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EDITED BY

Wu Yufeng,
Beijing University of Technology, China

REVIEWED BY

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Federal University of Health Sciences
Otukpo, Nigeria
Ayodeji Emmanuel Oke,
Federal University of Technology, Nigeria

*CORRESPONDENCE

Ladislav Pilař,
✉ pilarl@pef.czu.cz

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Sustainability reports: Differences between developing and developed countries

Lucie Kvasničková Stanislavská¹, Ladislav Pilař^{1*}, Martin Fridrich², Roman Kvasnička³, Lucie Pilařová¹, Bilal Afsar⁴ and Matthew Gorton⁵

¹Department of Management, Faculty of Economics and Management, Czech University of Life Sciences in Prague, Prague, Czechia, ²Department of Informatics, Faculty of Business and Management, Brno University of Technology, Brno, Czechia, ³Department of Systems Engineering, Faculty of Economics and Management, Czech University of Life Sciences in Prague, Prague, Czechia, ⁴Department of Management Sciences, Hazara University, Mansehra, Pakistan, ⁵Newcastle University Business School, Newcastle University, Newcastle Upon Tyne, United Kingdom

Achieving sustainability is a major challenge faced by many societies. The increasing moral consciousness of stakeholders has put pressure on companies, forcing these companies to include long-term policies that reflect the regionally specific needs of stakeholders. Using a structural topic model, this study identified differences between developing and developed countries with respect to sustainability disclosures. Data were obtained from 2100 sustainability reports published in the United Nations Global Compact database for the year 2020. In global terms, these sustainability reports addressed three main topics: 1) human rights, 2) diversity, equity, and inclusion, and 3) sustainable production. Moreover, the sustainability reports from developing and developed countries incorporated different communication strategies. Based on the prevalence (rate of occurrence) of content, sustainability reports from developed countries predominantly communicated issues related to "sustainable production" and "supply chain emissions", whereas sustainability reports from developing countries more frequently communicated issues related to "education" and "human rights".

KEYWORDS

developed countries, structural topic modeling, sustainability report, developing countries, human rights, sustainable production

1 Introduction

Achieving sustainable production and consumption are among the biggest challenges of the 21st century (Karagiannis et al., 2022). An organisation's ability to create long-term sustainable value is influenced by the management of relations with critical stakeholders (Ramadhini et al., 2020). The high level of stakeholder interest in social and environmental issues (Helmig et al., 2016; Latip et al., 2022) is one of the driving factors for development of corporate social responsibility (CSR) programs (Ying et al., 2021). CSR refers to a company's voluntary actions to integrate sustainability as part of its business strategy (Osagie et al., 2016). To maintain competitiveness, companies must therefore not only operate according to a sustainable business model (Schaltegger et al., 2016) but also inform their stakeholders about this model (Stutz et al., 2022). Reports on sustainability reports have therefore become frequent in corporate reporting, as performance in the area of social responsibility is a key

factor in determining the value of a company and its intangible assets (Patara and Dhalla, 2022).

According to KPMG (KPMG, 2020), approximately 80% of the top 100 companies by revenue in 52 countries and jurisdictions, called N100 companies, now publish sustainability reports. This represents a 68% increase compared with 1993, when KPMG started collecting data on sustainability reports. Sustainability reports, also called corporate responsibility reports (de Klerk and de Villiers, 2012), are important documents through which companies indicate their commitment to seriously consider issues of social and environmental responsibility (Fisher et al., 2019). Sustainability reporting positively affects consumers' knowledge, trust, and perception of a company's reputation (Hasseldine et al., 2005; Widiarto Sutantoputra, 2009; Antonia García-Benau et al., 2013; Kim, 2019), a company's financial performance (Margolis et al., 2009; Angelia and Suryaningsih, 2015; Azzam et al., 2020; Ting, 2021), organisational appeal for potential employees (Kim and Park, 2011; Lis, 2012; Joo et al., 2016; Tkalac Verčič and Sinčić Čorić, 2018), and a company's market value (Berthelot et al., 2012; Plumlee et al., 2015), as well as reducing a company's equity (Dhaliwal et al., 2011). These effects involved the three basic pillars of sustainability, economic, social and environmental activity (Książek and Fischbach, 2018), which are implemented according to regional context (Bezzola et al., 2022).

This positive effect of sustainability reporting has resulted in an exponential increase in the number of sustainability reports worldwide, thus providing the opportunity to examine global CSR trends and to identify social and environmental problems targeted by CSR in a given locality (Randles, 2013) through regional segmentation. Previous studies focused on analysis of reports at the national level (Amin et al., 2021; Garanina and Aray, 2021; Ting, 2021), or compared selected regions of the world (Goloshchapova et al., 2019; Mućko, 2021; Saeed and Zamir, 2021). Moreover, the dimensions covered in these sustainability reports, and variations in these reports across different countries, remain unclear. This study addressed the identified gaps in previous research and attempted to answer the following questions: *What are the main topics that appear in sustainability reports at the global level? Are there any differences in sustainability reporting between developing and developed countries? Do the reports cover all key dimensions of sustainability (i.e., economic, environmental, and social dimensions)? Do companies reflect the sustainable development goals (SDGs) in their sustainability reports?*

Based on these research questions, this study aims to identify differences in sustainability reporting between developed and developing countries through a new research approach based on structural topic modelling.

2 Corporate sustainability and corporate social responsibility

Corporate sustainability is an approach in which companies not only set economic goals but also set social and environmental goals, specifically those related to sustainable development, and create value for stakeholders (Massa et al., 2015) without compromising the demands of future generations (Carroll et al., 2017). This

concept has been defined as a combination of the creation of long-term economic prosperity (economic domain), an enterprise's contribution to social governance in society (social domain), and the ecological integrity of the enterprise and its efforts to reduce the size of its ecological footprint (environmental domain) (Miska et al., 2018). By contrast, corporate sustainability has also been defined as a company's activities that proactively seek to contribute to the balance of sustainability, including economic, environmental, and social dimensions, a concept called the first balance (Lozano et al., 2016). This concept also includes a temporal dimension or an intergenerational perspective, which dynamically interacts with the afore-mentioned dimensions concerning the future, addressing the corporate system and its stakeholders. Although the concept of corporate sustainability has global significance and covers developing and developed economies and all sectors (Pazienza et al., 2022), the main problem with corporate sustainability is the lack of a general definition (Swarnapali, 2017).

