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Carbon Performance in Airlines: A Qualitative Comparative Analysis of Institutional and Firm-Level Drivers

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ABSTRACT

Air transport is one of the fastest-growing sources of greenhouse gas emissions, yet it remains one of the most difficult sectors to decarbonize. The sector's climate impact is amplified by two factors: the steady rise in passenger demand and the absence of commercially viable low-carbon technologies for long-haul flights. At the same time, international regulation is fragmented, offering inconsistent incentives for airlines to reduce emissions. This study examines why some airlines perform better than others in reducing their carbon emissions. We analyze how company strategies interact with national and regional regulatory contexts. Using qualitative comparative analysis (QCA), we study a sample of 34 international airlines. Our contributions are threefold. First, stringent institutional pressures can act as country-specific advantages to push higher carbon performance. Second, institutional complexity can lead to higher carbon performance through possible compensation effects. Third, the ability of multinational enterprises to leverage such country-specific advantages depends on firm-specific conditions.

1 | Introduction

> A Big Climate Problem with Few Easy Solutions: Planes
>
> *New York Times*, May 28, 2021

Air travel has grown from just over one billion passengers in 1985 to 4.6 billion in 2024, with projections reaching 12.4 billion by 2050 (ICAO 2024). This remarkable expansion makes aviation one of the fastest-growing contributors to climate change. Although the industry has set an aspirational target of achieving net-zero carbon emissions by 2050 (ICAO 2024), reaching this goal will be exceptionally difficult.

Today, aviation accounts for around 3.5% of global greenhouse gas emissions. While this may appear modest, two factors make the sector's climate impact disproportionately large. First, the steady growth in air travel drives absolute emissions upward, even as airlines improve efficiency. Second, official statistics typically measure only direct carbon dioxide emissions from burning fuel, while ignoring other high-altitude effects, such as nitrogen and sulfur oxides. The Intergovernmental Panel on Climate Change (IPCC) estimates that these additional effects make aviation's total climate impact two to four times greater than its CO_2 emissions alone (IPCC 1999; Scheelhaase et al. 2021).

Aviation is considered a “hard-to-abate” sector because no low-carbon alternatives to fossil jet fuels are currently viable for long-distance flights (Walls and Wittmer 2022). Unlike road transport or power generation, where electrification is advancing rapidly, large aircraft cannot yet rely on batteries or hydrogen. Biofuels and other alternatives remain expensive and scarce, leaving the industry dependent on kerosene for the foreseeable future.

The regulatory environment adds to the challenge. Aviation is one of the most internationalized industries, yet it lacks

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binding global climate rules (Litrico and David 2017). The UN's International Civil Aviation Organization (ICAO) has promoted offsetting schemes, most recently the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) (Scheelhaase et al. 2018), but these measures have been widely criticized as inadequate (Scheelhaase et al. 2021). Regional initiatives, such as the European Union's inclusion of aviation in its Emissions Trading System (EU ETS), have applied stronger pressure, but only to flights within Europe (Cui and Li 2017). The result is a patchwork of national, regional, and global rules that generate inconsistent incentives for airlines worldwide.

Against this backdrop, there is growing interest among researchers in understanding how various factors influence airline performance (Yu and Rakshit 2023; Wang et al. 2025). The existing research has examined how airlines respond to regulation (Walker and Cook 2009) and how ownership structures affect airlines' engagement with SDGs (Perryman et al. 2022) and sustainability performance (Abdi et al. 2022; Long et al. 2020). Yet we still know little about how *firm-level strategies* (such as renewing fleets, improving fuel efficiency, or geographical scope) interact with *country-level contexts* (such as regulatory strength or policy support) to shape airlines' environmental performance.

The purpose of this study is to examine why some airlines succeed in reducing their carbon emissions while others do not, with particular attention to how company strategies and the policy environments in which they operate interact to shape these outcomes. Formally, we investigate:

1. What configurations of firm-level and country-level conditions are associated with improvements in carbon performance in the airline sector?
2. What underlying mechanisms help explain the differences between these configurations?

We approach these questions using the firm-specific advantage (FSA) and country-specific advantage (CSA) framework (Rugman and Verbeke 2001). This framework highlights how company-level capabilities and country-level institutions interact to influence outcomes. Applying it to aviation, we examine 34 international airlines between 2012 and 2016, a period when the EU and ICAO both introduced more ambitious climate measures. We employ qualitative comparative analysis (QCA) to identify patterns across firms and contexts, drawing on the Atmosfair Airline Index (Mayer et al. 2015; Cui et al. 2024), the most comprehensive and reliable dataset on airline carbon performance.

This paper makes four contributions to the literature on sustainability and international business. First, it addresses a research gap by showing how airlines' carbon performance is shaped not only by company-level strategies but also by the policies and institutions of their home and operating countries. Second, it offers an original angle by applying the FSA–CSA framework to examine the interaction between firm-specific commitments (such as efficiency measures or fleet renewal) and country- or region-specific conditions (such as regulatory strength). Third, it provides new empirical evidence: using QCA of 34 airlines, we identify specific combinations of firm and country factors that explain why some airlines achieve stronger carbon reductions. Finally, the study highlights the broader relevance of regional and national initiatives, showing that these play a decisive role in advancing sustainability in global, hard-to-abate industries.

In sum, this paper sheds light on how one of the world's most globalized industries navigates the challenge of decarbonization. Airlines reduce emissions most effectively when strong company commitments are matched by clear national or regional climate policies. Regional and national initiatives, rather than global agreements alone, are emerging as decisive drivers of sustainability in aviation.

2 | Theory and Conceptual Framework

In our conceptual framework we build mainly on the FSA-CSA framework and institutional theory. The FSA-CSA framework has been previously applied in the context of environmental policy (Rugman and Verbeke 1998), climate change mitigation (Kolk and Pinkse 2008), and green FDI (Patala et al. 2021). It posits that multinational enterprises (MNEs) generate value through developing and recombining FSAs with CSAs (Rugman and Verbeke 2001). FSAs are unique firm-specific resources and capabilities, while CSAs are distinctive attributes and resources that a particular country offers to businesses operating within its borders.

The alignment of climate change mitigation and sustainable competitive advantage requires MNEs to develop new green FSAs or add to existing FSAs, and this often, though not always, necessitates irreversible resource commitments (Kolk and Pinkse 2008). In the presence of uncertainty, for example, due to strong irreversibility of the investment and low expected profitability (Rugman and Verbeke 1998), such commitment strategies can give way to flexibility strategies, where the predominant focus is on operational changes, often at the expense of effectiveness (Backman et al. 2017; Lee 2012). Therefore, the effectiveness of reducing the carbon footprint of an MNE depends on internal conditions, that is, MNE-specific conditions, that alter the willingness and ability to engage in commitment and flexibility strategies.

In addition, and in line with institutional theory, studies have emphasized the influence of external conditions, and specifically the climate policy environment as an institutional pressure (Duan and Jiang 2021) that could act as a CSA for investing in greener operations (Patala et al. 2021). For MNEs, there are two interrelated elements to this. First, each MNE has its own unique geographic footprint that results in a firm-specific exposure to climate policy in different countries. Second, this entails a "balancing act" between home and host country climate change policies (Pinkse and Kolk 2012; Doh et al. 2021) due to the fact that these institutional pressures differ in stringency, leading to institutional multiplicity (Greenwood et al. 2011). This could either result in lowering the commitment of the MNE to green investment due to the ability to flexibly exploit weaker institutional pressures (Duan and Jiang 2021), or it could result in a stronger commitment due to adopting the highest standards for efficiency reasons (Rugman and Verbeke 1998).

From the perspective of MNE strategy, external conditions are not independent factors but interact to generate unique opportunity spaces (Jackson and Deeg 2008). Exploring the impact of external CSR pressures on MNEs, Marano and Kostova (2016) found that "*[institutional]* demands present themselves simultaneously and need to be evaluated in combination rather than in isolation" (p. 29). Also, the findings of Hartmann and Uhlenbruck (2015) highlight the role of institutional antecedents to corporate environmental performance. Moreover, a recent paper by Hartmann et al. (2022) examined eco-innovation leadership in the transportation sector, pointing out that "prior research has tended to either study external or internal antecedents to eco-innovation" (p. 3), but that it is configurations of these conditions that more accurately reflect the complex interplay observed in real-life cases. Taking a qualitative comparative approach results in the possibility of several conjunctions or paths, and emphasizes that the function of individual conditions might differ depending on the configuration of the paths (see, e.g., Misangyi et al. 2017). In the following section, we discuss in more detail the factors that form the essential FSA and CSA conditions related to carbon performance.

2.1 | Firm-Specific Conditions

2.1.1 | Long-Term Investment

There is a growing literature on the determinants of carbon performance in corporations that underlines the importance of firm size and tangible resources available to the firm (Luo et al. 2013). This literature is also showing that other organizational factors, such as voluntary disclosure, can have an impact on carbon performance, but are still often used for greenwashing purposes (Aragón-Correa et al. 2016; Velte 2021). Earlier findings suggest that there are two principal ways in which airlines can improve carbon performance, namely investments in low-carbon technologies (e.g., aircraft modernization or fleet renewal) and operational procedures (e.g., seat capacity, fuel efficiency procedures) (Brueckner and Abreu 2017). However, earlier research on financial performance and sustainability initiatives shows contradictory results. While firms from a wide variety of sectors demonstrate a positive association between financial performance and sustainability initiatives and CSR (Long et al. 2020), this does not seem to hold in the case of airlines, where financial performance does not encourage participation in sustainability initiatives (Abdi et al. 2022). There is evidence that other organizational factors such as alliance membership can have an impact on airlines' emissions (Payán-Sánchez et al. 2019; Yu et al. 2025), but carbon performance data suggests that the most substantive impact is through the fleet-related investment and operational dimension (AAI 2018). These dimensions can be viewed as expressions of either more committed strategies (long-term investments) or flexibility strategies (operational changes), and they are likely to be interdependent with other internal and external conditions.

