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ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) INITIATIVES AND FIRM EFFICIENCY IN THE GLOBAL TOURISM AND HOSPITALITY INDUSTRY: THE ROLE OF BUSINESS STRATEGY

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ABSTRACT

This study examines the impact of environmental, social and governance (ESG) practices on firm efficiency in the global tourism and hospitality industry, with a focus on the moderating role of business strategy. Utilising data from 59 firms in the travel, aviation and hotel sectors between 2017 and 2021, the analysis employs the enhanced Russell measure, directional distance function and truncated regression techniques. The findings indicate that the hotel sector outperforms others in both sustainability and market efficiency, while the aviation sector trails due to high energy consumption and disruptions caused by the COVID-19 pandemic. Contrary to the common perception that ESG practices diminish profitability, the results suggest that ESG practices enhance operational efficiency and corporate reputation. Furthermore, business strategy is found to significantly moderate the ESG–efficiency relationship. The study recommends that the aviation sector accelerate the adoption of sustainable aviation fuels, while hotel and travel sectors should continue deepening ESG integration to strengthen long-term resilience and competitiveness.

Keywords: Tourism and hospitality industry, ESG, Network DEA, Sustainable efficiency, Market efficiency

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INTRODUCTION

The global tourism and hospitality (GTH) industry occupies a significant position in the world economy due to its contributions to employment generation, economic growth and international trade. It enhances cultural exchange and promotes ecological preservation through sustainable tourism practices (Carrasco-Santos et al., 2024; Kumar et al., 2024; Nurmatov et al., 2021; Sørensen & Grindsted, 2021). In recent years, the industry has undergone rapid digital transformation, integrating technologies such as online bookings, itinerary management apps and virtual tours to improve convenience and operational efficiency (Ma & Ouyang, 2023). Despite its economic benefits and technological advancement, the GTH industry is increasingly under scrutiny for its environmental and social footprint, making the evaluation of environmental, social and governance (ESG) efficiency essential.

Given these concerns, it is important to understand how each sub-sector within the GTH industry specifically relates to ESG dimensions. From environmental perspective, for instance, the travel sector, encompassing tour operators and attractions, directly affects local ecosystems and cultural heritage sites (Holden, 2005; Kousis, 2000), where sustainable practices can contribute to community development, ecological protection and economic equity (Pan et al., 2018). In contrast, the aviation industry is a major contributor to greenhouse gas emissions (Andrejiová et al., 2020), with high fossil fuel consumption and limited immediate alternatives, making environmental sustainability a pressing concern. Pandemic-induced disruptions have further strained the sector's resilience and operational models. Airlines are under pressure to invest in sustainable aviation fuels, fleet upgrades, and route optimisation (Calvet, 2024). Meanwhile, the hotel industry tends to have relatively more controllable environmental outputs (e.g., energy and water use), and many hotel chains have actively pursued green certifications and energy efficiency programmes to improve sustainability (Abdou et al., 2020). From a social perspective, hotels also serve as major employers and contributors to local economies, making social responsibility and labour standards essential ESG considerations (Lin et al., 2024).

From a social standpoint, the GTH industry plays a key role in supporting local employment, preserving cultural identity and contributing to social welfare. Hotels and tourism operators often engage with communities by supporting local businesses, offering training opportunities and enhancing regional economic resilience (Koseoglu et al., 2021). Governance is also a vital pillar, as robust internal governance structures—such as transparent risk management, stakeholder accountability and ethical decision-making—are crucial for building investor confidence and sustaining competitiveness (Peng et al., 2021).

Furthermore, the relationship between ESG practices and firm efficiency is not uniform across all firms; rather, it can be significantly influenced by a firm's business strategy. Porter (1980) concretised such strategies by classifying them as cost leadership, differentiation and focus strategies and considering them as critical indicators of a company's competitiveness. Meanwhile, Miles et al. (1978) first categorised business strategies (BSs) into three distinct types: prospectors, defenders and analysers. According to Porter (1980) and Miles et al. (1978), strategic orientation (cost leadership, differentiation), or defender, prospector, analyser typologies significantly shapes firms' responses to environmental and social demands. Business strategies determine resource allocation (Maritan & Lee, 2017), risk tolerance (Kusnindar et al., 2024), and operational priorities, all of which shape how ESG practices are implemented and whether they align with a firm's competitive goals (Higgins et al., 2015). For example, firms with a prospector strategy, which emphasises innovation and market expansion, may invest more aggressively in ESG-related innovations, leveraging them to enhance long-term efficiency and brand differentiation (Wang et al., 2025). Conversely, firms with a defender strategy, which prioritises cost control and stability, may focus on ESG practices that improve operational efficiency or reduce regulatory risks (Kweh et al., 2024). Therefore, the business strategy of a firm can either strengthen or weaken the effectiveness of ESG practices in driving efficiency improvements, making it a crucial moderating factor in this relationship (Legendre et al., 2024). Understanding how business strategy influences ESG–efficiency linkages is critical for advancing both theory and practice in sustainable tourism and hospitality management (Bentley et al., 2013; Higgins et al., 2015).

In light of these challenges and opportunities, efficiency evaluation tools like Data Envelopment Analysis (DEA) are valuable for benchmarking efficiency across firms with varying ESG practices. DEA facilitates the comparison of input–output relationships, helping operators identify best practices, improve resource utilization, and conduct competitor analysis (Altin et al., 2018; Assaf & Josiassen, 2016; Nurmatov et al., 2021; Oukil et al., 2024). Through such evaluations, firms can gain insights into their ESG standing and guide their strategic transformations toward sustainability. Accordingly, this study aims to evaluate the ESG-efficiency nexus of firms in the GTH industry from 2017 to 2021, employing DEA, the enhanced enhanced Russell measure (ERM) and truncated regression analysis. It also investigates the moderating role of business strategy in the ESG–efficiency relationship, providing differentiated insights for each industry to inform policy and managerial decisions.

This study offers several contributions to the literature. Firstly, this study designs a global efficiency evaluation procedure for the GTH industry by conducting network DEA (NDEA), which combines the ERM and the directional distance

function (DDF), to assess the sustainability efficiency and market efficiency of the GTH industry. In addition, this study focuses on sustainable development within the GTH industry and evaluates its efficiency across the three ESG pillars to provide managers with indicators to assess their sustainability to develop future improvement strategies. Secondly, this study compares and analyses the efficiency of the GTH industry in the three ESG practices to help managers understand the strengths and weaknesses of each dimension to formulate improvement measures to address deficiencies. Lastly, this study conducts truncated regression analysis to explore the moderating role of business strategy in the impact of ESG practices on efficiency in the GTH industry to provide theoretical support and practical guidance to practitioners in formulating sustainable development strategies, enhancing their competitiveness and improving their efficiency management. This study aims to help practitioners effectively integrate ESG objectives into their operational strategies through the moderating effect of business strategy to achieve long-term sustainable development.

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

Global Tourism and Hospitality Industry

According to the United Nations World Tourism Organisation (UNWTO, 2024), international tourism grew by 34% in 2023 compared to 2022, reaching 88% of its pre-COVID-19 level. This upward trend is expected to continue, with international tourism projected to fully recover to pre-pandemic levels in 2024. The travel and tourism industry contributed approximately USD3.3 trillion in direct GDP in 2023, accounting for around 3% of global GDP—comparable to figures reported in 2019. This optimistic trajectory is further supported by the UNWTO Tourism Confidence Index Survey, where 67% of tourism professionals expressed confidence that industry prospects in 2024 would be better or substantially better than those in 2023.