The pillars of sustainability (social, economic, and environmental) (Purvis et al., 2019), also called the triple bottom line (Elkington, 1998), have been incorporated explicitly into the formulation of SDGs (UN – United Nations, 2012). Corporate sustainability may be implemented through the concept of CSR, as previously reported (Topal et al., 2009; Garay and Font, 2012; Kang et al., 2015; Elmualim, 2017; Belas et al., 2021; Sánchez-Teba et al., 2021). Moreover, CSR is regarded as nothing more than a transitional phase in achieving sustainability (Montiel and Delgado-Ceballos, 2014), further indicating that CSR is related to the pillars of sustainability.

2.1 Sustainability reporting

Companies can disclose their sustainable activities in many ways. Sustainability reports are an important part of a company's communication strategy and, to a certain extent, still serve as a marketing tool for the company (Bartikowski and Berens, 2021; Ngai and Singh, 2021). Sustainability reports provide information about the economic, social, and environmental impacts of a business over a certain period of time (Wolniak and Hąbek, 2016). Information is provided not only for the company, but also to influence the decision-making process of stakeholders (Moravcikova et al., 2015). For example, investors use a firm's social disclosure in making investment decisions (Lock and Seele, 2016; Verbeeten et al., 2016). Annual reports have emerged as the most frequently utilized communication channel for companies to report on their sustainability activities when such communication models first became mainstream (Ramdhony et al., 2010). These reports can facilitate adoption of a systematic approach to the management of socially responsible activities, identify future risks and opportunities, and thus help boost a company's competitiveness and its potential to continue its socially responsible activities (Moravcikova et al., 2015). Annual sustainability reports are utilized more frequently by larger multinational corporations to ensure that they connect with a wider range of stakeholders, whereas small- and medium-sized organisations may forgo this practice in favour of more direct communications with their stakeholders, who are more likely to be based locally (Wensen et al., 2011). Different

terms have been used to describe published documents reporting sustainability activities, including CSR reports, sustainability reports, and non-financial reports (Mučko, 2021). In this study, these documents will be called sustainability reports.

Although the publication of sustainability reports is largely regarded as voluntary, regulations that make publication mandatory for some companies are already in place (Mučko, 2021). For example, companies listed on the Chinese Shenzhen Stock Exchange, Shanghai Stock Exchange (Yu and Zheng, 2020), and London Stock Exchange (Hamed et al., 2022) are obliged to report their CSR activities. Moreover, the European Directive 2014/95/EU requires certain large undertakings and groups to publish non-financial reports (Dumitru et al., 2017).

One current drawback to sustainability reports is that those that are not regulated by standards or external guidelines may become nothing more than marketing tools (Tschopp, 2005; Jahdi and Acikdilli, 2009). There is therefore a growing pressure for corporate sustainability reports to be evaluated externally, thereby increasing the credibility of the published information (Perego and Kolk, 2012; Michelon et al., 2015). Independent auditors are becoming increasingly important, and focus on the development of recognized sustainability reporting guidelines (Berthelot et al., 2012) such as the Global Reporting Initiative 2013, the UN Global Compact, the World Business Council for Sustainable Development, and the initiative launched by the International Organisation for Standardisation, has increased considerably. Verification of sustainability reports by independent organisations increases both the credibility and quality of these reports (Pflugrath et al., 2011; Håbek, 2017).

The growing number of published sustainability reports is also attracting attention from academia. These reports have been used in several studies evaluating the attitude of companies concerning sustainability disclosures (Mučko, 2021), the effects of CSR performance on external CSR assurance (Karaman et al., 2021), the motivation of companies to publish sustainability reports (Deegan, 2002), and the method by which state ownership, as well as host market location, influences the nature and content of sustainability reporting in Russia (Aray et al., 2021) and China (Marquis and Qian, 2014).

Inasmuch as the concept of sustainability reports was developed in Western countries (Idemudia, 2011), it is unsurprising that most of these reports are published in developed economies (Matten and Moon, 2008; Ali et al., 2017). Nevertheless, the number of sustainability reports published in developing economies has increased in recent years (Khan, 2010). Similar findings were observed in a KPMG survey of Sustainability Reporting (KPMG, 2020), which showed that the reporting of N100 companies worldwide rose by 5%–80% between 2017 and 2020. Although there have been above-average increases in certain developing countries, such as Kazakhstan (34%), Ecuador (31%), and Peru (15%), other developing economies are already among leaders in sustainability reporting, including Mexico (100%), India (98%), and Malaysia (93%).

Most enterprises in developing countries have already recognized the importance of CSR as a factor in their long-term success (Siwar and Harizan, 2009), although there are major differences in the determinants of sustainability disclosure between developed and developing countries. For example, public

pressure to publish sustainability activities is lower for companies in developing than in developed countries (Ali et al., 2017). The main factor determining the publication of sustainability reports in developing countries tends to be stakeholders, such as international buyers, foreign investors, the international media, and international regulatory authorities (e.g., the World Bank).

2.2 Regional differences in sustainability reporting between developed and developing countries

Studies of differences in sustainability reporting between developing and developed countries show regional differences in the content, type, and extent of reporting (Dawkins and Ngunjiri, 2008; Vilar and Simão, 2015; Ali et al., 2017; Bhatia and Makkar, 2019; Sharma, 2019). Evaluation of content shows that reports from developing countries mainly address social performance, employees, and consumers, whereas reports from developed countries mainly address environmental performance (Bashrovaya, 2014). The main topic of sustainability reports in developed countries is management and reduction of environmental pollution, with these reports also emphasizing the support of groups within society (Sharma, 2019). By contrast, reports from developing countries mainly address investments in programs that positively affect living standards, such as investing in education or providing food and water. For example, CSR programs in developing countries focus on social areas through philanthropy, whereas programs in developed countries prioritize environmental issues (Khojastehpour and Jamali, 2021). Sustainability reports from developing countries place little emphasis on the area of human resources, such as equal opportunities for employees or the welfare of employees, whereas reports from developed countries did not prioritize community issues, such as donations/charities and community awareness programs (Bhatia and Makkar, 2019). Companies in both developed and developing countries assigned the highest importance to reporting on Customers and Products, such as product innovations or responsible marketing and communication. These findings indicate that sustainability reporting by companies is directed more at customers than at employees, as customers are regarded as the more important interest group.