2.1.2 | Firm Size and Network Scope

Firm size is a significant internal determinant of carbon performance, although the underlying causality is not straightforward or symmetrical. Small firms tend to have limited resources to invest in improving carbon performance (Darnall et al. 2010), whereas large firms are more likely to engage in long-term technology investments involving large capital expenditure (Cole et al. 2013). There is also an argument that large firms are likely to experience more stakeholder pressures, pushing them toward action (De Villiers et al. 2011; Lee 2012), but due to their scale, these companies often cannot choose flexibility strategies; that is, they depend on large capital expenditure in energy efficiency to improve their performance (Haque 2017). For example, larger airlines have greater fleet sizes that reduce the effectiveness of operational measures while simultaneously increasing the need for large capital outlays in new plane acquisitions (Arjomandi and Seufert 2014). Depending on the type of institutional pressures, the effect of firm size on carbon performance may thus differ. Moreover, the role of firm size grows more complicated due to its connection to geographic scope.

The geographic scope of MNEs is often proxied by the number of host countries, which is typically correlated with firm size (Thomas and Eden 2004). Researchers have found that the scope of the resulting MNE network impacts proactive environmental behavior, but the evidence is inconclusive. One study found that more multinational MNEs tend to have stronger disclosure efforts, but this does not always translate into better performance (Aragón-Correa et al. 2016). Another study identified network scope as a potential resource to develop green capabilities (Maksimov et al. 2022). Ahmadova et al. (2022) link network size and institutional complexity. Institutional complexity refers to the situation where an MNE faces multiple, diverse, and sometimes conflicting institutional demands, rules, or expectations from different stakeholders or institutional environments. This complexity creates challenges for how the organization should act, comply, and make decisions. They argue that network scope can have positive effects on environmental performance up to a point at which institutional complexity increases the difficulty of managing the resulting institutional pressures, possibly leading to avoidance strategies.

2.2 | Country-Specific Conditions

2.2.1 | Home Country and Operational Network Policy Stringency

There are two central theoretical lenses that describe the influence of the non-market environment on climate change mitigation efforts in corporations, namely the stakeholder and the institutional approach (Damert et al. 2017). While both are distinct in the relative importance they attribute to agency and structure, there is a strong argument to be made that stakeholder pressures are at least partly shaped by underlying institutional pressures (Damert et al. 2017; Lorenzoni and Pidgeon 2006). In other words, countries with stronger environmental regulation tend to have a stakeholder environment that places higher demands on corporations. Some research also indicates that institutional pressures from government intervention have the most effective impact on corporate carbon performance (Busch et al. 2022; Littlewood et al. 2018; Wu et al. 2024). On the one hand, and unlike other forms of pressures, this is because government intervention can be coercive as is the case with carbon taxes. On the other hand, governments now support and fund specific low-carbon technologies and activities much more openly, thus actively creating future green markets (Mazzucato 2018).

Therefore, we focus our conditions on the stringency of government intervention, that is, the comparative strength of government-induced pressures toward reaching net-zero. To reflect this choice, and to acknowledge the diversity of government interventions through regulation, market-based instruments, and technology incentives, we use the broad term *climate change policy stringency*. Airlines are not specifically targeted in these types of regulations, but indirect regulation is likely to occur. For example, airlines must follow certain rules in destination countries and airports. Airport operators have actively ramped up sustainability efforts and can influence airlines through compliance standards, such as noise reduction, runway usage times, and pollution (Thomas and Scandurra 2023a, 2023b). We expect these rules to be more stringent when the national climate policy context is more stringent, leading to higher compliance efforts and potentially improved carbon performance.

Besides the stringency of the pressures, MNEs are exposed to multiple national climate change policy environments (Doh et al. 2021). While the resulting institutional pressures from different national environments are likely to have an integrated impact on the MNE, two strands of research help to differentiate the link between corporate strategy and institutional multiplicity. First, MNEs tend to develop strategies that reflect the environments of their home country both in terms of their market-related activities (Verbeke and Asmussen 2016), and in terms of the “imprinting” of home country institutions on their non-market behavior (Cantwell et al. 2010). In line with this, evidence shows that MNEs are more likely to engage in both environmental innovation and capital investment when they are exposed to stringent institutional pressures in their home country (de La Leyva- Hiz et al. 2019; Kanagaretnam et al. 2022). For airlines, home countries have a strategic significance as air transportation is of national strategic importance. This was evident, for example, during the Covid-19 pandemic, when governments supported national airlines financially to avoid business failure. Second, the findings by Alonso-Martínez et al. (2020) highlight the inconclusive nature of causality between home market regulatory pressures and environmental performance. Their analysis of country-level drivers of corporate social performance (CSP) suggests that regulation may negatively impact CSP, implying that companies with higher CSP may compensate for weaker regulatory environments. At the same time, institutional pressures coming from various host countries, that is, the operational network of the MNE, have also been found to exhibit significant effects on environmental conduct (Husted 2005). Studies have found positive effects of host country environmental regulation on green innovation (Bu and Wagner 2016; Kim et al. 2021) and investments on the city-level (Pisani et al. 2019). MNEs are also more likely to adapt their strategies to those institutional environments that are more salient to their operations (Oliver 1991; Greenwood et al. 2011). The stock of long-term assets or market size are two possible proxies to model this country bias in MNE strategizing. Marano and Kostova (2016) applied this approach to national CSR pressures and subsequent practice adoption by MNEs, finding that firms more readily adapt to markets they heavily depend on.

In the following section we operationalize these firm-and country-specific factors into conditions whose interactions can be analyzed using a configurational model.

3 | Methods and Data

We rely on a case-oriented research approach in which airline companies are comparable cases. We utilize the fuzzy set qualitative comparative analysis (fsQCA) to systemize case comparisons (Huang et al. 2024; Lawton et al. 2024). QCA is particularly well suited for small- to medium-N case comparisons (Misangyi et al. 2017). The analysis focuses on configurations of conditions leading to the outcome rather than looking at each condition or variable in isolation (Fan et al. 2024). In other words, the combinations of conditions form a specific context that is associated with the outcome (Rihoux and Ragin 2009). The environmental performance of an MNE is an outcome of complex causal relationships, and a configurational approach makes visible multiple relevant paths that can lead to the same outcome. Furthermore, the method is well suited to understand the underlying causal complexity between firm-specific conditions, the policy environment, and environmental performance.

QCA allows an interplay between theoretical and case-oriented knowledge. In this study, the configurational model is built by drawing on previous literature (Misangyi et al. 2017) and utilizing the case knowledge when needed (Basurto and Speer 2012). These analyses were conducted using the QCA and SetMethods package for R. In the following, we present the outcome and conditions and their operationalizations.

3.1 | Outcome and Conditions

We measure the outcome *carbon performance* using the Atmosfair Airline Index (AAI) that is available to us from 2012 to 2016. We use the differences between 2012 and 2016 levels as an indication of carbon performance over the entire period. The index benchmarks an airline's actual emissions with an optimal flight on the level of city pairs and summarizes these to an aggregate score. The advantage of this measure is that it makes airlines directly comparable based on the actual operational emissions occurring on flights with the same city pairs. Hence, differences in the overall distance traveled are not distorting the emissions data.[1]

Home country institutional pressures are operationalized using the OECD environmental policy stringency (EPS) data that measures policy stringency considering regulatory, market-, and incentive-based instruments. It thus provides a

TABLE 1 | Overview of measurements used for fsQCA analysis.

Outcome/conditions	Variable	Measurement	Data source
Outcome	Carbon performance	Differences of AAI index level between 2012 and 2016.	Atmosfair Airline Index (AAI) data
Company conditions	High investment intensity	An average of CAPEX per sales (2012–2016)	S&P Compustat
	Wide geographic scope	The total number of countries an airline operates in based on the route data until 2014.	openflights.org
Policy context conditions	Home country institutional pressures	An average of EPS data (2012–2016)	OECD environmental policy stringency (EPS) data
	Network institutional pressures	A sum of individually weighted average EPS scores per host country (2010–2016). The EPS for each destination country is weighted by the number of routes into that country as a proportion of the total number of routes of the airline.	OECD environmental policy stringency (EPS) data. The route data from openflights.org.

holistic picture of government-related institutional pressures. We use an average between 2010 and 2016 to account for the lagged effects that institutional pressures can have on firm-level outcomes.[2]

Network institutional pressures are calculated by a similar approach found in Marano and Kostova (2016), that is, by a sum of individually weighted average EPS scores per host country. However, since we focus on airlines with a small FDI footprint, we did not use subsidiary location but route data. The EPS for each destination country is weighted by the number of routes into that country as a proportion of the total number of routes of the airline. Hence, our measure should detect the increased salience of host countries that the airline focuses its operations on. Less weight is given to institutional pressures from less frequented countries. The route data was acquired from openflights.org and was reliably collected through a third-party source until 2014. It provides an average representation of the destinations of airlines in their entire operations.

