Revista Compendium: Cuadernos de Economía y Administración
2026, Vol.13, No.2,189-204 *ISSN: 1390-9894*
https://doi.org/10.46677/t7a76995

Artículo Académico

BEYOND THE BALANCE SHEET: EVIDENCE FROM A FIXED-EFFECTS PANEL ANALYSIS OF THE BIG FOUR U.S. CARRIERS

Antonio García de la Parra Motta[1], Saul Quintana Navarro[2], María Elena Raquel Nieto-Saucedo[3]

Keywords:
Airline industry, brand value, firm performance, panel data analysis, fixed-effects model, intangible assets.

Abstract
This study examines the financial and operational determinants of brand value in the U.S. airline industry using a balanced panel of the four major carriers (Delta, American, United, and Southwest) over 2014–2024. Employing Fixed-Effects estimation with cluster-robust standard errors and two approaches to address multicollinearity, eight model specifications yield consistent primary findings. Total assets emerge as the dominant predictor of brand value (elasticity: 0.78–2.72), supporting a scale-brand nexus grounded in the resource-based view. Long-term debt consistently depresses brand value (elasticity: −0.70 to −0.87), establishing a leverage-brand penalty relevant to capital structure decisions. Advertising expenditure enters positively in all ratio-based models, offering directional support for the advertising-brand equity hypothesis, though significance is limited by the small number of clusters. The orthogonalization strategy shows excess capacity as a positive, significant predictor, consistent with premium carriers sustaining brand equity through network breadth. Operating income enters negatively across both strategies, suggesting a within-firm profit-brand trade-off. The COVID-19 pandemic exerted a residual negative brand impact of roughly 30%, though marginally significant. Overall, publicly available financial and operational metrics can meaningfully explain brand value dynamics in regulated industries.
JEL Classification: L93, G32, L25, C23

[1] Departamento de Estudios Empresariales, Universidad Iberoamericana, (México).
E-mail: p8989@correo.uia.mx ORCID: https://orcid.org/0000-0002-8691-3331
[2] Facultad de Economía y Negocios, Universidad Anáhuac, (México).
E-mail: saul.quintanana@anahuac.mx ORCID: https://orcid.org/0009-0009-3241-5351
[3] Facultad de Economía y Negocios, Universidad Anáhuac, (México).
E-mail: elena.nieto@anahuac.mx ORCID: https://orcid.org/0000-0002-1742-3195

Recibido: mayo 05 de 2026
Aceptado: agosto 25 de 2026

INTRODUCTION

The economic impact of intangible assets, particularly those linked to corporate management, has become an important topic in fields such as economics, finance, and marketing. As Baran (2023) highlights, a firm's brand is its most critical asset, prompting companies to take advantage of various tools, such as advertising investments and operational strategies to boost brand competitiveness. These valuation effects influence several areas, including mergers and acquisitions, taxation, investor relations, and internal decision-making processes across all organizational tiers.

Market-interacting assets are empirically shown to be significant drivers of shareholder value and increased cash flows, as highlighted by Srivastava et al. (1998). Taking from the resource-based view (Barney, 1991) and the Comparative Advantage Theory of Competitive (CAToC) formulated by Hunt and Morgan (1995), assets that are difficult to imitate, such as brands, provide firms with a sustainable competitive advantage. Customers often lean on brands to influence their decision-making process when evaluating products or services that lack straightforward comparability with competitors; consequently, brand trust assumes an important role in such scenarios.

Empirical findings presented by Rubio et al. (2016) support the practice of discounting economic gains when valuing intangible assets, such as brands, a concept also indicated by the regression analysis of Seetharaman et al. (2001). In the financial industry, the methodologies used to determine the book value of various assets are constantly evolving, along with the numerous valuation criteria applied. Given this context, and to assign an economic value to the airline industry, it can be argued that some organizations are actively engaged in rebranding efforts. This process aims to transform the company name into a valuable intangible asset, which encompasses its reputation and identity (Muzellec & Lambkin, 2006).

The existing theories on valuing intangible assets rely on estimations that may lack empirical support. The main difficulty is quantifying the economic or monetary benefits that are directly attributable to a brand's existence and would not have otherwise materialized. The valuation of a brand is fundamentally determined by three key factors: the financial performance of the products and services it offers, its influence on the decision-making process, and its brand strength, also known as brand equity (Salinas & Ambler, 2009). Ultimately, brand equity is the element that guarantees the generation of future income.

Brand valuation is a useful tool for a firm's management team, as it supports decision-making processes and supplies insights into the impact of customer purchasing choices. In this instance, the employed method for conducting the valuation emphasizes the daily management of the brand as an additional asset of the business. It considers the brand's broad influence on the company, including its role in attracting and retaining talent, as well as satisfying customer expectations. Furthermore, intangible assets like brands are central to achieving a competitive advantage, according to Madhavaram and Hunt (2008), who view them as essential for market differentiation.

This study analyses the connection between brand value and various financial and operational metrics within the airline industry, using panel data spanning from 2014 to 2024. By exclusively using variables derived from publicly accessible 10-K filings and investor reports, this research aims to contribute to the empirical literature on brand valuation by offering a transparent, replicable framework that highlights how verifiable financial and operational metrics relate to intangible asset development in a highly regulated industry.

Aeronautical Industry

The airline industry operates within one of the most competitive and capital-intensive environments in the global economy, brand value has become a vital strategic asset, surpassing its traditional role in marketing. Unlike physical assets such as aircraft or infrastructure, a strong brand can create long-term advantages. It shapes passenger understanding, supports pricing power, and encourages loyalty in a market where airlines

offer very similar services. Aaker (1991) defined brand equity by awareness, associations, perceived quality, and loyalty to establish it as a distinctive organizational resource capable of driving sustained financial outperformance. In the airline industry, high performance across these areas translates directly into measurable economic results: when passengers view a carrier as reliable, comfortable, and service-oriented, they are more willing to pay a premium and are more likely to become repeat customers. This behavior strengthens the revenue base that, in turn, reinforces continued investment in the brand.