Subsequent studies focused on the causes of differences in sustainability reporting by companies in developed and developing countries. Institutional factors (Welford, 2005; Bashrovaya, 2014), as well as political and economic conditions (Welford, 2005) have been reported responsible for these differences. Companies in developing countries, adapt to government programs and try to use sustainability activities to solve local social and economic issues (Sharma, 2019). Companies in developing countries may try to use their CSR programs to eliminate institutional gaps caused by corrupt governments or governments with insufficient resources (Visser, 2009). By contrast, companies operating in developed countries do not deal with issues such as lack of basic healthcare and education, regarding provision of these services to be the responsibility of their governments, thereby enabling them to invest in other areas as part of their CSR programs (Bhatia and Makkar, 2019).

Taken together, these findings indicate that sustainability policies in individual regions of the world reflect issues in these regions. Thus, analyses of sustainability reports would enable deeper insight into regional problems. None of the above-mentioned studies provides a comprehensive view of global sustainability reporting, as they only address selected parts of the world or compare selected countries. Although these studies showed differences in sustainability reporting in the analysed countries, they did not present a holistic view of the differences in sustainability reporting in developing and developed countries (Ali et al., 2017). Taken together, these findings highlight the need for comprehensive analyses of the contents of sustainability reports.

3 Materials and methods

This study used a computer-assisted strategy based on topic models and traditional qualitative reviews to analyse a large number of sustainability reports and contextualize possible findings. Although previous studies utilized a similar approach, those studies partially assumed identical topic distributions across external covariates (Goloshchapova et al., 2019; Zhou, 2021). To overcome this limitation, the present study used an STM (Roberts et al., 2016), which enabled incorporation of document metadata into the modelling process and further assessment of the relationships through simulations (Egami et al., 2018).

3.1 Structural topic model

An STM is classified as a non-linear generative probability model, a type of model that relies on an anticipated problem structure (document-topic, topic-word distributions) and calibration of its parameters with actual observations (texts) using iterative methods. In addition, an STM enables incorporation of external metadata. Inner workings can be described to a high level using plate notation. The model consists of three conceptual elements: (1) a document-topic component, (2) a topic-word component, and (3) a core language model that removes both sources of variation to produce actual topic-word assignments (Roberts et al., 2016).

The first component, the document-topic distribution, follows a log-normal probability distribution with the product of document covariates and outlining the expected value and the variation. The second component, the topic-word distribution, follows an exponential probability distribution based on the observed vocabulary and content covariates. Consequently, topic-word Dirichlet probability distributions using the respective components were reconciled using a non-conjugated variational expectation-maximization algorithm. Further details and technical implementation have been described (Roberts et al., 2016).

3.2 Topic quality

The FREX metric assesses topic quality with regard to exclusivity and word frequency. It is essential to offset these two outlooks

because recurring terms are not usually exclusive to a specific topic and specific terms are not usually informative (Airoldi and Bischof, 2012), followed by moderation of both aspects with a weighted harmonic mean. For words and topics, the metric was defined as:

$$FREX = \sum_{k=1}^K \sum_{f=1}^F \left(\frac{w}{E_{f,k}} + \frac{1-w}{F_{f,k}} \right)^{-1}$$

where w indicates weight, $F_{f,k}$ is the frequency score determined by the empirical cumulative distribution (ECDF) of word f in topic k , and $E_{f,k}$ is the conditional probability of observing topic k given word f and the respective ECDF. Practical results suggest that a high FREX can be obtained by simply using a large number of topics. Thus, broadening the evaluation perspective and considering semantic coherence have been recommended (Roberts et al., 2019).

Semantic coherence is influenced by the concept of pointwise mutual information and assumes that highly probable terms based on incoherent latent factors should co-occur within the exact text. Moreover, this metric approximates human judgment regarding topic quality (Mimno et al., 2011). Based on the words f_i and f_j , the metric for the set of the M most likely words in topic k can be expressed as:

$$C_k = \sum_{i=2}^M \sum_{j=1}^{i-1} \log \left(\frac{D(f_i, f_j) + 1}{D(f_j)} \right)$$

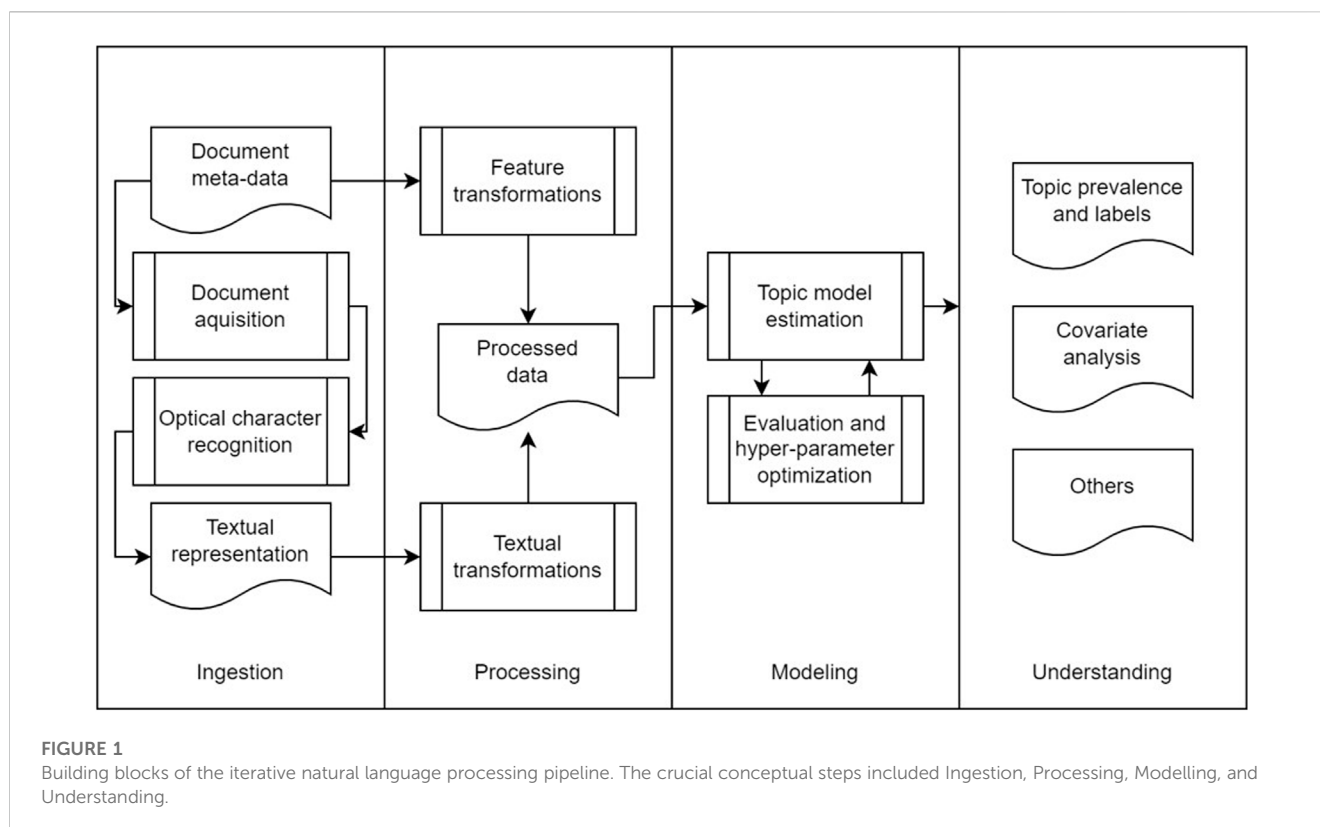
where $D(f_i, f_j)$ refers to the co-occurrence of words f_i and f_j and $D(f_j)$ describes the occurrence of the word f_j . In contrast to FREX, applications of semantic coherence suggest high values for models with a low number of topics predominantly containing frequent terms.

