



Board and executive gender diversity as a driver of airline efficiency: A network-DEA analysis

Pere Suau-Sanchez^{a,b,*}, Augusto Voltes-Dorta^c, Laura Lamolla^a

^a Faculty of Economics and Business, Universitat Oberta de Catalunya, Rambla del Poblenou 156, 08018 Barcelona, Spain

^b Faculty of Engineering and Applied Sciences, Cranfield University, Martell House, University Way, MK43 0TR, Cranfield, United Kingdom

^c University of Edinburgh Business School Management Science and Business Economics Group, EH8 9JS Edinburgh, United Kingdom

ARTICLE INFO

Keywords:

Airline efficiency
DEA
Gender
Post-covid
Executive team

ABSTRACT

This paper investigates the influence of gender diversity on the efficiency of airlines. Despite global progress towards gender equality, the airline industry continues to exhibit a considerable gender gap, especially in leadership positions. Our study utilises a Network Data Envelopment Analysis (DEA) to assess the performance of airlines concerning gender diversity in board and executive roles. By analysing a dataset of airlines of different continents and covering the period before and after the COVID-19 crisis, gender diversity's impact on airline efficiency (defined as the ratio of the sum of its weighted outputs to the sum of its weighted inputs) is examined. A second-stage estimation further enriches the analysis to assess the influence of external variables. Our findings reveal that airlines with higher gender diversity on their boards and executive teams exhibit better efficiency before and after COVID-19 crisis. The study contributes to the broader discourse on gender diversity in traditionally male-dominated sectors, offering insights into the strategic benefits of inclusive leadership practices.

1. Introduction

Women constitute 49.6% of the global population. Yet, their representation in the transportation sector, especially in higher status and better-compensated positions such as engineers, airline pilots, train drivers, ship captains, and transport company directors, is markedly low, with these roles predominantly occupied by men (Ison et al., 2019). The issue of underrepresentation of women is significantly relevant in aviation, with implications for workforce development and industry growth, and discrimination and sexism are the main challenges (Ferla and Graham, 2019). This underrepresentation is even worse for leadership positions in the aviation industry (Ziegler et al., 2012). For example, in 2021, in the UK, only 4.7% of the pilots are women; in the US, 5.5%, and the higher share of woman pilots is in India, with 12.4% (International Society of Women Airline Pilots (2021). Looking into management senior roles in the airline industry, the values are slightly higher for North America (23%), Europe (18%) and Asia-Pacific (15%), but these remain disappointing and difficult to accept (Flight Airline Business, 2022). While in some industries, the trends towards a higher representation of women have improved, the underrepresentation of women in aviation is a systematic issue that needs to be dealt with over a long period (Kim and Albelo, 2020). For instance, the share of women in

management positions at Japan Airlines has only increased from 14.1% in 2013 to 21.9% in 2021, with a target of 30% for 2025 (JAL, 2022). These numbers contrast with the targets of the fifth goal of the United Nations Sustainable Development Goals, which is to achieve gender equality by 2030, and confirm the UN's assessment that the world is not on track to achieve gender equality. At the current rate, it will take 140 years to achieve equal representation in leadership in the workplace. Systemic barriers need to be dismantled to accomplish this goal. As a cross-cutting objective, it must be a key focus of national policies, budgets and various types of institutions (UN, 2024).

Achieving gender diversity in the airline industry is paramount, not only for women and society but also for the industry. It is widely known that companies with more women in leadership positions outperform their sectors in terms of return on equity, operating results, stock price growth and general performance. A study by Conyon and He (2017) analysed more than 3000 US firms and found a positive effect of women on boards on firm performance, particularly in already high-performing firms. These views are also supported by global business consultancy groups like McKinsey and Company (Hunt et al., 2015). Indeed, Dworkin and Schipani (2018) reviewed various studies and concluded that many have found that women contribute to organisations in numerous ways, enabling firms to experience increased profitability and better

* Corresponding author. Faculty of Economics and Business, Universitat Oberta de Catalunya, Rambla del Poblenou 156, 08018, Barcelona, Spain.

E-mail address: psuau@uoc.edu (P. Suau-Sanchez).

<https://doi.org/10.1016/j.jairtraman.2025.102745>

Received 2 June 2024; Received in revised form 20 November 2024; Accepted 10 January 2025

Available online 16 January 2025

0969-6997/© 2025 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

financial ratios and indicators. A more extensive meta-analysis by Post and Byron (2015) combining the results of 140 studies found that women's board representation positively relates to accounting returns and that this relationship is more favourable in countries with stronger shareholder protections. These protections motivate boards to use each member's different knowledge, experience, and values. In that vein, in some countries, mandatory quotas laws have been instrumental in quickly achieving a higher representation of women and securing better companies' financial performance. In Spain, Reguera-Alvarado et al. (2017) analysed 125 non-financial firms listed on the Madrid Stock Exchange for the 2005–2009 period. They found an increase in the number of women on boards by 98% following compulsory legislation, which shows an efficient framework for executing the recommendations of Spanish codes of good governance. Additionally, they found that the increase in the number of women on the boards was positively related to higher economic results. Nevertheless, despite clear performance results, women and other minorities must spend massive energy negotiating their inclusion in leadership positions (Glass and Cook, 2020). When they achieve it, they still suffer discrimination (Goyal et al., 2023).

The airline industry has recognised the need for change as their gender pay gap numbers are remarkably large. For example, British Airways has a gender pay gap of 67% (BA, 2022) and Ryanair of 46% (Ryanair, 2022). As pilots are the primary source of the pay gap, primarily due to the low representation of women in this area, airlines have focused on increasing women pilots, and so has academic research (McCarthy et al., 2015; Yanikoglu et al., 2020; Marintseva et al., 2021; Yaşar, Dinçer and Yirmibeşoğlu, 2024). However, the low representation of women and their discrimination remains a major issue in other areas of the airline business (Ferla and Graham, 2019), and research is flurry.

The airline industry is well-known for being one of the least profitable segments within the aviation value chain, facing persistent challenges to its long-term financial sustainability (Tretheway and Markhvida, 2014). In light of these challenges, this study aims to investigate the potential of gender diversity as a driver for improving efficiency—a critical component of financial resilience in a highly competitive and low-margin industry. Unlike other sectors, aviation has made limited progress in integrating women into leadership positions, with gender diversity remaining low in both board and executive roles (Flight Airline Business, 2022). Despite evidence from other industries that gender diversity can enhance firm performance and resilience (e.g., Conyon and He, 2017; Dworkin and Schipani, 2018), there is a clear research gap in understanding how gender diversity impacts efficiency within the airline industry.

This study seeks to bridge this gap, firstly, by exploring the effects of gender diversity on airline efficiency using a Network Data Envelopment Analysis (DEA) model, distinguishing our research as the first to quantify the potential efficiency gains linked to gender diversity in a sector known for its significant operational and financial constraints. DEA is a non-parametric technique that measures the relative efficiency of decision-making units based on mathematical linear programming principles. It determines the efficiency of units by comparing their inputs and outputs, and establishes an efficient frontier to evaluate and compare homogeneous units without specific constraints (Özçağ and Akkaya, 2024). While most research in the field is built upon interviews or basic key performance indicators (KPIs), drawing from the airline benchmarking literature (Chen et al., 2021) and a complex Network Data Envelopment Analysis (DEA) model is developed to estimate the efficiency of a sample of 45 airlines worldwide observed in 2019 and 2022. The impact of board and executive gender diversity on airline efficiency is tested with a second-stage truncated regression (Simar and Wilson, 2007) on the DEA efficiency scores. Secondly, by examining airlines across different regions and through the COVID-19 crisis, the research also contributes to understanding how gender-diverse leadership may enhance resilience during periods of industry stress. COVID-19

has been the most important and long-standing crisis in the history of commercial aviation (Suau-Sanchez et al., 2020). In that regard, research has proven that women are selected as leaders in crisis contexts, the so-called 'glass cliff' (Bruckmüller and Branscombe, 2010; Ryan and Haslam, 2005) and that women have a leadership trust advantage in times of crisis (Post et al., 2019). In the context of COVID-19, some researchers have found that female leadership in public administration resulted in fewer deaths (Sergent and Stajkovic, 2020; Bruce et al., 2021).

The rest of this paper is structured as follows. In the Second Section, a more detailed literature review on gender diversity in male-dominated sectors and leadership positions in aviation is conducted. The Third Section presents the data and methodology. The results are discussed in the Fourth Section, and finally, the Fifth Section summarises the conclusions and results.

2. Literature review

2.1. Gender and organisations

To understand the potential impact of gender diversity on airline efficiency, this study draws on established theories related to organisational diversity, decision-making, and performance. These theories provide a conceptual foundation for examining how gender representation in leadership roles may influence efficiency outcomes in male-dominated industries like aviation.

