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ESG Risk Assessment in the Aviation Industry: A Comparative Analysis of Airbus, Boeing, and Bombardier's Financial and Sustainability Strategies

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Abstract: This report examines the impact of Environmental, Social, and Governance (ESG) risks, particularly climate-related risks, on the financial performance of three major players in the aviation industry: Airbus, Boeing, and Bombardier. The aviation industry, responsible for approximately 2-3% of global carbon emissions, faces increasing pressure to adopt sustainable practices. The report explores how Airbus has positioned itself as a leader in sustainability with initiatives such as zero-emission aircraft and sustainable aviation fuels (SAF), while Boeing continues to grapple with financial and operational challenges. Bombardier, though smaller, has made strides in sustainable technologies in the luxury aviation market. Through financial analysis, including Capital Asset Pricing Model (CAPM) and Fama-French Three-Factor Model, the report compares risk-return profiles of these companies and constructs portfolios to assess their market performance. The findings indicate that proactive ESG strategies, particularly in green technologies, are linked to stronger financial stability and investor confidence. The report also suggests that diversification, incorporating assets like gold and Bitcoin, can help manage aviation sector-specific risks while addressing ESG concerns.

Keywords: ESG Risks, Aviation Industry, Financial Stability, Investor Expectation.

1. Introduction

The growing impact of climate change has posed significant challenges for industries worldwide, particularly those with complex global supply chains. The aviation industry, which is highly dependent on fuel-intensive operations and cutting-edge technologies, is no exception [1]. The industry is now faced with evolving environmental, social, and governance (ESG) risks that are shaping corporate strategies and financial outcomes. Airbus, Boeing, and Bombardier—three major aviation players—are key examples of companies grappling with these emerging risks.

In recent years, the focus on sustainability in aviation has intensified. The aviation sector contributes approximately 2-3% of global carbon emissions with forecasts predicting a steady rise in air travel over the coming decades, further worsening its environmental impact [2]. With increased scrutiny from regulators and consumers alike, aviation companies are now under pressure to reduce carbon emissions, develop sustainable aviation fuels (SAF), and adopt new technologies that can

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reduce their climate footprint. Companies like Airbus, Boeing, and Bombardier have been forced to reevaluate their operations and strategies to align with these global sustainability goals.

ESG factors have become critical indicators of a company's ability to manage modern challenges, such as climate change. In the aviation industry, recent studies have shown that these risks are closely linked to financial performance [3]. Boeing and Airbus, two of the largest players in the industry, have taken distinct approaches to addressing climate-related risks. Boeing has faced operational challenges, including the grounding of its 737 MAX aircraft and supply chain disruptions worsened by extreme weather events [4]. In contrast, Airbus has positioned itself as a leader in sustainability, advancing zero-emission aircraft initiatives and investing heavily in SAF [5].

Despite Boeing's efforts to solve its operational challenges, the company continues to experience financial volatility, as reflected by its negative earnings per share (EPS) of -$5.64 [6]. Airbus, on the other hand, with a market value of $103.26 billion and a positive EPS of $3.98, demonstrates stronger financial health [5]. Studies suggest that companies with proactive ESG strategies tend to perform better financially in the long term, as they mitigate risks more effectively [7]. Bombardier, despite its smaller size and niche focus on business jets, has also embraced sustainability by developing fuel-efficient models for the luxury market [8].

This report examines the extent to which ESG risks, particularly those linked to climate change, affect the financial performance and risk profiles of Boeing, Airbus, and Bombardier. By incorporating both qualitative and quantitative analyses, this study will explore how these companies manage ESG risks and their implications for investors. The research will specifically focus on climate-related risks, including extreme temperatures, flooding, and regulatory shifts, and how these risks translate into financial outcomes.

Airbus, with its proactive sustainability stance, is better positioned to mitigate ESG risks and capitalize on opportunities presented by green technologies. In contrast, Boeing faces significant financial and operational hurdles, which limit its ability to manage these risks effectively. Bombardier, despite its smaller market share, has differentiated itself by focusing on sustainability within the luxury aviation market, suggesting that even smaller players in the industry can use sustainability to gain a competitive force. By analyzing how these companies address ESG risks, this report will be structured as follows: the Methodology section outlines the data selection and financial modelling processes, while the Results section presents the findings from both financial analysis and portfolio optimization. The Conclusion will summarize key insights and provide recommendations for future research.