3.3 Methodology and implementation

Topic modelling is an iterative process that consists of ingestion, processing, modelling, and understanding. The relationships between these steps are depicted in Figure 1. The solution is based on a systematic approach (Roberts et al., 2019), with essential modifications involving syntactical decomposition and model selection.

3.3.1 Ingestion

The study sample consisted of 2100 sustainability reports, known as Communications on Progress (COPs), downloaded from the United Nations Global Impact database. In these reports, business participants inform company stakeholders about progress made during a given year in implementing the Global Compact principles in each of the four issue areas: human rights, labour, environment, and anti-corruption. Each COP had to contain three elements: 1) a statement by the chief executive expressing continued support for the Global Compact; 2) a description of practical actions taken by the company; and 3) a measurement of outcomes. The overall format of a COP is flexible, can be prepared in any language, and should be fully integrated into the company's non-financial reports, e.g., a sustainability report (UN-United Nations, 2012). All English-language reports published in 2020 were included in the sample. Moreover, all documents were



in portable document format (pdf), allowing extraction of textual information using the Tesseract open-source OCR tool (OCR, 2021).

3.4 Processing

In the second stage, both structured and unstructured input data were organized using two processing branches. The first branch retained the required metadata, i.e., type economy type. Countries with advanced economies were considered developed countries, whereas countries with emerging economies and emerging markets were considered developing countries, as determined by the International Monetary Fund (e.g., Wieser and Silfvenius, 2000; Nielsen, 2013; Ylyash, et al., 2021). These classifications were based on three criteria: *per capita* income, export diversification, and degree of integration into the global financial system.

The second branch dealt with unstructured textual data. First, all characters were converted to lower-case, special characters were removed, and multiple spaces were collapsed. Second, only unique texts longer than 1000 characters written in English were retained. Finally, a vectorized spaCy language model (Honnibal, et al., 2019) was used for parsing, lemmatization, tokenization, and part-of-speech tagging. Thus, original documents could be reconstructed with the relevant lemmas using preselected part-of-speech tags and frequency thresholds. This approach avoided the time-consuming process of manual stop-word selection and improved the computational time of downstream models; however, it may also adversely impact performance.

3.4.1 Modelling

The building blocks were subsequently assembled on the preprocessed texts and covariates used in the previous processing stage. This allowed the relationship between topical prevalence and external covariates to be determined and resolved the parameter estimation options. Finally, viable models were preselected for further interpretation by a human reader.

First, the topical prevalence was hypothesized to depend linearly on the one-hot encoded type of economy. The internal parameters of the topic model were initialized using the spectral method and further refined using an additional 750 expectation-maximization iterations. A grid search was performed over a range of 5–50 topics, and the model was evaluated using the average FREX and average semantic coherence. Optimization was approached as a no-preference multi-objective problem with a utopian solution. Non-dominated observations closest to the ideal state were set as candidates. The resulting subset consisted of five models covering 11–17 underlying topics. Figure 2 shows the model selection procedure, with dimensions scaled for comparability and candidate models in red.

3.4.2 Understanding

A previously described approach (Roberts et al., 2019) was utilized to aid in interpretation of the imprinted model. However, the procedure was streamlined to (1) identify documents and tokens connected to particular topics, add labels, and estimate prevalence, and (2) describe associations between the latent factors and covariates. Representative tokens for each topic were obtained