The travel industry encompasses a wide range of services and experiences, driven by evolving tourist preferences. Self-guided tours, ecotourism and luxury vacations each reflect distinct traveller motivations, from cultural exploration and environmental consciousness to premium comfort and service quality. The industry continues to evolve in response to these demands through innovation, diversification and digital transformation (Laroche et al., 2023; Sebastia & Marzal, 2020).

Similarly, the aviation sector is a vital enabler of international tourism, connecting destinations across borders and facilitating global mobility (Lohmann & Peres de Oliveira, 2025). It supports over 87 million jobs and contributes billions

to global GDP. However, it is also one of the most energy-intensive components of the GTH industry, accounting for a significant share of global carbon emissions. In response, the sector is investing heavily in fuel efficiency, fleet modernisation, and sustainable aviation fuels. The aviation industry's ability to align operational efficiency with environmental goals is now a key strategic focus, particularly in the post-pandemic recovery phase, where resilience and sustainability are paramount (Taneja, 2021).

Within this broader industry, the hotel sector plays a pivotal role by providing the infrastructure for accommodation and hospitality services. The hotel industry not only supports tourism but also contributes substantially to employment, urban development, and national economies (Dogru et al., 2020). Sustainable practices in hotel operations such as energy-efficient buildings, waste management, and local community engagement are becoming essential components of responsible hospitality (Khalil et al., 2024). With increased expectations from both consumers and regulators, hotels are under growing pressure to adopt ESG practices to enhance long-term competitiveness, corporate reputation, and environmental responsibility.

Together, the travel, hotel and aviation industries form an interconnected ecosystem that drives GTH industry while also facing increasing scrutiny for their ESG impacts. Understanding the ESG dynamics across these sub-sectors is therefore critical for stakeholders aiming to balance growth with efficiency.

Theoretical Discussion

The Resource-Based View (RBV), as introduced by Wernerfelt (1984), serves as a cornerstone for understanding how businesses can capitalise on their unique assets to secure a competitive advantage. Barrutia and Echebarria (2015) emphasised the significance of RBV in strategic management, particularly its role in fostering sustainable competitive advantages. This view aligns with the findings of Savino and Shafiq (2018), who applied RBV to analyse how both tangible and intangible resources contribute to sustainability and improve operational performance. Similarly, Wijethilake and Ekanayake (2018) utilised RBV to investigate how companies could employ proactive strategies to tackle sustainability challenges, suggesting an extension of sustainability management beyond mere financial metrics to include sustainability control systems. The works of Lueg and Radlach (2016) further underscore the intensive efforts needed to employ proactive strategies for waste minimisation and pollution prevention in response to sustainability demands. Researches by Gadenne et al. (2012), along with Wijethilake and Ekanayake (2018), support the notion that such proactive strategies not only enhance a firm's sustainability efficiency but

also boost its social reputation and meet consumer expectations. This theoretical perspective posits that the integration of ESG practices into a firm's resource allocation and strategic planning not only bolsters sustainability but also enhances competitive advantage, as effective resource utilisation is crucial for maintaining a market edge.

In addition to RBV, this study incorporates Stakeholder Theory as a critical component of its theoretical framework, especially in discussions surrounding ESG. According to Freeman et al. (2010), businesses must address the needs of all stakeholders equitably, moving beyond the sole focus on maximising shareholder profits to achieve broader prosperity and growth. Uyar et al. (2023) caution that without a comprehensive consideration of all stakeholder needs and interests, firms may face reputational damage, regulatory challenges or opposition from stakeholders. For instance, neglecting the societal impacts on communities or the environmental effects on ecosystems could have detrimental consequences.

This study leverages RBV and Stakeholder Theory to develop an analytical framework aimed at exploring how various business strategies might affect the relationship between ESG investment and firm efficiency.

Hypotheses Development

ESG practices and firm efficiency

ESG initiatives have gained increasing importance in the global travel industry, as firms recognise their potential to enhance operational efficiency and build resilience. Dogru et al. (2022) examined the effects of ESG-related news on firm efficiency by applying an event study methodology. Their findings revealed that such news had no immediate impact on abnormal returns in the short term; however, further difference-in-differences analysis during the COVID-19 pandemic demonstrated that the adoption of sustainable practices significantly strengthened the resilience of travel firms against external shocks. Moreover, establishing sustainability committees was shown to effectively mitigate the adverse effects of ESG risks on firm efficiency.

Similarly, Ozdemir et al. (2023) analysed the influence of economic policy uncertainty (EPU) on the financial efficiency of hotel and travel firms, based on a sample of 113 companies from the hotel, catering, and aviation sectors spanning 2001–2018. They found that heightened EPU negatively impacted firm efficiency, notably through declines in Tobin's Q. However, companies that actively engaged

in corporate social responsibility initiatives, increased institutional ownership, and maintained high cash reserves were better positioned to cushion the negative effects of EPU. In another study, Erdem and Yel (2023) highlighted the economic and ecological dimensions of the travel industry's sustainability practices, emphasising the importance of minimising the sector's environmental footprint while maximising social benefits for host communities. Their results suggested that digitalisation, particularly through e-commerce can improve operational efficiency, foster industry growth and promote long-term sustainability.

Beyond the tourism industry, ESG practices have also been recognised more broadly as essential to sustaining firm efficiency and competitiveness, especially amid escalating global warming challenges (Pham et al., 2022; Shaikh, 2022). Firms that proactively adopt ESG initiatives tend to experience multiple strategic advantages, including stronger reputations, easier access to lower-cost financing, greater regulatory flexibility, heightened customer loyalty, the attraction of skilled human capital and improved stakeholder relations (Lee et al., 2016; Muhammad et al., 2015; Shaikh, 2022). These benefits collectively contribute to enhancing operational efficiency. For instance, a positive corporate image can broaden the customer base, driving revenue growth. Firms regarded as good corporate citizens can cultivate reciprocal goodwill among stakeholders (Muhammad et al., 2015), while securing financing at lower interest rates reduces operating expenses. ESG initiatives can also function as a form of insurance, minimising exposure to regulatory fines and compliance penalties, further improve efficiency (Raghunandan & Rajgopal, 2022). Additionally, firms with strong ESG commitments are more likely to attract and retain talented employees, improving efficiency (Song, 2024), and can build reliable supply chain relationships that enable smoother, more cost-effective operations (Thien et al., 2024).

However, despite these potential advantages, some researchers caution that ESG practices may exert a negative influence on firm efficiency. Gillan et al. (2021) argue that ESG practices are often costly, risky and characterised by delayed payoffs. The significant upfront capital required, coupled with uncertain future outcomes, means that the immediate economic burden of ESG activities can outweigh their short-term efficiency gains (Ren et al., 2022). Furthermore, the long-term nature of many ESG practices involve the risk that firms may not provide efficiency within a foreseeable timeframe. Taken together, the hypothesis is developed as follows:

H1: ESG practices has a significantly impact on firm efficiency.

Business strategy, ESG practices and firm efficiency

Different business strategies highlight distinct organisational orientations and priorities, especially when it comes to ESG practices (Morgan & Strong, 2003). Firms that adopt an aggressive strategy might view ESG practices as a means to gain a competitive advantage, using them to drive innovation and stay ahead of evolving societal expectations (Uyar et al., 2023). By actively integrating ESG practices, these firms can position themselves as industry leaders in sustainability, which not only enhances their market reputation but also allows them to quickly adapt to external changes.