Investment intensity is operationalized using average CAPEX per sales (McGee 2015) from 2012 to 2016 and was obtained from S&P Compustat. *Geographic scope* is the total number of countries an airline operates in based on the route data until 2014. The variable definitions and data sources are summarized in Table 1.

3.1.1 | Analysis

3.1.1.1 | Calibration. In the calibration, the original interval scaled values (Appendix 1) are transformed to a fuzzy-value scale ranging from 0 to 1. The calibration of the outcome and all the conditions was done with the direct method (Rihoux and Ragin 2009, 85). For defining the thresholds, we relied on extant literature and theoretical knowledge and also utilized the case knowledge (Appendix 2). Furthermore, we used visible value breaks in some cases to define the thresholds. The calibrated values can be found in Appendix 3. The truth table is presented in Appendix 4.

3.1.1.2 | Necessity Analysis. QCA allows for identifying necessary and sufficient combinations of conditions (Ragin 2008). A condition or a combination of conditions is considered necessary when the outcome cannot occur without this type of condition. We first conducted a necessity analysis for single conditions of both positive and negative outcomes, but we did not find any necessary conditions. We then ran a subset/superset function with high consistency, coverage, and relevance of necessity thresholds to find combinations of conditions that could form a necessary condition (Duşa 2018, 109). None of the combinations could be deemed necessary.

3.1.1.3 | Sufficiency Analysis. Throughout the analytical process we followed the latest information on best practices for conducting QCA (Greckhamer et al. 2018). In the sufficiency analysis, we applied the enhanced standard analysis (ESA) for sufficiency analysis (Schneider and Wagemann 2013). The use of ESA enabled us to deal with empirically unobserved cases to ensure that the outcome coding in the truth table (Appendix 3) does not contradict prior findings of necessity or sufficiency (Schneider and Wagemann 2012). We set the frequency threshold at one, consistency at 0.83, and PRI cut-off to 0.6 for the positive outcome and one, 0.8, and 0.6 respectively for the negative outcome. The results led to a solution consistency of 0.86 and coverage of 0.75 for the positive outcome. We attained a solution consistency of 0.83 and coverage of 0.65 for the negative outcome.

In the analytical process we considered the limited diversity of the sample. In other words, the set of empirical cases, which we have data on, is not an exhaustive sample including all possible combinations of conditions leading to specific outcomes. There can be empirically unobserved cases that lead to an outcome, and we performed the counterfactual analysis to take into account this type of limited diversity by making theoretically informed directional expectations. For the positive outcome we assumed that the presence of *high investment intensity*, and the presence of both *home and network institutional pressures* is associated with the positive outcome, that is, these conditions are easy counterfactuals (Haesebrouck 2023). For the negative outcome, we assumed that *low investment intensity* is associated with the negative outcome. By following these assumptions, we can recognize each solution's so-called core and peripheral causal conditions, which are marked in the results. Core conditions would remain in the solution term regardless of the simplifying assumptions made in the analysis, and for them, the evidence indicates a strong association with the outcome. Peripheral causal conditions instead consider what could be plausible, showing weaker empirical evidence for a causal relationship with the outcome. The results of our analysis are presented in the following section with the intermediate solution used as a baseline (Ragin and Fiss 2008) and the peripheral conditions visible.

Following the QCA analysis, the annual reports and corporate sustainability reports for 2012–2016 were collected and analyzed for selected key cases in each configuration to help interpret the results and draw valid causal inferences concerning the interplay of firm-level and country-level conditions on carbon performance (Schneider and Wagemann 2010).

4 | Results

The columns in Table 2 provide the configurations of causal conditions that lead either to high or low carbon performance. The circles represent the presence of a condition while their absence is marked with crossed-out circles. The conditions representing FSAs are denoted as firm-specific conditions, while the CSAs are denoted as policy context conditions.

4.1 | Configurations Leading to High Carbon Performance

Our analysis reveals four configurations leading to high carbon performance. The Australian Qantas Airways exemplifies configuration P1, which is characterized by home country policy stringency in addition to an absence of network policy stringency and narrow geographical scope as a firm-level condition. Qantas is subject to the Australian Emissions Trading Scheme and Clean Energy Act that is putting pressure on carbon performance. The airline went through a business transformation process during our study period focusing on operational efficiency through cost reductions, fleet simplification and fuel-efficiency measures in the Qantas Transformation Program (Annual Report, 2012, 2016). The Quantas Group also removed three aircraft from service in 2015–16 including two lease returns (Annual Report, 2016). Qantas Airlines, focusing on the Asia-Pacific region, operates half of its destination cities (approximately 80 cities) through codeshare services. This configuration also includes TUI Airways.

In contrast to P1, P2 is characterized by the presence of high network institutional pressures and an absence of home country policy stringency. The case companies under the configuration have low investment intensity and a narrow geographic scope. El Al Israel Airlines Ltd. represents this configuration. Established in 1948, El Al Israel Airlines operates as Israel's designated air carrier in most of the international routes operating to and from Israel. At the end of our study period, the company operated passenger flights to 34 direct destinations in Europe, North America, the Middle East, Central Asia, and other destinations, in addition to codeshare flights (2016 Annual Report). In the annual reports of our study period, network institutional pressures concerning emissions are reflected as increased stringency by the host governments (2015 Annual Report, p. A-82): "Following increased global awareness to the process of global warming up, governments are willing to monitor and limit the level of air pollution caused by engines. In the coming years, laws on the subject are expected to be enacted in various countries worldwide." In terms of regulative risks, the implementation of the EU ETS in incoming and outgoing EU flights is discussed at length. Configuration P2 also includes Aeromexico.

In contrast to configurations P1–P2, configurations P3-P4 share high investment intensity and absence of either home country (P4) or network institutional pressures (P3). China Southern Airlines represents configuration P3 which is dominated by airlines from the emerging markets of Brazil, China and India, representing contemporary state capitalism. In addition to high capital expenditure, this configuration is characterized by the absence of host countries' policy stringency. In terms of fleet size exceeding 700 aircraft, China Southern Airlines is the largest airline in China (2016 Corporate Social Responsibility Report). The airline reports significant changes in its fleet–which in 2016 together with optimization of flight routes for 79,000 flights "produced fuel savings of over 20,000 tons and CO_2 emission reduction of over 60,000 tons" (2016 Corporate Social Responsibility Report, p. 2). The estimated growth rate of the number of aircraft at the end of the 5-year period for 2017 was 8% (Annual Report, 2016, 29). The optimization of the fleet is the airline's main way of reducing fuel consumption and related emissions, thus improving its carbon performance. This configuration also includes American Airlines, Air Canada, Air India, China Eastern Airlines, Hainan Airlines, LATAM Airlines Brazil, Shenzhen Airlines, and Xiamen Airlines Company.

The Spanish Iberia exemplifies configuration P4 which is similarly characterized by high capital expenditure, but also a wide flight-destination network and weak home country policy stringency. In 2011, the merger between Iberia which was "in a fight for viability" (2012 Annual Report of IAG, p. 5) and British Airways took place leading to the formation of International Airlines Group (IAG)—a Spanish registered company with shares traded on the Spanish and London stock exchanges. The goal was consolidation and efficiency improvements through the pooling of investments into new, more efficient fleet, which would enable improved carbon

TABLE 2 | QCA results and representative cases.

	Configurations associated with high carbon performance				Configurations associated with low carbon performance	
	P1	**P2**	**P3**	**P4**	**N1**	**N2**
Firm-level conditions						
High investment intensity		⨂	●	●	⨂	⨂
Wide geographic scope	⨂	⊗		●	●	
Policy context conditions						
High home country institutional pressures	●	⨂		⨂		●
High network institutional pressures	⨂	●	⨂		⊗	●
Consistency	0.92	0.84	0.89	0.90	0.88	0.86
Unique coverage	0.08	0.06	0.16	0.03	0.06	0.11
Strong cases in the configuration	Qantas Airways, TUI Airways	Aeromexico, EI AI Israel Airlines	China Southern Airlines, China Eastern Airlines, Air India, Hainan Airlines, LATAM Airlines Brasil, Shenzhen Airlines, Xiamen Airlines Company	American Airlines, Iberia, Air China	United Airlines, Delta Airlines, Aeroflot Russian Airlines; Turkish Airlines, Brussels Airlines	SAS Scandinavian Airlines, Condor Flugdienst, Virgin Atlantic Airways, Air Transat, TUIfly; Air France, KLM, Lufthansa, Austrian Airlines
Solution consistency	0.86				0.83	
Solution coverage	0.75				0.65	
Key	Causal condition present			●		
	Causal condition absent			⨂		
	Peripheral causal condition present			•		
	Peripheral causal condition absent			⊗		

performance. During our study period, Iberia introduced about 10 new aircraft annually, reporting a savings of 15% in kerosene per aircraft (Corporate Responsibility Report, 2016). Iberia's extensive flight destination network culminates in its leadership position in the air traffic between Europe and Latin America. Within our study period, Iberia aggressively opened new routes, as reflected in the following quote: "During the year Iberia, along with Iberia Express, increased its seat offering per kilometer by 101%, whilst the number of passengers carried per kilometer grew by 1309%. This growth is the result of the two companies opening new routes to Havana, Cali, Medellin, Florence, Catania, Naples, Edinburgh, Hamburg, Gatwick, Charles de Gaulle, Manchester, Budapest and Funchal, in addition to other destinations." (2015 Corporate

Responsibility Report, p.7). This configuration also includes American Airlines and Air China.

