page)			
Links	Link to material topics	Direct link	Material topics are included in the sustainable value creation visualization or chapter, and each material topic is related to one or more impacts or outputs.
		Indirect link	Material topics are included in the sustainable value creation visualization or chapter but not assigned to impacts and outputs explicitly.
	Link to SDGs	Direct link	SDGs are included in the sustainable value creation visualization or chapter, and each SDG is related to one or more impacts or outputs.
		Indirect link	SDGs are included in the sustainable value creation visualization or chapter but not assigned to impacts and outputs explicitly.
	Link to business environment	Direct link	The business environment elements are included in the sustainable value creation visualization or chapter, and each element is related to one or more impacts or outputs.
		Indirect link	The business environment elements are included in the sustainable value creation visualization or chapter but not assigned to impacts and outputs explicitly.
Aggregation	KPIs in three areas (economic, social, environmental)	The firm lists KPIs in three different areas (business, environment, and society) in a table which looks like an income statement.	
	Monetarization of KPIs	The firm moves closer to an overall income statement by monetarizing KPIs such that numbers can be aggregated over the different sections.	
	Aggregation of monetarised KPIs to overall impact number	The firm provides an overall impact number which is the aggregation of earlier monetarised KPIs per sustainability area.	

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