According to Lin et al. (2021), business strategy has been shown to moderate the relationship between ESG and investment efficiency. Using data from over 3,000 U.S. firms (1996–2016), the study found that high ESG practice's firms are more likely to over-invest, but adopting defend or prospect strategies helps reduce this effect. Moreover, the moderating role of the defend strategy enhanced the relationship between the ESG practices and investment efficiency. Similarly, Chang et al. (2025) examined how business strategy moderates the relationship between ESG investment and efficiency on 29 gambling firms across North America, Europe, Asia and Oceania from 2019 to 2022. The findings reveal that aggressive strategy strengthens the impact of ESG practices on sustainability and marketability efficiency, highlighting the crucial role of business strategy in shaping ESG outcomes.

Conversely, firms that pursue a conservative strategy may prioritise stability and reliability, viewing ESG practices as tools for bolstering long-term resilience (Bendoraitienė & Darškuvienė, 2019). For these organisations, the focus is on maintaining consistent performance and minimising risks, with ESG initiatives serving as a foundation for sustainable growth over time. The moderating effect of ESG initiatives, therefore, depends on how well they align with and support the firm's overarching business strategy, either by fostering innovation and competitiveness in aggressive strategies or by reinforcing stability and resilience in conservative approaches. Consistently, Xaviera and Rahman (2024) analysed 194 non-financial firms listed on the Indonesia Stock Exchange from 2018 to 2022 using panel data regression. The findings reveal that business strategy moderates this relationship by strengthening the negative impact. Further analysis shows that a defender strategy can weaken the negative relationship between ESG performance and firm value, while other strategies show no moderating effect. Based on the discussion above, thus, the following hypothesis is formulated:

H2: The business strategy type significantly moderates the relationship between ESG practices and firm efficiency.

RESEARCH DESIGN AND METHODS

Research Framework

This study aims to investigate the impact of ESG practices on the firm efficiency of the GTH industry. First, this study conducts NDEA, which combines the ERM and the DDF, to analyse the sustainability efficiency (SE) and marketability efficiency (ME) of the GTH industry. Second, this study conducts truncated regression analysis and considers three control variables, namely, leverage, cash ratio, and market-to-book ratio, to explore the influence of ESG practices and the business strategy on the SE and ME of the GTH firms. Figure 1 presents the research framework.

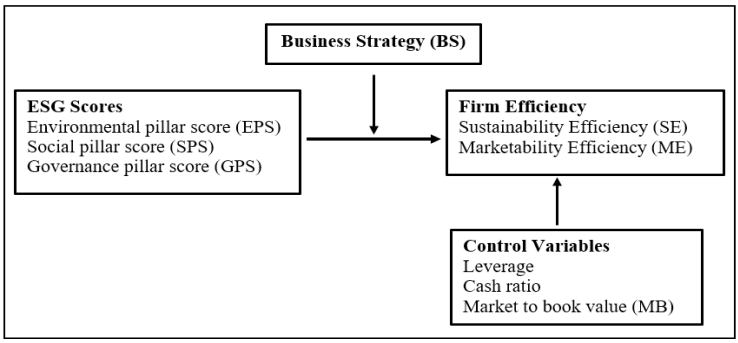

Figure 1: Research framework

Sources of Data and Sample Selection

This study focuses on the GTH industry and selects the sub-sectors with the highest total global output, namely, the travel, aviation and hotel sub-sectors. A total of 59 sample firms are selected across these three sub-sectors, with data covering the period from 2017 to 2021, resulting in 295 decision-making units (DMUs) for analysis. The list was obtained from the Datastream database. ESG scores are obtained from Refinitiv, MSCI and Bloomberg, following the classification framework outlined by Boffo and Patalano (2020) in accordance with OECD guidelines. As shown in Table 1, the market value of the selected sample firms accounts for a substantial portion of the global market across all years observed. Specifically, the sample represents between 60.4% and 76.5% of the total market value of GTH firms from 2017 to 2021. The average proportion across this period is 67.4%, indicating that the sample is highly representative of the overall industry. This high level of market coverage enhances the generalisability and robustness of the study's findings.

Table 1
Sample market value ratio of global tourism and hospitability firms

Year	Sample market value (Thousands of USD)	Proportion(%)
2017	881,870,923	76.50
2018	726,405,051	63.00
2019	820,945,396	71.30
2020	696,467,672	60.40
2021	756,046,161	65.60
Average	776,347,041	67.40

Source: Datastream database

Network DEA, Combining Enhanced Russell Measure and Directional Distance Function

Chung et al. (1997) introduced the use of the DDF as an output-oriented distance function, applying the same improvement rate to all inputs and outputs. The DDF is commonly used for measuring efficiency, especially when undesirable outputs are considered. However, the radial measure of the conventional DDF does not account for nonzero slack and all inefficiency sources, often leading to overestimated efficiency values. To address this, Li et al. (2020) developed a non-radial DDF, which provides highly reasonable and accurate estimation results. Alcaraz et al. (2021) highlighted that the traditional Russell model is extensively used to evaluate enterprise production efficiency due to its non-radial nature. Nonetheless, this characteristic makes the model challenging to solve. To tackle this issue, Wang and Wang (2022) proposed a modification for the traditional Russell algorithm and developed a DEA model network based on the improved algorithm.

Traditionally, the DEA output distance function applies the same improvement ratio to all the output items, whereas the ERM assigns distinct improvement ratios to each input-output item. Pastor et al. (1999) extended the Russell measure model by constructing the ERM. Lin and Lu (2024) introduced a new chance-constrained NDEA model that integrates the modified DDF and the ERM. This study examines the randomness of the data and combines the strengths of both the ERM and the DDF. Additionally, it considers inefficiency from a non-oriented perspective, simultaneously incorporating the direction vector and each input and output. The model enables the use of non-radial efficiency measures for each input and output across two production stages.

Lin and Lu (2024) presented a stochastic NDEA model to measure the efficiency of firms. In the first and second stages, each firm has m imputs, ko additional outputs, k intermediates, ki additional inputs and p outputs.

This study utilises the input term in the first stage to generate the output term of the intermediary and the additional output term . In the second stage, this study employs the input term of the intermediary and to produce the final output term. This study arranges the data sets into matrices $X = (x_j)$, $WO = (wo_j)$, $W = (w_j)$, $WI = (wi_j)$ and $Y = (y_j)$ and defines the production possibility set of the non-radial two-stage NDEA as follows:

$$PPS = Max\{(x, wo, w, wi, y)x \geq X\lambda, wo \leq WO\lambda, w \leq W\lambda, w \geq W\mu, wi \geq WI\mu, y \leq Y\mu, \lambda, \mu \geq 0\} \quad (1)$$

Where λ and μ are the semipositive vector in . The non-oriented non-radial NDEA model evaluates the efficiency of the observed DMU_d ($d = 1, \ldots, n$) based on the matrices (*X, WO, W, WI, Y*), with the assumptions of the variable returns-to-scale technology, as follows:

$$Max \sum_{i=1}^{m} \alpha_{id} + \sum_{v=1}^{ko} \pi_{vd} + \sum_{f=1}^{ki} \gamma_{fd} + \sum_{r=1}^{p} \beta_{rd}$$