2. Methodology

2.1. Data Selection

This study examines the impact of ESG risks on the financial performance of Airbus, Boeing, and Bombardier. Using a dataset that spans five years of monthly stock prices and key financial indicators, from 2019 to the present, sourced from Yahoo Finance, provides a comprehensive view of how these companies have performed over time in response to both internal operational changes and external factors such as climate-related risks and ESG challenges. The decision to focus on this time frame was motivated by the significant developments in both the regulatory landscape and investor focus on sustainability during this period. Additionally, the selected period captures the economic shocks and disruptions caused by COVID-19, which has had a profound impact on global supply chains, market volatility, and corporate sustainability efforts.

Airbus, headquartered in Europe, has been a leader in sustainability within the aviation sector. The company has committed to producing hydrogen-powered aircraft by 2035 and significantly increasing the use of SAF. Over the last five years, Airbus has demonstrated relative financial stability, reflected

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in a market value of $103.26 billion and a positive EPS of 3.98 as of the most recent financial data [6]. Airbus's stock performance over the past five years has been shaped by its proactive stance on ESG factors, with significant investments in green technologies, despite the challenges posed by market disruptions and regulatory shifts.

Boeing, based in the United States, has experienced substantial financial headwinds in recent years. The grounding of its 737 MAX aircraft, along with supply chain disruptions exacerbated by climate-related risks and the pandemic, has resulted in negative EPS of -5.64 and a current market value of $99.91 billion [7]. The stock performance of Boeing has been volatile, driven by its operational setbacks and the company's efforts to recover from both reputational and financial challenges. Despite these difficulties, Boeing remains a dominant player in the aviation industry, and its stock continues to be of interest to investors focused on long-term recovery and market resilience.

Bombardier, a Canadian aviation company, specializes in business jets and serves a niche market of high-net-worth customers. The company has embraced fuel-efficient technologies, aligning its product offerings with the growing demand for more sustainable business aviation solutions. Although Bombardier is smaller than both Airbus and Boeing, its focus on developing climate-friendly technologies has helped it carve out a competitive position in the luxury aviation market. Bombardier's financial performance reflects its ability to meet evolving customer expectations while managing ESG risks, though its smaller size makes it more vulnerable to market volatility and global economic disruptions.

2.2. Financial Modelling

This study employs two key financial models: the Capital Asset Pricing Model (CAPM) and the Fama-French Three-Factor Model [9]. These models provide insights into how these companies' stock performances relate to market risks, including those associated with climate change.

The CAPM formula used in this study is:

$$r_E = r_f + \beta \times (r_M - r_f) \tag{1}$$

Where:

- r_E is the expected return on equity,
- r_f is the risk-free rate (e.g., U.S. government bond yield),
- β represents the stock's volatility relative to the market,
- $(r_M - r_f)$ is the market risk premium.

This model is essential for calculating the cost of equity for Boeing and Airbus and determining how climate-related risks affect investor returns.

The Fama-French Model expands on the CAPM by incorporating two additional factors:

- SMB (Small Minus Big): Captures the size premium, reflecting the historical outperformance of small-cap stocks over large-cap stocks.
- HML (High Minus Low): Represents the value premium, indicating the outperformance of high book-to-market stocks overgrowth stocks.

This model was used to evaluate the risk-adjusted returns for Airbus and Boeing, allowing for a more detailed analysis of their sensitivity to market risks and ESG factors [8].

2.3. Portfolio Construction

This paper constructed two portfolios using the data from Airbus and Boeing, applying the following strategies:

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- Minimum Variance Portfolio: Aims to minimize overall risk by reducing the portfolio's standard deviation. Airbus was given a higher weight (83%) due to its stronger financial metrics and lower volatility, while Boeing was weighted at 17% to reduce exposure to its financial instability and higher market risk [10].
- Tangency Portfolio: Focuses on maximizing the portfolio's risk-adjusted return. Airbus still had a higher weight (91%) due to its relatively stable financial performance, while Boeing's weight was increased to 9% to take advantage of its potential for recovery, despite its higher risk [10].

These portfolios were then compared against the S&P 500, gold, and Bitcoin to evaluate diversification benefits and their potential impact on overall portfolio performance.

3. Results

3.1. Portfolio Construction and Optimization

The primary objective of this analysis was to construct and evaluate two investment portfolios: the Minimum Variance Portfolio and the Tangency Portfolio. These portfolios were developed by analyzing the stock performance of Airbus and Boeing, two key players in the aviation industry. Given their significant exposure to climate-related risks and ESG factors, this analysis aimed to assess their risk-return profiles and how their respective sustainability strategies influenced their financial outcomes.