Gender diversity in leadership roles is essential and contributes to reducing gender inequality. Still, from a feminist standpoint, it could be argued that alone does not create an inclusive or supportive environment for women across all levels of the organisation nor contributes to reducing gender inequality. However, several theories suggest that gender diversity in leadership can contribute to the just treatment of women and reduce patriarchy by impacting lower levels of the organisation hierarchy and benefit various types of decisions of the company. The critical mass theory argues that a certain proportion of minority group members (e.g., women in leadership) is necessary to influence group dynamics and decision-making effectively (Torchia et al., 2011; Zaccone and Argiolas, 2024) and drive change in the lower ranks because of a trickle-down effect that is more significant after 5 years (Gould et al., 2018). So, their influence becomes more substantive when the number of women reaches a "critical mass" (two or more women directors or holding 20% or more board seats, according to Biswas et al., 2021).

On the contrary, the tokenism theory (Kanter, 1977) looks into the effects of being a numerical minority in a group, such as women in a male-dominated leadership, which can generate behaviours by "tokens" and limit their contribution. One of them, being a high performer, aims to demonstrate that she deserves her appointed role while simultaneously attempting to minimise her visibility and avoid surpassing the male-dominant group. Hence, there is a need to move from tokenism to critical mass in top leadership (Torchia et al., 2011).

Several theories also highlight the value of gender diversity in leadership for the organisation's decisions. The upper echelons theory argues that the characteristics of top executives, including demographic factors like gender, shape organisational outcomes because leaders' values and cognitive styles influence strategic choices and performance (Roberson et al., 2024). Gender diversity in leadership can bring diverse perspectives that shape strategic decisions, potentially enhancing adaptability, resilience, and operational efficiency (Nishii et al., 2007). From another perspective, the social role theory (Franke et al., 1997; Eagly and Wood, 2012) and the resource-based view of diversity suggest that diversity can be seen as an organisational resource that enhances problem-solving and brings a new perspective to decision-making, with women, in some cases, showing higher levels of entrepreneurial orientation and social capital (Runyan et al., 2006). Hence, challenging the existing norms in leadership, like increasing women's representation,

can enhance innovation and adaptability in traditionally male-dominated sectors (Watanabe et al., 2017).

These theoretical perspectives are interlinked with feminism by advocating that gender diversity is not only a strategic asset for organisations but also an ethical imperative for achieving broader gender equality. From a feminist standpoint, the presence of women in leadership positions challenges systemic barriers and patriarchal norms embedded in male-dominated industries. Even in the most gender-equal societies, career choice and progression balance remain an issue in many professions (Tokbaeva and Achtenhagen, 2023). The critical mass and upper echelons theories support the idea that gender-diverse leadership can have trickle-down effects on lower levels of the organisation, fostering a culture that values inclusivity and addresses structural inequalities (Périlleux and Szafarz, 2022; Ali et al., 2021). Moreover, the feminist lens extends the resource-based view by framing diversity as a crucial organisational strength, enhancing decision-making and resilience and fulfilling a social responsibility to promote gender equality in historically exclusive spaces (Tate and Bals, 2018). By framing our study in these theories, gender diversity in leadership can be a catalyst for organisational transformation, aligning both with feminist ideals of equity and with improved organisational outcomes.

2.2. Gender diversity in male-dominated sectors and aviation

The aviation sector has long been male-dominated and male-oriented (Ferla and Graham, 2019). Like other masculinised sectors, the aviation industry commonly exhibits a gender imbalance in its workforce and leadership roles, such as CEOs, board members, and senior management staff, favouring men (Amaugo, 2022; Smith et al., 2021). This gender imbalance is further evidenced by the broad scope of studies on gender in organisations, which often highlight how and why women are disadvantaged. These disadvantages range from their over-representation in low-paid and low-status occupations to limited access to particular roles and occupations (Dick, 2024). In fact, gender inequality in leadership roles is related to vertical-gendered occupational segregation, which refers to different roles for specific occupations (Blackburn and Jarman, 2006).

Vertical segregation is related to women facing various obstacles related to the glass ceiling, an invisible barrier preventing them from advancing to leadership positions (Haslam and Ryan, 2008; Lewellyn and Muller-Kahle, 2020; Amaugo, 2022). One of those obstacles – and from the point of view of human capital theory – is underestimating the competencies, knowledge, resources or contacts of women to occupy these positions or the biased perception of the (limited) contribution that women can make (Bridges et al., 2023; Gabaldon et al., 2016; Groysberg and Bell, 2013). However, these beliefs are predicated on the assumption that certain competencies, knowledge, and skills hold greater significance. Technical skills, often associated with men, are more important than social skills, which are frequently attributed to women (Rubery and Grimshaw, 2015).

Another obstacle, in this case, related to social capital theory, is the ‘old boys’ network, which excludes women from decision-making networks and limits their access and acceptance (Groysberg and Bell, 2013; Wilson-Kovacs et al., 2006). However, concerning this type of behaviour, Pande and Ford (2011) found that as corporations look for candidates from their networks, they might not know women candidates for their boards as they are men’s networks. In that regard, male-dominated organisations favour peers (Ibarra, 1992; Gabaldon et al., 2016; Raddant and Takahashi, 2022). Gabaldon et al. (2016) use the concept of “taste-based discrimination” to explain that, sometimes, personal taste – often rooted in social norms – can cause a preference for males in top positions as they believe that men are more suitable to occupy these positions.

Besides the glass ceiling, as mentioned above, the glass cliff phenomenon has also been observed (Haslam and Ryan, 2008; Ryan et al., 2016). Women are more likely to occupy leadership positions in

companies in crisis or with a high risk of failure. This may lead women to be more exposed to criticism because of the company’s outcomes and can have future implications for them, as Ferris et al. (2003) highlighted. These authors found a positive relationship between the past performance of companies where a director served and the number of directorship positions held after. In this sense, it could be argued that if women serve companies in crisis, they will have fewer chances to have future directorship positions and will reinforce negative stereotypes about women. This is in line with Ingersoll et al. (2023), who found that corporations led by women undertake more financial risk and suggest that could potentially limit their career mobility. Still, research shows a higher integrity of woman directors and a negative association with corporate misconduct (Chen et al., 2023).

Organisational culture¹ is seen as one of the central issues in male-dominated sectors, producing and reproducing privileges for some members while creating and reproducing disadvantages for others (Gorlin and Bridges, 2021). For example, male-dominated organisations often offer poor flexibility in terms of work-life balance, lack family-friendly policies, and demand long working hours (Bridges et al., 2023). The male-dominated organisational culture may make these organisations less attractive to women in recruitment and retention (Sachdeva et al., 2022). This can lead to different stereotypes and the ‘natural’ suitability of men versus women’s unsuitability to perform particular work. Such association between work roles and gender identity can lead to favouring normative masculine values and practices in these jobs (Gorlin and Bridges, 2021; Powell et al., 2009).

The influence of organisational culture is powerful in the aviation industry. This masculine organisational culture has its roots in the early days of civil aviation, where masculine values, traditional gender roles, and the connection with the military sector as pilots’ suppliers predominated (Mills and Mills, 2006; Amaugo, 2022; Smith et al., 2021). The result is a hierarchical organisational structure in which women are underrepresented at most levels of positions of power and responsibility (Smith et al., 2021) and where men occupy roles such as pilots, engineers and managers, while women tend to perform roles such as flight attendants and ground support personnel (Amaugo, 2022; Smith et al., 2021). Moreover, they have limited training and development and insufficient role models and mentors (Seligson, 2019 and Turnbull, 2013). Indeed, the masculinity of certain jobs is not solely produced on the job but during education (Prokos and Padavic, 2002). Organisations like the International Aviation Womens Association (IAWA) try to counterbalance that with scholarship programmes that support the development of women in selected universities like Cranfield University, Embry Riddle Aeronautical University, Swinburne University and TU Delft, among others (IAWA, 2019). But women are still under-represented in leading positions. Regardless of airline efforts to create more diverse communities (Plucinska, 2023), pilots and senior managers remain predominantly white and male (Hansen and Oster, 1997). According to IATA (2018, 2022), in 2018, women represented only 3% of airlines’ CEOs and COOs, 8% of CFOs and 32% of HR Directors. Values in 2022 marginally improved to 6% of CEOs and COOs, 12% of CIOs, 13% of CFOs and CCOs and 40% of HR directors.²

Beyond exploring the difficulties and barriers, a stream of literature demonstrates the positive impact of gender diversity, especially on boards of directors and in various company aspects like financial results, corporate social responsibility and decision-making (Sanchez-Tebe et al., 2020). Some studies are also more sectorial, focusing, for example, on finance and investment and how women provide more financial resilience by reducing high-risk decisions (Rossi et al., 2017) or on

¹ Culture is understood as the values, attitudes, beliefs, language and the behaviours, practices and rituals shared by members of a group.