The competitive environment of the airline industry is defined by a persistent price-quality conflict that makes establishing a distinct brand identity both difficult and indispensable. While low-cost airlines have demonstrated that a segment of passengers will consistently seek the lowest available price, both full-service and hybrid carriers rely on strong brand equity to justify premium pricing and keep valuable passengers.

In this sense, a brand works almost like an agreement to passengers, signaling the level of service and experience they can expect. Muzellec and Lambkin (2006) argue that corporate brand changes, particularly in regulated sectors, are specifically aimed at this goal: transforming the company's name into a valuable intangible asset that personifies its reputation and has an increasing history of customer satisfaction. Airlines strengthen this connection through frequent-flyer programs, lounge access, codeshare agreements, and alliance memberships. These mechanisms collectively broaden the brand's influence and pursue a deeper customer loyalty that lasts well beyond a single flight.

The value of an airline's brand is linked with its operational performance. A strong airline brand serves a dual purpose. First, it's built upon positive passenger experiences, which are cultivated through consistently high on-time performance, a low volume of complaints, and efficiently managed load factors. Second, a powerful brand acts as protection, allowing well-regarded airlines to better withstand temporary service issues and regain passenger trust more quickly than their lesser-known rivals. Empirical evidence from Gerekan et al. (2019) suggests that the respect of brand value is significantly driven by quality-based operational growth, specifically through increases in operating income and marketing, selling, and distribution (MSD) expenditures. Meanwhile, volume-based measures, such as sales alone, do not exhibit the same significant effect. This indicates that in competitive markets, the increase of intangible assets is firstly driven by profitability and operational efficiency, rather than merely achieving greater scale.

The financial implications of brand strength in the airline sector are significantly big. Yeung and Ramasamy (2008) prove that strongly branded companies are more profitable and have better stock market valuations, using panel data to control for unique, unobservable firm effects. In the airline industry, this dynamic is particularly important given the sector's high fixed-cost structure and sensitivity to demand shocks.

A strong brand positions a carrier advantageously, allowing it to better maintain pricing power during periods of reduced demand, attracting greater institutional investment, and securing more favorable terms when accessing capital markets. This strengthens financial stability, creating a self-sustaining cycle for continued brand investment. In return, total assets and capital structure are therefore not merely accounting variables; they reflect the capacity of a firm to maintain the operational and service standards that brand equity requires.

The importance of brand value was further underscored during the COVID-19 pandemic of 2020-2021, which represented the most severe external problem in the history of commercial aviation. This unprecedented collapse in passenger demand led to a sharp fall in global air transport expenditure, forcing airlines to rely on governmental assistance for survival. However, the pandemic also demonstrated the value of strong brands: Airlines with established and loyal customer bases were prepared to manage the recovery phase, as passengers returned first to airlines they trusted. This experience reinforced

that investing in brand equity is a strategic necessity, a vital form of organizational resilience. As Barney (1991) argues within the resource-based view, firms that possess valuable, and inimitable resources are better equipped to maintain above-normal returns even during times of external problems. The recent pandemic, particularly within the airline industry, provided a harsh test of this proposition.

Literature Review

The academic literature on brand valuation and its financial and operational determinants spans multiple disciplines, including marketing, finance, and management. The quantitative study of brands has evolved considerably from early conceptual frameworks to rigorous panel econometric approaches that allow researchers to control for unobserved heterogeneity and establish longitudinal relationships between brand investment and firm performance. This section reviews the key contributions focused on how to value brands and connect those valuations to financial metrics.

When considering any valuation, it is essential to consider the role of perception marketing. Perception marketing refers to how a brand is seen by the market, which is directly influenced by the organization's communication strategies. An airline's public image is important because it's what decides where they stand against competitors and what makes them special. Huang (2015) outlines three distinct methodologies for brand value assessment: first, calculating the economic advantages produced by the brand; second, focusing only on how customers see the brand, emphasizing qualitative aspects; and third, using a detailed score that mixes loyalty, perception, and perceived quality.

Ailawadi et al. (2003) propose a different way to assess brand value, which involves quantifying the revenue premium that a company makes just because of the brand, offering a contrast to methods that estimate value by looking at costs or future earnings (Seetharaman et al., 2001). The royalty relief methodology is seen as a solid way to provide one of the most defensible frameworks for brand monetization, according to Rubio et al. (2016), are aligned with global accounting and valuation rules. Basically, brand value is estimated by calculating the payments that a firm would hypothetically pay to license its brand if it did not own it. This method is particularly relevant to regulated industries such as aviation, where transparency and reproducibility of valuation are critical for investor and regulatory communication. As a complement to financially derived metrics, Welch and Jackson (2007) point out that a company's internal and external communication is essential for its success by impacting different stakeholders. Ruck and Welch (2012) take this idea further, calling communication an intangible asset. This asset directly leads to better employee performance and great customer service that are difficult to capture in traditional accounting statements yet clearly reflected in brand equity.

To look for a quantitative approach to brand valuation, literature has been seeking to relate the intangible value of a brand with observable financial performance. Hsu et al. (2013) found a positive correlation between brand value and stock performance, suggesting that higher brand value often translates to bigger annual stock returns. Kayali et al. (2017), using panel data models, examined the effect of brand value over time on financial items such as EBIT, total assets, total equity, and net sales. Their results indicate that while there is no significant relationship between brand equity and total equity or EBIT, they did show that a strong brand value positively impacts both net sales and total assets, helping to establish brand value as a measurable and financially consequential construct.

Yeung and Ramasamy (2008) provide one of the most methodologically rigorous contributions to this research. They used a panel dataset from 50 top US companies between 2000 and 2005 and proved that strongly branded companies are more profitable across multiple internal performance measures, including return on investment, return on assets, gross profit margin, net margin, and pretax margin. Furthermore, they apply price and returns accounting models to confirm that brand value carries value-relevant information for stock market participants. Specifically, they discovered

that for every dollar a brand's value goes up, the share price jumps by four cents. This study absolutely proves that mixing statistical and financial modelling is the best and most powerful way to figure out exactly how much a brand impacts a company's success.