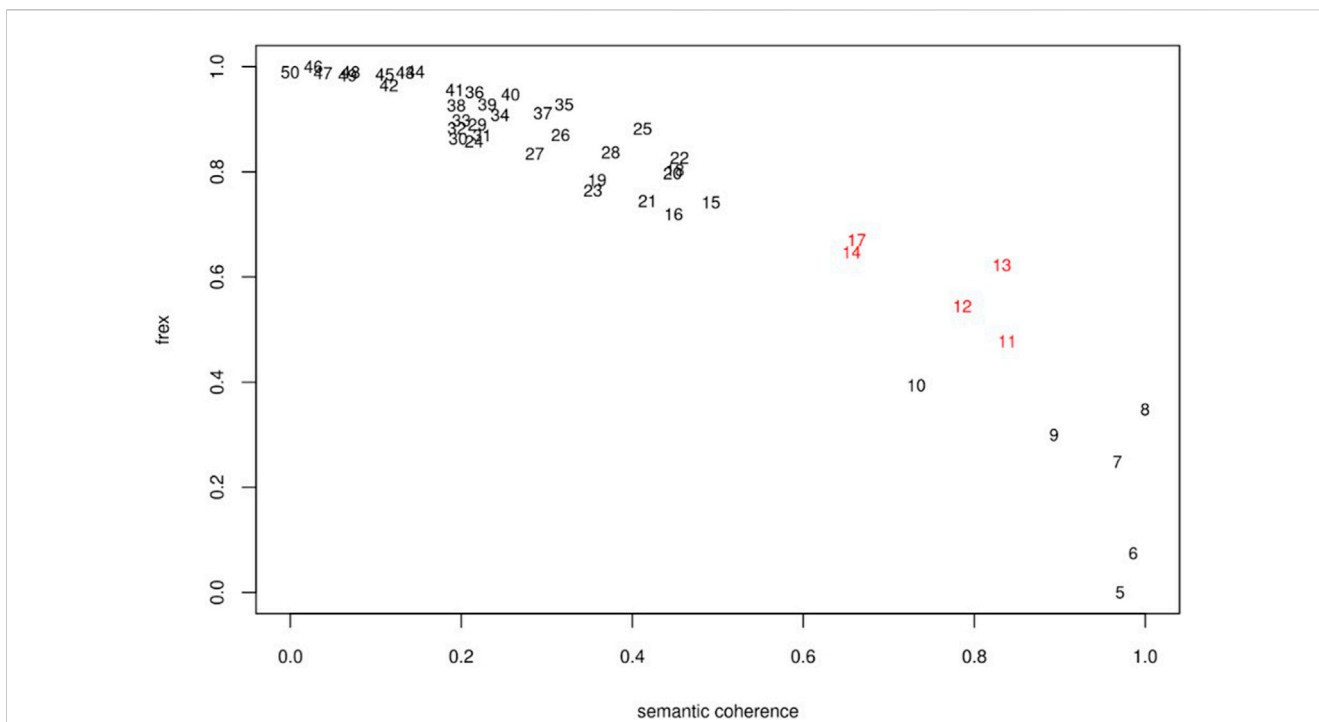


FIGURE 2 Model quality trade-off between FREX and Semantic coherence concerning the feasible number of topics. The models on the non-dominated decision boundary and closest to the utopia point are depicted in red.

TABLE 1 The 30 most frequently used individual words in sustainability reports from developed and developing countries.

| No. | Developed | Developing | No. | Developed | Developing | No. | Developed | Developing |
|-----|------------|-------------|-----|----------------|----------------|-----|---------------|------------|
| 1 | Group | Company | 11 | Include | Work | 21 | Environmental | Provide |
| 2 | Company | Employee | 12 | Value | Value | 22 | Service | Operation |
| 3 | Business | Management | 13 | Product | Include | 23 | Base | Support |
| 4 | Report | Report | 14 | Sustainability | Sustainability | 24 | Asset | Customer |
| 5 | Management | Business | 15 | Customer | Service | 25 | Information | Social |
| 6 | Employee | Year | 16 | Share | Policy | 26 | Corporate | Corporate |
| 7 | Year | Financial | 17 | Board | Environmental | 27 | Support | Energy |
| 8 | Financial | Group | 18 | New | Project | 28 | Policy | Right |
| 9 | Risk | Risk | 19 | Total | Total | 29 | Provide | Process |
| 10 | Work | Development | 20 | Development | Asset | 30 | Global | Global |

using the conditional probability of occurrence or FREX. Similarly, documents with a high prevalence of underlying factors were investigated. Consequently, the topic labels were suggested and discussed, and the overall topic prevalence was estimated. The expected difference between the classes of interest was computed using a simulation with global uncertainty (e.g., Roberts et al., 2019). The candidate set was explored and evaluated using the outlined strategy. This resulted in selection of an STM consisting of 11 latent factors, with an average semantic coherence of -7.89 and an average FREX of 9.05 .

4 Results

Frequency analysis of the 30 most used individual words (Table 1) revealed no important differences between developed and developing countries. The five most frequent words published in sustainability report in both developed and developing countries were “group”, “company”, “business”, “report”, and “management”. The word “employee” was in second place in developing countries, and in sixth place in developed countries. By contrast, the word “group” was in first place in developed countries and in eighth place in developing countries.

TABLE 2 The 30 most frequently used two-word connections (bigrams) in sustainability reports from developed and developing countries.

| No. | Developed | Developing | No. | Developed | Developing |
|-----|-----------------------|-------------------------|-----|-------------------------|------------------------|
| 1 | Human right | Financial statement | 16 | Management approach | Year end |
| 2 | Financial statement | Human right | 17 | Sustainable development | Financial asset |
| 3 | Annual report | Annual report | 18 | Anti-corruption | Climate change |
| 4 | Board director | Sustainability report | 19 | Year end | Cash flow |
| 5 | Long term | Global compact | 20 | Consolidated financial | Consolidated financial |
| 6 | Sustainability report | Health safety | 21 | Group company | Product service |
| 7 | Supply chain | Board director | 22 | Product service | Occupational health |
| 8 | Fair value | Sustainable development | 23 | Non-financial | Group company |
| 9 | Health safety | Risk management | 24 | Executive officer | Social responsibility |
| 10 | Risk management | Fait value | 25 | Supervisory board | Communication progress |
| 11 | Cash flow | Corporate governance | 26 | Social responsibility | Profit loss |
| 12 | Global compact | Anti-corruption | 27 | Fiscal year | Principle business |
| 13 | Corporate governance | Long term | 28 | Greenhouse gas | Material topics |
| 14 | Climate change | Management approach | 29 | Environmental impact | Environmental social |
| 15 | Code conduct | Supply chain | 30 | Energy consumption | Integrate annual |