² CEO: Chief Executive Officer; COO: Chief Operating Officer; CIO: Chief Information Officer; CFO: Chief Financial Officer; CCO: Chief Commercial Officer.

corporate reputation, particularly for companies that operate with end consumers (Brammer et al., 2009). To the best of our knowledge, few studies have specifically examined the impact of gender diversity on company efficiency within the aviation industry.

2.3. Airline Efficiency analysis

The analysis of Gorlin and Bridges (2021) highlights that previous researchers have had significant challenges conducting gender research in aviation. Most issues concern resistance from men (i.e., male pilots) to contribute and participate in qualitative research, such as surveys and interviews. They also report cases of openly hostile responses to questionnaires or male pilots openly resentful that women were receiving attention (Davey, 1996; Wilson-Kovacs et al., 2006; Mitchell et al., 2005; Germain et al., 2012; Gibbon, 2014; Zirulnik, 2015). Hence, considering the experience of previous researchers and the fact that this research aims to analyse the impact of gender diversity on airline efficiency, it was decided to take a quantitative approach.

The vast literature on airline performance often relies on quantitative, non-parametric methods like DEA-Data Envelopment Analysis (see e.g., Liu et al., 2020; Cui et al., 2020; Yen and Li, 2022). These methods conceptualise airlines as decision-making units (DMUs) with the behavioural objective of transforming inputs into outputs in an optimal way. A common expansion of said paradigm is to split the airlines' production process into multiple phases (e.g., operations and marketing), allowing for increased transparency and detail in the analysis (Chen et al., 2021). The formal linkages between the production phases gave rise to Network-DEA models, which can still be solved with standard linear programming techniques.

Typical output and input variables to assess the airlines' core operational performance are Revenue Passenger Kilometers (RPKs), Available Seat Kilometers (ASK), number of employees, operating expenses, or total assets (Choi, 2017; Merkert and Hensher, 2011). To those, a layer of sustainability performance can be added by also considering the undesirable outcomes of airline operations, such as noise or carbon emissions (Wang et al., 2020; Cui et al., 2022). While these environmental concerns were relegated in importance during the COVID-19 pandemic in favour of the airlines' operational viability and survival, recent research has shown that global carriers are once again constrained by sustainability factors (Tanriverdi et al., 2023).

The estimation of airline efficiency is the first stage in most analyses, which often focus on identifying the external drivers of such performance using a second-stage regression technique. The usual variables considered at this stage are airline size, business model, length of haul, and market competition. There is broad consensus that larger airlines tend to be more efficient (Nguyen et al., 2022), since they often have a better capability to capture market share and boost their load factors. This high capacity utilisation, alongside a much leaner corporate structure, explains why low-cost carriers are also considered more efficient (Lu et al., 2012; Lee and Worthington, 2014; Yu et al., 2019). Regarding the average length of haul, or distance travelled, long-haul airlines typically have the edge over the short-haul ones, enjoying both lower costs per ASK and higher yields from long-haul passenger traffic (Merkert and Hensher, 2011; Lu et al., 2012; Zhang et al., 2017; Yu et al., 2017). On the other hand, market concentration may positively or negatively influence airline performance (Yu et al., 2017). While some argue that competitive pressures within a level playing field incentivise carriers to be more productive and efficient, the higher market power of airlines in oligopolistic or monopolistic settings might boost their revenue potential.

The link between corporate governance and airline efficiency has also been investigated. For example, Wang et al. (2011) found that board size and independence significantly influenced the efficiency of US airlines. Lu et al. (2012) arrived at a similar conclusion regarding executive share ownership, while Duppati et al. (2016) highlighted the impact of board strategies and government intervention on airline performance.

Despite that, no airline efficiency studies specifically included board gender diversity as a second-stage regression variable.

In view of that, there is an opportunity to fill a knowledge gap by quantifying airline performance using an established DEA method and then investigating the impact of board gender diversity as an external driver of efficiency with a second-stage regression. While past studies on gender diversity in aviation suggest this key variable would have a positive impact on performance, the use of complex quantitative methodology is warranted due to the existence of many other relevant factors, such as airline type, network size, length of haul, or the degree of competition.

3. Data and methodology

3.1. Sample airlines

We compiled a balanced panel dataset of 45 consolidated airline groups observed in 2019 and 2022, including carriers from the Americas (15), Europe (12), and the Asia-Pacific region (18). The sample is diverse in size, length of haul, and business models, featuring both global full-service carriers such as American Airlines and smaller low-cost operators like Wizzair. The complete list is provided in Appendix 1. The sample airlines were chosen based on the availability of gender diversity data from Refinitiv, Capital IQ, or their respective annual reports. The specific timeframe of our study spans the COVID-19 period, with the last pre-pandemic year (2019) contrasted with the post-COVID recovery (2022). This is expected to facilitate an analysis of how airline efficiency evolved during this turbulent period.

3.2. Methodology

Mathematically, our output-oriented model assumes variable returns to scale (VRS) given the wide range in airline sizes within our sample. Having a dataset of n airlines, s inputs, r intermediate outputs, and m outputs, the linear program for phase one can be written as follows (Banker et al., 1984):

$$\max \theta_i^1 \quad (1)$$

s.t.

$$\theta_i^1 z_i \leq Z\lambda$$

$$x_i \geq X\lambda$$

$$\lambda \geq 0, \Sigma \lambda = 1, \theta_i^1 \geq 0,$$

where X is the $s \times n$ input matrix, Z is the $r \times n$ intermediate output matrix, and λ is a $n \times 1$ vector of firm weights. θ_i^1 denotes the maximum feasible expansion of z for the i -th airline given inputs and technology. Analogously, the VRS linear program for phase two can be defined as:

$$\max \theta_i^2 \quad (2)$$

s.t.

$$\theta_i^2 y_i \leq Y\gamma$$

$$z_i \geq Z\gamma$$

$$\gamma \geq 0, \Sigma \gamma = 1, \theta_i^2 \geq 0,$$

where Y is the $m \times n$ output matrix, and γ is a $n \times 1$ vector of firm weights. θ_i^2 denotes the maximum feasible expansion of y for the i -th airline given intermediate outputs and technology. The DEA efficiencies of phase one (capacity) and phase two (KPIs) are obtained as the inverse of θ_i^1 and θ_i^2 , respectively. These efficiency estimates range between 0 and 1, with 1 denoting full efficiency.

In order to properly account for the relationships between both production phases, the models are not solved in sequence but rather simultaneously following the efficiency decomposition approach detailed in [Chen et al. \(2009\)](#) that gives the first production phase pre-emptive priority. The calculations are carried out in full for each sample period.

With the efficiencies estimated for both 2019 and 2022, we then run a second-stage truncated normal regression using the bootstrapping procedure set out by [Simar and Wilson \(2007\)](#). The model regresses the phase-level DEA efficiencies against a number of external factors. Assuming T time periods and K airline regions, the specification is shown in Equation (3):

$$\begin{aligned} Efficiency_{it} = & \beta_0 + \beta_1 board_{it} + \beta_2 exec_{it} + \beta_3 netsize_{it} + \beta_4 alh_{it} + \beta_5 hhi_{it} + \beta_6 lcc_i \\ & + \sum_{k=1}^K \beta_k region_i + \sum_{t=1}^T \beta_t year_t + \varepsilon_{it} \end{aligned} \quad (3)$$

where i and t denote the firms and time periods, respectively, and ε denotes the model's residual. Netsize refers to the airlines' network size (number of airports served), alh refers to the average length of haul in km, hhi measures market concentration (proxied by the Hirschmann-Herfindahl Index-HHI at the carrier's main hub), lcc is a dummy variable denoting whether the carrier is a low-cost operator, and region and year indicate the airline's region and time period. This operational data was sourced from OAG (Official Airline Guide).

The key variables for our study are board and exec, which, respectively, denote the proportion of women on the airline's board and on the executive team. These variables (both sourced from Refinitiv) serve as proxies for gender diversity and were used alternatively in the specification.

[Table 1](#) provides descriptive statistics of the selected variables. Despite the massive restructuring efforts prompted by the pandemic crisis, the size of airlines' assets grew between 2019 and 2022. However, the average number of employees decreased by about 6 per cent during the same period. Capacity, measured by ASKs, had not yet recovered its pre-COVID levels by 2022, which, coupled with a prolonged demand slump ([IATA, 2023](#)), explains the drop in load factors as well. This highlights the challenging operational environment in which we conduct our efficiency study.

The environmental and social outputs of the DEA model are derived from the airlines' sustainability scoreboards, ranging between 0 and 100, where higher scores indicate better performance. Among other factors, the environmental score is higher for airlines with carbon emission reduction plans at all stages of their supply chain. The social score captures programs and policies aimed at reducing workplace discrimination and improving diversity and overall working conditions. Contrary to the poor operational performance, the sustainability KPIs

improved between 2019 and 2022.