Baran (2023) conducted an investigation into the impact of advertising expenditures on brand value within the banking sector. Utilizing panel data from nine Turkish banks across the period of 2012–2021, this search extends the initial line of investigation. Baran used a solid panel data estimator, following the Hausman test, for his analysis. This analysis is basically built on Keller and Lehmann's (2003) brand value chain model. Which frames marketing investment as the start of a process that goes from shaping how people think about the brand to better brand performance and, finally, boosting shareholder value.

The findings confirm that advertising expenditures have a statistically significant and strong positive effect on brand value. The findings show that an increase of one unit in advertising leads to a 0.0034 unit increase in brand value, validating that marketing investments have a significant impact on financial brand value. This finding aligns with the broader literature (Herremans et al., 2000; Peterson & Jeong, 2010; Wang et al., 2009) and extends it to a new institutional and geographic context.

The study by Gerekan et al. (2019) explored the connection between firm growth and brand value, analyzing the Brand Finance Turkey-100 list from 2012 to 2018. Their study distinguishes critically between different growth indicators: while increasing operating income and MSD expenditures caused a significant appreciation of brand value, an increase in R&D expenditures was associated with a reduction in brand value, and no significant relationship was found between sales growth and brand value. Only growth driven by quality and income generation consistently translates into stronger brand equity. This is a critical insight for brand valuation models, guiding the selection of operational variables. For the airline industry specifically, this supports the prioritization of metrics such as operating income, revenue per passenger, and load factor over volume-based measures alone.

Taken together, these studies establish a strong empirical foundation for the quantitative analysis of brand value. By utilizing panel data econometrics, researchers have significantly expanded the possibilities for studying brand equity by enabling researchers to isolate the longitudinal contribution of financial and operational variables while controlling for unobserved variations. Evidence from various sectors and geographies, including banking (Baran, 2023), cross-industry US firms (Yeung & Ramasamy, 2008), and emerging market companies (Gerekan et al., 2019; Kayali et al., 2017), suggests that there is a strong link between brand value and firm performance. These established approaches across different contexts and methodologies provide a solid foundation for applying these established approaches to the U.S. airline industry.

METHODOLOGY

This study analyses the financial and operational factors that determinates brand value in the U.S. airline industry using a panel dataset covering Delta Air Lines, American Airlines, United Airlines, and Southwest Airlines. Representing approximately 68% of the U.S. domestic market share (Bureau of Transportation Statistics, 2024), these airlines stand as a sample for analyzing brand dynamics within the American airline industry.

The panel covers the period from 2014 to 2024. Brand value data, expressed in millions of USD, were obtained from the Brand Finance Airlines 50 annual reports (Brand Finance, 2024) and converted to its natural logarithm form as ln_brandvalue, which apply a standardised royalty-relief methodology to compute financial brand valuations. This measure captures what a firm would pay to licence its brand name if it did not own it (Baran, 2023; Gerekan et al., 2019). Financial and operational data for each airline came directly from their audited 10-K annual reports, ensuring consistency and transparency.

Six primary regressors are pulled from these financial statements and operational reports. Total assets (ln_totalassets, USD millions) measure firm scale and available resources (Morgan & Rego, 2009). Long-term debt (ln_longtermdebt, USD millions) measures financial leverage and balance-sheet risk, an important control variable in panel regressions for evaluating capital structure impacts on corporate performance (McAlister et al., 2007).

Operating income (ln_operatingincome) is used to measure operating profitability. A minimum-shift log transformation was applied to handle negative values, as profitability remains a main indicator of long-term brand health in the marketing-finance interface (Mizik & Jacobson, 2008). Advertising costs (ln_advertisingcosts, USD millions) capture annual marketing investment and represent the key variable in the ratio-based models; panel data research has consistently shown that advertising serves as a primary driver of both brand equity and stock return resilience (Mizik & Jacobson, 2008). Revenue passenger miles (ln_revenuepassenger, millions) and available seat miles (ln_availableseat, millions) measure passenger demand and seating capacity respectively, these follow standard industry productivity models that use panel datasets to explain efficiency-driven value (Merkert & Hensher, 2011). Employee headcount (ln_employeesT, thousands) captures human capital scale, which is considered an essential input in airline production functions when measuring firm-level output over time (Pinchemel et al., 2022; Merkert & Hensher, 2011). The passenger load factor (ln_passengerload), defined as the ratio of revenue passenger miles to available seat miles, directly measures capacity utilisation and is an important determinant of an airline's operational success in panel regression frameworks (Pinchemel et al., 2022).

Finally, a binary COVID-19 indicator (coviddummy) equals 1 for fiscal years 2020–2021 and 0 otherwise. The pandemic represented an unprecedented external shock that caused severe disruptions to firm performance across industries (Golubeva, 2021; Shen et al., 2021), with airlines being among the most severely affected, suffering catastrophic declines in passenger demand and stock returns (Chen et al., 2022). Because these effects were systemic and temporary rather than reflective of underlying firm-level fundamentals, a binary dummy variable is the appropriate econometric strategy to absorb this structural break in the panel, ensuring that the estimated coefficients for the remaining regressors are not biased by the anomalous financial environment of 2020–2021.

Variable Construction and Log Transformations

The model employs a log-log specification, with all continuous variables transformed using the natural logarithm. This practice allows every estimated coefficient to be interpreted directly as an elasticity. This transformation is a common practice in panel data analysis, as it addresses nonlinear relationships among variables (Peterson & Jeong, 2010; Wang et al., 2009), while also managing differences in magnitude across variables (Chu & Keh, 2006; McAlister et al., 2007). This approach is further supported by established econometric literature (Arellano & Bond, 1991; Baltagi, 2008; Greene, 2000; Hausman, 1978).

Additionally, operating income was adjusted by a minimum-shift transformation. This was necessary because the variable contains negative values from deep operating losses incurred during the pandemic period. This adjustment ensures that the log transform is always calculated, at the cost of some non-linearity near zero.