Subject to

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{id} - \alpha_{id} g_{idx}, \; i = 1, \ldots, m,$$

$$\sum_{j=1}^{n} \lambda_j wo_{vj} \geq wo_{vd} + \pi_{vd} g_{vdwo}; \; v = 1, \ldots, ko,$$

$$\sum_{j=1}^{n} \lambda_j w_{hj} \geq w_{hd}; h = 1, \ldots, k,$$

$$\sum_{j=1}^{n} \mu_j w_{hj} \leq w_{hd}; h = 1, \ldots, k,$$

$$\sum_{j=1}^{n} \mu_j wi_{fj} \leq wi_{fd} - \gamma_{fd} g_{fdwi}; f = 1, \ldots, ki,$$

$$\sum_{j=1}^{n} \mu_j y_{rj} \geq y_{rd} + \beta_{rd} g_{rdy}; r = 1, \ldots, p,$$

$$\sum_{j=1}^{n} \lambda_j = 1;$$

$$\sum_{j=1}^{n} \mu_j = 1;$$

$$\lambda_j, \mu_j, \alpha_{id}, \pi_{vd}, \gamma_{fd}, \beta_{rd} \geq 0. \quad (2)$$

To evaluate the DDF, this study further defines the direction vector as $g = (g_x = x, g_{wo} = wo, g_w = w, g_{wi} = wi, g_y = y)$.

This study accounts for the "subject to" in the optimum solution for Equation (2).

$$\left\{\lambda_j^*,\ \mu_j^*, j=1,...,n;\ \alpha_{id}^*, i=1,...,m;\ \pi_{vd}^*,\ v=1,...,ko; \gamma_{fd}^*, f=1,...,ki; \beta_{rd}^*,\right.$$
$$\left. r=1,...,p\ \right\}$$

Technical efficiency in the first stage ($TE01$) and the second stage ($TE02$) is defined as:

$$TE01 = \frac{1}{2}\left[\sum_{i=1}^{m}\left(1-\alpha_{id}^*\right)\Big/ m + \sum_{v=1}^{ko}\left[1\Big/\left(1+\pi_{vd}^*\right)\right]\Big/ ko\right]$$

and

$$TE02 = \frac{1}{2}\left[\sum_{f=1}^{ki}\left(1-\gamma_{fd}^*\right)\Big/ ki + \sum_{r=1}^{p}\left[1\Big/\left(1+\beta_{rd}^*\right)\right]\Big/ p\right],$$

respectively, with values ranging from 0 to 1.

$\sum_{i=1}^{m}\frac{1-\alpha_{id}^*}{m}$ is the input-oriented efficiency obtained by averaging the specific input efficiency of the observed DMU_d in the first stage, and $\sum_{v=1}^{ko}\left[1/\left(1+\pi_{vd}^*\right)\right]/ ko$ is the output-oriented efficiency obtained by averaging the specific additional output efficiency of the observed DMU_d in the first stage. $\sum_{f=1}^{ki}\frac{1-\gamma_{fd}^*}{ki}$ is the input-oriented efficiency obtained by averaging the specific additional input efficiency of the observed DMU_d in the second stage, and $\sum_{r=1}^{p}\left[\frac{1}{1+\beta_{rd}^*}\right]/ p$ is the output-oriented efficiency obtained by averaging the specific output efficiency of the observed DMU_d in the second stage.

Variables Measurements

Dependent variable: Efficiency measurement

This study utilises the NDEA combining with ERM and DDF to measure firm efficiency. In the first stage, the input variables are the number of employees, operating expenses, total energy use and fixed assets, and the output variable is

sales revenue. In addition, the undesirable output of total carbon emissions is considered to measure the SE of each GTH company. In the second stage, sales revenue is the input variable, and market value and net profit are the output variables in the assessment of the ME of each GTH company. The input and output variables are listed in Table 2.

Table 2
Definition of input/intermediate/output DEA indicators

Variable name	Unit	Measurement	References
First-stage inputs			
Number of employees	Persons	Number of full-time and part-time employees disclosed in company's financial statements (excluding temporary employees)	Karadayi and Ekinci (2019); Lu, Hamori, et al. (2022)
Operating expenses	USD	Operating expenses related to company's operations	Hsieh et al. (2021); Zhang et al. (2021)
Total energy usage	Kilotons	Total direct and indirect energy consumption in company	Mardani et al. (2017); Sueyoshi and Yuan (2018)
Fixed assets	USD	Net value of tangible assets, such as property, plant, and equipment, after deduction of accumulated depreciation	Kweh et al. (2022); Lee and Pai (2011)
First-stage undesirable output			
CO_2 emissions Tons CO_2e		Greenhouse gas emissions measured in CO_2 equivalent (CO_2e)	Halkos et al. (2016); Hsieh et al. (2021)
First-stage output/Second stage input			
Sales revenue	USD	Net total sales and other operating income after deduction of sales discounts and returns	Hou et al. (2019); Hsieh et al. (2021)
Second-stage output			
Market value	USD	Total market value of company's circulating stocks at end of year	Lu, Kweh, et al. (2022); Yang and Okada (2019)
Net profit	USD	Company's total income from products and services after deduction of all operating costs or expenses	Liao (2023); Wang et al. (2018)

Data source: Datastream database

Table 3 presents the descriptive statistics of the input and output variables to determine the efficiency of the GTH firms. As shown in Table 3, the three major GTH sub-sectors exhibit significant differences in their human resources and resource inputs, as well as in their output results. Among them, the aviation industry has the highest average number of employees, that is, 48,287, followed by the hotel industry, with 44,831 employees, and the tourism industry, with the lowest average number of employees of only 30,949. In addition, compared with the hotel and tourism industries, the aviation industry has the highest average carbon emissions (14,311,330 tons of CO_2e) and average energy consumption (257,175,431 kilotons), thereby indicating that the aviation industry must increase its efforts in sustainable energy conservation and carbon emissions reduction.

Table 3
Descriptive statistics of input and output variables

Variables	Mean	Min.	Max.	S. D.	Normality test	Sample firms
Sub 1: Travel industry						
First-stage inputs						
Number of employees	30,949	827	104,000	27,902	$p < 0.01$	70
Operating expenses	4,266,854	524,066	17,546,000	3,328,096	$p < 0.01$	70
Total energy use	11,835,992	110,726	138,281,441	29,788,813	$p < 0.01$	70
Fixed assets	9,459,973	568,749	39,443,000	11,056,190	$p < 0.01$	70
Undesirable output						
CO_2 emissions	1,280,059	9,030	10,769,826	2,432,799	$p < 0.01$	70
First-stage output/second-stage input						
Sales revenue	4,514,770	812,594	20,825,000	3,938,108	$p < 0.01$	70
Second-stage outputs						
Market value	15,424,609	1,519,297	47,653,660	12,661,640	$p < 0.01$	70
Net profit	–57,312	–10,236,000	4,947,746	2,284,873	$p < 0.01$	70
Sub 2: Aviation industry						
First stage inputs						
Number of employees	48,287	3,310	138,353	35,928	$p < 0.01$	130

(*Continued on next page*)

Table 3 (*Continued*)