3.3. Informants

We sought insights from informants within the aviation industry to complement the quantitative analysis and enrich the discussion. These informants included executives, board members, and senior managers from airlines representing all regions and airline business types. A total of 24 individuals were contacted, comprising 16 women and eight men. Unfortunately, none of the men responded. This aligns with the challenges that [Gorlin and Bridges \(2021\)](#) encountered, who found men resistant to participating in surveys and interviews about gender equality in aviation. The responses were received from those listed in [Table 2](#). While a few responses were received, the main three airline business models are represented. The insights obtained are sufficient to provide a better understanding of the results and the performance of airlines concerning gender, which is the core focus of the study.

We posed two questions to these informants: the first focused on their interpretation of our study's findings regarding the relationship between gender diversity in leadership and airline efficiency, while the second sought their perspectives on the glass ceiling and glass cliff phenomena in aviation. Their feedback provided valuable qualitative context, which we used to support the interpretation of results and identify potential future research directions. While these insights do not constitute formal interviews nor the results of qualitative research, they offer an informal yet meaningful contribution to the study's findings.

4. Results and discussion

[Table 3](#) presents the distribution of gender diversity across boards and executive teams in 2019 and 2022, highlighting a notable trend: the growing presence of women in these senior roles in the airline industry. Specifically, boards show a rise in the percentage of women, suggesting that many airlines prioritise gender balance at the governance level. Similarly, the composition of executive teams reveals an upward trend in woman representation, although, in Latin America and the Caribbean, it has decreased. The fact that women percentages in executive positions are relatively lower than in boards can be determined because boards, in some regions such as Europe, are subject to compliance with gender diversity quotas ([Reguera-Alvarado et al. \(2017\)](#)). It should also be taken

Table 2
List of informants.

Informant number	Position	Type of airline
#01	C-Level	Low-cost carrier
#02	Senior Management	Charter/Holiday carrier
#03	C-Level	Network Carrier

Table 1
Descriptive statistics of the chosen variables.

Variable	2019					2022				
	no. obs	mean	s.d.	min.	max.	no. obs	mean	s.d.	min.	max.
DEA variables										
assetsppp	45	2.46E+10	2.09E+10	2.47E+09	7.23E+10	45	2.70E+10	2.27E+10	2.63E+09	7.63E+10
fte	45	35056	35489	2924	138353	45	32955	33385	2684	129700
ASK	45	1.42E+11	1.21E+11	1.69E+10	4.53E+11	45	1.11E+11	1.06E+11	1.08E+10	4.16E+11
lf	45	0.801	0.040	0.698	0.916	45	0.711	0.112	0.432	0.902
env	45	49.072	24.139	6.624	86.528	45	52.990	22.999	5.969	89.605
social	45	56.616	20.228	16.777	88.679	45	60.311	18.724	13.183	95.448
Second-stage variables										
board	45	18.262	14.264	0.000	50.000	45	21.743	12.634	0.000	50.000
exec	45	14.581	11.602	0.000	40.000	45	18.658	12.977	0.000	50.000
netsize	45	162.889	95.477	29.000	384.000	45	154.978	96.740	29.000	437.000
alh	45	1926.590	730.194	993.011	4107.971	45	1806.689	827.653	893.083	4626.120
hhi	45	0.314	0.194	0.081	0.914	45	0.341	0.191	0.099	0.931

Table 3
Gender diversity variables in our airline industry sample per region, 2019–2022.

Region	board (%)		exec (%)	
	2019	2022	2019	2022
Asia-Pacific	12.3	16.1	10.4	15.8
Europe	28.2	31.8	21.1	22.6
Latin-America and Caribbean	6.8	12.4	9.8	8.5
North America	24.4	25.9	17.5	26.0
Total	18.3	21.7	14.6	18.7

into account that the composition of boards is much more visible among stakeholders and society than companies' executive layers. In this sense, this situation can influence companies to prioritise board diversity before executive positions for reputational questions (Brammer et al., 2009). The differences observed between regions are in line with other studies that use a smaller sample. *Flight Airline Business* (2022) reports similar values for 2021 as this study does for 2022, being North America, Europe and Asia-Pacific, the regions with more women in the executive.

Nevertheless, the overall results show that gender balance is still far from achieved. Informant #03 highlighted that “a 50/50 gender parity at every level is a reasonable goal: including at Boards, ExCo, Director and Senior Leadership. Currently, airlines are nowhere close. Despite widespread commitment to 50/50 diversity (or at least 30/70 in many cases), few airlines have reached the 30% female in senior roles targeted by 2020!”

Table 4 summarises the results of our network-DEA model—the average ‘capacity’ and ‘KPI’ efficiencies for each of the four sample regions. On either side of the COVID period, airlines appeared to be less adept at optimising capacity given inputs (60–66% efficiency) than at filling their planes in a sustainable fashion (90–95% efficiency). Moreover, there was a decline in performance in both categories between 2019 and 2022. This confirms the impact of travel restrictions on airline operations across the board, with most sample carriers achieving lower labour productivity ratios (ASK per employee) than before the shock. However, this negative impact varies between regions, with Asia-Pacific and Latin American carriers faring noticeably worse than their North American and European counterparts.

This discrepancy could be attributed to the massive state aid programs supporting European flag carriers (Pantazi, 2022), many of which compelled recipients to restructure their networks, staff, and fleet to improve productivity and sustainability. For instance, Air France/KLM halted non-essential spending and external hiring while moderating salaries (Airfranceklm.com, 2022). Although they failed to recover their pre-COVID capacity, their focus on high-density routes bolstered their load factors (Lemonde.fr, 2023). Conversely, Asia-Pacific operators, especially those primarily serving international traffic, took longer to recover due to their countries' isolationist policies to contain the spread of the virus. Carriers like Air New Zealand, Singapore Airlines, or Eva Air were hampered by border closures until nearly mid-2022, exacerbated by political tensions across the Taiwan Strait (Eva Air, 2022).

Tables 5 and 6 present the second-stage truncated normal regression results using board and executive gender diversity, respectively, as independent variables. All models are globally significant, and, according to the Variable Inflation Factors (VIFs), there are no multicollinearity

Table 4
2-stage DEA efficiency results per region.

Region/Airline	Stage 1 - Capacity		Stage 2- KPIs	
	2019	2022	2019	2022
Asia - Pacific	0.540	0.367	0.927	0.850
Latin American and Caribbean	0.457	0.543	0.969	0.931
Europe	0.843	0.794	0.972	0.950
North America	0.814	0.855	0.969	0.930
Grand Total	0.664	0.602	0.953	0.903

issues. The results from both models are similar, indicating that our conclusions are robust regardless of the diversity variable chosen.

Interestingly, network size has a positive impact on capacity efficiency and a negative impact on KPI performance. This can be attributed to the challenges faced by global carriers with expansive networks in achieving sustainable load factors in the current context. Low-cost carriers also demonstrate lower efficiency in optimising capacity, which may be attributed to the one-model fleet strategy commonly employed by such operators. For example, EasyJet had to remove seats from their A319s to reduce regulatory crew requirements and control costs (Browning, 2022).

Regarding our key variables, both board and executive gender diversity (i.e., the share of woman personnel) exhibit a positive and statistically significant correlation with both efficiencies. The stronger significance of executive diversity on KPI efficiency suggests a better alignment of executive decision-making with environmental and workplace diversity goals. A moderating factor in this presumed causal relationship could be the established result that firms with more women in leadership positions tend to perform better financially. These results are aligned with recent research on the critical mass of women on corporate boards and firm performance. Zaccane and Argiolas (2024), show that the impact of the critical mass of women at the top leads to enhanced firm performance, particularly when an individualistic culture characterises the institutional context, as it has been traditionally considered the airline industry.

Clearly, amid the dire situation caused by the COVID-19 pandemic, any financial margin that airlines could have over the edge of bankruptcy would facilitate a shift in executive mindset from short-term survival to long-term strategy. In that regard, Informant #01 said that “at the beginning of COVID-19 all expenditure was stopped, but our airline brand was dying, so I decided it was needed to act and do charity actions to help those in need and make our airline brand survive in the long term”. The long-term strategy is also the realm where sustainability targets are set, and specific paths to achieve them are laid down, implemented, and followed through. The fact that women, in general, have a more pronounced ethical sensitivity than men (Post and Byron, 2015) can also influence the board of directors and senior management to increase attention by monitoring and adopting activities related to environmental sustainability (Kassinis et al., 2016) one of the critical matters in companies' operational performance. Thus, in the case of aviation, gender diversity's positive impact on efficiency may be related to the fact that women provide other mental schemes resulting from different experiences, knowledge and values, which contribute positively to the quality of decisions made by the boards and executive teams (Post and Byron, 2015). This is confirmed by Informant #02, who argues that “In my experience, female leaders will be equal to male counterparts in their approach to ‘hard’ information, such as KPIs, financial data, market analysis, fleet information, and their use of such information to steer a business. I have observed that most female leaders, (not all) will often supplement these leadership attributes with ‘soft’ data such as leadership team connection, alignment of communication across the organisation, and attention to individuals' personal situations.