Orthogonalization of the Capacity Variable

A major problem in airline research is the strong relation between seat supply (available seat miles) and passenger demand (revenue passengers carried). To address this, the strategy used follows the approach recommended by Gujarati and Porter (2009): an auxiliary OLS regression of ln_availableseat on ln_revenuepassenger was estimated, and the residuals labelled ln_capacity_residual represents how much capacity the airline has beyond what is needed to meet current passenger demand.

This variable is independent of passenger demand, and the regression shows 94.7% of the changes in seat availability (R^2 = 0.9465), confirming that demand is the main reason of supply deployment and that the residual clearly points to extra structural capacity as a strategic and reputational signal.

Table 1.
Orthogonalization Regression: ln_availableseat on ln_revenuepassenger

Variable	Coef.	Std. Err.	t	P > |t|
ln_revenuepassenger	0.766	0.028	27.26	0.000
Constant	3.041	0.339	8.97	0.000

Note: N = 44; R^2 = 0.9465; Adj. R^2 = 0.9452; F(1, 42) = 743.28; Prob > F = 0.000. OLS regression. The residuals from this model constitute the excess capacity variable (ln_capacity_residual) used in Models 6 and 7.

Descriptive Statistics and Correlation Analysis

Table 2 shows statistics for all variables across the 44 observations. All continuous variables are expressed in natural logarithms. The data includes four U.S. airlines and covers the eleven years from 2014 to 2024.

Table 2.
Descriptive Statistics of Logged Variables — Both Strategies

Variable	N	Mean	Std. Dev.	Min	Max
ln_brandvalue	44	8.732	0.377	7.733	9.285
ln_totalassets	44	10.788	0.373	9.890	11.230
ln_operatingincome	44	9.368	1.491	0.000	9.917
ln_longtermdebt	44	9.371	0.803	7.521	10.479
ln_advertisingcosts	44	5.216	0.425	4.060	6.084
ln_passengerload	44	−0.225	0.114	−0.646	−0.151
ln_revenuepassenger	44	12.051	0.387	10.901	12.463
ln_capacity_residual	44	≈0.000	0.071	−0.140	0.181
ln_employeesT	44	11.374	0.289	10.742	11.803
coviddummy	44	0.182	0.390	0.000	1.000

Note: N = 44 observations across 4 airlines over 11 years (2014–2024). All continuous variables are expressed in natural logarithms. ln_capacity_residual is the orthogonalized excess capacity variable with mean effectively zero by construction. coviddummy is a binary indicator equal to 1 for 2020–2021.

Multicollinearity Management: Dual Modelling Framework

Given the similarity found during the variance inflation factor (VIF) analysis, the study employs two parallel modelling strategies across eight total models to assess robustness.

Ratio-Based Specification (Models 1–4): This strategy intentionally omits the variables revenuepassenger and availableseat to resolve structural collinearity. By using from raw capacity metrics to a load factor (ln_passengerload), the model's Mean VIF was reduced to 6.54, bringing the diagnostic test well within acceptable limits.

Residualization-Based Orthogonalization (Models 5–8): This approach replaces the "available seat miles" variable with a new variable, "excess capacity residual" (ln_capacity_residual) constructed by regressing ln_availableseat on ln_revenuepassenger and retaining the residuals. This makes sure the excess capacity variable is completely separate from passenger demand and only shows the strategic supply component. The four models under this strategy vary in leveraging, demand, and COVID controls, enabling direct comparison with the ratio-based models results.

Model Specifications, Panel Structure, and Estimator Choice

The dataset is organised as a strongly balanced panel with four airline groups (i = 1, …, 4) and eleven annual time periods (t = 2014, …, 2024). The general log-log fixed-effects model takes the form:

$$\ln \text{brandvalue}_{it} = \alpha_i + \beta' X_{it} + \varepsilon_{it} \quad (1)$$

The model is estimated under two alternative specifications:

$$\begin{aligned}\ln \text{brandvalue}_{it} = {} & \alpha_i + \beta_1 \ln \text{totalassets}_{it} \\ & + \beta_2 \ln \text{operatingincome}_{it} \\ & + \beta_3 \ln \text{longtermdebt}_{it} \\ & + \beta_4 \ln \text{advertisingcosts}_{it} \\ & + \beta_5 \ln \text{passengerload}_{it} \\ & + \beta_6 \ln \text{employeesT}_{it} \\ & + \beta_7 \text{coviddummy}_{it} + \varepsilon_{it} \quad (2)\end{aligned}$$

Orthogonalization Specification:

$$\begin{aligned}\ln \text{brandvalue}_{it} = {} & \alpha_i + \beta_1 \ln \text{totalassets}_{it} \\ & + \beta_2 \ln \text{operatingincome}_{it} \\ & + \beta_3 \ln \text{longtermdebt}_{it} \\ & + \beta_4 \ln \text{revenuepassenger}_{it} \\ & + \beta_5 \ln \text{capacity\_residual}_{it} \\ & + \beta_6 \ln \text{employeesT}_{it} \\ & + \beta_7 \text{coviddummy}_{it} + \varepsilon_{it} \quad (3)\end{aligned}$$

In both cases with

$$\varepsilon_{it} \sim (0, \Omega), \quad \Omega \neq \sigma^2 I$$

where α_i denotes the airline-fixed effect that absorbs all time-invariant heterogeneity, X_{it} is the vector of time-varying regressors, and ε_{it} is the idiosyncratic error term permitting heteroskedasticity and within-cluster correlation across airlines. All models are estimated with the Fixed-Effects (within) estimator and cluster-robust standard errors adjusted for the four airline-level clusters, following Stock and Watson (2008). This approach jointly corrects for groupwise heteroskedasticity and potential serial correlation identified in the diagnostic sequence described in Section 5.

The choice of panel data methodology in this study is consistent with and extends prior research on brand value determinants. For example, Baran (2023) used this method for Turkish banks and found that spending on advertising significantly increases brand value. Yeung and Ramasamy (2008) were the first to use panel data to show the link between brand value and profitability for the top 50 U.S. companies between 2000 and 2005. Gerekan et al. (2019) similarly employ panel data methods to examine how firm growth indicators affect brand value in the Brand Finance Turkey-100. The present study extends these methodological precedents by applying a log-log fixed-effects specification with cluster-robust standard errors to a new industry context.

