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Impact of sustainability on financial distress in the air transport industry: the moderating effect of Asia–Pacific

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Abstract

The tremendous impact of the coronavirus pandemic on the global aviation industry has led to many cases of airline financial distress and bankruptcy. The Asia–Pacific region (APAC) contains more than half of the world's population, and its airlines had the highest profit margin of any region. In this study, we investigate whether corporate sustainability practice can reduce the financial distress risk of air carriers, and, if so, what would the effect be in APAC? We first examine the relationship between environmental, social, and governance disclosure and the likelihood of financial distress of airlines as measured by the Altman Z″-score. Second, we analyze the moderating role of being an APAC airline in this relationship. The findings support the claim that implementing environmental actions may increase financial distress risk, and by improving social and governance activities, airlines can mitigate the risk of financial distress. The negative influence of the environmental pillar and the positive influence of the social pillar can be smaller for APAC airlines. Our study provides empirical evidence of the influence of environmental, social, and governance (ESG) on the likelihood of financial distress in the airline industry. Moreover, we analyze the moderating role of being an APAC airline in the relationship between sustainability and financial distress. This study has significant implications for executives, managers, and policymakers in the aviation industry on ESG strategy decisions and the general issue of sustainability.

Keywords: Altman Z-score, Airline industry, Environmental, social, and governance (ESG) score, Corporate social responsibility (CSR), Financial distress, Sustainability

Introduction

Over the past 50 years, financial distress prediction has become a topic of increasing interest to researchers worldwide. It is an effective approach for detecting risk and is of great importance for policymakers, managers, and investors. It has been widely applied in both academic and industrial fields (Tang et al. 2020). Being financially distressed can be costly. In the extreme case of falling into bankruptcy, it has been estimated that financial distress cost can range from 9.5% to 16.5% of a firm's value—after accounting for an additional 28% loss of value, as little as 56% of a firm's value can remain for claim holders (Branch 2002). Financial distress also leads to incurring indirect costs

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such as deterioration in the relationship with stakeholders and being at a disadvantage when competing for market share (Opler and Titman 1994; Beijer and Pålsson 2021). By receiving early-warning messages from a financial distress prediction approach, executives and managers can take precautionary measures and mitigate losses (Kou et al. 2021a).

Financial distress prediction can be particularly important during difficult periods such as the ongoing coronavirus (COVID-19) pandemic (Kou et al. 2021b). Because of its vulnerability to external factors, the air transport industry has been significantly disrupted and suffered massive losses (Agrawal 2020; Pongpirul et al. 2020; Bock et al. 2020; Carrillo-Hidalgo et al. 2023). According to an International Air Transport Association (IATA) report, the industry had a net loss of $118 billion in 2020, and revenue passenger kilometers declined by 66.3% from 2019 (IATA 2020). From the onset of the pandemic to October 2020, over 40 airlines went into bankruptcy (Abigail 2020) and more airlines are struggling to survive.

Corporate sustainability and corporate responsibility are two terms frequently used to express sustainability in the corporate world. The concept of corporate responsibility has economic, social, and environmental dimensions and lies within the domain of corporate sustainability. After the 2008 Global Financial Crisis, it has been demonstrated that governance is systemically important, and it has been added to corporate responsibility, leading to the emergence of the concept of ESG (Beijer and Pålsson 2021). In recent years, ESG disclosure has become increasingly important for institutional investors to make investment decisions. In the airline industry, sustainability is a useful strategic focus for airlines and airports (Stevenson and Martinseva 2019) as it can provide stakeholders with a transparent and disclosed assessment. There are four notable areas for disclosure to the airline industry's shareholders—greenhouse gas emissions, labor practices, competitive behavior, and accident and safety management. There is growing importance for sustainable reporting by airlines, requiring them to improve their environmental and social image (Yowell 2021).

Some scholars have argued that firms with a higher level of sustainability are likely to have lower downside risk, are more solid, and find it easier to recover during turbulent times (Broadstock et al. 2021; Hoepner et al. 2019; Hussain et al. 2021). It is argued that effective corporate governance management can help to reduce or even prevent the worst aspects of a crisis (Ferrero-Ferrero et al. 2013). Good corporate governance, such as high managerial ownership, market power, and independent boards, leads to a more transparent decision-making process. A better-governed firm can have lower downside risk through fewer negative shocks, lower capital cost, and lower default risk (Wang et al. 2015). Evidence reveals that during the 2008–2009 Global Financial Crisis, firms in the U.S. that had higher ESG scores had higher financial performance than other firms (Lins et al. 2017; Cornett et al. 2016). It is suggested that a win–win situation can be achieved when a firm engages in sustainable activities as it can enhance its market position and obtain better long-term profits (Beijer and Pålsson 2021). Corporate sustainability activities improve a firm's competitive strength by creating opportunities to gain profits and enhance the differentiation of a company from its competitors (Miles and Covin 2000). Thus, firms with good sustainability practices are more likely to survive in turbulent situations (Mecaj and Bravo 2014). Airlines face challenges regarding

sustainability because of their environmental impact, and higher carbon emissions imply higher tail risks (Ilhan et al. 2020). To position themselves for the future, it is crucial for the long-term business strategy of firms to include sustainable initiatives (Karaman and Akman 2018; Song et al. 2018; Kou et al. 2022).

Although the literature has investigated the relationship between corporate sustainability and firm performance in some depth, no consensus has been reached, so researchers are encouraged to further explore this relationship. Very few studies (Al-Hadi et al. 2017; Harymawan et al. 2021; Beijer and Pålsson 2021; Kaur 2021) have focused on the relationship between sustainability and corporate financial distress. This is especially true for the aviation sector, and therefore, we contribute to the literature by providing new insight into the relationship between sustainability and corporate financial distress in this sector. Some authors have indicated that the lack of a positive sustainability orientation can have serious consequences, such as loss of reputation, political and media pressure, potential fines, penalties, and even customer boycott (Al-Hadi et al. 2017). The probability of falling into financial distress can be decreased by increasing positive corporate sustainability activities (Al-Hadi et al. 2017; Cooper and Uzun 2018; Chollet and Sandwidi 2018).