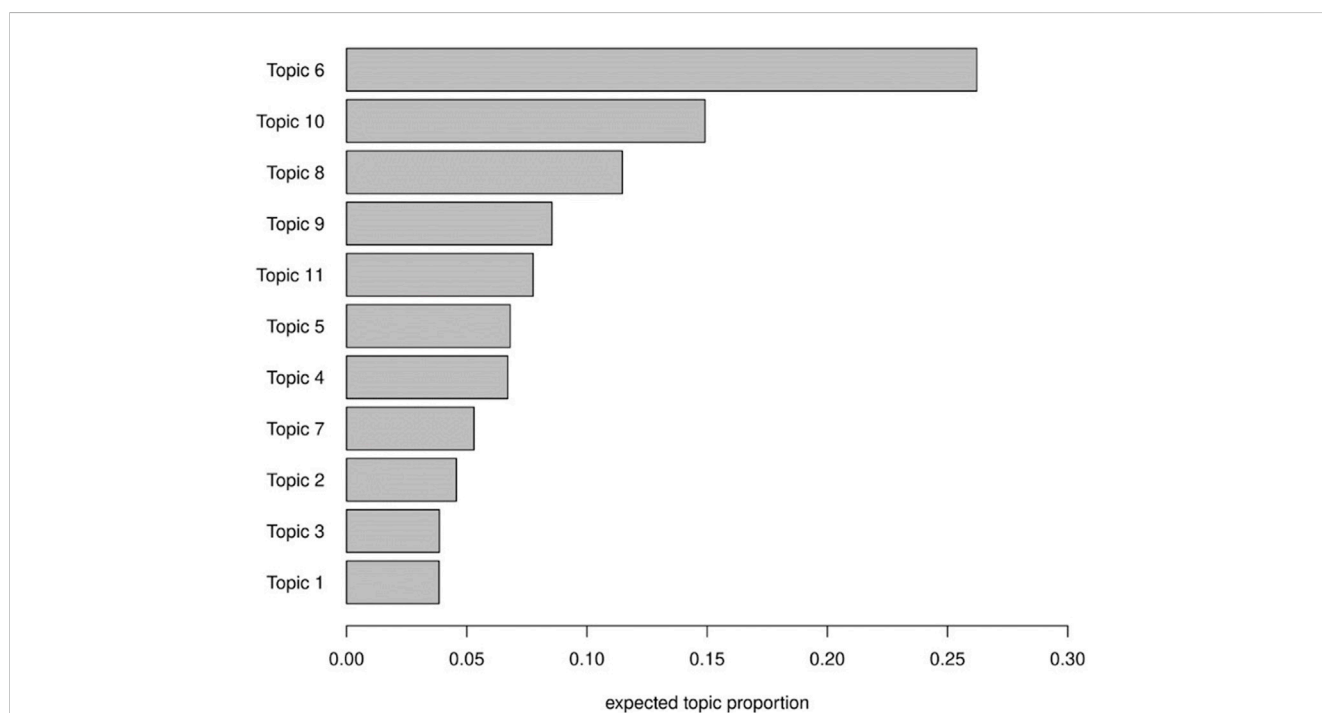


FIGURE 3 Proportion of topics (x-axis) estimated by the final STM model, with topics sorted from the most to the least prevalent.

Frequency analysis of the 30 most used two-word connection or bigrams (Table 2), showed that the most significant representation of bigrams was also from the economic area of sustainability. The

most frequent bigrams in reports from developed countries included “financial statement” (second place), “annual report” (third place), “board director” (fourth place), and “cash flow” (eleventh place),

TABLE 3 Topic labels and defining tokens.

| Topic | Conditional probability | FREX |
|--------------------------------------|---|--|
| 1. Corporate Governance | Group, company, director, board, share, corporate, management, information, document, shareholder | Document, universal, shareholder, director, entity, resolution, committee, share |
| 2. Value Management | Business, company, group, management, corporate, value, system, fiscal, executive, risk | Fiscal, director, corporation, growth, agree, supervisory, stock, medium, creation, business |
| 3. Risk Management | Risk, bank, financial, management, investment, credit, insurance, business, loan, service | Bank, credit, insurance, loan, portfolio, finance, risk, bond, client, capital |
| 4. Supply Chain Emission | Product, global, supplier, emission, report, material, process, include, risk, management | Organization, chain, product, chemical, safety, ton, supplier, treatment, supply, emission |
| 5. Energy Management | Company, energy, management, project, development, system, power, plant, gas, electricity | Power, electricity, gas, project, plant, energy, capacity, wind, infrastructure, electric |
| 6. Human Rights | Employee, right, principle, policy, company, human, work, corruption, global, compact | Labor, compact, principle, right, discrimination, human, policy, respect, communication, staff, progress |
| 7. Financial Statement | Financial, asset, statement, company, value, liability, income, report, annual, cash | Liability, cash, asset, income, lease, loss, expense, tax, flow, statement |
| 8. Sustainable Production | Sustainability, product, material, sustainable, supplier, production, customer, food, waste | Food, raw, production, plastic, forest, produce, sustainability, material, wood |
| 9. Education | Employee, management, activity, system, company, environmental, social, training, support, promote | Department, school, education, promote, centre, activity, prevention, child, establish, organize |
| 10. Diversity, Equity, and Inclusion | Business, people, work, global, help, team, impact, community, sustainable, solution | Help, people, team, partnership, world, platform, inclusion, leadership, talent, network |
| 11. GRI | Report, sustainability, management, community, approach, include, employee, emission, performance, impact | Community, GRI, engagement, approach, water, disclosure, sustainability, stakeholder, contractor, topic |

whereas the most frequent bigrams in reports from developing countries included “financial statement” (first place), “annual report” (third place), “board director” (seventh place), “cash flow” (nineteenth place), and others. In the social area, the most frequent bigrams in reports from developed countries included “human rights” (first place) and “health safety” (ninth place), whereas the most frequent bigrams in reports from developing countries included “human rights” (second place) and “health safety” (sixth place). In the environmental area, “climate change” appeared in third place in reports from developed and eighteenth place in reports from developing countries. Interestingly, the bigrams “greenhouse gas” (twenty-eighth place), “environmental impact” (twenty-ninth place), and “energy consumption” (thirtieth place) appeared in reports from developed but were not among the top 30 bigrams in developing countries. This finding indicates that developed countries place greater emphasis on topics associated with the environment.

An STM was used to extract 11 topics, with Figure 3 showing their expected topic proportions.

This study identified five main topics based on their expected proportion in sustainability reports: Human Rights; Diversity, Equity, and Inclusion (DEI); Sustainable Production; Education; and Global Reporting Initiative (GRI). The dominant topic from a global perspective was Human Rights. Table 3 shows the most frequent words within individual topics according to FREX and Prob. Conditional probability showed that the topic Human Rights included terms such as “employee”, “principle”, and “policy”; whereas FREX showed that the topic Human Right included terms such as “labour”, “discrimination”, “respect”,

“communication”, and “staff”. The second most frequent topic was DEI, which included words such as “people”, “help”, “team”, and “community” as determined by Prob and terms such as “team”, “partnership”, “inclusion”, “leadership”, and “network” as determined by FREX. The third most frequent topic was Sustainable Production, which included words such as “sustainability”, “material”, “supplier”, “food”, and “waste” according to Prob and terms such as “food”, “production”, “plastic”, “forest”, “produce”, and “wood” according to FREX. The next most frequent topic was Education, which included words such as “employee”, “management”, and “training” according to Prob and terms such as “school”, “education”, “prevention”, and “child” according to FREX. Of the five topics, the least frequent was GRI, which included aspects relating to sustainability reporting initiative.