Variables	Mean	Min.	Max.	S. D.	Normality test	Sample firms
Operating expenses	14,225,174	1,029,086	42,062,000	10,775,235	$p < 0.01$	130
Total energy use	257,175,431	6,469	1,923,688,698	270,663,798	$p < 0.01$	130
Fixed assets	16,526,695	759,760	43,732,000	11,449,263	$p < 0.01$	130
Undesirable output						
CO_2 emissions	14,311,330	590,901	41,439,616	10,072,611	$p < 0.01$	130
First-stage output/Second-stage input						
Sales revenue	14,196,770	607,033	47,007,000	11,631,493	$p < 0.01$	130
Second-stage output						
Market value	9,684,529	243,853	39,603,087	8,555,408	$p < 0.01$	130
Net profit	–348,911	–12,385,000	4,767,000	2,552,891	$p < 0.01$	130
Sub 3: Hotel industry						
First-stage inputs						
Number of employees	44,831	28	223,370	58,100	$p < 0.01$	95
Operating expenses	3,589,790	380,716	21,536,682	4,295,420	$p < 0.01$	95
Total energy use	12,510,092	296,140	111,533,108	22,812,265	$p < 0.01$	95
Fixed assets	5,038,079	120,000	25,928,298	5,619,401	$p < 0.01$	95
Undesirable output						
CO_2 emissions	1,156,492	8,315	7,919,844	1,879,043	$p < 0.01$	95
First-stage output/Second-stage input						
Sales revenue	4,116,241	335,968	22,444,036	4,903,800	$p < 0.01$	95
Second-stage outputs						
Market value	16,242,356	101	98,526,906	21,810,338	$p < 0.01$	95
Net profit	324,439	–3,690,847	4,865,000	1,177,201	$p < 0.01$	95

Notes: Unit for number of employees is people; unit for total energy use is kilotons; unit for CO2 emissions is tons of CO2e; other variables are in USD.

The correlation analysis of the input and output variables is detailed in Table 4. The results show that the first- and second-stage input and output variables exhibit significant positive correlations, thereby indicating the presence of isotonicity, which means that an increase in the input units will not lead to a decrease in the outputs, thereby allowing the variables to be included in the DEA model (Roll et al., 1989). Furthermore, according to the effectiveness of the DEA proposed by previous scholars, the number of firms (DMUs) should be at least twice the sum of the input items and output items, that is, the number of DMUs > 2 × (number of input items + number of intermediate items + number of output items). This study involves four input items, two intermediate items, and two output items, with 295 > 2 × (4 + 2 + 2) = 16 meeting the requirements (Roll et al., 1989). The normality test indicates that the p-value of all the variables is less than 0.01. At the 5% significance level, they all exhibit nonnormality, thereby making them suitable for the model used in this study.

Table 4
Correlation analysis of input and output variables

First-stage correlation coefficients of input and output variables						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Number of employees (1)	1					
Operating expenses (2)	0.5053***	1				
Total energy use (3)	0.2365***	0.5449***	1			
Fixed assets (4)	0.4209***	0.7274***	0.3766***	1		
Sales revenue (5)	0.4915***	0.9767***	0.5363***	0.6636***	1	
CO_2 emissions (6)	0.4884***	0.9189***	0.5979***	0.7139***	0.9117***	1
Second-stage correlation coefficients of input and output variables						
Variable	(5)	(7)	(8)			
Sales revenue (5)	1					
Market value (7)	0.2502***	1				
Net profit (8)	0.2479***	0.2572***	1			

Note: *** indicates significance at 1% level.

Independent variable: ESG measurement

The ESG data used in this study are sourced from the Refinitiv Eikon database, which provides ESG scores on a scale from 0 to 100. These indicators are grouped into three main dimensions: the Environmental Pillar Score (EPS), which covers aspects such as resource use, carbon emissions and innovation; the Social Pillar Score (SPS), which reflects considerations related to employee welfare, human

rights, community engagement and product responsibility; and the Governance Pillar Score (GPS), which addresses issues pertaining to corporate governance, shareholder rights and CSR practices. The definition of the ESG indicator variables is shown in Table 5.

Table 5
Measurements of three ESG dimensions

Dimension	Indicator	Measurement	References
EPS	Resource use	Measures company's performance and ability to reduce use of materials, energy or water resources	Boffo and Patalano (2020); Bruna et al. (2022); Danisman and Tarazi (2024); Dobrick et al. (2023)
	Carbon emissions	Measures company's commitment to and efficiency in reducing carbon emissions during production and operations	
	Innovation	Reflects company's creation of new market opportunities through environment-friendly technologies, processes or products that can reduce environmental costs for customers	
SPS	Workforce	Company's provision of healthy and safe working environment, diversity, equal opportunities and development opportunities for employees	Boffo and Patalano (2020); Bruna et al. (2022); Danisman and Tarazi (2024); Dobrick et al. (2023)
	Human rights	Measures company's adherence to fundamental human rights conventions	
	Community relations	Measures company's commitment to protecting public health, respecting business ethics and maintaining good community relations	
	Product responsibility	Reflects company's ability to provide high-quality goods and services while considering customer health and safety integrity	
GPS	Management capability	Measures company's commitment to and performance in adhering to best corporate governance practices	Boffo and Patalano (2020); Bruna et al. (2022); Danisman and Tarazi (2024); Dobrick et al. (2023)
	Shareholder rights	Measures company's performance in treating shareholders equitably and anti-takeover mechanisms	
	Social responsibility strategy	Company's communication and implementation of ESG aspects in its daily decision-making process	

Source: Datastream Refinitiv ESG scoring methodology

Moderating variable: Business strategy

In this study, business strategy (BS) serves as a moderating variable to examine its influence on the relationship between ESG practices and firm efficiency. The measurement of BS follows the approach proposed by Bentley et al. (2013), which has been widely validated in empirical research for capturing firm-level strategic orientation based on observable financial indicators. Five financial indicators are used to reflect different aspects of a firm's strategic behaviour: Employee-to-sales ratio (EMP5), revenue growth rate (REV5), selling, general and administrative (SG&A) expenses to sales ratio (SGA5), capital intensity (CAP5) and employee number volatility (SIGEMP5). Each indicator is calculated using a five-year moving average to reduce short-term fluctuations and better represent a firm's consistent strategic posture. For each company-year observation, these indicators are ranked into quintiles, assigning a score of 5 to the highest group and 1 to the lowest. The scores across all five indicators are then summed to generate a composite BS score, ranging from 5 to 25. A higher score reflects a more aggressive, prospector-like strategy, while a lower score indicates a more conservative, defender-like strategy.

Although Dalwai and Salehi (2021) used six financial ratios and assigns strategy types based on a broader score range (1 to 30), this study follows Bentley et al. (2013) approach due to its strong theoretical foundation in Miles et al. (1978)'s typology and methodological strengths. It uses five well-established financial indicators, offering a parsimonious and replicable measure while minimising multicollinearity. The five-year moving average enhances reliability in longitudinal analysis (Landi et al., 2022), and the continuous BS score allows greater flexibility for examining moderating effects in regression models. The definition of the BS variables is provided in Table 6.

Table 6
Measurement of moderating variables

Variables	Unit	Measurement
Strategy score	Score	Discrete indicator consisting of sum of ranking scores of five indicators, ranging from 5 to 25
Employee-to-sales ratio (EMP5)	%	Ratio of number of employees to sales computed over rolling prior five-year average

(*Continued on next page*)

Table 6 (*Continued*)

Variables	Unit	Measurement
Revenue growth rate (REV5)	%	One-year percentage change in total sales computed over rolling prior five-year average
SG&A-to-sales ratio (SGA5)	%	Ratio of SG&A expenses to sales computed over rolling prior five-year average
Capital intensity (CAP5)	%	Measured as net PPE scaled by total assets computed over rolling prior five-year average
Employee number volatility (SIGEMP5)	Number	Standard deviation of number of employees computed over rolling prior five-year average

Control variables measurement

In addition, this study uses leverage, cash ratio, and market-to-book value (MB) ratio as the control variables to identify the factors that may influence the performance of the travel firms. The definition of the control variables is presented in Table 7.