The passenger airline business has been tremendously affected by the COVID-19 pandemic. According to the report released by the IATA in 2021, international passenger traffic markets are below the 2019 levels due to the travel restrictions in 2021. Asia–Pacific stands out for maintaining the highest international travel stringency and has the weakest industry-wide revenue (passenger/kilometers) compared with the rest of the world (IATA 2021). This leads to considerable concern about the Asia–Pacific airline industry. As we seek to analyze the influence of ESG performance on the financial distress of airlines, we aim to answer the following two research questions: "What is the impact of an ESG score on the likelihood of financial distress in the airline industry?" and "In this relationship, is there any moderating role of being an APAC airline?" The objective of this study is thus twofold. First, applying Altman's approach, we seek to examine the influence of ESG disclosure scores on the likelihood of financial distress of airlines. Second, we aim to explore the moderating role of APAC airlines in the relationship between sustainability and financial distress risk, which is novel in this research field. For both objectives, we contribute to the literature by providing empirical evidence regarding the influence of ESG on financial distress in the airline industry. Furthermore, to the best of our knowledge, this is the first study to consider APAC as a moderator in the relationship between ESG and financial distress in the airline industry.

The rest of this paper is organized as follows. First, "Literature review and hypothesis development" section reviews relevant literature, and research hypotheses are presented. The methodology is introduced in "Methodology" section with sample data, variables used, and the proposed model. "Empirical results and discussions" section provides the results of the empirical analysis and discussion. Finally, sections "Conclusions and implications" and "Limitations and future research" present the conclusions, implications, and limitations.

Literature review and hypothesis development

Financial distress in the airline industry

Some studies define financial distress as a condition that a firm falls into when it lacks liquidity and meets its financial obligations with difficulty (Lee et al. 2011; Wu et al. 2008; Baldwin and Mason 1983; Mahtani and Garg 2018). The first signals of a financially distressed firm are violations of debt covenants along with reduced or no dividends (Almeida and Philippon 2007). Financial distress and ultimately bankruptcy have a great negative impact on stakeholders (e.g., debtholders, customers, suppliers, and employees). Therefore, it is essential for a company to predict and avoid financial distress (Kou et al. 2014).

Much literature has used the Altman Z-score as the measurement of financial distress risk when analyzing the relationship between a firm's financial risk and sustainability (Kristanti and Herwany 2017; Kaur 2021; Beijer and Pålsson 2021; Harymawan et al. 2021; Al-Hadi et al. 2017; Boubaker et al. 2020; Cooper and Uzun 2019; Chan et al. 2017). The Z-score was introduced by Altman in 1968 to predict the likelihood of bankruptcy (Altman 1968). It is a pioneering model that uses a multivariate discriminant analysis (MDA) approach, and the original model was claimed to be able to correctly predict the bankruptcy of 95% of public manufacturing firms one year prior to failure. Later, Altman presented a Z′-score model in which he replaced market value with the book value of equity to make the model suitable for privately traded companies. Additionally, he provided a modified Z′-score model, named Z″-score, in which he excluded the sales/total assets ratio, claiming that this model, can be used to predict bankruptcy for firms in the service sector. He applied the Z″-score model to 31 European companies and three non-European companies, and the model had very satisfactory performance in an international context (Altman et al. 2017).

The Altman Z-score model has been widely applied in the air transportation industry (Gritta 1982; Gritta et al. 2011; Scaggs and Crawford 1986; Golaszewski and Saunders 1992; Stepanyan 2014; Kolte et al. 2018). Gritta (1982) applied the Z-score model to U.S. air carriers and stated that it can reflect different situations of airlines in different stages of the economic cycle. The application of the Z-score in the airline industry is not limited to U.S. airlines; it has been recommended to Indian banks, shareholders, and financial institutions as an effective tool for predicting financial distress (Kolte et al. 2018). More recently, Agrawal (2020) found declining Z-scores when estimating the influence of the COVID-19 pandemic on the Indian aviation sector, and he assumed this to be a consequence of the lockdown policies of governments and the sharp fall in passenger demand. In the present study, we adopted the modified Altman Z″-score model due to its specific application to the service sector. Moreover, it has been widely applied as a proxy for the risk of financial distress in the aviation industry (Kiraci 2019; Davalos et al 1999; Kroeze 2004).

Corporate sustainability and financial distress

Several theories of corporate sustainability are discussed in the literature, and the most important three are the stakeholder, legitimacy, and resource-based theories. First, the stakeholder theory considers that a business should consider every stakeholder that may be affected in achieving its objectives (Freeman and Reed 1983; Beijer and Pålsson 2021;

Rivera et al. 2017). This theory proposes that when a firm meets the demand of its stakeholders, organizational sustainability can be achieved (Abdi et al. 2022). However, some questions arise from this perspective. Although this theory may identify possible ethical problems, its effectiveness is questionable. In addition, the problem of balancing conflicting interests should be addressed (Orts and Strudler 2009). For example, if a firm benefits its customers by minimizing the prices of its products, lower profits might be provided to shareholders, although both actors are stakeholders.

Second, the legitimacy theory was interpreted by Thomas and Lamm (2012) as "the perception that organizational (strategic, structural, or procedural) changes that are proposed or implemented by organizational leaders are desirable, proper, or appropriate within some socially constructed system of norms, values, or beliefs." The theory suggests that economic issues should be considered within a political, social, and institutional framework because society, politics, and economics are inseparable (Deegan 2002). Being legitimate is important for an organization because it can improve both the comprehensibility and stability of organizational activities and therefore lead to better long-term survival. This is due to other bodies being more willing to supply resources to organizations that seem desirable, proper, or appropriate (Suchman 1995).

Third, the resource-based theory focuses on the resources necessary to achieve competitive advantages. Resources are understood to be any asset that a firm utilizes to meet its goals or obtain the best performance in its critical success factors (Barrutia and Echebarria 2015). This theory emphasizes the crucial importance of resources for the survival, growth, and overall effectiveness of an organization and those managers should identify, invest in, and protect such resources. In the context of corporate sustainability, disclosure is believed to bring competitive advantages to firms (Abdi et al. 2020).