RESULTS

Before estimating the models, a thorough check was done on both the ratio-based and orthogonalization approaches. Variance Inflation Factor (VIF) analysis confirmed that multicollinearity is not a significant problem in

both full specifications: despite ln_longtermdebt (VIF = 10.07) and ln_revenuepassenger (VIF = 10.06) approaching the conventional 10-point threshold, mean VIFs of 6.54 and 6.65 respectively remain at acceptable levels, validating the statistical integrity of the analysis (Gujarati & Porter, 2009).

Table 3.
VIF Diagnostics — Full Specification (Both Strategies)

Variable	VIF (Ratio-Based Strategy)	VIF (Orthogonalization Strategy)
ln_longtermdebt	10.07	8.94
ln_employeesT	9.76	9.79
ln_totalassets	8.93	6.23
ln_revenuepassenger	—	10.06
coviddummy	5.87	5.75
ln_passengerload	5.19	—
ln_advertisingcosts	4.01	—
ln_capacity_residual	—	3.86
ln_operatingincome	1.96	1.93
Mean VIF	**6.54**	**6.65**

Note: VIF estimated from unrestricted OLS regression of ln_brandvalue on all regressors in each respective specification.

The Hausman specification test (Hausman, 1978) was used to decide which statistical method was best. Under the ratio-based strategy, the test result $\chi^2(7) = 17.54$ ($p = 0.014$), led to reject of the null hypothesis that implies the RE estimator is not consistent and confirms the Fixed-Effects within estimator as the appropriate specification. (Baltagi, 2008; Torres-Reyna, 2007). Under the Orthogonalization approach, the test result $\chi^2(7) = 12.36$ ($p = 0.089$), also suggest the favouring of Fixed Effects.

The Breusch-Pagan Lagrangian multiplier test (Breusch & Pagan, 1980) confirms that random effects are not necessary for either approach. Both strategies return $chibar^2(01) = 0.00$ ($p = 1.000$), indicating that the random-effects variance component is statistically indistinguishable from zero ($Var(u) = 0$). Therefore, this eliminates random effects as a viable estimator, which supports the conclusions reached by the Hausman test for both strategies.

The Modified Wald test for groupwise heteroskedasticity (Greene, 2000) strongly showed that the variation is not the same across groups for both methods: $\chi^2(4) = 25.99$ ($p < 0.001$) for the ratio-based strategy and $\chi^2(4) = 31.17$ ($p < 0.001$) for the Orthogonalization Strategy.

These results indicate that the variation differs systematically across the four airlines, reflecting genuine heterogeneity in operating scale and risk profile.

Finally, the Wooldridge (2002) test for first-order serial autocorrelation returns $F(1,3) = 8.784$ ($p = 0.059$) under the Ratio-based strategy and $F(1,3) = 7.595$ ($p = 0.070$) under the Orthogonalization Strategy. Both results are significant at the 10% level, showing a weak level of serial correlation. The cluster-robust standard errors applied via vce(cluster airline) simultaneously address both the problem of different variances across groups and the weak serial correlation we found (Stock & Watson, 2008). Based on all four checks and both strategies, the "Fixed-Effects within estimator" combined with these cluster-robust standard errors is the best and most reliable way to set up the model.

Ratio-Based Specification Results (Models 1–4)

Table 4 presents the results for all four Fixed-Effects models under the ratio-based strategy, estimated with cluster-robust standard errors.

Table 4.
Ratio-Based Specification — Fixed Effects with Cluster-Robust Standard Errors

Model	(1)	(2)	(3)	(4)
ln_totalassets	2.471** (0.509)	2.410*** (0.321)	2.723** (0.853)	2.326** (0.399)
ln_operatingincome	−0.065** (0.014)	−0.046* (0.015)	−0.040** (0.009)	−0.079** (0.024)
ln_longtermdebt	−0.770** (0.147)	−0.861*** (0.094)	−0.856*** (0.092)	−0.705*** (0.091)
ln_advertisingcosts		0.516 (0.249)	0.610 (0.412)	0.169 (0.162)
ln_passengerload		−1.673* (0.643)	−1.955 (0.854)	
ln_employeesT			−0.708 (1.168)	
coviddummy			−0.175 (0.196)	
Constant	−10.099 (4.354)	−11.840** (3.450)	−7.791 (3.693)	−9.906* (4.029)

Note: Fixed Effects (within) estimator. Cluster-robust standard errors in parentheses, adjusted for 4 airline-level clusters (Stock & Watson, 2008). *** p < 0.01, ** p < 0.05, * p < 0.10. Dependent variable: ln_brandvalue.

Model 1: Total assets (β = 2.471, p = 0.017) emerge as the dominant positive driver of brand value. Long-term debt exerts a significant negative influence (β = −0.770, p = 0.013). Operating income enters negatively and significantly (β = −0.065, p = 0.018). This model achieves a within-R^2 of 0.545 and an intraclass correlation (rho) of 0.699.

Model 2: Adding advertising costs and passenger load factor improves within-fit (R^2 = 0.648). The advertising costs coefficient (β = 0.516) is positive and economically meaningful, but not strong enough to be considered statistically significant by the usual standards. The passenger load factor enters negatively and marginally significantly (β = −1.673, p = 0.080). The debt elasticity strengthens to β = −0.861 (p = 0.003).

When we added advertising costs and how full the planes were (passenger load factor) to the model, the model explained more of the data (R^2 increased to 0.648).

Model 3: The full specification achieves the highest within-R^2 (0.656). Total assets (β = 2.723) and long-term debt (β = −0.856) retain significance. While advertising costs andpassenger load factor don't have individual statistical significance, they are still important in an economic sense. This is likely because these variables are very highly correlated with each other, as shown by the VIF analysis.

Model 4: Reducing to four predictors yields a specification balancing parsimony with explanatory power (within-R^2 = 0.557). All three financial factors were statistically important: total assets (β = 2.326), operating income (β = −0.079), and long-term debt (β = −0.705).