Table 7
Measurement of control variables

Variable	Unit	Measurement	References
Leverage	%	Ratio of company's total debt to its total assets	Buallay et al. (2022); Nourani et al. (2022)
Cash ratio	%	Ratio of company's cash to its total liabilities	Anh and Gan (2023); Erdem and Yel (2023);
MB ratio	Times	Product of company's outstanding shares at end of period and end-of-period price divided by book value of common stock	Wu et al. (2020); Zhu (2000)

Truncated regression

This study aims to further explore the impact of ESG practices on the efficiency of the GTH firms by conducting regression analysis. Owing to the upper or lower limits of the efficiency values obtained via DEA, tobit regression is commonly conducted to analyse the impact of external environmental factors on efficiency

(Lu, Kweh, et al. (2022)). However, the method assumes a parametric normal distribution for the efficiency error distribution of the DMUs when the DEA is inherently nonparametric in nature. Moreover, when the parametric form of the likelihood function is incorrectly specified, the tobit estimates will be inconsistent (Simar & Wilson, 2007). To overcome such limitations, Simar and Wilson (2007) used the bootstrap method to compare the truncated regression and tobit regression methods and showed that truncated regression outperforms tobit regression. Therefore, this study adopts the truncated regression method proposed by Simar and Wilson (2007) and the equation models are presented, as follows. Models 1 and 3 examine the main effects of ESG initiatives on firm efficiency, while Models 2 and 4 assess the moderating role of BS in the relationship between ESG practices and firm efficiency.

Model 1: Sustainability efficiency

$$SE_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 SPS_{it} + \beta_3 GPS_{it} + \beta_4 Leverage_{it} + \beta_5 Cash_{it} + \beta_6 MB_{it} + \varepsilon_{it}$$

Model 2: Sustainability efficiency

$$SE_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 SPS_{it} + \beta_3 GPS_{it} + \beta_4 BS_{it} + \beta_5 EPS_{it} \times BS_{it} + \beta_6 SPS_{it} \times BS_{it} + \beta_7 GPS_{it} \times BS_{it} + \beta_8 Leverage_{it} + \beta_9 Cash_{it} + \beta_{10} MB_{it} + \varepsilon_{it}$$

Model 3: Marketability efficiency

$$ME_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 SPS_{it} + \beta_3 GPS_{it} + \beta_4 Leverage_{it} + \beta_5 Cash_{it} + \beta_6 MB_{it} + \varepsilon_{it}$$

Model 4: Marketability efficiency

$$ME_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 SPS_{it} + \beta_3 GPS_{it} + \beta_4 BS_{it} + \beta_5 EPS_{it} \times BS_{it} + \beta_6 SPS_{it} \times BS_{it} + \beta_7 GPS_{it} \times BS_{it} + \beta_8 Leverage_{it} + \beta_9 Cash_{it} + \beta_{10} MB_{it} + \varepsilon_{it}$$

where β_0 is a constant term; β_n, where n = 1 to 10, represents the coefficients of the independent, moderating or control variables; i represents a firm; t represents the year; and ε_{it} is an error term. Moreover, SE is the sustainability efficiency (first-stage efficiency); ME is the marketability efficiency (second-stage efficiency); EPS, SPS and GPS represent the three ESG dimensions; BS is the business strategy; Leverage represents the firm's debt ratio; Cash is the firm's size; and MB is the firm's market to book value ratio.

RESULTS AND FINDINGS

ESG Performance of Global Tourism and Hospitality Industry

ESG scores of observed period

Table 8 presents the annual average ESG scores across the three ESG pillars, along with the five-year average for each aspect, based on the full sample of firms from 2017 to 2021. Overall, the ESG practices of the sample firms, covering the environmental, social and governance pillars exhibit a slight upward trend over the five-year period.

From EPS perspective, resource use has the highest score (mean = 71.20). The scores of the travel firms in the dimension demonstrate stable growth over the years. Specifically, the carbon emissions item improves from 72.69 in 2017 to 81.55 in 2021 (an increase of 12.19%), and the resource use item increases from 65.58 in 2017 to 76.67 in 2021 (an increase of 16.91%), thereby reflecting the active efforts of the travel firms in recent years in addressing sustainability issues by reducing their carbon emissions and using resources efficiently. The innovation item also shows a slight increase of around 6.69% (from 25.85 in 2017 to 27.58 in 2021), which may be related to the firms meeting social expectations and ever-growing customer demands.

Regarding the SPS, workforce has the highest average score (mean = 76.63), which reflects the GTH firms' enthusiasm for service and effective interaction with customers and recognition of their service attitude, dedication, seriousness and responsibility. Moreover, the human rights item demonstrates the most significant progress, whose score increases by 28.00% (from 49.84 in 2017 to 63.79 in 2021). The substantial increase in the human rights score may be influenced by the enhancement of international human rights standards and simultaneously reflect the considerable attention paid by GTH firms to their employees' well-being and stakeholders' rights. Meanwhile, the product responsibility item shows minimal progress, with an increase of only 4.09% (from 52.99 in 2017 to 55.16 in 2021). Community relations have a steady improvement from 63.32 in 2017 to 71.74 in 2021. Moreover, the product responsibility score declines slightly in 2021 compared with that in 2020, possibly owing to the decrease in customer data security and the quality of services related to product responsibility during the pandemic, with the rise of remote work. The ESG practices show a slight continuous growth trend over the five-year research period, which indicates that the GTH firms have focused increasingly on their role in society and in the international community and seeking opportunities for social participation.

Moreover, the five-year average for GPS is 64.54. The most significant improvement is observed in the social responsibility strategy, which increases by 27.41% (from 54.44 in 2017 to 69.36 in 2021). The improvement of the governance pillar's score may be driven by the promotion of corporate governance practices and the requirements of relevant regulations, which can encourage GTH firms to enhance their internal management, transparency and organisational structure.

Table 8
ESG scores of 59 firms in travel industry from 2017 to 2021

Indicator	2017	2018	2019	2020	2021	Average
EPS						
Resource use	65.58	67.75	71.54	74.45	76.67	71.20
Carbon emissions	72.69	73.70	77.23	77.86	81.55	76.61
Innovation 25.85 25.00 23.91				23.86	27.58	25.24
SPS						
Workforce	73.58	75.81	78.23	77.21	78.33	76.63
Human rights	49.84	56.41	60.38	62.20	63.79	58.52
Community relations	63.32	66.37	68.53	72.26	71.74	68.44
Product responsibility	52.99	54.03	54.76	57.39	55.16	54.86
GPS						
Management	61.85	65.18	68.33	67.93	69.43	66.54
Shareholder rights	56.68	55.19	56.27	58.33	65.09	58.31
Social responsibility strategy	54.44	59.51	67.52	68.83	69.36	63.93

ESG scores of tourism and hospitality industry by subsectors

This study examines 59 GTH firms categorised into three subsectors based on the Global Industry Classification Standard: 14 in the travel industry, 26 in the aviation industry and 19 in the hotel industry. Table 9 presents the ESG practices of subsectors by calculating the five-year average values.