As a dimension of corporate sustainability, ESG has been a popular research topic (Beijer and Pålsson 2021; De Lucia et al. 2020; Folqué et al. 2021). From the beginning of the 1970s, many but inconclusive studies have examined whether ESG is positively or negatively related to a firm's performance. In particular, Friede et al. (2015) analyzed more than 2,100 company-focused empirical studies to examine the relationship between ESG reporting and corporate firm performance. The majority of these studies suggested that ESG reporting is positively related to financial performance. However, there are opponents to this view who argue that investment in corporate sustainability is costly (Becchetti et al. 2008) and that to achieve ESG commitment, a firm usually needs to sacrifice financial resources (Harymawan et al. 2021). Additionally, some findings demonstrated that the benefits of ESG reporting may not be truly achieved in all cases (Revelli and Viviani 2015) and that there are firms that either may not obtain any payoff from investing in ESG (Harymawan et al. 2021) or may obtain a payoff that is less than its costs (Friedman 1970). The findings vary between a positive, negative, or no relationship between corporate sustainability and firm performance (Abdi et al. 2022), and there is no conclusive result (Kaur 2021). The use of varying data sources and the consideration of moderation and mediation variables may explain the mixed results obtained by previous literature (Wang and Sarkis 2017; Orlitzky et al. 2003).

While a large body of literature has analyzed the impact of ESG reporting on corporate financial performance, some authors have sought to investigate whether a firm's financial condition affects its ESG reporting. Campbell (2007) proposed a theory that

a firm in a weak financial state is less likely to implement corporate social responsibility (CSR) investment. This is not due to any lack of will but rather to a lack of sufficient capital (Harymawan et al. 2021). A financially distressed firm is likely to be forced to implement a low-cost strategy, and the fear of losing resources reduces its willingness to achieve better sustainability performance. Conversely, other authors have proposed that firms with high sustainability enjoy lower downside risk and are stronger during turbulent times (Broadstock et al. 2021; Hoepner et al. 2019). By using ESG investment to enhance product differentiation and offer product portfolio diversification, firms can reduce systematic risk exposure. On the one hand, Chang et al. (2013) obtained consistent results that good ESG performance can provide insurance-like protection and enhance operational management quality, productivity, efficiency, and effectiveness in firms during a global crisis, and this in turn decreases the likelihood of financial distress. On the other hand, some authors have indicated that investment in ESG damages a firm's value (Friedman 1970). Obtaining a socially responsible reputation may require massive resources that could have been allocated to other investment projects, resulting in reduced competitiveness (Tristiarini et al 2017; Kaur 2021) and a higher risk of financial distress.

ESG in the airline industry

The airline industry is regarded as a challenging sector for implementing sustainability because of its environmental impacts and contribution to global climate change. In 2019, global flight activities released around 915 million tons of carbon dioxide into the atmosphere, representing about 2% of human carbon emissions (Abdi et al. 2020). Environmentally sustainable initiatives for airlines include actions such as upgrading to environmentally friendly aircraft and offsetting emission footprints (Amankwah-Amoah 2020; Rotaris et al. 2020). The International Civil Aviation Organization (ICAO) proposed that a sustainable aviation system "should be affordable, should operate safely, securely, efficiently, and should offer choices of air service while supporting a competitive economy and balanced regional development" (ICAO 2013; Stevenson and Marintseva 2019).

Emerging literature focuses on sustainability issues in the airline industry (Stevenson and Martinseva 2019; Yowell 2021; Hagmann et al. 2015; Chen et al. 2022). Stevenson and Martinseva (2019) conducted a review of CSR assessment and reporting techniques in the airline industry, finding that "*CSR can be a useful strategic focus for airlines and airports, subject to the creation of transparent, disclosed assessment methodologies that allow a comparative analysis for all interested stakeholders.*" CSR reporting practice was also analyzed by Yowell (2021), who highlighted the industry's four most notable areas for disclosure to their shareholders—greenhouse gas emissions, labor practices, competitive behavior, and accident and safety management. She highlighted the growing importance of CSR reporting by airlines. To help them improve their environmental and social image, airlines should continuously provide stakeholders with additional information in these four notable areas. The influence of an airline's green image is also reflected in passenger choice—passengers are willing to pay extra for an airline they perceive to be environmentally friendly (Hagmann et al. 2015).

Previous authors have examined the relationship between corporate sustainability practice and corporate financial distress. Sustainability is found to be a risk-reduction tool (Beijer and Pålsson 2021). Firms with a higher sustainability level are found to have a lower financial distress risk (Boubaker et al. 2020) and a lower possibility of going bankrupt (Cooper and Uzun 2019). In turbulent times such as the COVID-19 pandemic, firms with higher ESG portfolios generally outperform low-ESG portfolio firms, which indicate that corporate sustainability practice mitigates financial distress risk during a financial crisis (Broadstock et al. 2021). In the airline industry, improving the environmental and governance pillar scores will have a positive impact on airlines' market-to-book ratio (Abdi et al. 2022), which implies a lower financial distress risk, according to Fama and French (1995). As we found that there is little literature that examines the relationship between corporate sustainability and financial distress in the airline industry, we sought to fill this gap through this study.

APAC airlines and ESG

In addition to the general increasing concern with airlines' sustainability implementation, studies have sought to examine APAC airlines because of their particular characteristics. The APAC region includes more than half of the world's population, and its airlines have higher profit margins than others (Lee et al. 2018). Some authors have compared APAC airlines' sustainability performance with that of European airlines and have found that APAC airlines have poor CSR performance on the Dow Jones Sustainability Indices (Chang et al. 2013). This is assumed to be because the concept of CSR was initially proposed in Western countries and APAC countries are just starting to adopt this practice. For example, consistent with this argument, Broadstock et al. (2021) also noted that ESG investment in China is still at an early stage of maturity. In developed markets, institutional investors have a great influence on ESG investment practices, but there are relatively fewer institutional investors in China, and the demand for ESG products remains low. Therefore, Chinese investors are just beginning to consider ESG. Arjomandi and Seufert (2014) evaluated the technical and environmental performance of major airlines worldwide and concluded that airlines in China and North Asia are the most technically efficient, but airlines in Europe have the best environmental performance. The finding of Harymawan et al. (2021) that Indonesian nonfinancial listed firms with a low quality of ESG disclosure are likely to have financial distress raises the question of whether ESG disclosure by APAC airlines might have an impact on financial distress. Specifically, it is worth investigating whether APAC airlines can use ESG disclosure to mitigate the risk of financial distress.