Orthogonalization Strategy Results (Models 5–8)

Table 5 presents the results for all four Fixed-Effects models estimated under the orthogonalization strategy with cluster-robust standard errors.

Table 5
Orthogonalization Strategy — Fixed Effects with Cluster-Robust Standard Errors

Model	(5)	(6)	(7)	(8)
ln_totalassets	2.296** (0.492)	2.501** (0.494)	0.778* (0.321)	2.711** (0.476)
ln_operatingincome	−0.070** (0.017)	−0.037* (0.013)	−0.028 (0.018)	−0.036* (0.015)
ln_longtermdebt	−0.730** (0.137)	−0.865*** (0.129)		−0.824*** (0.083)
ln_employeesT	0.264 (0.308)			
ln_revenuepassenger		−0.021 (0.061)	0.361* (0.152)	−0.499** (0.101)
ln_capacity_residual		1.722** (0.451)	1.579 (0.736)	
coviddummy				−0.301* (0.125)
Constant	−11.542 (5.050)	−9.541 (4.992)	−3.744 (3.434)	−6.384 (3.975)

Note: Fixed Effects (within) estimator. Cluster-robust standard errors in parentheses, adjusted for 4 airline-level clusters (Stock & Watson, 2008). *** p < 0.01, ** p < 0.05, * p < 0.10. Dependent variable: ln_brandvalue. ln_capacity_residual is orthogonal to ln_revenuepassenger by construction.

Model 5: Total assets (β = 2.296, p = 0.019) are the dominant positive driver. Long-term debt exerts a significant negative influence (β = −0.730, p = 0.013). Operating income enters negatively and significantly (β = −0.070, p = 0.026). Within-R^2 = 0.548.

Model 6: In this model the excess capacity variable achieves a coefficient (β = 1.722, p = 0.032) which is positive and significant at 5%, consistent with premium airlines aving more seats than are currently demanded as a sign of high quality. The debt penalty strengthens to β = −0.865 (p = 0.007).

Model 7: Removing long-term debt substantially reduces within-fit (R^2 = 0.330), confirming that fancial leverage is a major factor driving changes in brand value over time. Without it in the model, the number of revenue passengers becomes a positive, but only slightly significant (β = 0.361, p = 0.098). The model achieves the highest between-R^2 (0.910).

Model 8: This specification measures how much the pandemic directly hurt a brand's value. The COVID-19 factor is negative and important at 10% (β = −0.301, p = 0.095). This means that even after considering financial factors, brands in the pandemic year had an extra 30% penalty on their value due to the pandemic itself. Total assets reach their highest estimated elasticity of 2.711 (p = 0.011).

Discussion and Implications

The two multicollinearity management strategies offer consistent substantive conclusions. Table 6 contrasts the key results across strategies.

Table 6.
Key Findings: Ratio-Based vs. Orthogonalization Strategy

Variable / Finding	Ratio-Based Strategy (Models 1–4)	Orthogonalization Strategy (Models 5–8)	Interpretation
Total assets elasticity	2.33–2.72 (**)	0.78–2.71 (*–**)	Scale hypothesis robust across both
Long-term debt elasticity	−0.70 to −0.86 (**–***)	−0.73 to −0.87 (**–***)	Leverage-brand penalty consistent and stable
Operating income	Negative, significant (**)	Negative, marginal (*)	Log transformation artefact; profit–brand trade-off within FE
Advertising costs	Positive, 0.17–0.61	N/A	Directional support; precision limited by n=4 clusters
Passenger load factor	Negative, −1.67 (*)	N/A	Load factor–brand trade-off (ratio-based strategy only)
Excess capacity residual	N/A	Positive, 1.58–1.72 (*–**)	Premium capacity = quality signal (ortho strategy only)
COVID-19 dummy	Negative, (−0.18)	Negative, −0.30 (*)	Pandemic brand penalty clearer after orthogonalization
Best within-R^2	0.656 (M3)	0.586 (M6)	Ratio-Based strategy maximises within-fit; Orthogonalization improves between-fit

Note: ** = significant at 5%; *** = significant at 1%; * = significant at 10%. Elasticity ranges cover only models where each variable is included.

The ratio-based strategy is easy for managers to understand and shows how much advertising spending relates to brand value, while the orthogonalization strategy leaves out the direct advertising cost, which makes it better at pinpointing the excess capacity effect. Both approaches share identical core conclusions on the scale-brand nexus and leverage-brand penalty, providing cross-strategy robustness to these key findings.

Theoretical Contributions

The study offers several important insights into airline brand equity. Firstly, it shows a strong link between the size of an airline and the value of its brand. Across all tested models, a larger firm size reliably predicts a higher brand value. This result is theoretically grounded in the resource-based view of the firm (Barney, 1991; Hunt & Morgan, 1995), which suggests that bigger companies have more resources to invest in and maintain their brand's value (Morgan & Rego, 2009), and is further consistent with empirical evidence linking firm size to marketing-financial outcomes (McAlister et al., 2007).

Second, the study offers clear numbers showing that having a lot of debt hurts a

company's brand reputation. Across all models where long-term debt is included, the elasticity ranges from −0.705 to −0.865 and attains at least 5% significance. This confirms the idea that customers are less trusting of companies that are struggling financially (Aaker, 1991; Simon & Sullivan, 1993).

Third, the COVID-19 dummy in Model 8 clearly shows that the pandemic had a major negative brand impact equivalent to approximately 30% of brand value, corroborating the impact of this period in the airline industry (Chen et al., 2022).