Our results reinforce the importance of initiatives such as IATA's 25by2025, which aims to significantly increase the number of women in leadership roles within the aviation industry (IATA, 2024). This initiative seeks to increase the proportion of women in executive positions to 25% by 2025. Highly efficient carriers like IAG, the holding company that brings together airlines like British Airways, Iberia and Vueling, and Lufthansa, have signed onto IATA's initiative. However, as underscored by Informant #03, “optimistic targets and well-meaning diversity narratives will not lead to meaningful change. More radical action is needed if the industry is serious about improving diversity”.

Extrapolating the results of our study to that aspirational target, if the carriers were to increase the proportion of women in executive positions from their 2022 average (18.7%) to 25%, they could gain 1.9% in capacity efficiency and 3.2% in KPI efficiency. Moreover, in a region like

Table 5

Truncated regression results: efficiency scores vs external variables (board gender diversity).

Variable	Stage 1 - Capacity				Stage 2 - KPIs			
	coeff.	s.d.	prob.	sig.	coeff.	s.d.	prob.	sig.
board	0.005	0.001	0.000	***	0.005	0.002	0.061	*
netsize	0.001	0.000	0.000	***	−0.001	0.000	0.011	**
alh	0.000	0.000	0.035	**	0.000	0.000	0.214	
hhi	−0.145	0.093	0.119		0.202	0.151	0.181	
year_2022	−0.076	0.029	0.009	***	−0.207	0.055	0.000	***
region_EUR	0.089	0.053	0.095	*	0.140	0.087	0.106	
region_LAC	0.128	0.051	0.013	**	0.103	0.087	0.235	
region_NAM	0.286	0.049	0.000	***	0.146	0.083	0.078	*
lcc	−0.132	0.039	0.001	***	0.035	0.056	0.530	
constant	0.284	0.060	0.000	***	0.933	0.082	0.000	***
sigma	0.121	0.010	0.000	***	0.101	0.016	0.000	***
No. obs.	80				73			

Note: Standard errors are bootstrapped with 2000 replications as per [Simar and Wilson \(2007\)](#).**Table 6**

Truncated regression results: efficiency scores vs external variables (executive gender diversity).

Variable	Stage 1 - Capacity				Stage 2 - KPIs			
	coeff.	s.d.	prob.	sig.	coeff.	s.d.	prob.	sig.
exec	0.003	0.002	0.057	*	0.005	0.002	0.049	**
netsize	0.001	0.000	0.000	***	−0.001	0.000	0.007	***
alh	0.000	0.000	0.037	**	0.000	0.000	0.349	
hhi	−0.123	0.099	0.213		0.156	0.149	0.296	
year_2022	−0.074	0.030	0.015	**	−0.203	0.054	0.000	***
region_EUR	0.144	0.056	0.010	***	0.179	0.078	0.021	**
region_LAC	0.108	0.054	0.046	**	0.132	0.093	0.155	
region_NAM	0.326	0.048	0.000	***	0.154	0.074	0.038	**
lcc	−0.138	0.040	0.001	***	0.043	0.054	0.430	
constant	0.314	0.060	0.000	***	0.966	0.076	0.000	***
sigma	0.129	0.011	0.000	***	0.100	0.015	0.000	***
No. obs.	80				73			

Note: Standard errors are bootstrapped with 2000 replications as per [Simar and Wilson \(2007\)](#).

Latin America, the efficiency benefits could be as high as 6.3% and 8.3%, respectively, since the benefits of board gender diversity are yet to be fully realised. Hence, gender diversity data ([Table 3](#)) and initiatives like IATA's 25by2025 confirm the existence of a glass ceiling in the aviation sector at a global level ([Amaugo, 2022](#); [Catalyst, 2022](#); [Ferla and Graham, 2019](#)). Indeed, as highlighted by Informant #02, barriers are strong and are highly influenced by the social and organisational context still based on the “ideal” worker ([Acker, 1990](#)): “In practical terms, the senior female leaders I have known and worked with invariably have not had children, and therefore not had a break in career for maternity reasons. I believe this remains a barrier for females and that societal systems which continue to orientate towards females as the primary childcare provider contribute towards this”. In this vein, Informant #03 calls attention to the “large drop-out rates at child rearing and menopause age. Between 40 and 50% of airlines’ female workforce leave or step back to more junior roles at these important life stages. There is a general lack of proactive support to help women navigate this period and remain in the workplace operating at senior levels. To do so requires flexibility and modernisation with radical creative thinking. Leading on from this is a pipeline issue; fewer women are in the senior management pool, and more men are available to promote. It is not a level playing field to start with”.

5. Conclusions

In this paper, the influence of gender diversity at the board and executive levels on the efficiency of 45 international consolidated airline groups for 2019 and 2022 is investigated. We analysed that using a network DEA method with a second-stage regression.

Airlines demonstrated greater proficiency in filling planes

sustainably (90–95% efficiency) than optimising capacity given inputs (60–66% efficiency). However, both categories experienced performance declines between 2019 and 2022 due to the impact of COVID-19 travel restrictions. Notably, Asia-Pacific and Latin American carriers fared worse than their North American and European counterparts during this period.

From a gender diversity perspective, the results are clear-cut: board and executive gender diversity have a positive correlation regarding capacity efficiency and KPI efficiency. Executive diversity had a more substantial impact on KPI efficiency than board-level diversity, suggesting a better alignment of decision-making with environmental and workplace diversity goals. The results obtained are aligned with previous studies. However, those studies analyse other KPIs that do not coincide with the ones used in this study to measure operational performance, such as firm profitability ([Post and Byron, 2015](#)), company's net sales ([Rodríguez-Fernández et al., 2020](#)), gross profit ([Smith et al., 2006](#)) and return on equity ([Lückerath-Rovers, 2013](#)). Yet, they can be considered similar since all of them indirectly aim to measure and confirm the business case of gender diversity in top positions.

Our results reinforce the importance of gender balance industry initiatives, which aim to significantly increase the number of women in leadership roles within the aviation industry, as promoting gender diversity within aviation companies leads to efficiency improvements and efficiency gains in terms of capacity and KPI efficiency linked to gender diversity can be easily measured. However, as with previous research ([Gorlin and Bridges, 2021](#)), we have encountered resistance from men to participating as informants in our research. This is relevant in two aspects. First, there is a demand from women in the airline industry for men to act more actively to achieve gender balance. Informant #03 underscored that “male champions and sponsors proactively advocating

for women is required". Second, the increasing tendency towards gender political polarisation (Benson, 2023), including hostility against women political leaders (Håkansson, 2024) and voter punishment of ambitious women (Bauer et al., 2024), should not percolate to an already male-dominated industry. The airline industry is global and should take responsibility for its influence in promoting diversity worldwide.

However, the paper's conclusions must be qualified in several ways due to the limitations of our methodology. First, the challenge of combining airlines from different regions arises from inconsistent accounting practices and reporting periods. Despite efforts to standardise fiscal years, some discrepancies are inevitable. Second, the sample size is limited by data availability, and the representation of the Middle East region is inadequate. Third, the model used is passenger-centric; cargo traffic, a significant source of airline activity during the pandemic, is not considered. Metrics such as revenue tons kilometres (RTKs) or factors like fleet age and fuel consumption could enhance the model, especially given its sustainability focus. Future research could address these issues when additional data becomes accessible. Fourth and last, concerning the limitations of the insights incorporated from informants, qualitative research could be carried out to understand better the specific contributions of women in leadership roles to the performance of airlines.