4.2 | Configurations Leading to Low Carbon Performance

We found two configurations associated with the negative outcome, that is, low carbon performance. Configurations N1 and N2 are characterized by the absence of high capital expenditure. Although the absence of high capital conditions is in all configurations leading to the negative outcome, they don't fill the criteria of being necessary conditions (cf. Necessity analysis section). This configuration of firm-level conditions is very distinct in comparison to the high carbon performance results.

The US Delta Airlines exemplifies N1, with its flight destination network reaching out to 57 countries and over 300 destinations. Instead of heavy investments in fleet renewal during the study period, Delta worked to improve fuel-efficiency through operational measures such as "reducing onboard weight, lowering shades and opening vents in the passenger cabin when landing at warm destinations" (2016 Corporate Responsibility Report p. 2). The airline is subject to a dynamic regulative environment both at home and abroad: "Unless the EU amends the current legislation following the 2016 Assembly of the International Civil Aviation Organization ("ICAO"), the ETS will apply to all flights originating or landing in the European Union beginning in 2017... In the US, the Environmental Protection Agency (EPA) regulates aircraft emissions and has historically implemented emissions control standards adopted by ICAO." (2016 Corporate Responsibility Report, p. 23).

Air France represents N2. Different from NI, N2 has both home and host countries' institutional pressures present. In 2012, when Air France celebrated the 10-year anniversary of its merger with KLM, all "indicators were in red", as noted by the then Chairman and CEO (2013 Annual Report, p. 3). Subsequently, the Group launched a "Transform 2015 Strategic Plan" with focus on reducing group debt and implementing cost-savings (2014 Corporate Social Responsibility Report). While Air France has phased out some older aircraft and invested in fleet modernization, its environmental indicators (ktonnes of CO_2 emissions) remained constant between 2014 and 2016, while KLM showed a slight decrease (2016 Registration Document). Despite the fact that Air-France–KLM Group was named the leader of the airline category of the Dow Jones Sustainability Index in 2016 for the twelfth consecutive year (2016 Annual Report), our analysis shows low carbon performance for the group as a whole. This somewhat contradictory finding is likely to reflect earlier investments in fleet renewal but lower improvement of carbon performance during our study period. This finding also aligns with a recent study showing that the science-based targets set by the Air-France–KLM Group in line with the UN Paris Agreement will not be achieved with the proposed measures (Peeters et al. 2023). This configuration also includes SAS Scandinavian Airline, Condor Flugdienst, Virgin Atlantic Airways, Air Transat, TUIfly, and Austrian Airlines.

4.3 | Robustness Tests

We employed three approaches that are commonly used to conduct robustness tests for a fsQCA analysis, comprising adjustments in calibration, alterations in the case frequencies, and modifications in consistency thresholds (Oana and Schneider 2021). First, we tested the sensitivity of the calibration of conditions to find out lower and upper threshold bounds for exclusion, crossover, and inclusion values (Appendix 5). Second, we tested the sensitivity of the frequency cut-off. For the frequency cut-off, the results would stay the same if the frequency cut-off is increased to 2 (from the original 1) in both positive and negative outcomes. Third, we used the rob.inclrange function of the SetMethods package of R to test how sensitive the solution is to modifying the solution consistency cut-off from the main analysis values 0.83 (high performance) and 0.8 (low performance). We found that particularly the negative outcome is sensitive to changing the threshold, but the positive outcome stays the same if the threshold is moderately lowered. We can conclude that based on the sensitivity tests the results from the main analysis hold.

5 | Discussion

Sustainable development practices are transforming the aviation industry throughout, from airlines (Perryman et al. 2022) to airports (Thomas and Scandurra 2023a, 2023b). In this paper, we focused on examining how international airlines cope with environmental performance requirements. Overall, our results depicted two contrasting configuration pairs regarding firm-level conditions associated with high carbon performance and one configuration pair associated with low carbon performance. Configurations P1 and P2 are characterized by low investments and narrow geographical scope, whereas P3 and P4 are centered around high investment intensity, with P4 further reinforced by a wide geographical scope. Configurations N1 and N2 are essentially driven by low investment intensity. Based on these findings, we proceed to interpret the results and create propositions from our findings: subsequently, we present three main theoretical arguments. First, that stringent institutional pressures can act as CSAs to push higher carbon performance. Second, that institutional complexity can lead to higher carbon performance through possible compensation effects and third that the ability of MNEs to leverage such CSAs depends on firm-specific conditions.

Configurations P3 and P4 represent airlines that realize higher carbon performance through high investments. Furthermore, configuration P4 includes a wide geographical scope as a present condition, whereas P3 is ambivalent in this regard. It is noteworthy that in our data set, configuration P3 is the most common, and the configuration is based on emerging market airlines with a large domestic market. Interestingly, we also found an absence of network institutional pressures in P3, which might be explained due to the strategic focus of these airlines to serve other emerging markets with low climate policy stringency. In other words, these firms engage in investments with a positive effect on carbon performance even though they are not subjected to strong institutional pressures. Thus, models of state capitalism might be able to control certain forms of transition risks through direct government intervention rather than relying on other regulatory measures. This aligns with earlier studies and the argument that state ownership can play a key role in the sustainability participation of the firm (Abdi et al. 2022; Zu and Song 2009). This leads us to the following proposition:

Proposition 1. *Airlines reach high carbon performance when they have wide geographical scope and high investment intensity and face weak institutional pressures.*

Configurations P1 and P2, which also lead to high carbon performance, are characterized by institutional pressures emanating from the home country or the operational network. This aligns with previous literature that has found both home- and host-country institutions to affect the environmental performance of MNEs (Pinkse and Kolk 2012). We complement this literature by highlighting that a lack of institutional pressures can be compensated by the MNE's network. The configurations P1 and P2 raise the possibility that institutional complexity, by generating interfaces between different "varieties of capitalism" (Saka-Helmhout et al. 2016) could have positive effects on the carbon performance of firms, potentially contributing to a race-to-the-top dynamic (see Madsen 2009). This leads us to propose that:

Proposition 2. *Airlines reach high carbon performance when they have limited geographical scope and face strong home or network institutional pressures.*

Let us address the negative outcomes. Our results identify two configurations, N1 and N2, associated with low-carbon performance. The shared characteristic of these negative configurations is the low investment intensity among the case airlines. Notably, airlines serving wide geographical scope are prone to poor performance if the renewal of their fleet is slow (N1). It is noteworthy that some airlines operating in a policy context in which both home country and network institutional pressures are high (N2) also achieve low carbon performance. This finding contrasts with the study of Korean airlines by Wu et al. (2024), which found that regulatory requirements are the main driver of carbon reductions. The N2 configuration has high unique coverage, indicating that most of the negative cases follow this configuration. The cases under the configuration are European airlines. We interpret this to mean that stringent regulations, which increase carbon costs without providing accessible mitigation support, squeeze airline profit margins (cf. Netherlands Aerospace Centre (NLR) and SEO Amsterdam Economics 2025). This can result in reduced investments, particularly in acquiring new, fuel-efficient aircraft and lead to the re-deployment of older aircraft. Therefore, we propose:

Proposition 3. *Airlines reach low carbon performance when they have low investment intensity and face strong home and network institutional pressures.*

Collectively, these findings make three contributions to the nexus of the literature on FSA-CSA analysis, institutional theory and environmental performance. First, we show how institutional pressures in the form of carbon policy stringency can act as CSAs under certain conditions, but how their presence is no guarantee for higher carbon performance. This is an important finding for understanding the firm-level variation in assessing policy impacts. For example, Ahmadova et al. (2022) have argued that firm-level conditions moderate the effect of multinational scope on environmental performance, but they build on a large-N analysis that abstracts from observations and assesses the average effect of institutional complexity. We complement this finding with a more nuanced view in which firm- and country-specific conditions are treated as configurations that produce contexts in which airlines achieve higher carbon performance.

Second, we make visible the contingent nature of institutional complexity. We found that institutional complexity can lead to higher carbon performance through possible compensation effects, that is, that a lack of regulation in the home or network can be balanced out. This is an interesting finding in the context of the comparative capitalism literature. In our case analysis, we identified firms from liberal market economies that did not face stringent regulation at home but that were subjected to high institutional pressures from their network. The high carbon performance of these firms points to potential complementarities that arise from complex institutional exposure. Such contagion effects somewhat challenge the country-of-origin and imprinting views that underpin some studies. For instance, Backman et al. (2017) analyzed the carbon performance of European and US firms separately due to differences in their institutional origin, but our findings raise the question of whether such a separation is adequate for highly internationalized firms that may be affected by network institutional pressures.