For the EPS, the travel industry scored the highest at 68.76, followed closely by aviation at 68.32, while the hotel industry recorded the lowest at 67.17. When looking at specific environmental aspects, carbon emissions scores were the highest among all, with aviation leading at 77.28. In terms of resource use, travel again ranked the highest (73.41), showing better management of natural resources. The hotel industry showed relatively lower scores in both resource use (70.45) and carbon emissions (76.79) compared to the other two.

For the SPS, travel had the top score (67.76), followed by aviation (66.95), while the hotel sector lagged behind at 62.94. Despite this, all three sectors performed quite well in the workforce category, with travel scoring 79.19, aviation 77.10 and hotels 75.65. Under the GPS, aviation slightly outperformed the other subsectors with 66.19, while travel and hotels followed at 65.57 and 62.14, respectively. Notably, the aviation sector stood out in terms of shareholder rights (62.07) and social responsibility strategy (66.47), indicating stronger governance practices.

Overall, the travel industry shows stronger performance in environmental and social aspects, aviation leads in governance and the hotel sector may need more improvement across all three pillars.

Table 9
ESG scores of tourism and hospitality

Indicator	Sub 1: Travel industry	Sub 2: Aviation industry	Sub 3: Hotel industry
EPS	68.76	68.32	67.17
Resource use	73.41	71.87	70.45
Carbon emissions	76.85	77.28	76.79
Innovation	24.10	24.35	28.36
SPS	67.76	66.95	62.94
Workforce	79.19	77.10	75.65
Human rights	59.44	58.64	59.78
Community relations	68.32	69.42	67.57
Product responsibility	61.31	58.13	47.19
GPS	65.57	66.19	62.14
Management	69.24	67.40	64.14
Shareholder rights	56.60	62.07	54.24
Social responsibility strategy	60.71	66.47	63.95

Performance Analysis of Tourism and Hospitality Industry

This section evaluates the SE and ME of the global travel firms from 2017 to 2021. This study finds that the SE and ME of the sample firms fluctuate during the study period. First, this study conducts a difference test to understand whether differences exist in the observed values between the three groups of sample firms. The test involves the use of two common methods: Analysis of variance, which assumes that the variables follow a normal distribution, and the Kruskal-Wallis test (K-W test), which assumes that the variables do not follow a normal distribution.

The variables in this study are non-normally distributed; thus, this study uses the K-W test to conduct a grouping difference test on the variables.

Table 10 shows the test results. Regarding the individual SE and ME values, the efficiency values of the different subsectors, namely, the travel industry, aviation industry and hotel industry, show significant differences at the 1% level ($p = 0.000$). Within a single industry, the SE and ME values also show significant differences. For instance, the SE and ME values of the travel industry are significant at the 90% confidence level ($p = 0.0823$). According to the results of the SE analysis in Table 10, the overall SE of the GTH industry from 2017 to 2021 categorised by subsectors show that the hotel industry has the highest SE (SE = 0.534), followed by the travel industry (SE = 0.487) and the aviation industry, with the lowest SE (SE = 0.304). In the ME evaluation, the hotel industry demonstrates the best overall ME (ME = 0.433), whereas the aviation industry exhibits the lowest ME (ME = 0.185).

When businesses engage in sustainability activities, they incur additional costs, which will reduce their profitability and lead to a decline in their ME. However, the empirical results of this study indicate that the hotel industry demonstrates superior ME and relatively high SE. By contrast, the SE and ME of the aviation industry lag behind those of the two other sectors of the GTH industry. The findings suggest that when resources are allocated to sustainability activities, the travel industry may improve its operational processes and adopt energy-efficient equipment to gain increased consumer recognition, enhance its efficiency, and improve its corporate image, which may lead to improved ME.

Table 10
Sustainability efficiency and marketability efficiency of subsectors in global tourism and hospitality industry (2017–2021)

Sector	SE	ME	
Sub 1: Travel industry	0.487	0.401	$p = 0.0823$*
Sub 2: Aviation industry	0.304	0.185	$p = 0.000$***
Sub 3: Hotel industry	0.534	0.433	$p = 0.030$**
K-W Test (p-value)	$p = 0.000$***	$p = 0.000$***	

Note: ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Regression Analysis

Table 11 presents the truncated regression results of the analysis of the impact of the three ESG practices and the moderating effect of BS on firm efficiency of the GTH industry. The result of Model 1 shows that only the GPS has a statistically

significant positive effect on sustainability efficiency ($\beta = 0.066$, $p < 0.01$). This suggests that good governance practices play a crucial role in driving sustainable efficiency in the GTH industry. In contrast, while environmental and social practices are important, their effects might take longer to materialise or may not be directly linked to operational efficiency in the short term (Kweh et al., 2024).

This study further investigates how BS moderates the relationship between ESG practices and SE in the GTH industry. As shown in Model 2 of Table 11, two significant interaction effects are observed. First, the interaction EPS and BS shows a significant negative relationship with SE ($\beta = –0.655$, $p < 0.05$). This suggests that when firms adopt aggressive business strategies, the positive impact of environmental practices on sustainability efficiency may be reduced. Similarly, the interaction between GPS and BS is also significantly negative ($\beta = –0.719$, $p < 0.1$). This indicates that the effectiveness of governance practices in enhancing sustainability efficiency may depend on how well they align with the firm's chosen strategy.

Table 11
Truncated regression analysis on ESG practices, business strategy and sustainability efficiency

Variables	Model 1	Model 2
Independent variables		
EPS	–0.043	0.409
SPS	–0.202	–0.413**
GPS	0.066***	0.566
Moderator		
BS		0.600**
Interaction terms		
EPS × BS		–0.655**
SPS × BS		0.403
GPS × BS		–0.719*
Control variables		
Leverage	–0.291***	–0.257***
Cash ratio	–0.025	–0.009
MB ratio	0.035	0.041
F Model	4.861	3.676
R^2	0.113***	0.156**
Adjusted R^2	0.094***	0.125**

Note: *** and ** indicate significance at 1% and 5%, respectively.

Table 12 presents the effect of ESG practices, BS to ME in the global travel industry. The results of Model 3 indicate that EPS has a significant positive impact on ME ($\beta = 0.307, p < 0.01$). This suggests that firms with stronger environmental initiatives tend to achieve higher levels of market efficiency and the result is consistent with Shaikh (2022). This finding implies that environmental responsibility is not only a sustainability concern but also a strategic asset. Firms that effectively manage resource use, reduce carbon emissions and invest in environmental innovation are likely viewed more favourably by investors and stakeholders (Xu et al., 2023).

Model 4 of Table 12 explores the moderating effect of BS on the relationship between ESG practices and ME in the GTH industry. The results reveal that the interaction between SPS and BS is positively significant ($\beta = 1.031$, $p < 0.05$), indicating that BS strengthens the positive relationship between social practices and ME. Likewise, the interaction between GPS and BS also shows a significant positive effect on ME ($\beta = 0.192, p < 0.01$). These findings suggest that BS plays an important moderating role, particularly in enhancing the impact of social and governance-related ESG efforts on market performance (Chang et al., 2025).