APPENDIX

Table A1
Airline Sample

Airline Name	Region	Country	Type	Employees (2022)
Qantas	Asia-Pacific	Australia	Full-service	23,500
Air China	Asia-Pacific	China	Full-service	87,190
China Eastern	Asia-Pacific	China	Full-service	80,193
China Southern	Asia-Pacific	China	Full-service	97,899
Hainan Airlines	Asia-Pacific	China	Full-service	34,576
Juneyao Airlines	Asia-Pacific	China	Full-service	9371
Spring	Asia-Pacific	China	Low-cost	9256
IndiGo	Asia-Pacific	India	Low-cost	32,407
ANA	Asia-Pacific	Japan	Full-service	40,507
Japan Airlines	Asia-Pacific	Japan	Full-service	36,039
Korean Air Lines	Asia-Pacific	South Korea	Full-service	19,448
AirAsia	Asia-Pacific	Malaysia	Low-cost	16,149
Air New Zealand	Asia-Pacific	New Zealand	Full-service	11,474
Singapore Airlines	Asia-Pacific	Singapore	Full-service	22,819
China Airlines	Asia-Pacific	Taiwan	Full-service	10,785
Eva Airways	Asia-Pacific	Taiwan	Full-service	16,967
Asia Aviation	Asia-Pacific	Thailand	Low-cost	4478
Thai Airways	Asia-Pacific	Thailand	Full-service	10,640
Finnair	Europe	Finland	Full-service	5230
Air France KLM	Europe	France	Full-service	71,500
Lufthansa	Europe	Germany	Full-service	109,509
Aegean Airlines	Europe	Greece	Full-service	2684
Ryanair	Europe	Ireland; Republic of	Low-cost	22,261
Norwegian Air Shuttle	Europe	Norway	Low-cost	3871
SAS	Europe	Sweden	Full-service	8000
Wizz Air	Europe	Switzerland	Low-cost	7389
Pegasus	Europe	Turkey	Low-cost	6765
Turkish Airlines	Europe	Turkey	Full-service	40,264
Easyjet	Europe	United Kingdom	Low-cost	13,951
IAG	Europe	United Kingdom	Full-service	66,044
Azul	Latin-America and Caribbean	Brazil	Low-cost	14,247
Gol Linhas Aereas	Latin-America and Caribbean	Brazil	Low-cost	14,048
LATAM	Latin-America and Caribbean	Chile	Full-service	32,507
Avianca	Latin-America and Caribbean	Colombia	Full-service	13,000
Volaris	Latin-America and Caribbean	Mexico	Low-cost	7364
Copa Airlines	Latin-America and Caribbean	Panama	Full-service	7265
Air Canada	North America	Canada	Full-service	30,500
Alaska Airlines	North America	United States of America	Full-service	22,922
American Airlines	North America	United States of America	Full-service	129,700
Delta	North America	United States of America	Full-service	95,000
Hawaiian Airlines	North America	United States of America	Full-service	7108

(continued on next page)

Further research should also explore additional dimensions of gender diversity in the airline industry. While gender diversity at the leadership level is critical, it does not automatically foster a supportive or inclusive environment for women across all organisational levels. In that regard, Informant #01 mentioned that "some women can become men when they reach top leadership, particularly when a man promoted them, and they are in a minority position". Indeed, this links with the importance of moving from tokenism to critical mass to achieve change (Biswas et al., 2021; Torchia et al., 2011). Hence, future studies should extend this analysis to examine to what extent gender diversity at the top can impact down the hierarchy, ensuring that benefits of inclusivity reach all levels of the workforce.

CRedit authorship contribution statement

Pere Suau-Sanchez: Writing – review & editing, Writing – original draft, Validation, Resources, Investigation, Data curation, Conceptualization. **Augusto Voltes-Dorta:** Writing – review & editing, Writing – original draft, Resources, Methodology, Formal analysis. **Laura Lamolla:** Writing – review & editing, Writing – original draft, Validation, Investigation, Conceptualization.

Table A1 (continued)

Airline Name	Region	Country	Type	Employees (2022)
JetBlue	North America	United States of America	Low-cost	16,669
Southwest	North America	United States of America	Low-cost	66,656
Spirit	North America	United States of America	Low-cost	12,025
United	North America	United States of America	Full-service	92,795

Data availability

The raw data supporting the findings of this study are not available due to legal and ethical restrictions. The processed data and results presented in the paper are available upon reasonable request.

References

- Acker, J., 1990. Hierarchies, jobs, bodies: a theory of gendered organisations. *Gend. Soc.* 4 (2), 139–158.
- Airfranceklm.com, 2022. Second quarter 2020. Performance Strongly Impacted by the Covid-19 Crisis, Significant Liquidity Available to Weather the Crisis. https://www.airfranceklm.com/sites/default/files/2022-09/q2_2020_press_release_en_final.pdf.
- Ali, M., Grabarski, M.K., Konrad, A.M., 2021. Trickle-down and bottom-up effects of women's representation in the context of industry gender composition: a panel data investigation. *Hum. Resour. Manag.* 60 (4), 559–580.
- Amaugo, A., 2022. Examining the culture of women in aviation leadership: a case of UK airports. In: Wright, T., Budd, L., Ison, S. (Eds.), *Women, Work and Transport, Transport and Sustainability*, vol. 16. Emerald Publishing Limited, pp. 189–206, 16.
- BA, 2022. British Airways pay gap report 2022. URL: <https://www.britishairways.com/cms/global/pdfs/information/about-ba/British-Airways-Gender-Pay-Gap-Report-2023.pdf>.
- Banker, R., Charnes, A., Cooper, W., 1984. Some models for the estimation of technical and scale inefficiencies in data envelopment analysis. *Manag. Sci.* 1078–1092.
- Bauer, N.M., Harman, M., Russell, E.B., 2024. Do voters punish ambitious women? Tracking a gendered backlash toward the 2020 democratic presidential contenders. *Polit. Behav.* 46, 1–20.
- Benson, J., 2023. Democracy and the epistemic problems of political polarization. *Am. Polit. Sci. Rev.* 1–14.
- Biswas, P.K., Roberts, H., Stainback, K., 2021. Does women's board representation affect non-managerial gender inequality? *Hum. Resour. Manag.* 60 (4), 659–680.
- Blackburn, R.M., Jarman, J., 2006. Gendered occupations: Exploring the relationship between gender segregation and inequality. *Int. Sociol.* 21 (2), 289–315.
- Brammer, S., Millington, A., Pavelin, S., 2009. Corporate reputation and women on the board. *Br. J. Manag.* 20 (1), 17–29.
- Bridges, D., Wulff, E., Bamberly, L., 2023. Resilience for gender inclusion: developing a model for women in male-dominated occupations. *Gend. Work. Organ.* 30 (1), 263–279. <https://doi.org/10.1111/gwao.12672>.
- Browning, S., 2022. EasyJet to take out seats so it can fly with fewer crew. <https://www.bbc.co.uk/news/business-61370175>.
- Bruce, R., Cavgias, A., Meloni, L., Remigio, M., 2021. Under pressure: women's leadership during the COVID-19 crisis. *J. Dev. Econ.* 154, 102761.
- Bruckmüller, S., Branscombe, N.R., 2010. The glass cliff: when and why women are selected as leaders in crisis contexts. *Br. J. Soc. Psychol.* 49 (3), 433–451.
- Catalyst, 2022. Women in management: quick take. <https://www.catalyst.org/research/women-in-management/>.