Third, our results indicate that there are clearly distinguishable groups within the airline industry, highlighting the importance of firm-level variation when researching transition outcomes. Among these groups we found a configuration representing emerging market enterprises, specifically from India, Brazil and China. There is a strong representation of Chinese state-owned airlines, and these firms engage in a high level of investments to improve their carbon performance even though they face limited institutional pressures. While strong institutional pressures can act as CSAs by reducing the uncertainty associated with large capital investments, this mechanism seems not to apply for firms with high state involvement that pursue a diversity of social, political, and diplomatic objectives (Musacchio and Lazzarini 2018). This is in line with the literature on EMNEs that views state ties as advantages to hedge against investment risks (Cannizzaro and Weiner 2018).

6 | Conclusions and Policy Implications

Our study set out to understand how international airlines cope with environmental performance requirements in a sector that is both rapidly growing and very difficult to decarbonize. This question is societally important because aviation is a visible and expanding source of greenhouse gas emissions, yet remains one of the hardest industries to align with global climate goals (IEA 2022).

We find that aviation faces a persistent paradox. At the firm level, many airlines have achieved improvements in fuel efficiency, largely through investment in newer fleets. Yet these gains are overshadowed by rising passenger demand, which drives absolute emissions upwards. Over time, the industry has promoted a range of technological solutions ranging from sustainable aviation fuels to electric or hydrogen-powered aircraft, but most have not materialized at scale. These "technology myths" (Peeters et al. 2016) complicate regulation by suggesting that sustainable aviation is always just around the corner, even as governments hesitate to impose stronger measures that might raise ticket prices and limit mobility.

Against this backdrop, our findings show that progress depends on both firm-specific and country- or region-specific conditions. Airlines can improve their performance through investment cycles and operational strategies, but these efforts are insufficient without external pressure. In particular, regional initiatives such as the EU's ReFuelEU regulation (Council of the European Union 2023), which sets binding targets for sustainable aviation fuel use, highlight how regional governance can play a decisive role when global agreements fall short. This confirms the primacy of CSAs in periods of technological transition and demonstrates that regions now act not only as markets but also as critical regulatory forces.

In this study, we found that either investment cycles or institutional pressures can drive improvements in carbon performance. Airlines that can invest in younger fleets achieve significant fuel-efficiency gains, while regulatory pressures at national or regional levels, such as the EU's ReFuelEU initiative, push firms to adopt more sustainable practices. Yet neither mechanism alone is sufficient to solve the problem of rising absolute emissions. Our results confirm the primacy of CSAs in times of technological transition and highlight the growing importance of regional regulation as a driver of industry change. Airlines reduce their emissions most effectively when strong institutional pressures are matched by firm-level investments; regulation without commitment or commitment without pressure is not enough.

This study is not without limitations. First, because of the limited number of cases, we had to restrict the number of conditions in the QCA model to four. Future studies should include a larger sample of cases and develop a more comprehensive model. Second, our data were collected in the pre-COVID era. The COVID-19 outbreak caused asymmetric changes across the aviation sector. While our selected time period enhances the robustness of the results, we acknowledge that the industry is in constant flux, and future studies should explore possibilities for extending the dataset to a more recent time frame. Third, our data are based on secondary sources. New primary data and additional data collection methods, such as interviews or surveys, would help expand the set of conditions or variables and enrich the interpretation of the results.

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Endnotes

[1] Atmosfair airline index: https://www.atmosfair.de/wp-content/uploads/aai2018-englischfarbe_final_mn.pdf. "The challenge of comparing airlines from a climate policy viewpoint has been convincingly scientifically solved by atmosfair." Prof. Dr. Stefan Gössling, Lund University.

[2] OECD EPS: https://stats.oecd.org/Index.aspx?DataSetCode=EPS.

References

AAI. 2018. *Atmosfair Airline Index 2018*, 12. atmosfair. https://www.atmosfair.de/wp-content/uploads/aai2018-englischsw.pdf.

Abdi, Y., X. Li, and X. Càmara-Turull. 2022. "How Financial Performance Influences Investment in Sustainable Development Initiatives in the Airline Industry: The Moderation Role of State-Ownership." *Sustainable Development* 30, no. 5: 1252–1267. https://doi.org/10.1002/sd.2314.

Ahmadova, G., M. Bueno García, B. Delgado-Márquez, and L. Pedauga. 2022. "Firm- and Country-Specific Advantages: Towards a Better Understanding of MNEs' Environmental Performance in the International Arena." *Organization & Environment* 36: 468–497. https://doi.org/10.1177/10860266221129699.

Alonso-Martínez, D., V. De Marchi, and E. Di Maria. 2020. "Which Country Characteristics Support Corporate Social Performance?" *Sustainable Development* 28, no. 4: 670–684. https://doi.org/10.1002/sd.2018.

Aragón-Correa, J. A., A. Marcus, and N. Hurtado-Torres. 2016. "The Natural Environmental Strategies of International Firms: Old Controversies and New Evidence on Performance and Disclosure." *Academy of Management Perspectives* 30, no. 1: 24–39. https://doi.org/10.5465/amp.2014.0043.

Arjomandi, A., and J. Seufert. 2014. "An Evaluation of the World's Major Airlines' Technical and Environmental Performance." *Economic Modelling* 41: 133–144. https://doi.org/10.1016/j.econmod.2014.05.002.

Backman, C. A., A. Verbeke, and R. A. Schulz. 2017. "The Drivers of Corporate Climate Change Strategies and Public Policy." *Business & Society* 56, no. 4: 545–575. https://doi.org/10.1177/000765031557845.

Basurto, X., and J. Speer. 2012. "Structuring the Calibration of Qualitative Data as Sets for Qualitative Comparative Analysis (QCA)." *Field Methods* 24, no. 2: 155–174. https://doi.org/10.1177/1525822X11433998.

Brueckner, J. K., and C. Abreu. 2017. "Airline Fuel Usage and Carbon Emissions: Determining Factors." *Journal of Air Transport Management* 62: 10–17. https://doi.org/10.1016/j.jairtraman.2017.01.004.

Bu, M., and M. Wagner. 2016. "Racing to the Bottom and Racing to the Top: The Crucial Role of Firm Characteristics in Foreign Direct Investment Choices." *Journal of International Business Studies* 47, no. 9: 1032–1057. https://doi.org/10.1057/s41267-016-0013-4.

Busch, T., A. Bassen, S. Lewandowski, and F. Sump. 2022. "Corporate Carbon and Financial Performance Revisited." *Organization & Environment* 35, no. 1: 154–171. https://doi.org/10.1177/10860266209356.

Cannizzaro, A. P., and R. J. Weiner. 2018. "State Ownership and Transparency in Foreign Direct Investment." *Journal of International*

Business Studies 49, no. 2: 172–195. https://doi.org/10.1057/s41267-017-0117-5.

Cantwell, J., J. H. Dunning, and S. M. Lundan. 2010. "An Evolutionary Approach to Understanding International Business Activity: The Co-Evolution of MNEs and the Institutional Environment." *Journal of International Business Studies* 41, no. 4: 567–586. https://doi.org/10.1057/jibs.2009.95.

Cole, M. A., R. J. R. Elliott, T. Okubo, and Y. Zhou. 2013. "The Carbon Dioxide Emissions of Firms: A Spatial Analysis." *Journal of Environmental Economics and Management* 65, no. 2: 290–309. https://doi.org/10.1016/j.jeem.2012.07.002.

Council of the European Union. 2023. "ReFuelEU Aviation Initiative: Council Adopts New Law to Decarbonise the Aviation Sector." https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/refueleu-aviation-initiative-council-adopts-new-law-to-decarbonise-the-aviation-sector/.

Cui, Q., J. Antunes, P. Wanke, Y. Tan, D. Roubaud, and C. J. C. Jabbour. 2024. "The Impact of Chinese Airport Infrastructure on Airline Pollutant Emissions: A Hybrid Stochastic-Neural Network Approach Based on Utility Functions." *Journal of Environmental Management* 352: 120117. https://doi.org/10.1016/j.jenvman.2024.120117.

Cui, Q., and Y. Li. 2017. "Will Airline Efficiency Be Affected by 'Carbon Neutral Growth From 2020' Strategy? Evidence From 29 International Airlines." *Journal of Cleaner Production* 164: 1289–1300. https://doi.org/10.1016/j.jclepro.2017.07.059.

Damert, M., A. Paul, and R. J. Baumgartner. 2017. "Exploring the Determinants and Long-Term Performance Outcomes of Corporate Carbon Strategies." *Journal of Cleaner Production* 160: 123–138. https://doi.org/10.1016/j.jclepro.2017.03.206.

Darnall, N., I. Henriques, and P. Sadorsky. 2010. "Adopting Proactive Environmental Strategy: The Influence of Stakeholders and Firm Size." *Journal of Management Studies* 47, no. 6: 1072–1094. https://doi.org/10.1111/j.1467-6486.2009.00873.x.

de La Leyva- Hiz, D. I., N. Hurtado-Torres, and M. Bermúdez-Edo. 2019. "The Heterogeneity of Levels of Green Innovation by Firms in International Contexts: A Study Based on the Home-Country Institutional Profile." *Organization & Environment* 32, no. 4: 508–527. https://doi.org/10.1177/1086026618761623.

De Villiers, C., V. Naiker, and C. J. Van Staden. 2011. "The Effect of Board Characteristics on Firm Environmental Performance." *Journal of Management* 37, no. 6: 1636–1663. https://doi.org/10.1177/0149206311411506.