On reviewing relevant literature, there is no conclusive result on the type of relationship that exists between corporate sustainability and the likelihood of financial distress. Some authors have confirmed that firms with higher CSR have lower financial distress risk (Boubaker et al. 2020) and that ESG improves the accuracy of the financial distress prediction model (Citterio and King 2023), while Beijer and Pålsson (2021) indicated that only the environmental and social factors contribute to the risk of financial distress. Therefore, in this study, we contribute to the inconclusive literature by examining the relationship between ESG performance and the financial distress of airlines. Additionally, previous relevant studies have mainly analyzed cross-regional worldwide airlines (Kuo et al. 2021; Abdi et al. 2022; Yang and Baasandorj 2017). Some authors

concentrated on airlines' sustainability in specific regions such as Europe (Coles et al. 2013) and the U.S. (Lee et al. 2013; Seo et al. 2015). However, we hardly found any empirical evidence of ESG impact on airlines' financial distress risk, particularly studies that shed light on the role of APAC regions. Therefore, this study takes the first initiative to investigate the moderating role of being an APAC airline in the relationship between ESG and the likelihood of financial distress, and the following hypotheses are proposed:

H1 Corporate environmental, social, and governance (ESG) pillar scores have a negative impact on the likelihood of financial distress in airlines.

H2 Being an APAC airline moderates the effect of ESG on the likelihood of financial distress.

Methodology

Data

We extracted accounting and ESG data for international passenger airlines from 2011 to 2021 from the Thomson Reuters Eikon database for testing and analysis. This database provides the most comprehensive historical data and ESG information for 5,000 globally listed companies. The Thomson Reuters ESG pillar score aims at transparently and objectively assessing a company's sustainability performance based on reported company data (Abdi et al. 2020).

Regarding the sample selection, we followed the same procedure as that of Abdi et al. (2020 and 2022), Migdadi (2018), and Kim and Son (2021) to include a sample of global airlines with available information randomly. First, the airline needed to have the requisite accounting and financial data for calculating the Altman Z″-score (as well as for the other ratios used in this study). The Altman Z″-score model was chosen because it is commonly applied to companies in the service sector such as airlines (Kiraci 2019; Davalos et al 1999; Kroeze 2004). Second, the airline also had to have ESG data for the same time frame as the accounting data. We used 253 observations for the analysis of 23 airlines. Among the sampled airlines, six were from Europe, six from North and South America, and 11 from the APAC region. The dataset formed a balanced panel with 23 sampled worldwide airlines (see Appendix 2).

Variable and model specification

Dependent variable

The Altman Z-score has been adopted by previous studies as a measurement of financial distress risk in analyzing the relationship between ESG disclosure and financial distress (Kaur 2021; Beijer and Pålsson 2021). Kaur (2021) used the Z-score as a proxy for financial distress risk when evaluating the impact of financial distress on the ESG performance of UK firms. The Altman Z-score (Altman 1968) is a five-factor MDA model that is claimed to be able to correctly predict the bankruptcy of 95% of public manufacturing firms one year prior to failure (and 72% two years prior). In 2017, he applied a reestimated four-variable model called the Z″-score model that excluded the sales/total assets

ratio, claiming that it can predict bankruptcy for private and public manufacturing and nonmanufacturing firms. As our dataset includes worldwide airlines, we adopted the Z''-score model because it was stated by Altman et al. (2017) that it has very good performance, especially in an international context. As our dataset includes airlines from different continents, we chose the Altman Z''-score for the service sector as a dependent variable in our study (Kiraci 2019; Davalos et al. 1999; Kroeze 2004).

Altman himself used an MDA to construct this model, and the modified Altman Z''-score for the service sector uses the coefficients and variables of the following equation:

6.56 (Working capital/Total Assets) + 3.26 (Retained earnings/Total Assets) + 6.72 (Earnings Before Interest and Taxation/Total Assets) + 1.05 (Book Value of Equity/Book Value of Total Liabilities), and a constant coefficient of 3.25 for firms in emerging markets.

According to the zone of discrimination established by Altman, a Z''-score higher than 2.6 indicates a low possibility of going bankrupt, and lower than 1.1 indicates a high possibility. When used as a proxy for financial risk, it is considered that a firm with a low Z''-score is less financially healthy.

Main variable

The ESG pillar score offered by the Thomson Reuter Eikon database was used in this study to measure the sustainability performance of airlines. The scoring process involved more than 450 measurements of corporate sustainability performance with score values ranging from 0 to 100, where the higher the score a company obtains, the better its performance (EIKON 2017). These measurements reflect CSR aspects such as emissions, environmental product innovation, human rights, employment quality, training and development, community, and shareholders (Duque-Grisales and Aguilera-Caracuel 2019). They are classified into three subgroups—"environmental," "social," and "governance" pillars. The environmental pillar concerns a firm's environmental responsibility. It reflects how well a firm adopts the best policies and investments to avoid environmental risk and capitalize on environmental opportunities (Abdi et al. 2022), including an evaluation of resource use, emissions reductions, and innovation. The social pillar reveals a firm's commitment to the community, relating to aspects such as health, safety, workplace diversity, training and labor rights, employee and customer satisfaction, and the percentage of female employees. Finally, the governance pillar refers to the use of good corporate governance practices (Kuo et al. 2021) to ensure that corporate decisions made by its members and board executives are in the best long-term interests of its shareholders. The governance pillar score indicates a firm's strengths and weaknesses regarding management, such as board functions and structures, and CSR strategy.