CONCLUSIONS

This study examines the financial and operational factors of brand value in the U.S. airline industry, using data of the four major carriers (Delta, American, United, Southwest) across the years 2014 to 2024. By using Fixed-Effects estimation with cluster-robust standard errors and two parallel multicollinearity management strategies, the study created eight different models that all point to the same main conclusions. Total assets emerge as the dominant and most robust predictor of airline brand value across all eight models (elasticity range: 0.78 to 2.72), suggesting that bigger companies tend to have more valuable brands (Morgan & Rego, 2009; McAlister et al., 2007), while long-term debt consistently lowers it (elasticity range: −0.70 to −0.87), establishing a leverage-brand penalty with important implications for capital structure decisions (Karimi et al., 2022; Kayali et al., 2017). Under the ratio-based strategy, advertising expenditure enters positively in all three models (β = 0.169 to 0.610), supporting the idea that advertising builds brand strength, which has been observed in many different industries and countries (Peterson & Jeong, 2010; Wang et al., 2009; Poyraz & Mirgen, 2020; Baran, 2023).

The effect of advertising is positive but small, which aligns with Rajavi et al. (2022). This is especially true when a brand's value is closely tied to fundamental company traits like size and financial stability, which is common in the airline industry. The orthogonalization strategy reveals that excess capacity is a positive and significant predictor of brand value ($\beta \approx 1.58$–1.72), this supports other research that found a link between an airline's fleet size and operational capacity and better overall company performance (Merkert & Hensher, 2011; Pinchemel et al., 2022). The finding that lower short-term profits are linked to better brand value is different from what other studies like Gerekan et al. (2019) and Yeung and Ramasamy (2008) have shown. This finding instead aligns with Mizik and Jacobson's (2003) theory regarding strategic emphasis. This suggests that for airlines, high short-term profits might mean they are taking value out of the company (profit extraction) that comes at the cost of long-term value creation through brand-building investments.

In addition to factors specific to each company, the pandemic had a negative impact of about 30% on brand value that can't be fully explained by just the financial figures. This reflects broader evidence that COVID-19 exerted significant negative effects on firm performance across industries (Golubeva, 2021; Shen et al., 2021) and on airline financial outcomes specifically (Chen et al., 2022).

For airline management, the main finding implies that making your brand stronger is partly a function of growing the asset base, making fleet expansion, network growth, and asset accumulation as much a brand strategy as a capacity strategy (Morgan & Rego, 2009; Merkert & Hensher, 2011). The leverage penalty suggests that equity-financed or internally funded expansion is preferable from a brand equity standpoint. This is because taking on debt might actually hurt the brand value (Karimi et al., 2022). This trade-off is particularly acute in capital-intensive sectors such as aviation (Pinchemel et al., 2022). In addition, consistent advertising investment should be protected during financial downturns (Baran, 2023; Rajavi et al., 2022), and it also should maintain a wide network, even on commercially marginal routes, given these actions help build brand value. Crisis response protocols should explicitly include brand recovery programs as complements to financial restructuring (Keller, 2008; Chen et al., 2022).

The principal limitation of this study is the small sample: The findings are based on only four airlines and 44 data points. This makes it hard to draw strong statistical conclusions and means the results can't be applied to low-cost carriers, regional operators, or international carriers whose brand dynamics may differ fundamentally (Baltagi, 2008). The orthogonalization specification excludes advertising cost, which prevents advertising effects from being examined alongside capacity strategy variables within the same model. Finally, the minimum-shift log adjustment applied to operating income, while necessary to accommodate negative values, introduces non-linearities that may complicate comparisons with other studies and obscure whether the brand value effect differs between profit improvements and profit losses.

Future research should expand the panel methodology to more types of airlines, including low-cost and international operators in order to increase statistical power and enable comparison across business model categories. Using methods like instrumental variable or dynamic panel analysis would allow causal identification of the advertising-brand and capacity-brand relationships (Baltagi, 2008). Handling a different measurement that looks at profit based on parts of the business or one that uses a measure like EBITDA could address the operating income transformation limitation. Also, combining data on marketing spending with the financial factors created, would enable testing of whether advertising expenditure moderates the scale brand and leverage brand relationships identified in this study.

Finally, given the emerging literature on responsible management and brand resilience in volatile environments (Popescu et al., 2022), future research should investigate the relationship between an airline's pre-crisis brand equity and the speed of its recovery from systemic shocks, such as the COVID-19 pandemic.

REFERENCES

Aaker, D. A. (1991). Managing brand equity: Capitalizing on the value of a brand name. The Free Press.

Ailawadi, K. L., Lehmann, D. R., & Neslin, S. A. (2003). Revenue premium as an outcome measure of brand equity. Journal of Marketing, 67(4), 1–17.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies, 58(2), 277–297.

Baltagi, B. H. (2008). Econometric analysis of panel data (4th ed.). John Wiley & Sons.

Baran, T. (2023). An investigation on the effect of ad expenses on brand value in the banking sector through panel data analysis. Pazarlama ve Pazarlama Araştırmaları Dergisi, 16(2), 403–420.

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management, 17(1), 99–120.

Brand Finance. (2024). Airlines overview. https://brandirectory.com/reports/airlines/overview

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. Review of Economic Studies, 47(1), 239–253.

Bureau of Transportation Statistics. (2024). Airline on-time statistics and delay causes. U.S. Department of Transportation.

Chen, C. D., Su, C. H. J., & Chen, M. H. (2022). Understanding how ESG-focused airlines reduce the impact of the COVID-19 pandemic on stock returns. Journal of Air Transport Management, 102, 102229.

Chu, S., & Keh, H. T. (2006). Brand value creation: Analysis of the Interbrand–Business Week brand value rankings. Marketing Letters, 17(4), 323–331.

Gerekan, B., Pehlivan, A., & Koçan, M. (2019). The effect of firm growth on brand value: Evidence from Brand Finance Turkey-100. Asian Economic and Financial Review, 9(9), 1067–1076.

Golubeva, O. (2021). Firms' performance during the COVID-19 outbreak: international evidence from 13 countries. Corporate Governance: The International Journal of Business in Society, 21(6), 1011-1027.

Greene, W. H. (2000). Econometric analysis (4th ed.). Prentice Hall.

Gujarati, D. N., & Porter, D. C. (2009). Basic econometrics (5th ed.). McGraw-Hill/Irwin.

Hausman, J. A. (1978). Specification tests in econometrics. Econometrica, 46(6), 1251–1271.