An extrapolation of individual topics revealed that the most frequently mentioned topics in sustainability reports were Human Rights and DEI. These issues are related (Lin et al., 2018; Hamed et al., 2022); for example, their joint application can have a positive impact on a company’s image (Bear et al., 2010) and can increase CSR performance (Harjoto et al., 2015). Topics associated with Sustainable Production were the third most prevalent.

Figure 4 outlines differences in topic prevalence between developed and developing countries, including their respective 95% confidence intervals, with the dashed line representing no difference. The right side of the plot shows topics with a higher prevalence within developed countries, whereas the left side shows topics more frequent within developing countries. Sustainable Production, Supply Chain Emissions, and Value Management

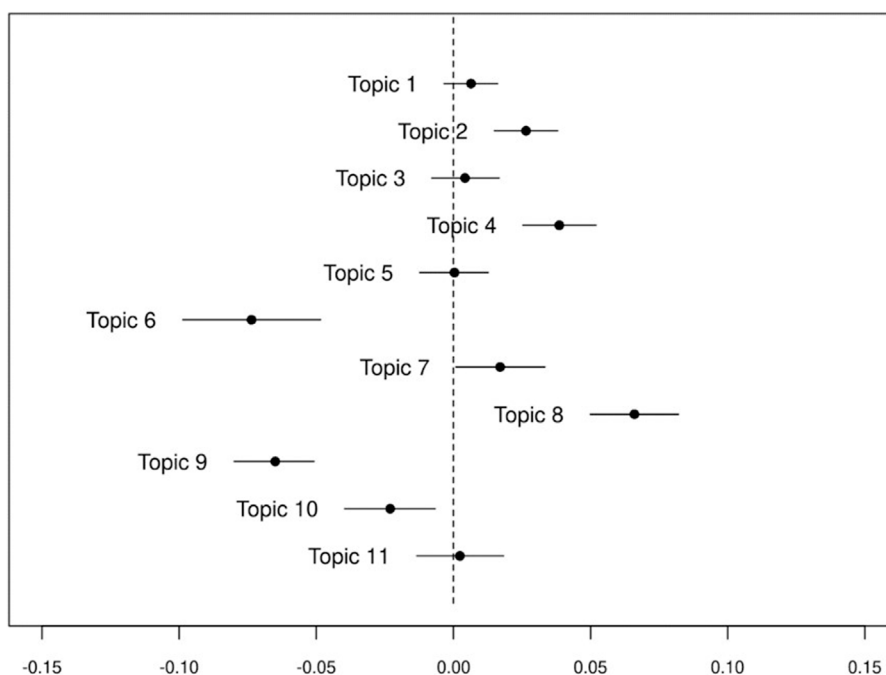


FIGURE 4 Estimated differences in topic prevalence as a function of the type of economy. A positive difference (x-axis) indicated higher prevalence in developed states, whereas a negative difference indicated higher prevalence in developing countries.

TABLE 4 Identified topics in relation to sustainability pillars.

| Sustainability pillars | Identified topics | Developed countries* | Developing countries* |
|------------------------|--|---|-------------------------|
| Social Pillar | Human Rights, Education, Diversity, Equity, and Inclusion | | Human Rights, Education |
| Environmental Pillar | Energy Management, Supply Chain Emission, Sustainable Production | Supply Chain Emission, Sustainable Production | |
| Economic Pillar | Corporate Governance, Value Management, Risk Management, Financial Statement | | |

Based on a prevalence of 0.05, including spread.

were more closely associated with sustainability reports from developed economies; whereas Human Rights, Education, and Diversity, Equity, and Inclusion initiatives were more prevalent within sustainability reports from developing economies. The prevalence of the remaining factors showed little (Financial Statements) to no (Corporate Governance, Risk Management, Energy Management) differences between developed and developing economies.

Table 4 shows the distribution of identified topics according to the individual dimensions of sustainability (social, environmental, and economic). Thematically, the economic dimension was the most frequently covered, but these were the four proportionally smallest identified topics. By contrast, the social dimension was proportionally the largest content in sustainability reports, with the topics Human Rights and DEI being the largest identified.

Based on a prevalence of 0.05, including spread.

5 Discussion

5.1 Global view

The present results reveal that topics relating to human rights are highly prevalent worldwide in sustainability reports, thereby confirming the significant links between human rights and the CSR concept (Ramasastry, 2015; Wheeler, 2015; Obara and Peattie, 2018; Grosser and Tyler, 2021). Together with the finding that the second most prevalent topic was DEI, these results show that companies are responding to the challenge of the United Nations Sustainable Development Goals (United Nations, 2015) and are implementing diversity and inclusion rules in practice.

DEI has been closely linked to “human rights”, the importance of which was underlined by a 2013 initiative by governing bodies that called for the establishment of a World Health Organisation (WHO) initiative dealing with “Gender, Equity and Human Rights”

(Magar et al., 2019). This initiative was designed to mainstream gender, equity, and human rights criteria across all organisational levels within a 5-year period. Gender, equity, and human rights were integrated to expose and analyse determinants lacking on barrier assessments, using the results of this analysis to reduce inequities and monitor progress through continual reporting. The aim of this scheme was to identify the causes of inequality and poor health and to identify solutions to these problems (Nidumolu et al., 2015).

DEI is a complex topic that involves factors such as age, race, ethnicity, cultural background, gender, sexual orientation, and religion. Society is now actively trying to reduce these inequalities by exerting pressure through various initiatives, such as the well-known #MeToo, #BlackLivesMatter, and #StopAAPIHate campaigns. These initiatives have encouraged individual companies to develop programs to reduce these inequities (Byerley, 2018; Prothero and Tadjewski, 2021). Indeed, one study shows that a single claim of sexual harassment could have a marked adverse impact on a company's reputation (Does et al., 2018). Therefore, companies now strive to adopt a proactive approach by implementing anti-harassment policies and introducing mandatory training to prevent sexual harassment and the subsequent public outcry. Because investors are cautious regarding this issue, anti-sexual harassment policies are becoming a crucial criterion in investment-related decision-making. Thus, sustainability reports may play a key role in developing corporate culture, and demonstrate companies' proactive strategies (Does et al., 2018).