Control variable

We used four control variables—leverage, liquidity, profitability, and size. These variables are from the literature that has analyzed the relationship between sustainability and financial distress (Al-Hadi et al. 2017; Harymawan et al. 2021; Beijer and Pålsson 2021; Kaur 2021). Leverage, as measured by total liabilities to total assets, is adopted as a measurement of a firm's capital structure. According to the trade-off theory, on the one

Table 1 Summary of variables and measurement

Variable category	Variable name	Abbreviation	Measurement
Dependent variable	Altman Z″-score	Z	6.56 (Working capital/Total Assets) + 3.26 (Retained earnings/Total Assets) + 6.72 (Earnings Before Interest and Taxation/Total Assets) + 1.05 (Book Value of Equity/Book Value of Total Liabilities), and a constant coefficient of 3.25 for the firms that belong to emerging markets
Main variables	Environmental pillar score	ENV	Thomson Reuters score for environmental disclosure
	Social pillar score	SOC	Thomson Reuters score for social disclosure
	Governance pillar score	GOV	Thomson Reuters score for governance disclosure
Control variables	Leverage	LEV	Total liabilities to Total assets
	Liquidity	LIQ	Current Assets to Current Liabilities
	Profitability	PROF	Net income/Operating revenues
	Firm size	SIZE	Total assets
Moderating role	Asian-pacific airlines	AS	Dummy variable, where being Asian-pacific airlines = 1 and non-Asian-pacific airlines = 0

Table 2 Diagnostic test result

Effects test	Statistic	Prob	Result
LM test	7.72	0.003	Random > Pooled
F test	3.59	0.000	Fixed > Pooled
Hausman	31.44	0.012	Fixed > Random

hand, increasing leverage can bring financial benefit to a firm because firms can reduce income tax through the tax advantages of interest expenses. On the other hand, increasing leverage can result in financial distress costs. In the airline industry, the extreme importance of fixed assets leads to a capital-intensive structure. As a tool for examining a firm's ability to pay off current debt obligations, liquidity has commonly been introduced in model constructions. It has been considered in previous studies that analyzed the airline industry's financial risk (Lee and Hooy 2012; Lee and Jang 2007; Kiraci 2019). Profitability is one of the commonly used metrics for analyzing a firm's ability to generate profits and assets. It is often assumed to have a positive influence on a firm's financial stability. Regarding firm size, there is no unanimity as to whether firm size has a positive or negative impact on the financial status of an airline (Seo et al. 2015). Operating efficiency is more accessible for larger airlines than for smaller ones (Bers and Springer 1997). However, larger airlines are also more likely to suffer from operating inefficiency caused by complexity or organizational structure (Canback et al. 2006). The previously mentioned variables and the corresponding measurements are presented in Table 1.

Model specification

The present study carried out panel data analysis (Baum 2006; Torres-Reyna 2010), while pooled regression, the fixed effect model, and the random effect model are commonly used. To choose a suitable model, we first conducted an LM test, and the p-value is 0.000,

suggesting that the random effect is more suitable than pooled regression (see Table 2). Next, the F-test results indicate that the fixed effect is better than pooled regression. Finally, the Hausman test is employed, and the result indicates that the fixed effect is better than the random effect model. Therefore, we adopted the two-way fixed effect model for the main analysis. In this model, we considered the time-varying and cross-sectional effects. Through the Hausman test, we first considered the individual effect that does not change with time. Second, because a global pandemic occurred during the study period, almost all industries were affected. Therefore, we also considered the time effect, which does not change individually. On this basis, we incorporated a time dummy variable and then used the F-test to examine the joint significance of the time dummy variable. The p-value obtained was very low, supporting the time fixed effect. Therefore, a two-way fixed effect model is adopted in this study.

The models employed are as follows:

$$\text{Model 1: } Z_{it} = \beta_0 + \beta_1 ENV_{it} + \beta_2 SOC_{it} + \beta_3 GOV_{it} + \beta_4 LEV_{it} + \beta_5 LIQ_{it} + \beta_6 PROF_{it} + \beta_7 SIZE_{it} + \varepsilon_{it}.$$

$$\text{Model 2: } Z_{it} = \beta_0 + \beta_1 ENV_{it} + \beta_2 SOC_{it} + \beta_3 GOV_{it} + \beta_4 LEV_{it} + \beta_5 LIQ_{it} + \beta_6 PROF_{it} + \beta_7 SIZE_{it} + \beta_8 ENV^*AS_{it} + \beta_9 SOC^*AS_{it} + \beta_{10} GOV^*AS_{it} + \varepsilon_{it}.$$

where Z represents the degree of financial distress, measured by the modified Z''-score for service sectors (Altman et al. 2017); ENV represents the environmental pillar score; SOC represents the social pillar score; GOV represents the governance pillar score; LEV represents the leverage ratio (measured by debt ratio=total liabilities to total assets); LIQ represents the liquidity ratio, measured by current assets divided by current liabilities; PROF represents net operating margin, measured by net income divided by operating revenues; SIZE represents firm size, measured by the total assets of the last year available; and AS is the APAC moderating role, i.e., a dummy variable that takes the value of 1 if it is an Asian-Pacific airline and 0 otherwise. In both model specifications, all the explanatory variables are lagged by one year. In this study, we used the statistical computing software Stata to conduct panel data analysis.

Empirical results and discussions

Descriptive statistics

The results of the descriptive statistics are presented in Table 3. The mean Z''-score of the sampled airlines is 0.118, with a range of -11.663–3.956 and a standard deviation

Table 3 Summary statistics

Variables	N	Mean	Sd	Min	Max
Z	253	0.118	1.929	− 11.663	3.956
ENV	253	54.210	22.278	3.364	88.538
SOC	253	57.378	18.175	13.266	93.801
GOV	253	54.801	24.703	5.852	96.069
LEV	253	0.810	0.236	0.415	2.462
PROF	253	− 0.043	0.373	− 2.959	2.555
LIQ	253	0.811	0.374	0.065	2.436
SIZE (total assets, million euros)	253	20,800	15,257	2,467	72,459