Doh, J. P., P. Budhwar, and G. Wood. 2021. "Long-Term Energy Transitions and International Business: Concepts, Theory, Methods, and a Research Agenda." *Journal of International Business Studies* 52: 951–970. https://doi.org/10.1057/s41267-021-00405-6.

Duan, Y., and X. Jiang. 2021. "Pollution Haven or Pollution Halo? A Re-Evaluation on the Role of Multinational Enterprises in Global CO_2 Emissions." *Energy Economics* 97: 105181. https://doi.org/10.1016/j.eneco.2021.105181.

Duşa, A. 2018. *QCA With R: A Comprehensive Resource*. Springer. https://doi.org/10.1007/978-3-319-75668-4.

Fan, D., Y. Su, and M. W. Peng. 2024. "A Configurational Approach to Political Risks and Institutional Logics." *Journal of International Management* 30: 101088. https://doi.org/10.1016/j.intman.2023.101088.

Greckhamer, T., S. Furnari, P. C. Fiss, and R. V. Aguilera. 2018. "Studying Configurations With Qualitative Comparative Analysis: Best Practices in Strategy and Organization Research." *Strategic Organization* 16, no. 4: 482–495. https://doi.org/10.1177/1476127018786487.

Greenwood, R., M. Raynard, F. Kodeih, E. R. Micelotta, and M. Lounsbury. 2011. "Institutional Complexity and Organizational Responses." *Academy of Management Annals* 5, no. 1: 317–371. https://doi.org/10.5465/19416520.2011.590299.

Haesebrouck, T. 2023. "Relevant, Irrelevant, or Ambiguous? Toward a New Interpretation of QCA'S Solution Types." *Sociological Methods & Research* 52, no. 4: 1737–1764. https://doi.org/10.1177/00491241211036153.

Haque, F. 2017. "The Effects of Board Characteristics and Sustainable Compensation Policy on Carbon Performance of UK Firms." *British Accounting Review* 49, no. 3: 347–364. https://doi.org/10.1016/j.bar.2017.01.001.

Hartmann, J., A. Inkpen, and K. Ramaswamy. 2022. "An FsQCA Exploration of Multiple Paths to Ecological Innovation Adoption in European Transportation." *Journal of World Business* 57, no. 5: 101327. https://doi.org/10.1016/j.jwb.2022.101327.

Hartmann, J., and K. Uhlenbruck. 2015. "National Institutional Antecedents to Corporate Environmental Performance." *Journal of World Business* 50, no. 4: 729–741. https://doi.org/10.1016/j.jwb.2015.02.001.

Huang, X., Y. Liang, and D. Webber. 2024. "Strategic Asset-Seeking Acquisitions by Emerging Market Multinational Enterprises and the Liability of Emergingness." *Journal of International Management* 30: 101157. https://doi.org/10.1016/j.intman.2024.101157.

Husted, B. W. 2005. "Culture and Ecology: A Cross-National Study of the Determinants of Environmental Sustainability." *Management International Review* 45, no. 3: 349–371. http://www.jstor.org/stable/40836056.

ICAO [International Civil Aviation Organization]. 2024. "Strategic Plan 2026–2050." https://www2023.icao.int/Meetings/a42/Documents/ICAO-Strategic-Plan-2026-2050-V2.pdf.

Intergovernmental Panel on Climate Change. 1999. "IPCC Special Report on Aviation and the Global Atmosphere." https://www.ipcc.ch/site/assets/uploads/2018/03/av-en-1.pdf.

International Energy Agency. 2022. "Aviation." https://www.iea.org/reports/aviation.

Jackson, G., and R. Deeg. 2008. "Comparing Capitalisms: Understanding Institutional Diversity and Its Implications for International Business." *Journal of International Business Studies* 39, no. 4: 540–561. https://doi.org/10.1057/palgrave.jibs.8400375.

Kanagaretnam, K., G. J. Lobo, and L. Zhang. 2022. "Relationship Between Climate Risk and Physical and Organizational Capital." *Management International Review* 62, no. 2: 245–283. https://doi.org/10.1007/s11575-022-00467-0.

Kim, I., C. Pantzalis, and Z. Zhang. 2021. "Multinationality and the Value of Green Innovation." *Journal of Corporate Finance* 69: 101996. https://doi.org/10.1016/j.jcorpfin.2021.101996.

Kolk, A., and J. Pinkse. 2008. "A Perspective on Multinational Enterprises and Climate Change: Learning From "an Inconvenient Truth"?" *Journal of International Business Studies* 39, no. 8: 1359–1378. https://doi.org/10.1057/jibs.2008.61.

Lawton, T. C., M. A. De Villa, and S. M. Santamaria-Alvarez. 2024. "Making Sense of Socio-Political Risks in International Business: A Configurational Approach to Embracing Complexity." *Journal of International Management* 30, no. 2: 101066. https://doi.org/10.1016/j.intman.2023.101066.

Lee, S. Y. 2012. "Corporate Carbon Strategies in Responding to Climate Change." *Business Strategy and the Environment* 21, no. 1: 33–48. https://doi.org/10.1002/bse.711.

Litrico, J. B., and R. J. David. 2017. "The Evolution of Issue Interpretation Within Organizational Fields: Actor Positions, Framing Trajectories, and Field Settlement." *Academy of Management Journal* 60, no. 3: 986–1015. https://doi.org/10.5465/amj.2013.0156.

Littlewood, D., R. Decelis, C. Hillenbrand, and D. Holt. 2018. “Examining the Drivers and Outcomes of Corporate Commitment to Climate Change Action in European High Emitting Industry.” *Business Strategy and the Environment* 27, no. 8: 1437–1449. https://doi.org/10.1002/bse.2194.

Long, W., S. Li, H. Wu, and X. Song. 2020. “Corporate Social Responsibility and Financial Performance: The Roles of Government Intervention and Market Competition.” *Corporate Social Responsibility and Environmental Management* 27, no. 2: 525–541.

Lorenzoni, I., and N. F. Pidgeon. 2006. “Public Views on Climate Change: European and USA Perspectives.” *Climatic Change* 77, no. 1: 73–95. https://doi.org/10.1007/s10584-006-9072-z.

Luo, L., Q. Tang, and Y. Lan. 2013. “Comparison of Propensity for Carbon Disclosure Between Developing and Developed Countries: A Resource Constraint Perspective.” *Accounting Research Journal* 26, no. 1: 6–34. https://doi.org/10.1108/ARJ-04-2012-0024.

Madsen, P. M. 2009. “Does Corporate Investment Drive a “Race to the Bottom” in Environmental Protection? A Reexamination of the Effect of Environmental Regulation on Investment.” *Academy of Management Journal* 52, no. 6: 1297–1318. https://doi.org/10.5465/amj.2009.47085173.

Maksimov, V., S. L. Wang, and S. Yan. 2022. “Global Connectedness and Dynamic Green Capabilities in MNEs.” *Journal of International Business Studies* 53, no. 4: 723–740. https://doi.org/10.1057/s41267-019-00275-z.

Marano, V., and T. Kostova. 2016. “Unpacking the Institutional Complexity in Adoption of CSR Practices in Multinational Enterprises.” *Journal of Management Studies* 53, no. 1: 28–54. https://doi.org/10.1111/joms.12124.

Mayer, R., T. Ryley, and D. Gillingwater. 2015. “Eco-Positioning of Airlines: Perception Versus Actual Performance.” *Journal of Air Transport Management* 44: 82–89. https://doi.org/10.1016/j.jairtraman.2015.03.003.

Mazzucato, M. 2018. “Mission-Oriented Innovation Policies: Challenges and Opportunities.” *Industrial and Corporate Change* 27, no. 5: 803–815. https://doi.org/10.1093/icc/dty034.

McGee, J. 2015. *Investment Intensity*, 1–2. Wiley Encyclopedia of Management. https://doi.org/10.1002/9781118785317.weom120051.

Misangyi, V. F., T. Greckhamer, S. Furnari, P. C. Fiss, D. Crilly, and R. Aguilera. 2017. “Embracing Causal Complexity.” *Journal of Management* 43, no. 1: 255–282. https://doi.org/10.1177/0149206316679252.

Musacchio, S., and S. G. Lazzarini. 2018. “State-Owned Enterprises as Multinationals: Theory and Research Directions.” In *State-Owned Multinationals: Governments in Global Business*, edited by A. Cuervo-Cazurra, 255–276. Palgrave Macmillan.

Netherlands Aerospace Centre (NLR), and SEO Amsterdam Economics. 2025. “DEstination 2050: A Route to Net Zero European Aviation.” https://www.destination2050.eu.

Oana, I.-E., and C. Schneider. 2021. “A Robustness Test Protocol for Applied QCA: Theory and R Software Application.” *Sociological Methods & Research* 53, no. 1: 57–88. https://doi.org/10.1177/00491241211036158.

Oliver, C. 1991. “Strategic Responses to Institutional Processes.” *Academy of Management Review* 16, no. 1: 145–179. https://doi.org/10.5465/amr.1991.4279002.

Patala, S., J. K. Juntunen, S. Lundan, and T. Ritvala. 2021. “Multinational Energy Utilities in the Energy Transition: A Configurational Study of the Drivers of FDI in Renewables.” *Journal of International Business Studies* 52, no. 5: 930–950. https://doi.org/10.1057/s41267-020-00387-x.