Table 12
Truncated regression analysis on ESG practices, business strategy and marketability efficiency

Variables	Model 3	Model 4
Independent variables		
EPS	0.307***	0.739***
SPS	–0.248	0.180
GPS	0.042	0.941***
Moderator		
BS		0.030***
Interaction terms		
EPS × BS		–0.611
SPS × BS		1.031**
GPS × BS		0.192***
Control variables		
Leverage	–0.156**	0.158**
Cash ratio	0.127**	0.145**
MB ratio	–0.002	–0.007
F Model	6.866	2.608
R^2	0.142***	0.192**
Adjusted R^2	0.124***	0.163**

Note: *** and ** indicate significance at 1% and 5%, respectively.

CONCLUSION

Discussion of Findings

The GTH industry plays a pivotal role in society, and its impact can extend beyond the economic sphere to cultural, social and environmental dimensions. The industry faces numerous challenges in terms of its sustainable development owing to climate change, such as rising sea levels, extreme weather events and changes in ecosystems. In addition, operational processes within the industry contribute to carbon emissions, and consumers have become increasingly concerned about the sustainability of firms. Thus, the global travel industry should not overlook the continuous promotion of sustainable practices.

This study selects and analyses the three largest sectors of the GTH industry, namely, the travel sector, aviation sector and hotel sector. The empirical results show that among the three subsectors of the global travel industry, the hotel sector demonstrates the highest sustainability efficiency and marketability efficiency, whereas the aviation sector exhibits the lowest sustainability efficiency and marketability efficiency. This implies the aviation industry consumes a large amount of energy for transportation and was severely affected by the pandemic, which may have led to its relatively poor efficiency. This empirical result differs from the traditional stereotype that firms' investment in sustainability activities will increase related costs, reduce their profitability and lead to a decline in their marketability efficiency. Instead, the result implies that though sustainability activities in the GTH industry may increase certain costs, they can also save on other expenses by improving operational processes and replacing equipment with energy-efficient alternatives. In addition, such activities may enable firms to gain consumer recognition and thus enhance their profitability and image.

Moreover, the result shows that only governance practices bring significant positive impact to sustainability efficiency. This explains that governance practices such as transparent decision-making, effective risk management, strong internal controls and accountability to stakeholders improve efficiency (Kweh et al., 2024). Good governance framework helps firms allocate resources more wisely, reduce inefficiencies and better integrate sustainability goals into corporate strategy (Küfeoğlu, 2024). However, environmental and social practices are not the antecedents of sustainability efficiency. This implies that environmental initiatives such as reducing emissions or improving resource use often require substantial upfront investments (Huang et al., 2024). Similarly, social practices like community engagement or promoting workforce diversity, while valuable, may not immediately translate into measurable improvements in firm-level efficiency (Chang et al., 2025).

In contrast, environmental initiatives significantly improve marketability efficiency. Firms that effectively manage resource use, reduce carbon emissions and invest in environmental innovation are likely to be viewed more favourably by investors and stakeholders (Xu et al., 2023). These actions can enhance a firm's reputation, strengthen stakeholder trust and provide better access to capital, all of which contribute to higher marketability efficiency.

The findings reveal that firms adopting a more aggressive business strategy may place less emphasis on environmental and governance-related sustainability controls. This suggests that when firms pursue aggressive strategies, the positive impact of environmental practices on sustainability efficiency may be diminished. Aggressive strategies often prioritise short-term growth or cost-cutting measures, which can conflict with the long-term investments needed for effective environmental initiatives (Didonet et al., 2020). In other words, business strategy plays a significant moderating role and, in some cases, may even weaken the positive effects of ESG practices, particularly in the environmental and governance domains on sustainability efficiency. However, an aggressive approach appears to enhance the impact of social and governance-related ESG initiatives on market efficiency. When GTH firms adopt a proactive or aggressive business strategy, such as one centered on innovation, customer engagement or sustainability-driven branding (Chang et al., 2025), it can strengthen the positive effects of social initiatives on how efficiently the market perceives and values the firm. Aligning social and governance practices with a well-defined, forward-looking business strategy helps firms gain more favourable recognition from investors and the market, thereby improving their marketability efficiency (Chang et al., 2025).

Research Implications

This study provides the significant implications. From theoretical perspectives, this study extends the ESG–performance literature by highlighting the differentiated impacts of ESG practices on sustainability and market efficiency within the GTH industry. The study enriches RBV and stakeholder theories by showing that firms that strategically leverage ESG initiatives can convert intangible sustainability assets into measurable efficiency gains. The evidence supports the view that strategic ESG integration is key to maximising firm value and improving stakeholder relationships. The study also contributes to the theoretical understanding of the moderating role of BS in the ESG-efficiency nexus. The significant interaction effects observed between BS and both SPS and GPS on market efficiency underscore that ESG efforts do not operate in isolation, their

effectiveness depends on the strategic orientation of the firm. This highlights the importance of integrating ESG practices within the broader framework of corporate strategy to achieve tangible efficiency outcomes.

With respect to practical implications, the findings offer several important implications for various stakeholders in the GTH industry. For policymakers and government agencies, it is suggested that ESG reporting standards should be tailored to encourage not just disclosure but also strategic alignment of ESG with business goals. The evidence that ESG practices, particularly in governance and environmental areas enhances firm efficiency and market response reinforces the importance of creating policy frameworks that promote ESG maturity across the sector.

For business leaders and managers, the results underscore the importance of embedding ESG practices into their core business strategies rather than treating them as standalone initiatives. Firms with aggressive, sustainability-driven strategies can magnify the positive effects of their social and governance efforts on market efficiency. Managers should align workforce welfare, governance transparency and stakeholder engagement practices with broader firm goals to drive sustainable competitive advantage.

For investors, they are encouraged to evaluate not only a firm's ESG scores but also how well these initiatives are integrated with the firm's strategic direction. The results suggest that firms with high social and governance scores, coupled with strong business strategies, are more likely to perform efficiently in the market. Thus, ESG should be assessed as both a risk mitigation tool and a signal of strategic foresight and value creation.

Limitations and Future Studies

This study has some limitations that should be acknowledged. First, this study focuses only on three sectors of the GTH industry, namely travel, aviation and hotels without including other important sectors such as cruise lines, car rentals or alternative accommodations. This limited scope may restrict the generalisability of the findings to the broader travel ecosystem. Future research should expand the sectoral coverage by incorporating additional segments of the travel industry to provide a more comprehensive understanding of ESG practices and firm performance across the entire tourism value chain.

Second, the analysis is conducted within a specific time frame, which may not fully reflect long-term trends or industry evolution, especially considering the rapid shifts brought by global events like the COVID-19 pandemic or environmental crises. Future studies are encouraged to adopt longitudinal designs over extended periods to capture long-term effects and dynamic changes in the relationship between ESG practices, business strategies and firm performance.

Third, the study does not differentiate between geographical regions, potentially overlooking the influence of local regulations, cultural factors and regional environmental challenges on firms' sustainability initiatives and market efficiency. Future research should incorporate a regional or country-level analysis to explore how different regulatory environments, cultural attitudes and socio-economic contexts shape ESG effectiveness and business outcomes.

Fourth, the study identifies associations between ESG practices and firm efficiency but does not establish causal relationships, leaving room for potential external or unobserved factors to influence the results. Future research should apply advanced causal inference methods, such as difference-in-differences or propensity score matching, to better isolate the causal impact of ESG initiatives on sustainability and market efficiency.

AVAILABILITY OF DATA AND MATERIALS

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

COMPETING INTERESTS

The authors declare that they have no competing interests.

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