Table 4 Correlation matrix

	Z	ENV	SOC	GOV	LEV	PROF	LIQ	SIZE
Z	1							
ENV	− 0.308*	1						
	0.000							
SOC	− 0.248*	0.798*	1					
	0.000	0.000						
GOV	− 0.152*	0.298*	0.198*	1				
	0.0213	0.000	0.003					
LEV	− 0.742*	0.216*	0.215*	0.0546	1			
	0.000	0.001	0.001	0.410				
PROF	0.4255*	− 0.121	− 0.1400*	− 0.0489	− 0.4010*	1		
	0.000	0.067	0.034	0.460	0.000			
LIQ	0.5738*	− 0.3199*	− 0.2897*	− 0.102	− 0.3847*	0.0957	1	
	0.000	0.000	0.000	0.124	0.000	0.148		
SIZE	0.0283	0.5019*	0.4003*	0.1693*	− 0.0868	0.0372	− 0.2450*	1
	0.670	0	0	0.010	0.190	0.575	0.000	

$*p < 0.1$; $**p < 0.05$; $***p < 0.01$

of 1.929. According to the interval established by Altman (2017), a Z''-score in the range of 1.1–2.6 is a "grey zone," implying a moderate risk of bankruptcy. However, our relatively low Z''-score of 0.118 is consistent with the literature (Scagg and Crawford 1986; Golaszewski and Saunders 1992; Chung and Szenberg 2012; Stepanyan 2014) that found that airlines can operate with low Z''-scores. All the ENV, SOC, and GOV scores are measured on a scale of 0–100. In our dataset, all their mean values are above 50, with the SOC score (57.378) having the highest mean value, followed by the GOV (54.801) and ENV (54.210) scores. This is inconsistent with the results obtained by Beijer and Pålsson (2021), whose sample contained ESG data of several industries in different regions and revealed that average firms received a higher score on the governance pillar. Profitability has a negative mean of − 0.043, indicating that, on average, the sampled airlines have negative net income caused by low revenue that is not enough to cover their costs. The mean value of liquidity is 0.811, which is less than 1, implying that the sampled airlines may face the risk of being unable to meet their short-term obligations.

Table 4 presents Pearson's correlation analysis for the variables of this study. ENV (r = − 0. 308), SOC (r = − 0.248), and GOV (r = − 0.152) all negatively correlate with the Z''-score. There is a high correlation between ENV and SOC (r = − 0.798). Our study also provides variance inflation factor (VIF) values and tolerance to examine the possibility of multicollinearity (see Table 5). The VIF values are less than the problematic level of 10 (Chatterjee and Hadi 2013; Lee and Jang 2007; Kaur 2021; O'brien 2007). The tolerance values are more than 0.1. The determinant (Det) of the correlation matrix is higher than 0.1, indicating no severe multicollinearity in this analysis.

Empirical results

In Table 6, the results of the main effects of the model revealed that ENV is statistically significant at the 1% level with a coefficient of − 0.019, demonstrating that a unit change in ENV leads to a − 0.019 change in the likelihood of financial distress measured by Z''-score. Thus, a unit increase in the environmental pillar score leads to a − 0.019 unit

Table 5 Variance inflation factor

Variable	Vif	Tolerance
ENV	3.330	0.301
SOC	2.790	0.358
GOV	1.100	0.906
LEV	1.500	0.665
LIQ	1.320	0.756
PROF	1.210	0.829
SIZE	1.470	0.680
Mean VIF		1.820
Det		0.139

decrease in the financial distress score of the sampled airlines. A higher Z''-score implies less financial risk, which means that higher ENV increases the risk of financial distress of sampled airlines. SOC and GOV have a positive and statistically significant relationship with the Z''-score, which means that SOC and GOV are negatively related to financial distress. This result supports H1.

Table 6 Summary of the regression estimate

	(1) Model 1: Main effect panel	(2) Model 2: With interactions
ENV_{t-1}	− 0.019* [0.010]	− 0.021** [0.009]
SOC_{t-1}	0.018** [0.008]	0.029*** [0.010]
GOV_{t-1}	0.010* [0.005]	0.010** [0.005]
ENV_{t-1}*AS		0.403** [0.202]
SOC_{t-1}*AS		− 0.483*** [0.182]
GOV_{t-1}*AS		0.020 [0.129]
$SIZE_{t-1}$	0.922* [0.547]	1.112** [0.527]
LEV_{t-1}	− 2.164* [1.153]	− 1.611 [1.271]
LIQ_{t-1}	0.998*** [0.323]	1.028*** [0.336]
$PROF_{t-1}$	1.672*** [0.619]	1.771*** [0.596]
_cons	− 21.151 [13.233]	− 26.601** [12.956]
r2_within	0.366	0.395
F	4.970	4.742
N	230.000	230.000

Standard errors are in brackets

*p < 0.1; **p < 0.05; ***p < 0.01

Table 7 Normality test result

	2011–2019		2020–2021		Result
	Z value	P value	Z value	P value	
Residuals	3.283	0.00051	2.969	0.00149	Not normally distributed

Table 8 Mann–Whitney U test result

	Obs	Rank sum	Expected
2012–2019	184	20,591	21,252
2020–2021	46	5974	5313
Combined	230	26,565	26,565
Z value	− 1.638		
P value	0.1015		

Model 2 aggregates the interaction terms ENVxAS, SOCxAS, and GOVxAS to determine the moderating role of being an APAC airline in the relationship between sustainability initiatives and the risk of financial distress. The results of ENV in Model 2 are consistent with those of Model 1 in that a negative relationship is found with the Z"-score at the 5% level. SOC is still positive and significant, but the coefficient is more positive than that in Model 1 (from $\beta = 0.018$ to $\beta = 0.029$). GOV is positively and significantly related to financial distress risk at the 5% level with a slightly greater estimated coefficient (from $\beta = 0.00994$ to $\beta = 0.01007$). ENVxAS and SOCxAS are significantly related to the Z"-score, with a coefficient of 0.403 and − 0.483, respectively. This implies that ENV and SOC influence the likelihood of financial distress in APAC airlines, supporting H2. The negative influence of ENV on the Z"-score is lower in the case of APAC airlines, and the positive influence of SOC on the Z"-score is also lower in the case of APAC airlines. GOVxAS has a positive relationship with the Z"-score and is statistically insignificant.