Payán-Sánchez, B., M. Pérez-Valls, and J. A. Plaza-Úbeda. 2019. “The Contribution of Global Alliances to Airlines' Environmental Performance.” *Sustainability* 11, no. 17: 4606. https://doi.org/10.3390/su11174606.

Peeters, P., H. Buijtendijk, and E. Eijgelaar. 2023. “KLM, Science-Based Targets, and the Paris Agreement. Expert Report.” https://pure.buas.nl/ws/portalfiles/portal/32555525/Peeters_Buijtendijk_Eijgelaar_ExpertReport_v4_Final.pdf.

Peeters, P., J. Higham, D. Kutzner, S. Cohen, and S. Gössling. 2016. “Are Technology Myths Stalling Aviation Climate Policy?” *Transportation Research Part D: Transport and Environment* 44: 30–42. https://doi.org/10.1016/j.trd.2016.02.004.

Perryman, M., L. Besco, C. Suleiman, and L. Lucato. 2022. “Ready for Take Off: Airline Engagement With the United Nations Sustainable Development Goals.” *Journal of Air Transport Management* 103: 102246. https://doi.org/10.1016/j.jairtraman.2022.102246.

Pinkse, J., and A. Kolk. 2012. “Multinational Enterprises and Climate Change: Exploring Institutional Failures and Embeddedness.” *Journal of International Business Studies* 43, no. 3: 332–341. https://doi.org/10.1057/jibs.2011.56.

Pisani, N., A. Kolk, V. Ocelík, and G. Wu. 2019. “Does It Pay for Cities To Be Green? An Investigation of FDI Inflows and Environmental Sustainability.” *Journal of International Business Policy* 2: 62–85. https://doi.org/10.1057/s42214-018-00017-2.

Ragin, C. C. 2008. *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*. University of California Press. https://doi.org/10.5565/rev/papers/v80n0.1835.

Ragin, C. C., and P. C. Fiss. 2008. “Net Effects Analysis Versus Configurational Analysis: An Empirical Demonstration.” In *Redesigning Social Inquiry: Set Relations in Social Research*, edited by C. C. Ragin, 190–212. University of Chicago Press.

Rihoux, B., and C. Ragin. 2009. *Configurational Comparative Methods. Qualitative Comparative Analysis (QCA) and Related Techniques*. Sage. https://doi.org/10.4135/9781452226569.

Rugman, A. M., and A. Verbeke. 1998. “Corporate Strategies and Environmental Regulations: An Organizing Framework.” *Strategic Management Journal* 19, no. 4: 363–375. https://doi.org/10.1002/(SICI)1097-0266(199804)19:4<363::AID-SMJ974>3.0.CO;2-H.

Rugman, A. M., and A. Verbeke. 2001. “Subsidiary-Specific Advantages in Multinational Enterprises.” *Strategic Management Journal* 22, no. 3: 237–250. https://doi.org/10.1002/smj.153.

Saka-Helmhout, A., R. Deeg, and R. Greenwood. 2016. “The MNE as a Challenge to Institutional Theory: Key Concepts, Recent Developments and Empirical Evidence.” *Journal of Management Studies* 53, no. 1: 1–11. https://doi.org/10.1111/joms.12156.

Scheelhaase, J., S. Maertens, and W. Grimme. 2021. “Options for Improving the EU Emissions Trading Scheme (EU ETS) for Aviation.” *Transportation Research Procedia* 59: 193–202. https://doi.org/10.1016/j.trpro.2021.11.111.

Scheelhaase, J., S. Maertens, W. Grimme, and M. Jung. 2018. “EU ETS Versus CORSIA—A Critical Assessment of Two Approaches to Limit Air Transport's CO_2 Emissions by Market-Based Measures.” *Journal of Air Transport Management* 67: 55–62. https://doi.org/10.1016/j.jairtraman.2017.11.007.

Schneider, C. Q., and C. Wagemann. 2010. “Standards of Good Practice in Qualitative Comparative Analysis (QCA) and Fuzzy-Sets.” *Comparative Sociology* 9, no. 3: 397–418. https://doi.org/10.1163/156913210X12493538729793.

Schneider, C. Q., and C. Wagemann. 2012. “Set-Theoretic Methods for the Social Sciences.” In *A Guide to Qualitative Comparative Analysis*.

Cambridge University Press. https://doi.org/10.1080/13645579.2013.762611.

Schneider, C. Q., and C. Wagemann. 2013. “Doing Justice to Logical Remainders in QCA: Moving Beyond the Standard Analysis.” *Political Research Quarterly* 66, no. 1: 211–220.

Thomas, A., and G. Scandurra. 2023a. “The Journey Toward the Integrated Reporting of Italian Airport Operators: Empirical Evidence.” *Business Strategy and the Environment* 32, no. 6: 2896–2909. https://doi.org/10.1002/bse.3277.

Thomas, A., and G. Scandurra. 2023b. “The Transition Toward Sustainability of Airport Operators. Evidence From Italy.” *Journal of Air Transport Management* 112: 102470. https://doi.org/10.1016/j.jairtraman.2023.102470.

Thomas, D. E., and L. Eden. 2004. “What Is the Shape of the Multinationality-Performance Relationship?” *Multinational Business Review* 12, no. 1: 89–110. https://doi.org/10.1108/1525383X200400005.

Velte, P. 2021. “Environmental Performance, Carbon Performance and Earnings Management: Empirical Evidence for the European Capital Market.” *Corporate Social Responsibility and Environmental Management* 28, no. 1: 42–53. https://doi.org/10.1002/csr.2030.

Verbeke, A., and C. G. Asmussen. 2016. “Global, Local, or Regional? The Locus of MNE Strategies.” *Journal of Management Studies* 53, no. 6: 1051–1075. https://doi.org/10.1111/joms.12190.

Walker, S., and M. Cook. 2009. “The Contested Concept of Sustainable Aviation.” *Sustainable Development* 17, no. 6: 378–390. https://doi.org/10.1002/sd.400.

Walls, J. L., and A. Wittmer. 2022. *Sustainable Aviation: A Management Perspective*. Springer International Publishing. https://doi.org/10.1007/978-3-030-90895-9.

Wang, C.-N., P.-T. Thi Nguyen, and N.-L. Nhieu. 2025. “A Southeast Asia National Aviation Company Benchmarking by Regret Theory-Based Data Envelopment Analysis Model.” *Journal of Engineering Research* 13, no. 3: 2603–2613. https://doi.org/10.1016/j.jer.2024.07.005.

Wu, B., L. M. Cong, M. P. Williams, and S. Lee. 2024. “Institutional Entrepreneurship and Carbon Reduction Practices—Evidence From South Korea Aviation Industry.” *Transportation Research Part D: Transport and Environment* 136: 104394. https://doi.org/10.1016/j.trd.2024.104394.

Yu, M., Y. Guo, and K. F. See. 2025. “Analysing Group- and Metatechnology Efficiencies and Technology Gap of Airlines for a Sustainable Future.” *Sustainable Development* 33, no. 2: 1649–1669. https://doi.org/10.1002/sd.3149.

Yu, M.-M., and I. Rakshit. 2023. “Target Setting for Airlines Incorporating CO_2 Emissions: The DEA Bargaining Approach.” *Journal of Air Transport Management* 108: 102376. https://doi.org/10.1016/j.jairtraman.2023.102376.

Zu, L., and L. Song. 2009. “Determinants of Managerial Values on Corporate Social Responsibility: Evidence From China.” *Journal of Business Ethics* 88, no. S1: 105–117. https://doi.org/10.1007/s10551-008-9828-7.

Main case material

Qantas:

Annual Report, 2012, retrieved from https://www.qantas.com.au/infodetail/about/investors/2012AnnualReport.pdf.

Annual Review, 2016, retrieved from https://www.qantas.com.au/infodetail/about/investors/2016AnnualReport.pdf.

Annual Report 2019, retrieved from https://www.qantas.com.au/infodetail/about/investors/2019AnnualReport.pdf.

Air Canada:

Annual Report, 2019, retrieved from https://www.aircanada.com/content/dam/aircanada/portal/documents/PDF/en/annual-report/2019_ar.pdf.

Air New Zealand:

Annual Report, 2015, retrieved from http://nzx-prod-s7fsd7f98s.s3-website-ap-southeast-2.amazonaws.com/attachments/AIR/269073/219364.pdf.

Annual Databook, 2019, retrieved from https://indd.adobe.com/view/7aba8401-f5b3-496c-853b-f62f8149896e.

China Southern Airlines:

Corporate Social Responsibility Report, 2018, retrieved from https://www.csair.com/en/about/investor/qitabaogao/2019/resource/3c29183e2343c78126eb686943d79ed0.pdf.

Corporate Social Responsibility Report, 2019, retrieved from https://www.csair.com/en/about/investor/qitabaogao/2019/resource/3c29183e2343c78126eb686943d79ed0.pdf.

Iberia/IAG:

Annual Report of IAG, 2012, retrieved from https://www.iairgroup.com/~/media/Files/I/IAG/annual-reports/iag-annual-reports/en/annual-report-and-accounts-2012-iag.pdf.

Corporate Responsibility Report, 2015, retrieved from https://grupo.iberia.es/contents/archives/475/109/pdfcontent/475_109_1551816615.pdf.