- Chen, Y., Cook, W.D., Li, N., Zhu, J., 2009. Additive efficiency decomposition in two-stage DEA. *Eur. J. Oper. Res.* 196, 1170–1176.
- Chen, Y., Cheng, S., Zhu, Z., 2021. Exploring the operational and environmental performance of Chinese airlines: a two-stage undesirable SBM-NDEA approach. *J. Clean. Prod.* 289, 25711.
- Chen, S., Chen, Y., Jebran, K., 2023. Beyond the glass ceiling: informal gender-based status hierarchy and corporate misconduct. *J. Bus. Res.* 169, 114281.
- Choi, K., 2017. Multi-period efficiency and productivity changes in US domestic airlines. *J. Air Transport. Manag.* 59, 18–25.
- Conyon, M.J., He, L., 2017. Firm performance and boardroom gender diversity: a quantile regression approach. *J. Bus. Res.* 79, 198–211.
- Cui, Q., Lin, J., Jin, Z., 2020. Evaluating airline efficiency under “carbon neutral growth from 2020” strategy through a network interval slack-based measure. *Energy* 193, 116734.
- Cui, Q., Hu, Y., Yu, L., 2022. Can the aviation industry achieve carbon emission reduction and revenue growth simultaneously under the CNG2020 strategy? An empirical study with 25 benchmarking airlines. *Energy* 245, 123272.
- Davey, C., 1996. Gender, power and discourse: a critical examination of commercial aviation and the experiences of women pilots. University of Manchester Institute of Science and Technology. Doctoral dissertation.
- Dick, P., 2024. Rethinking gender inequalities in organisations. In: *Rethinking Gender Inequalities in Organisations*. Edward Elgar Publishing.
- Duppati, G., Scrimgeour, F., Stevenson, R., 2016. Corporate governance in the airline industry - evidence from the asia-pacific region. *Corp. Own. Cont.* 13 (2), 329–335.
- Dworkin, T.M., Schipani, C.A., 2018. The role of gender diversity in corporate governance. *University of Pennsylvania Journal of Business Law* 21, 105–141.
- Eagly, A.H., Wood, W., 2012. Social role theory. In: Lange, P.A.M., Kruglanski, A.W., Tori Higgins, E. (Eds.), *Handbook of Theories of Social Psychology*. Sage, London, pp. 458–476.
- Eva Air, 2022. Eva air investor conference nov 2022. https://www.evaair.com/images/global/investor-conference-2022Q3-en_tcm33-83451.pdf.
- Ferla, M., Graham, A., 2019. Women slowly taking off: an investigation into female underrepresentation in commercial aviation. *Research in Transportation Business & Management* 31, 100378.
- Ferris, S.P., Jagannathan, M., Pritchard, A.C., 2003. Too busy to mind the business? Monitoring by directors with multiple board appointments. *J. Finance* 58 (3), 1087–1111.
- Flight Airline Business, 2022. Gender Distribution Among Senior Roles in the Airline Industry in 2021, by Region. Statista. Statista Inc. Accessed: April 08, 2024. URL: <https://www.statista.com/statistics/741182/airline-industry-senior-roles-by-gender-and-region/>.
- Franke, G.R., Crown, D.F., Spake, D.F., 1997. Gender differences in ethical perceptions of business practices: a social role theory perspective. *J. Appl. Psychol.* 82 (6), 920–934.
- Gabaldon, P., De Anca, C., Mateos de Cabo, R., Gimeno, R., 2016. Searching for women on boards: an analysis from the supply and demand perspective. *Corp. Govern. Int. Rev.* 24 (3), 371–385.
- Germain, M.L., Herzog, M.J.R., Hamilton, P.R., 2012. Women employed in male-dominated industries: Lessons learned from female aircraft pilots, pilots-in-training and mixed-gender flight instructors. *Human Resour. Develop. Int.* 15 (4), 435–453.
- Gibbon, D., 2014. Unexpected turbulence: The barriers and challenges faced by women pilots in the Australian Defence Force. UNSW, Sydney. Doctoral dissertation.
- Glass, C., Cook, A., 2020. Performative contortions: how White women and people of colour navigate elite leadership roles. *Gend. Work. Organ.* 27 (6), 1232–1252.
- Gorlin, I., Bridges, D., 2021. Aviation culture: a ‘glass sky’ for women pilots - literature review. *International Journal of Aviation, Aeronautics, and Aerospace* 8 (2).
- Gould, J.A., Kulik, C.T., Sardeshmukh, S.R., 2018. Trickle-down effect: the impact of female board members on executive gender diversity. *Hum. Resour. Manag.* 57 (4), 931–945.
- Goyal, R., Kakabadse, N., Kakabadse, A., Talbot, D., 2023. Female board directors' resilience against gender discrimination. *Gend. Work. Organ.* 30 (1), 197–222.
- Groysberg, B., Bell, D., 2013. Dysfunction in the boardroom. *Harvard business review*, 91 (6), 89–97.
- Håkansson, S., 2024. Explaining citizen hostility against women political leaders: a survey experiment in the United States and Sweden. *Polit. Gend.* 20 (1), 1–28.
- Hansen, J.S., Oster, Jr C.V., 1997. Taking Flight: Education and Training for Aviation Careers. National Academies Press.
- Haslam, S.A., Ryan, M.K., 2008. The road to the glass cliff: differences in the perceived suitability of men and women for leadership positions in succeeding and failing organisations. *Leader. Q.* 19 (5), 530–546.
- Hunt, D.V., Layton, D., Price, S., 2015. Why diversity matters. URL: <https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/why-diversity-matters>.
- IATA, 2018. IATA economics' chart of the week: international women's day 2018 – aviation has further to go. International Air Transport Association. URL: <https://www.iata.org/en/iata-repository/publications/economic-reports/international-womens-day-aviation-has-further-to-go/>.
- IATA, 2022. IATA economics' chart of the week: women are still under-represented in leading positions at airlines. International Air Transport Association. URL: <https://www.iata.org/en/iata-repository/publications/economic-reports/women-are-still-under-represented-in-leading-positions-at-airlines/>.
- IATA, 2023. Air passenger market analysis december 2022. Available at: <https://www.iata.org/en/iata-repository/publications/economic-reports/air-passenger-market-analysis-december-2022/>.
- IATA, 2024. Advancing diversity, equity & inclusion with 25by2025. <https://www.iata.org/en/about/our-commitment/25-by-2025/>.
- IAWA, 2019. International Aviation Womens Association 2019 Annual Report.
- Ibarra, H., 1992. Homophily and differential returns: sex differences in network structure and access in an advertising firm. *Adm. Sci. Q.* 422–447.
- Ingersoll, A.R., Cook, A., Glass, C., 2023. A free solo in heels: corporate risk taking among women executives and directors. *J. Bus. Res.* 157, 113651.
- Ison, S., Budd, L., Attard, M., 2019. Editorial: women, employment and transport. *Research in Transportation Business & Management* 31, 100430.
- JAL, 2022. JAL report 2022. JAL group integrated report. URL: https://www.jal.com/en/sustainability/report/pdf/index_2022a.pdf.
- Kanter, R.M., 1977. Some effects of proportions on group life: skewed sex ratios and responses to token women. *Am. J. Sociol.* 82 (5), 965–990.