Robustness test

Considering the impact of COVID-19 on the 2020 and 2021 data, we performed a structural break analysis of the dataset to examine the possible bias. Due to the issue of non-normality of our sample (see Table 7), the Mann–Whitney U test (Mann and Whitney 1947) was adopted to detect if there is any significant difference in our model before and after 2020.

The null hypothesis is that the two populations are equal, and a p-value of 0.1015 cannot reject H_0, indicating no significant influence of structural difference on the estimation of models (see Table 8). This may be due to COVID-19 emerging in December 2019, so only two years' data (2020 and 2021) are affected and the impact is not yet reflected in the results.

Endogeneity test

Endogeneity often refers to a correlation between an explanatory variable and an error term. To further verify whether the core explanatory variables are endogenous, this study

Table 9 GMM regression estimation

	1 ENV	2 SOC	3 GOV
ENV_{t-1}	− 0.021*** [0.006]	− 0.015*** [0.005]	− 0.020*** [0.004]
SOC_{t-1}	0.015** [0.007]	0.008 [0.007]	0.015*** [0.005]
GOV_{t-1}	− 0.003 [0.003]	− 0.003 [0.003]	− 0.004 [0.003]
$SIZE_{t-1}$	0.364*** [0.099]	0.366*** [0.101]	0.362*** [0.100]
LEV_{t-1}	− 5.062*** [0.650]	− 5.031*** [0.656]	− 5.063*** [0.645]
LIQ_{t-1}	2.006*** [0.218]	2.007*** [0.219]	2.006*** [0.218]
$PROF_{t-1}$	1.19 [0.763]	1.179 [0.754]	1.195 [0.758]
_cons	− 5.726** [2.535]	− 5.602** [2.561]	− 5.640** [2.551]
Chi-square value for exogeneity test	0.017	1.417	0.566
P value for exogeneity test	0.896	0.234	0.452
Conclusion	Accept the null hypothesis of exogeneity	Accept the null hypothesis of exogeneity	Accept the null hypothesis of exogeneity
r2	0.751	0.749	0.751
N	207	207	207

Standard errors are in brackets

*p < 0.1; **p < 0.05; ***p < 0.01

used the lagged one period of the three explanatory variables as instrumental variables for the generalized method of moments (GMM) regression estimation, i.e., endogeneity testing (see Table 9). Through three regression tests, we found that the core explanatory variables are all exogenous, and no severe endogeneity problem was detected.

Discussion

We first investigated the impact of ESG pillar scores on the likelihood of financial distress measured by the Z''-score, and the result supports H1. Then, we examined the moderating effect of being an Asian-Pacific airline in this relationship and found that H2 is partially supported. As the ESG data were lagged for a year, it suggests that sustainability actions of the previous year can have an impact on the risk of financial distress in the present year (Beijer and Pålsson 2021). The finding of a significant relationship between the environmental pillar and financial distress risk is consistent with the finding of Beijer and Pålsson (2021), but we found that environmental activities increase financial distress risk. This result implies that implementing initiatives to reduce environmental risk, such as reductions in emissions or resource use, increases the likelihood of financial distress. Some authors have found a weak (although negative) correlation between the environmental pillar and firm risk because, to obtain a more environmentally friendly image, airlines need to make great efforts. Environmental commitments may require expensive and long-term investment, such as waste disposal, emissions treatment, and remediation costs (Chollet and Sandwidi 2018; Orlitzky and Benjamin 2001). Possibly, the costs

incurred in gaining an environmentally friendly reputation may not be recovered as it was found that passengers are willing to pay extra for a green image, but they are more willing to pay extra for amenities (Hagmann et al. 2015).

The finding of a significant and positive relationship between the social pillar and the Altman Z″-score is consistent with that of Beijer and Pålsson (2021) but is inconsistent with the finding of Dumitrescu et al. (2019) that the social pillar increases financial distress risk. The negative relationship between social performance and financial risk that we found supports the hypothesis that the capacity to obtain trust and loyalty within an airline's workforce, customer base, and society in general has positive impacts on reducing financial distress. It has been suggested by some authors that social actions can contribute to creating shareholder value over the long-term and thus have an effect on reducing corporate financial distress risk.

The finding of a significant and negative relationship between the governance pillar and financial distress risk is consistent with the finding of Dumitrescu et al. (2019) but inconsistent with that of Beijer and Pålsson (2021), who did not find any significant relationship between the governance pillar and financial distress risk. The difference in their findings might be explained by their use of a dataset including various industries, while ours considered only the airline industry. Some corporate governance aspects, such as board independence, board size, and female directorship, are claimed to enhance ESG voluntary disclosure (Lagasio and Cucari 2019; Mukherjee and Sen 2022). Board composition and CEO/board chair structure were found to be important in corporate bankruptcy. For example, separating the positions of CEO and board chairperson and structuring the board with a majority of independent directors have been recommended to reduce the possibility of a CEO and inside directors behaving self-servingly or detrimentally to a firm's owners. Such governance structures would allow the board to better exercise its control function and consequently reduce financial risk. Conversely, with an inappropriate governance structure (e.g., lacking a separate board structure or having an insider-dominated board), a firm would face an excessive risk of crises or bankruptcy (Daily and Dalton 1994).

We found that being an APAC airline moderated the relationship between environmental and social disclosure and the likelihood of financial distress. The moderating effect of being an Asia–Pacific airline in the relationship between governance and the likelihood of financial distress was found to be not significant. This study provides a new perspective on an Asia–Pacific airline's sustainability. Environmental performance was found to be negatively related to the financial distress of Australian firms by Jia and Li (2022), who suggested that investing in environmental practice is economically meaningful. By improving environmental performance, a firm could obtain valuable intangible assets, leading to competitive advantages and profitability, which can mitigate financial distress risk (Malik 2015). However, social performance is found to be positively related to the financial distress risk of APAC airlines. Studies related to the relationship between the social pillar and financial distress risk in the APAC airline industry is limited. Therefore, this study seeks to fill this gap. Zhang (2021) indicated that APAC airlines focused on labor-management relations and supplier assessment and that they placed special attention on the adequacy of social information in their CSR reports as compared with European airlines. Our study contributes to the literature with the novel findings of the

moderating role of APAC airlines in the relationship between social performance and financial distress risk.