Corporate Responsibility Report, 2016, retrieved from https://grupo.iberia.es/contents/archives/475/109/pdfcontent/475_109_1551817220.pdf.

Corporate Responsibility Report, 2019, retrieved from https://grupo.iberia.es/contents/archives/475/109/pdfcontent/475_109_1551817703.pdf.

Delta Airlines:

Corporate Responsibility Report, 2018, retrieved from http://www.corporatereport.com/delta/2018/crr/.

Appendix 1

Raw Data

	High investment intensity	Wide geographic scope	Home country institutional pressures	Network institutional pressures	OUTCOME (high carbon performance)
AirFrance	6.18	122	3.99	2.08	-9.7
TurkishAirlines	8.51	110	2.59	1.32	−10.7
American Airlines	12.20	97	2.45	1.99	0.5
United Airlines	6.46	97	2.45	1.64	−1.8
KLM	6.18	96	3.17	2.09	−4.2
Lufthansa	8.15	95	3.11	2.18	−2.5
BritishAirways	10.80	91	3.40	2.15	−3.2
Delta Airlines	6.69	77	2.45	1.93	−1.6
Iberia	10.80	69	2.49	2.65	4.7
Air Canada	11.15	67	3.10	1.93	2.7
AeroflotRussianAirlines	6.17	57	0.96	1.84	−11
AustrianAirlines	8.15	53	3.05	2.03	−11.9
BrusselsAirlines	8.15	50	2.94	1.95	15.2
Air China	15.36	44	2.48	2.35	3.1
SASScandinavianAirlines	7.01	41	3.53	3.23	−4.6
China Southern Airlines	12.53	40	2.48	1.35	4.6
Qantas Airways	9.80	38	3.00	1.06	2.6
China Eastern Airlines	28.23	35	2.48	1.75	2.3
Air India	15.05	32	1.96	1.16	11.3
Condor Flugdienst	1.34	30	3.11	2.02	1.4
Aeromexico	7.11	26	1.31	2.11	9.8
EI AI Israel Airlines	7.04	26	0.98	2.40	4.3
Hainan Airlines	28.23	25	2.48	1.94	3.2
VirginAtlanticAirways	6.69	20	3.40	2.18	6.7
Air New Zealand	15.50	19	0.80	2.22	8.7
LATAM Airlines Brasil	14.21	18	0.52	1.54	3.7
Garuda Indonesia	7.97	17	0.83	1.34	−2.8
Air Transat	1.87	16	3.10	2.18	−9.2
TUI Airways	1.97	15	3.40	1.65	6.5
Icelandair	11.48	13	0.75	3.23	−8
Shenzhen Airlines	15.36	10	2.48	1.41	−0.1
Xiamen Airlines Company	12.53	9	2.48	0.47	11.6
Hawaiian Airlines	13.08	9	2.45	2.41	−4.1
TUIfly	3.58	8	3.11	2.68	−5.7

Appendix 2

Calibration Thresholds

Outcome/condition	Full out	Cross-over point	Full in
High carbon performance	−10	0	10
High investment intensity	3.4	10	20
Wide geographic scope	12.6	41.3	100.1
Home country institutional pressures	0.8	2.5	3.5
Network institutional pressures	1	2	3

Appendix 3

Calibrated Values

	High investment intensity	Wide geographic scope	Home country institutional pressures	Network institutional pressures	OUTCOME (high carbon performance)
AirFrance	0.15	0.98	0.99	0.56	0.05
TurkishAirlines	0.34	0.97	0.56	0.12	0.04
American Airlines	0.66	0.94	0.48	0.50	0.54
United Airlines	0.17	0.94	0.48	0.26	0.37
KLM	0.15	0.94	0.88	0.57	0.23
Lufthansa	0.30	0.94	0.86	0.63	0.32
BritishAirways	0.56	0.92	0.93	0.61	0.28
Delta Airlines	0.19	0.86	0.48	0.45	0.38
Iberia	0.56	0.80	0.49	0.87	0.80
Air Canada	0.58	0.78	0.85	0.45	0.69
AeroflotRussianAirlines	0.15	0.69	0.06	0.39	0.04
AustrianAirlines	0.30	0.64	0.83	0.52	0.03
BrusselsAirlines	0.30	0.61	0.78	0.47	0.99
Air China	0.83	0.53	0.49	0.74	0.71
SASScandinavianAirlines	0.21	0.49	0.95	0.97	0.21
China Southern Airlines	0.68	0.47	0.49	0.13	0.79
Qantas Airways	0.48	0.42	0.82	0.06	0.68
China Eastern Airlines	1.00	0.34	0.49	0.33	0.66
Air India	0.82	0.28	0.28	0.08	0.97
Condor Flugdienst	0.02	0.24	0.86	0.51	0.60
Aeromexico	0.22	0.17	0.11	0.58	0.95
EI AI Israel Airlines	0.21	0.17	0.07	0.77	0.78
Hainan Airlines	1.00	0.16	0.49	0.45	0.72
VirginAtlanticAirways	0.19	0.10	0.93	0.63	0.88
Air New Zealand	0.83	0.09	0.05	0.65	0.93
LATAM Airlines Brasil	0.78	0.08	0.03	0.20	0.75
Garuda Indonesia	0.29	0.08	0.05	0.12	0.30
Air Transat	0.03	0.07	0.85	0.63	0.06
TUI Airways	0.03	0.06	0.93	0.26	0.87

	High investment intensity	Wide geographic scope	Home country institutional pressures	Network institutional pressures	OUTCOME (high carbon performance)
Icelandair	0.61	0.05	0.05	0.97	0.09
Shenzhen Airlines	0.83	0.04	0.49	0.15	0.49
Xiamen Airlines Company	0.68	0.04	0.49	0.01	0.97
Hawaiian Airlines	0.71	0.04	0.48	0.77	0.23
TUIfly	0.05	0.03	0.86	0.88	0.16

Appendix 4

Truth Table

Wide geographic scope	High investment intensity	High home country institutional pressures	High network institutional pressures	OUTCOME	*n*	Incl.	PRI	Cases
0	1	0	0	1	7	0.96	0,96	China Southern Airlines, China Eastern Airlines, Air India, Hainan Airlines, LATAM Airlines Brasil, Shenzhen Airlines, Xiamen Airlines Company
1	1	0	1	1	2	0.93	0,93	Iberia, Air China
0	0	1	0	1	2	0.89	0,89	Qantas Airways, TUI Airways
1	1	0	0	1	1	0.89	0.89	American Airlines
1	1	1	1	0	1	0.87	0.87	British Airways
1	1	1	0	1	1	0.87	0.87	Air Canada
0	0	0	1	1	2	0.84	0.84	Aeromexico, EI AI Israel Airlines
0	0	0	0	0	1	0.83	0.83	Garuda Indonesia
0	1	0	1	0	3	0.82	0.82	Air New Zealand, Icelandair, Hawaiian Airlines
1	0	0	0	0	3	0.74	0.74	United Airlines, Delta Airlines, Aeroflot Russian Airlines
1	0	1	0	0	2	0.73	0.73	Turkish Airlines, Brussels Airlines
0	0	1	1	0	5	0.69	0.69	SAS Scandinavian Airlines, Condor Flugdienst, Virgin Atlantic Airways, Air Transat, TUIfly
1	0	1	1	0	4	0.68	0.68	AirFrance, KLM, Lufthansa, Austrian Airlines

Appendix 5

Robustness Protocol Report

	Sensitivity ranges								
	Exclusion			Crossover			Inclusion		
Calibration anchors	**Lower bound**	**Threshold**	**Upper bound**	**Lower bound**	**Threshold**	**Upper bound**	**Lower bound**	**Threshold**	**Upper bound**
High investment intensity (CAPEX)	NA	3.4	NA	NA	10	NA	NA	20	NA
Wide geographic scope (DEST)	NA	12.6	NA	8.3	41.3	NA	NA	100.1	NA
High home country institutional pressures (HOME)	NA	0.8	NA	0.6	2.5	3.9	NA	3.5	NA
High network institutional pressures (HOST)	NA	1	NA	0.5	2	3.2	NA	3	NA
Robustness parameters (for the positive outcome)									
Fit oriented	$\mathrm{RF}_{\mathrm{cons}}$:	0.996	$\mathrm{RF}_{\mathrm{COV}}$:	0.961	$\mathrm{RF}_{\mathrm{sc\_minTS}}$:	0.957	$\mathrm{RF}_{\mathrm{SC\_maxTS}}$:	0.901	
Case oriented	RCRtyp:	1.00	$\mathrm{RCR}_{\mathrm{dev}}$:	0.333	RCC_Rank:	2			
Robustness parameters (for the negative outcome)									
Fit oriented	$\mathrm{RF}_{\mathrm{cons}}$:	1.1	$\mathrm{RF}_{\mathrm{COV}}$:	0.582	$\mathrm{RF}_{\mathrm{sc\_minTS}}$:	0.436	$\mathrm{RF}_{\mathrm{SC\_maxTS}}$:	0.435	
Case oriented	RCRtyp:	0	$\mathrm{RCR}_{\mathrm{dev}}$:	0	RCC_Rank:	4			
Worst performing model (for positive outcome)									
Model	~DEST*~HOST + DEST*CAPEX + ~DEST*~CAPEX*~HOME								
Worst performing model (for negative outcome)									
Model	DEST*~CAPEX + HOME*HOST								