The Minimum Variance Portfolio is designed to minimize overall portfolio risk by reducing the standard deviation of returns. Given Airbus's proactive ESG initiatives and more stable financial performance, the portfolio was heavily weighted toward Airbus. The company's leadership in Sustainable Aviation Fuel (SAF) and its commitment to reducing carbon emissions have contributed significantly to its more stable market performance and enhanced investor expectations [8].

In this portfolio, Airbus was assigned a weight of 83%, while Boeing accounted for the remaining 17%. The overall risk, measured by the standard deviation, was reduced to 11.1%, which is lower than the individual volatilities of both companies. Airbus's relatively lower volatility is attributable to its strong focus on green technologies and decarbonization initiatives, making it a more attractive option for risk-averse investors. Conversely, Boeing continues to face higher volatility, driven by ongoing operational challenges and financial instability [5].

The risk-adjusted return of the Minimum Variance Portfolio makes it particularly appealing for investors seeking to minimize their exposure to climate-related disruptions while still maintaining a stake in the aviation sector. Airbus's leadership in developing zero-emission aircraft and its significant investments in decarbonization provide further stability, reducing its overall ESG-related risks and offering greater certainty to investors.

The Tangency Portfolio was constructed to maximize the Sharpe Ratio, optimizing the balance between risk and return [11]. Airbus continues to dominate this portfolio due to its stronger sustainability profile and lower volatility. However, Boeing's weight was further decreased in this portfolio to reflect its operational risks and potential downside if it fails to recover from recent setbacks.

In this portfolio, Airbus was allocated a weight of 91%, while Boeing accounted for just 9%. The portfolio achieved a Sharpe ratio of 4%, with an expected return of 7.7% and a standard deviation of 11.2%. Although Airbus provides the portfolio with stability and growth potential, Boeing's volatility remains a risk factor. The company's financial and operational challenges, including supply chain disruptions and safety concerns, have contributed to its higher risk profile. However, investors who are willing to take on this risk and believe in Boeing's recovery potential may find this portfolio

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attractive, particularly if Boeing successfully addresses these challenges and leverages opportunities for future growth [4].

3.2. Financial Metrics Analysis: Airbus vs. Boeing

Airbus and Boeing present stark differences in their financial metrics, driven by their varying approaches to managing ESG risks.

Airbus has demonstrated strong financial performance, with a positive EPS of 3.98, a PE ratio of 34.17, and a market value of $103.26 billion. The company's focus on sustainability has been well-received by investors, as evidenced by its lower stock volatility and higher investor confidence. Airbus has committed to reducing its carbon emissions by 50% by 2050 and has taken significant steps toward developing zero-emission aircraft [7].

Boeing, on the other hand, continues to face financial struggles, with a negative EPS of -5.64 and a beta of 1.58, indicating higher volatility. Boeing's recent operational issues, including the grounding of the 737 MAX and ongoing supply chain disruptions, have weakened investor confidence. While Boeing is working to address these challenges, its financial instability makes it a high-risk, high-reward stock [8].

3.3. ESG Impact on Risk and Return

ESG risks have played a central role in shaping the financial and operational performance of Airbus and Boeing. Both companies face significant climate-related risks, but their strategies for addressing these risks differ, leading to contrasting impacts on their stock prices and financial stability.

Airbus has taken a proactive approach to addressing climate risks, particularly through its SAF initiatives and its commitment to developing zero-emission technologies. Airbus's long-term strategy of decarbonizing its fleet has resulted in lower stock volatility and a reduced cost of equity, as investors are increasingly factoring in the company's ability to mitigate ESG risks [7].

Boeing, while making efforts to improve its sustainability reporting, faces reputational risks from past safety issues and struggles with operational efficiency. These issues have increased the company's cost of capital, as investors demand higher returns to compensate for the risks associated with Boeing's uncertain recovery [6]. Boeing's exposure to climate-related disruptions in its supply chain further exacerbates its ESG risk profile.

4. Discussion

In constructing an optimal investment portfolio that includes aviation stocks such as Airbus, Boeing, and Bombardier, it is essential to evaluate how different asset classes interact to manage risk and maximize returns. This study conducted a comparative analysis of these companies' stocks alongside traditional and alternative asset classes like the S&P 500 Index, gold, and Bitcoin. This comparison helps clarify how diversification with these assets impacts portfolio stability and growth, particularly in the context of climate-related ESG risks.

4.1. Diversification with S&P 500 Index

The S&P 500 Index serves as a broad market benchmark, making it a valuable diversification tool for portfolios heavily weighted toward aviation stocks. Airbus and Boeing are significantly affected by global economic conditions and climate-related disruptions like extreme weather and regulatory changes. By adding S&P 500 stocks to an aviation-heavy portfolio, investors can mitigate sector-specific risks, particularly for companies like Boeing, which face supply chain issues exacerbated by climate challenges. Moderate-risk investors can benefit from this broader market exposure, as it

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balances aviation sector volatility, making it ideal for long-term investors seeking stable returns with moderate risk.