Through robustness analysis, we found no significant changes in the estimation, and the impact of COVID-19 was not strongly reflected. Data covering a longer period will be needed to capture the structural break caused by the pandemic.

Conclusions and implications

This study aimed to examine the relationship between ESG disclosure and financial distress risk, as well as the moderating role of being an APAC airline in such a relationship. Our sample consisted of 11 years of ESG and financial data for 23 global airlines, and we used the two-way fixed effect model for the study. Some results were consistent with the theoretical expectations and established hypotheses, whereas they are inconsistent with some studies. First, our results revealed a significant relationship between ESG scores and the likelihood of financial distress. Additionally, the positive influence of the environmental pillar and the negative influence of the social pillar are both lower in the case of APAC airlines.

Our findings enriched the inconclusive literature by evaluating the relationship between ESG and financial distress in the aviation industry and the moderating role of being an APAC airline in such a relationship. The topic of corporate sustainability is undergoing rapid change, and research in the field also needs to be updated (Beijer and Pålsson 2021). The literature on the relationship between sustainability and financial distress in the airline industry is scarce, and we sought to conduct a novel study to contribute to the limited literature and fill the gap. The results of this study are consistent with some studies in the literature about the impact of sustainability initiatives on firm performance and financial stability. However, our results disagree with other studies in the literature; this is not surprising as no clear consensus has yet been reached on this subject (Lee et al 2013).

In practical terms, this study can have significant implications for executives, managers, and policymakers in the aviation industry on sustainability issues. Our findings can act as a reference when making ESG strategy decisions. As a highly capital-intensive and leveraged sector, the airline industry is especially vulnerable to financial distress (Opler and Titman 1994). Consequently, if airline management pays more attention to aspects such as improving management structure and ESG strategies, as well as maximizing shareholder benefits, financial stability can be enhanced. As stated by Chang et al. (2013), APAC airlines may need to make more efforts to improve their sustainability program as compared with those of Western countries.

This study provides some strategy and policy recommendations. As we have confirmed that ESG practice can reduce airlines' financial distress risk, managers should develop mutual trust with the community and enhance boards' quality of supervision and control of airlines, focusing on the main aspects such as the community of stakeholders, board size, board composition, CEO duality, and female leadership. Moreover, integrating corporate sustainability into firms' goal planning can turn a reactive approach into a proactive approach, especially in the airline industry. Although such an initiative would involve expenditure, it is believed to be a good investment for reducing financial distress risk. For policymakers in the aviation industry, it is

recommended to promote corporate sustainability implementation by establishing appropriate policy, which involves not only economic support but also creating a positive image via suitable propaganda. The benefits of investing in sustainable development should be channeled to airline managers and investors. Despite the cost of investment, ESG disclosure can contribute to creating value and provide strategic advantages in the long-term.

Limitations and future research

There are some limitations of this study, which should be addressed in future research. The first limitation is related to the sample size. The dataset used consisted of only 23 airlines, which are basically the biggest airlines in their countries. This was a consequence of the sampling being restricted to the availability of ESG data over a full 11-year period. It was also mentioned by Cowper-Smith and de Grosbois (2011) that, in 2009, only 14 of 41 airlines had publicly available annual CSR reports. Future research may use a bigger sample size as corporate sustainability and ESG disclosure is becoming crucial and better reported. Another possible research line is to expand the research period based on data availability to include other economic recessions, such as the 2007–2008 Global Financial Crises and the 1997–1998 Asian Financial Crisis, to explore and compare the impact of ESG during a non-recession period.

The second limitation arises from the selection of variables (Li et al. 2022). Besides the Altman Z-score model, there are many other models for measuring the degree of financial distress of a firm, such as the Springate S-score model (Springate 1978), the Zmijewski model (Zmijewski 1984), and Merton's distance to default model (Merton 1974). Future research may consider using alternative models or other financial ratios (e.g., cover ratios and leverage ratios) as benchmarks of financial distress and market-based models.

The third limitation is that the impact of COVID-19 on airline performance has not yet been reflected in our model estimation. This structural break presumably needs more time to be appreciated, and future research may shed light on the impact of the pandemic on the aviation industry.

Appendix 1 List of abbreviations

Abbreviation	Description
APAC	The Asia–Pacific region
ESG	Environmental, Social and Governance
IATA	International Air Transport Association
CSR	Corporate Social Responsibility
CO2	Carbon dioxide
ICAO	The International Civil Aviation Organization
SASB	Sustainability Accounting Standard Board
ROA	Return on Assets Ratio
DJSI	Dow Jones Sustainability Indices
VIF	Variance Inflation Factor
DET	Determinant of Correlation Matrix
RE	Random effect model
FE	Fixed effect model
OLS	Ordinary least squares
PCSE	Panel-Corrected Standard Error

Appendix 2 List of sampled airlines

	Company name	Region
1	Air Canada	North America
2	Air China Ltd	Asia&Pacific
3	Air France KLM SA	Europe
4	Airasia Group Bhd	Asia&Pacific
5	ANA Holdings Inc	Asia&Pacific
6	Cathay Pacific Airways Ltd	Asia&Pacific
7	China Airlines Ltd	Asia&Pacific
8	China Southern Airlines Co Ltd	Asia&Pacific
9	Copa Holdings SA	South America
10	Delta Air Lines Inc	North America
11	Deutsche Lufthansa AG	Europe
12	Easyjet PLC	Europe
13	Eva Airways Corp	Asia&Pacific
14	Gol Linhas Aereas Inteligentes SA	South America
15	International Consolidated Airlines Group SA	Europe
16	Korean Air Lines Co Ltd	Asia&Pacific
17	LATAM Airlines Group SA	South America
18	Qantas Airways Ltd	Asia&Pacific
19	Ryanair Holdings PLC	Europe
20	SAS AB	Europe
21	Singapore Airlines Ltd	Asia&Pacific
22	Thai Airways International PCL	Asia&Pacific
23	United Airlines Holdings Inc	North America

Declarations

Competing interests
The author declare that they have no competing interests.

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