- Kassinis, G., Panayiotou, A., Dimou, A., Katsifaraki, G., 2016. Gender and environmental sustainability: a longitudinal analysis. *Corp. Soc. Responsib. Environ. Manag.* 23, 399–412.
- Kim, E., Albelo, J.L.D., 2020. Women in aviation: a phenomenological study exploring the needs & wants necessary for graduation. *Collegiate Aviation Review International* 38 (2), 67–81.
- Lee, B., Worthington, A., 2014. Technical efficiency of mainstream airlines and low-cost carriers: new evidence using bootstrap data envelopment analysis truncated regression. *J. Air Transport. Manag.* 38, 15–20.
- Lemondre, fr, 2023. Air France emerges from the pandemic more profitable. https://www.lemondre.fr/en/economy/article/2023/02/18/air-france-emerges-from-pandemic-stronger-and-more-profitable-6016304_19.html.
- Lewellyn, K.B., Muller-Kahle, M.I., 2020. The corporate board glass ceiling: the role of empowerment and culture in shaping board gender diversity. *J. Bus. Ethics* 165 (2), 329–346.
- Liu, X., Hang, Y., Wang, Q., Zhou, D., 2020. Drivers of civil aviation carbon emission change: a two-stage efficiency-oriented decomposition approach. *Transport. Res. Transport Environ.* 89, 102612.
- Lu, W., Wang, W., Hung, S., Lu, E., 2012. The effects of corporate governance on airline performance: production and marketing efficiency perspectives. *Transp. Res. E: Logist. Transport Rev.* 48 (2), 529–544.
- Lückerath-Rovers, M., 2013. Women on boards and firm performance. *J. Manag. Govern.* 17, 491–509.
- Marinteva, K., Mahanecs, A., Pandey, M., Wilson, N., 2021. Factors influencing low female representation in pilot training recruitment. *Transport Pol.* 115, 141–151.
- McCarthy, F., Budd, L., Ison, S., 2015. Gender on the flightdeck: experiences of women commercial airline pilots in the UK. *J. Air Transport. Manag.* 47, 32–38.
- Merkert, R., Hensher, D., 2011. The impact of strategic management and fleet planning on airline efficiency – a random effects Tobit model based on DEA efficiency scores. *Transport. Res. Pol. Pract.* 45 (Issue 7), 686–695. <https://doi.org/10.1016/j.tra.2011.04.015>.
- Mills, A.J., Mills, J.H., 2006. Masculinity and the making of Trans-Canada Air Lines, 1938–1940: a feminist poststructuralist account. *Canadian Journal of Administrative Sciences* 23 (1), 34–44.
- Mitchell, J., Kristovics, A., Vermeulen, L., Wilson, J., Martinussen, M., 2005. How pink is the sky?: a cross-national study of the gendered occupation of pilot. *Employ. Relat. Record* 5 (2), 43–60.
- Nguyen, M., Yu, M., Lirn, T., 2022. Revenue efficiency across airline business models: a bootstrap non-convex meta-frontier approach. *Transport Pol.* 117, 108–117. <https://doi.org/10.1016/j.tranpol.2022.01.007>.
- Nishii, L., Gotte, A., Raver, J., 2007. Upper Echelon Theory Revisited: the Relationship between Upper Echelon Diversity, the Adoption of Diversity Practices, and Organizational Performance. *Cornell University School of Industrial and Labor Relations. Working paper* 07-04.
- Özgaç, M., Akkaya, O., 2024. Sustainability, climate change and energy efficiency. *Reference Module in Social Sciences*. <https://doi.org/10.1016/B978-0-44-313776-1.00198-7>.
- Pande, R., Ford, D., 2011. *Gender Quotas and Female Leadership: A Review*. World Bank, Washington, DC.
- Pantazi, T., 2022. State aid to airlines in the context of covid-19: damages, disturbances, and equal treatment. *Journal of European Competition Law & Practice* 13 (4), 268–277. June 2022.
- Périlleux, A., Szafarz, A., 2022. Women in the boardroom: a bottom-up approach to the trickle-down effect. *Small Bus. Econ.* 58, 1783–1800.
- Plucinska, J., 2023. Global airlines say more work needed on gender diversity goals. *Reuters*. URL: <https://www.reuters.com/sustainability/global-airlines-say-more-work-needed-gender-diversity-goals-2023-06-06/>.
- Post, C., Byron, K., 2015. Women on boards and firm financial performance: a meta-analysis. *Acad. Manag. J.* 58 (5), 1546–1571.
- Post, C., Latu, I.M., Belkin, L.Y., 2019. A female leadership trust advantage in times of crisis: under what conditions? *Psychol. Women Q.* 43, 215–231.
- Powell, A., Bagilhole, B., Dainty, A., 2009. How women engineers do and undo gender: consequences for gender equality. *Gend. Work. Organ.* 16 (4), 411–428.
- Prokos, A., Padavic, I., 2002. ‘There oughtta be a law against bitches’: masculinity lessons in police academy training. *Gend. Work. Organ.* 9 (4), 439–459.
- Raddant, M., Takahashi, H., 2022. Interdependencies of female board member appointments. *Int. Rev. Financ. Anal.* 81, 102080.
- Reguera-Alvarado, N., de Fuentes, P., Laffarga, J., 2017. Does board gender diversity influence financial performance? Evidence from Spain. *J. Bus. Ethics* 141, 337–350.
- Roberson, Q., Gerkin, E., Hill, A., 2024. Diversity in top management teams and upper echelons of firms. *Curr. Opinion Psychol.* 60, 101901.
- Rodríguez-Fernández, M., Gaspar-González, A.I., Sánchez-Teba, E.M., 2020. Does diversity in top management teams contribute to organisational performance? The response of the IBEX 35 companies. *Soc. Sci.* 9 (4), 36.
- Rossi, F., Hu, C., Foley, M., 2017. Women in the boardroom and corporate decisions of Italian listed companies: does the “critical mass” matter? *Manag. Decis.* 55 (7), 1578–1595.
- Rubery, J., Grimshaw, D., 2015. The 40-year pursuit of equal pay: a case of constantly moving goalposts. *Camb. J. Econ.* 39 (2), 319–343.
- Runyan, R.C., Huddleston, P., Swinney, J., 2006. Entrepreneurial orientation and social capital as small firm strategies: a study of gender differences from a resource-based view. *Int. Entrepreneurship Manag. J.* 2, 455–477.
- Ryan, M.K., Haslam, S.A., 2005. The glass cliff: evidence that women are over-represented in precarious leadership positions. *Br. J. Manag.* 16 (2), 81–90.
- Ryan, M.K., Haslam, S.A., Morgenroth, T., Rink, F., Stoker, J., Peters, K., 2016. Getting on top of the glass cliff: reviewing a decade of evidence, explanations, and impact. *Leader. Q.* 27 (3), 446–455.
- Ryanair, 2022. *Ryanair pay gap report 2022*. URL: <https://investor.ryanair.com/wp-content/uploads/2022/12/Ryanair-DAC---Gender-Pay-Gap-Report---2022.pdf>.
- Sachdeva, L., Bharti, K., Badhotiya, G.K., 2022. Modeling of career entry barriers for women in male dominated occupations: a case of Indian railways. *Research in Transportation Business & Management* 45, 100871.
- Sanchez-Teba, E.M., Benítez-Márquez, M.D., Porras-Alcalá, P., 2020. Gender diversity in boards of directors: a bibliometric mapping. *Journal of Open Innovation: Technology, Market, and Complexity* 7 (1), 12.
- Seligson, D., 2019. *Women and Aviation: Quality Jobs, Attraction and Retention*. International Labour Organization. Working Paper No. 331, Sectoral Policies Department.
- Sergeant, K., Stajkovic, A.D., 2020. Women’s leadership is associated with fewer deaths during the COVID-19 crisis: quantitative and qualitative analyses of United States governors. *J. Appl. Psychol.* 105 (8), 771–783.
- Simar, L., Wilson, P., 2007. Estimation and inference in two-stage semi-parametric models of production processes. *J. Econom.* 136, 31–64.
- Smith, N., Smith, V., Verner, M., 2006. Do women in top management affect firm performance? A panel study of 2,500 Danish firms. *Int. J. Prod. Perform. Manag.* 55 (7), 569–593. <https://doi.org/10.1108/17410400610702160>.
- Smith, W.E., Cohen, S., Kimbu, A.N., de Jong, A., 2021. Reshaping gender in airline employment. *Ann. Tourism Res.* 89, 103221.
- Suau-Sanchez, P., Voltes-Dorta, A., Cugueró-Escofet, N., 2020. An early assessment of the impact of COVID-19 on air transport: just another crisis or the end of aviation as we know it? *J. Transport Geogr.* 86, 102749.
- Tanrıverdi, G., Merkert, R., Karamaşa, C., Asker, V., 2023. Using multi-criteria performance measurement models to evaluate the financial, operational and environmental sustainability of airlines. *J. Air Transport Manag.* 112, 102456.
- Tate, W.L., Bals, L., 2018. Achieving shared triple bottom line (TBL) value creation: toward a social resource-based view (SRBV) of the firm. *J. Bus. Ethics* 152, 803–826.
- Tokbaeva, D., Achtenhagen, L., 2023. Career resilience of female professionals in the male-dominated IT industry in Sweden: toward a process perspective. *Gend. Work. Organ.* 30 (1), 223–262.
- Torchia, M., Calabrò, A., Huse, M., 2011. Women directors on corporate boards: from tokenism to critical mass. *J. Bus. Ethics* 102, 299–317.
- Trethowan, M.W., Markhvida, K., 2014. The aviation value chain: economic returns and policy issues. *J. Air Transport. Manag.* 41, 3–16.
- Turnbull, P., 2013. *Promoting the Employment of Women in the Transport Sector: Obstacles and Policy Options*, Working Paper No. 298, Sectoral Activities Department. International Labour Organization.
- UN, 2024. Goal 5: achieve gender equality and empower all women and girls. *Sustainable Development Goals*. URL: <https://www.un.org/sustainabledevelopment/gender-equality/>.
- Wang, W., Lu, W., Tsai, C., 2011. The relationship between airline performance and corporate governance amongst US Listed companies. *J. Air Transport Manag.* 17 (2), 148–152.
- Wang, Z., Xu, X., Zhu, Y., Gan, T., 2020. Evaluation of carbon emission efficiency in China’s airlines. *J. Clean. Prod.* 243, 118500.
- Watanabe, C., Naveed, K., Neittaanmäki, P., 2017. ICT-driven disruptive innovation nurtures un-captured GDP – harnessing women’s potential as untapped resources. *Technol. Soc.* 51, 81–101.
- Wilson-Kovacs, D.M., Ryan, M., Haslam, A., 2006. The glass-cliff: women’s career paths in the UK private IT sector. *Equal Opportun. Int.* 25 (8), 674–687.
- Yaniköglü, Ö., Kılıç, S., Küçükönel, H., 2020. Gender in the cockpit: challenges faced by female airline pilots. *J. Air Transport. Manag.* 86, 101823.
- Yaşar Dinçer, F.C., Yirmibeşoğlu, G., 2024. Constraints on women pilots in airline industry: a rising sector of international trade. *J. Air Transport. Manag.* 115, 102538.
- Yen, B., Li, J., 2022. Route-based performance evaluation for airlines – A metafrontier data envelopment analysis approach. *Transport. Res. Part E: Logist. Transport. Rev.* 162, 102748.
- Yu, M., Chen, L., Chiang, H., 2017. The effects of alliances and size on airlines’ dynamic operational performance. *Transport. Res. Part A: Pol. Pract.* 106, 197–214.
- Yu, H., Zhang, Y., Zhang, A., Wang, K., Cui, Q., 2019. A comparative study of airline efficiency in China and India: A dynamic network DEA approach. *Res. Transport. Econ.* 76, 100746.
- Zacccone, M.C., Argiolas, A., 2024. Is a critical mass of women always enough to improve firm performance? The importance of the institutional context. *Corp. Govern.* 24 (8), 1–21.
- Zhang, J., Fang, H., Wang, H., Jia, M., Wu, J., Fang, S., 2017. Energy efficiency of airlines and its influencing factors: A comparison between China and the United States. *Resour. Conserv. Recycl.* 125, 1–8.
- Ziegler, Y., Graml, R., Weissenrieder, C., 2012. Gender diversity culture check: study of the influencing factors of the organisational culture on the number and acceptance of women in leadership positions in the aviation industry in Germany. *Int. J. Econ. Manag. Eng.* 6, 2544–2548.
- Zirulnik, M.L., 2015. *Communicative experiences of African American female pilots on the flight deck: An application of co-cultural theory and narrative nonfiction to inform crew resource management*. Arizona State University.



DSPACE

<https://dspace.org/>

Board and executive gender diversity as a driver of airline efficiency: a network-DEA analysis

Suau-Sanchez, Pere; Voltes-Dorta, Augusto; Lamolla, Laura

2025-04-01

Elsevier

<https://doi.org/10.1016/j.jairtraman.2025.102745>

Suau-Sanchez P, Voltes-Dorta A, Lamolla L. (2025) Board and executive gender diversity as a driver of airline efficiency: a network-DEA analysis. Journal of Air Transport Management, Volume 124, April 2025, Article number 102745