4.2. Role of Gold in Portfolio Stabilization

Gold has traditionally been viewed as a safeguard asset, especially during periods of market volatility and economic uncertainty. Given that climate-related risks can disrupt the aviation industry through events like extreme weather or regulatory changes, gold can act as a stabilizer in an aviation-heavy portfolio. With a standard deviation of 5%, much lower than Airbus, Boeing, or the S&P 500, gold helps risk-averse investors reduce portfolio volatility. Though gold's expected return is lower, around 4%, its ability to protect against downside risk makes it valuable for investors focused on capital preservation, particularly considering the aviation industry's exposure to ESG risks. However, the trade-off is a potential reduction in growth opportunities, especially as companies like Airbus push forward with green aviation technologies.

4.3. Speculation Potential of Bitcoin

At the opposite end of the risk spectrum, Bitcoin offers potential for high returns but comes with extreme volatility. Its standard deviation exceeds 80%, far higher than aviation stocks or the S&P 500, yet its expected return of 15% may appeal to risk-seeking investors looking for short-term gains. Bitcoin's non-correlation with traditional markets, including aviation, can provide diversification benefits. However, Bitcoin's volatility makes it unsuitable for conservative investors, and its sustainability issues related to high energy consumption conflict with the goals of ESG-focused portfolios [12]. Investors aiming for long-term sustainability should carefully consider the drawbacks of including Bitcoin in their portfolios.

4.4. Tailoring Portfolio Strategies Based on Investor Risk Profiles

Given the varying risk and return characteristics of Airbus, Boeing, and Bombardier stocks, along with the different asset classes analyzed (S&P 500, gold, and Bitcoin), it becomes clear that portfolio construction must be tailored to the risk tolerance and investment objectives of different types of investors.

- Risk-averse investors: For those who prioritize stability and are less tolerant of market volatility, a portfolio that includes gold as a stabilizing asset, alongside Airbus and S&P 500 Index stocks, offers a balanced approach. The inclusion of Airbus, which is well-positioned to capitalize on the transition to green aviation technologies, provides long-term growth potential, while gold mitigates short-term volatility. Boeing might be included at a lower weight, given its higher operational risks, especially concerning supply chain issues exacerbated by climate change.
- Moderate-risk investors: Investors willing to take on moderate levels of risk but still seeking diversification can benefit from including both S&P 500 and Airbus in their portfolios, with the addition of Boeing for higher upside potential. For these investors, the S&P 500 serves as a buffer against the sector-specific risks of aviation, while the inclusion of Boeing offers the chance for higher returns as the company works to recover from its operational setbacks. The combination of these assets balances risk and reward, making it suitable for long-term investors who are moderately risk-tolerant and interested in the growth potential of the aviation industry alongside broader market exposure.
- Risk-seeking investors: For those with a high-risk tolerance and a focus on short-term, high-potential gains, including Bitcoin alongside Airbus and Boeing offers the chance to capitalize on uncorrelated growth opportunities. While Bitcoin's volatility introduces significant risk, its

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potential for high returns, particularly during periods of market disruption, makes it attractive for aggressive investors who are less concerned with portfolio stability and more focused on speculative gains. However, caution should be exercised when incorporating Bitcoin into portfolios for investors with ESG-focused goals, as its environmental impact contradicts the sustainability focus of many green investment strategies.

5. Conclusion

Future research could expand on this study by exploring regional regulatory differences affecting companies like Airbus and Boeing, and how these shape ESG strategies and investor behavior. Additionally, tracking the long-term effects of sustainability investments like SAF over an extended period could reveal deeper insights into the financial returns of green technologies. Including more aviation companies such as Embraer or Lockheed Martin could provide a more comprehensive view of the sector's response to ESG risks. Lastly, research on the effects of ESG reporting standards on investor sentiment and market outcomes would also add value.

This study relies on historical financial data from Yahoo Finance, which limits its ability to capture the full extent of non-financial ESG risks such as reputational damage. The geographic focus on these three major companies may not fully generalize to smaller or regionally focused firms. Additionally, the inclusion of Bitcoin as a diversification tool focuses on one aspect of alternative assets, and its high volatility might not be representative of other digital assets or emerging sustainable financial instruments like green bonds. Lastly, this study does not account for future technological advancements in zero-emission aircraft or other breakthroughs that could significantly alter the industry's response to ESG risks.

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