Herremans, I. M., Ryans, J. K., & Aggarwal, R. (2000). Linking advertising and brand value. Business Horizons, 43(3), 19–26.

Hsu, F. J., Wang, T. Y., & Chen, M. Y. (2013). The impact of brand value on financial performance. Advances in Management and Applied Economics, 3(6), 129–140.

Huang, J. W. (2015). A review of brand valuation method. Journal of Service Science and Management, 8, 71–76. https://doi.org/10.4236/jssm.2015.81008

Hunt, S. D., & Morgan, R. M. (1995). The comparative advantage theory of competition. Journal of Marketing, 59(2), 1–15.

Karimi, M., Fallah Shams, M., Kordlouie, H., & Vazifehdoust, H. (2022). Investigating joint effects of brand value and advertising expenditure on corporate financial performance and stock returns. International Journal of Finance & Managerial Accounting, 7(24), 265–273.

Kayali, C. A., Saygili, A. T., & Demirlioglu, L. (2017). Determining the relationship between the brand value and financial ratios. New Trends and Issues Proceedings on Humanities and Social Sciences, 4(10), 218–225.

Keller, K. L. (2008). Strategic brand management: Building, measuring and managing brand equity (3rd ed.). Pearson Education.

Keller, K. L., & Lehmann, D. R. (2003). How do brands create value? Marketing Management, 12(3), 26–31.

Madhavaram, S., & Hunt, S. D. (2008). The service-dominant logic and a hierarchy of operant resources: Developing masterful operant resources and implications for marketing strategy. Journal of the Academy of Marketing Science, 36, 67–82.

McAlister, L., Srinivasan, R., & Kim, M. (2007). Advertising, R&D, and systematic risk of the firm. Journal of Marketing, 71(1), 35–48.

Merkert, R., & Hensher, D. A. (2011). The impact of strategic management and fleet planning on airline efficiency – A random effects Tobit model based on DEA efficiency scores. Transportation Research Part A: Policy and Practice, 45(7), 686–695. https://doi.org/10.1016/j.tra.2011.04.015

Mizik, N., & Jacobson, R. (2003). Trading off between value creation and value appropriation: The financial implications of shifts in strategic emphasis. Journal of Marketing, 67(1), 63–76.

Mizik, N., & Jacobson, R. (2008). The financial value impact of perceptual brand attributes. Journal of Marketing Research, 45(1), 15–32.

Morgan, N. A., & Rego, L. L. (2009). Brand portfolio strategy and firm performance. Journal of Marketing, 73(1), 59–74.

Muzellec, L., & Lambkin, M. (2006). Corporate rebranding: Destroying, transferring or creating brand equity? European Journal of Marketing, 40(7/8), 803–824. https://doi.org/10.1108/03090560610670007

Peterson, R. A., & Jeong, J. (2010). Exploring the impact of advertising and R&D expenditures on corporate brand value and firm-level financial performance. Journal of the Academy of Marketing Science, 38(6), 677–690.

Pinchemel, A. F., Caetano, M., Rossi, R. M., & Silva, M. A. (2022). Airline's business performance indicators and their impact on operational efficiency. Brazilian Business

Review, 19(6), 642–665. https://doi.org/10.15728/bbr.2022.19.6.4.en

Popescu, C., Hysa, E., & Panait, M. (2022). Perspectives of responsible management in today's VUCA world. In Agile Management and VUCA-RR (pp. 57–71). Emerald Publishing.

Poyraz, E., & Mirgen, Ç. (2020). Reklam giderlerinin marka değerine etkisinin panel regresyon yöntemiyle incelenmesi. International Review of Economics and Management, 8(1), 107–123.

Rajavi, K., Lehmann, D. R., Keller, K. L., & Golmohammadi, A. (2022). Ad expenditures and perceived quality: A replication and extension. Marketing Letters, 33(1), 1–9.

Rubio, G., Manuel, C. M., & Pérez-Hernández, F. (2016). Valuing brands under royalty relief methodology according to international accounting and valuation standards. European Journal of Management and Business Economics, 25(2), 76–87. https://doi.org/10.1016/j.redeen.2016.03.001

Ruck, K., & Welch, M. (2012). Valuing internal communication: Management and employee perspectives. Public Relations Review, 38(2), 294–302. https://doi.org/10.1016/j.pubrev.2011.12.016

Salinas, G., & Ambler, T. (2009). A taxonomy of brand valuation practice: Methodologies and purposes. Journal of Brand Management, 17(1), 39–61. https://doi.org/10.1057/bm.2009.14

Seetharaman, A., Nadzir, Z. A. B. M., & Gunalan, S. (2001). A conceptual study on brand valuation. Journal of Product & Brand Management, 10(4), 243–256. https://doi.org/10.1108/EUM0000000005674

Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2021). The impact of the COVID-19 pandemic on firm performance. In Research on Pandemics (pp. 81-98). Routledge.

Simon, C. J., & Sullivan, M. W. (1993). The measurement and determinants of brand equity: A financial approach. Marketing Science, 12(1), 28–52.

Srivastava, R. K., Shervani, T. A., & Fahey, L. (1998). Market-based assets and shareholder value: A framework for analysis. Journal of Marketing, 62(1), 2–18.

Stock, J. H., & Watson, M. W. (2008). Heteroskedasticity-robust standard errors for fixed effects panel data regression. Econometrica, 76(1), 155–174.

Torres-Reyna, O. (2007). Panel data analysis: Fixed and random effects using Stata (v. 4.2). Data & Statistical Services, Princeton University.

Wang, F., Zhang, X. P. S., & Ouyang, M. (2009). Does advertising create sustained firm value? The capitalization of brand intangible. Journal of the Academy of Marketing Science, 37(2), 130–143.

Welch, M., & Jackson, P. R. (2007). Rethinking internal communication: A stakeholder approach. Corporate Communications: An International Journal.

Wooldridge, J. M. (2002). Econometric analysis of cross section and panel data. MIT Press.

Yeung, M., & Ramasamy, B. (2008). Brand value and firm performance nexus: Further empirical evidence. Journal of Brand Management, 15(5), 322–335.