Similar situations have been observed regarding race, ethnicity, age, and religion, whereby companies produce sustainability reports to prevent inappropriate behaviours, as well as to communicate their commitment to society (Schulz, 2017). Moreover, diversity with respect to age, professional tenure, and expertise can benefit company performance by, for example, enhancing innovation and worker productivity (Arioglu, 2021; Mothe and Nguyen-Thi, 2021). However, diversity in the workplace can also result in problems with communication, cooperation, and cohesion among employees, having a negative impact on the performance of the company (Kunze et al., 2011; Arioglu, 2021; Talavera et al., 2021). Efforts to enhance diversity should therefore be thought out correctly, and not just implemented.

Another important topic across regions was Sustainable Production. Sustainable production and consumption have received considerable attention in recent decades (Karagiannis et al., 2022) and have become standard elements in the agendas of policymakers and institutions, as well as being included in company strategies (Pilař et al., 2019).

5.2 Regional view

Analysis of regionally segmented topics showed that words associated with sustainable production and the environment were more prevalent in developed than in developing countries. Similar results were observed in a study examining the differences between developed and developing countries regarding perception of CSR on social media (Kvasničková Stanislavská et al., 2020). Large corporations in developed countries have long been pressured by their stakeholders to adopt a more sustainable approach (Hassini

et al., 2012), with the results of the present study confirming that environmental issues are currently the main priority in Western countries (Kvasničková Stanislavská et al., 2020), with many initiatives in these countries, such as the 2030 Agenda, Rio+20, and the European Green Deal, focusing on this area. In developing countries, however, keeping product prices low is the main priority of stakeholders, and there is less demand for an environmental approach (Sardana et al., 2020). Companies in developing countries are concerned that increased sustainable production will actually have an adverse impact on competitiveness and profitability, as sustainability requires deployment of additional resources (Nidumolu et al., 2015). However, conditions regarding solid waste production (Das et al., 2019) and inadequate sustainable supply chain management (Ali and Kaur, 2021) have become alarming in many developing countries, suggesting that future sustainability reports will place greater emphasis on sustainable production.

The present study also found that the topic of education was more prevalent in sustainability reports from developing countries than from developed countries, in agreement with previous findings (Chapple and Moon, 2005; Makka and Nieuwenhuizen, 2018; Massoud et al., 2019). The developing world is facing problems that, to a large extent, could be resolved by improving education (Kvasničková Stanislavská et al., 2020), making it logical for companies in developing countries to devote special attention to education in their CSR programs.

These results identified several significant regional differences. Based on the definition of CSR as painting a picture of regional problems (Randles, 2013), the present study identified human rights and education as major issues in developing countries, as well as representing opportunities for socially responsible companies in these countries. By contrast, sustainable production and supply chain emissions were found to be major challenges for companies in developed countries.

5.3 The theoretical and practical implications

The many theoretical contributions of this study can be used by academics, company managers, and policymakers. First, to the best of our knowledge, there are no holistic views of sustainability reporting described to date. Although studies have identified several factors relevant to sustainability reporting (e.g., Bashtovaya, 2014; Bhatia and Makkar, 2019), the present study is the first (to the best of our knowledge) to analyse factors in detail. Second, a thorough comparison of sustainability reporting in developing and developed countries would add to the current body of knowledge. Third, the present study provided a methodological contribution by introducing an automated machine learning approach to analyse the contents of sustainability reports. Previous studies analysed the contents of these reports using the manual coding techniques commonly used in mainstream sustainability disclosure/communication research.

The results of the present study also have several key practical implications. These findings can be viewed from two perspectives. The first is a reflection of the regional issues dealt with by individual

companies, with the activities addressing these issues included in sustainability reports. This perspective made possible the identification of Supply Chain Emission and Sustainable Production as key areas for developed countries and the identification of Human Rights and Education as key areas for developing countries. These findings may be important for policymakers, allowing them to prepare early for future challenges faced by their regions. The second perspective is the shift of individual areas from developing to developed countries. Improvements in lifestyle may result in the increased predominance in developing countries of factors encountered in developed countries. Business managers in developing countries should also consider that, although challenges vary among these countries, sustainability reports from developing countries should include factors such as sustainable production and supply chain emissions. Companies' sustainability reports should include not only regional but also global aspects of sustainability, thereby communicating more effectively about their sustainability perspectives.

6 Future studies and limitations

The findings of this study reveal several opportunities for future studies. For example, follow-up studies can focus on individual industrial segments, determining whether there are any differences between individual areas of an economy, such as differences between services and industry. These studies can include comparisons between companies in the service and manufacturing sectors and/or a comparison between companies within the same sector.

Because DEI was the second most frequent topic in sustainability reports, further research should examine the qualitative aspects of DEI by focusing on the representation and strategies of individual areas of DEI in sustainability reports. These results should also be compared among individual countries and regions.

The present study had several limitations. First, it only included data from 2020. Thus, it did not evaluate changes in individual topics over time. Second, it used the World Bank classification of regional economies, which might not fully reflect differences between developing and developed countries.

7 Conclusion

Corporate sustainability is of global interest, but the challenges faced by individual companies differ by country and region. By analysing the contents of sustainability reports, the present study determined the method by which companies communicate sustainability. A structural modelling method was used to examine the content of sustainability reports from two basic perspectives—a global perspective and a regional perspective, according to the economic status of a country (i.e., developed or developing).

From a methodological point of view, this study represents a new approach to the analysis of sustainability reporting and contributes to the literature in several ways. First, this study

provides a comprehensive view and new findings and insights into sustainability report publishing worldwide. To the best of our knowledge, this study is the first to examine sustainability reporting activities to such an extent, including all countries in the world that disclose sustainability reports through the United Nations Global Compact. Second, in examining sustainable activities included in sustainability reports, the study used an automated machine-learning approach rather than the manual coding technique commonly used in mainstream sustainability disclosure/communication research. Third, the study expands the literature by identifying differences in reporting of sustainable activities between developed and developing countries. Because CSR programs can be regarded as pictures of regional problems, identifying the main topics in these CSR programs can reveal the main problems within monitored regions.

Data availability statement

The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation.

Author contributions

LK initiated the study and co-wrote the manuscript; LaP assessed the feasibility of the research and co-wrote the manuscript; MF processed the data and created a structural model; RK assessed the systematic quality and adequacy of the methodology; LuP co-wrote the manuscript; BA and MG revised the manuscript. All authors made a substantial contribution to the article and approved the final submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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