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An Econometric Analysis on Factors Influencing Operational Expenses in Indian Airlines

Ananya Srivastava

Student of BBA in Aviation Management, School of Business, Galgotias University

Abstract:
This paper aims to evaluate the impact of different factors on the operational costs of Indian Airlines using data from the Directorate General of Civil Aviation spanning a decade, from 2007–2008 to 2016–2017. The study examines five variables—average seats per kilometer, average payload, average stage length, average fuel price and airline ownership and their regression against expense/revenue passenger kilometers in order to understand their influence on total operational expenses. The results show that these selected variables significantly affect an airline's operational expenses with together explaining 80.9% of the model outcome. Therefore, managing and considering these variables could enhance airlines' cost efficiency leading to sustainability in a competitive market.

Keywords: Indian airlines, Operational expense, RPK, DGCA, Conceptual framework, Regression

1. INTRODUCTION

India is the seventh largest nation globally and has a land boundary of 15,200 km along with a coastline stretching 7500 km (O'Connell & Williams, 2006);(O'Connell et al., 2013). Faster transportation is becoming increasingly necessary in India, making the role of air transportation important due to its long-distance capabilities, unmatched speed, and time-saving characteristics. The Indian air transport industry began evolving in December 1912 with the first international flight from India on the London-Karachi-Delhi route. The growth of the industry was limited to the elite class until the entry of low-cost carrier 'Air Deccan' in 2003. With increasing GDP per capita and affordable airfares, there has been exceptional growth in the Indian air transport sector over the last decade. Passenger traffic increased from 73.4 million to 223.6 million within a decade (2006–2016). During the financial year 2016–2017, both domestic and international air passenger traffic witnessed a positive growth rate of 17.37 percent compared to previous years. This progress is evident as scheduled Indian carriers' fleet size increased by 177% (162–448) and scheduled aircraft departures increased by 200% during 2003–2015.

India's accomplishments have propelled it to the ninth position among the world's largest aviation markets (Saranga & Nagpal, 2016). The growth of the aviation market in India can be attributed to several factors, including an increase in average income per Indian, affordable fares provided by airlines, the introduction of new airlines, and the expansion of new flight routes. According to forecasts from Airbus and Boeing, there is a projected 5% annual increase in global Revenue-Passenger Kilometers, which is also expected to apply within the Indian context. This surge will lead to a requirement for over 1100 aircraft in India (Airbus, 2007) along with around 400 airports across the nation (Jain & Natarajan, 2015) to exploit this opportunity.

Despite the achievements mentioned above, the Indian aviation sector consistently faces challenges due to cost-sensitive passengers, economic volatility (including taxes and fuel price fluctuations), and intense competition (Saranga & Nagpal, 2016).All these elements led to economic setbacks for numerous airlines. The leading Indian airlines collectively owe approximately 13 billion dollars. Consequently, the Indian aviation sector, often labeled as a "loss-making industry," must generate profits to maintain competitiveness and sustainability in the long term. These airlines have two available choices to boost their profitability: (a) raising fares and maximizing revenue from passengers or (b) cutting costs and enhancing airline travel appeal by offering extra amenities. Although airlines used to pass on their financial liabilities and losses to passengers by raising airfare for a long time, the practice has been limited due to liberalization and the entry of low-cost carriers. As a result, airlines have had to focus on maintaining high operational efficiency by reducing their expenses, particularly fuel costs which make up about 35%–40% of their total operational expenses. Many airlines have transitioned into low-cost carriers in order to achieve fruitful results such as AirAsia and Indigo, who are leaders in investing in fuel-efficient aircraft and implementing policies to conserve fuel. Recently, these low-cost carriers have started integrating traits of both low-cost and full-service carriers, transforming into hybrid air-carriers (Klophaus et al., 2012).
All the situations and possibilities make the Indian air transport sector an important and suitable subject for our study. However, there is limited literature on the Indian air transport industry and its aspects. Various research articles have explored the relationship between operational cost (efficiency) and operating characteristics of airlines from different countries (Brueckner & Abreu, 2017); (Kwan & Rutherford, 2015); (Lee et al., 2001); (Ryerson & Hansen, 2013); (Swan & Adler, 2006); (Zuidberg, 2014). These studies either examined substitutes for airline operational costs (such as fuel expenses, cost per aircraft movement, efficiency or performance) or were concentrated on a small number of variables. Moreover, only a restricted amount of research has explored airline expenditure as a dependent factor. A study by Proctor and Duncan (1954) The research is an early exploration of how airline characteristics affect the costs for airlines in the United States. The study found that factors such as load factor, capacity, and aircraft utilization play a significant role in determining airline costs. Further, in the year 1975, Särndal and Statton a relationship was found between the average duration of flights and the cost per unit for airlines. However (Zuidberg, 2014) A recent study showed that there is a strong connection between operating costs and density as well as load factor, while the impact of stage length seemed to be less important (Brueckner & Abreu, 2017) investigated factors influencing airline fuel consumption. Although this study may not be directly connected to airline operational expenses, given the significant portion of fuel in total operating costs, its findings are important to report. The research identified aircraft size, stage length, and younger aircraft age as key factors leading to reduced aviation fuel usage. In the context of European airlines (Lozano & Gutiérrez, 2011) demonstrated that upgrading the fleet increases airlines' operational expenses. Additionally, one study by (Assaf & Josiassen, 2011) A rise in fuel costs has led to an increase in the overall operating expenses for numerous U.K. airlines, with only a small number of studies on this topic available (Jain & Natarajan, 2015); (Saranga & Nagpal, 2016); (Sakthidharan & Sivaraman, 2018) In the context of the Indian air transport industry, various studies have been conducted focusing on generating revenue output. However, amidst the challenges and advancements in this field, it is crucial to comprehend the developments in operational expenses for Indian airlines related to their fleet, flight operations, and strategies. Addressing this gap involves evolving the correlation between total operational costs and airline characteristics. This current study concentrates specifically on an airline's operational expenses, diverging from previous research. An econometric model incorporating these

variables is developed based on a conceptual framework. The outcomes of this study will provide insights into how an airline's operational costs are influenced by payload size, stage length, aircraft size, aviation fuel price fluctuations, and type of ownership.

Airline operational performance literature demonstrates the utilization of various methodologies, including fuzzy logic (Chang, 2011), analytic hierarchy process (Berrittella et al., 2009);(Tsai & Kuo, 2004), structural equation modeling, data envelopment analysis (Sakthidharan & Sivaraman, 2018); (Saranga & Nagpal, 2016); (Oum et al., 2000), translog model and regression (Brueckner & Abreu, 2017); (Hakim & Merkert, 2019);(Mantin & Wang, 2012):(Zuidberg, 2014). Regression analysis has been extensively used among the mentioned methods, mainly due to its broad applicability, straightforward estimation, and relatively easy interpretations (Washington et al., 2020). This study uses regression analysis to calculate the influence of payload, stage length, aircraft size, fuel price, and ownership on the operational costs of Indian airlines. This will uncover how these factors contribute to effectively managing the total operational expenses of an airline. With this context in mind, the research aims to accomplish the following objectives

a) To identify the attributes of airline operational expenses in the Indian context.

b) To present a model so as to minimize the operational expense of airlines by managing these attributes.

The research paper consists of four parts. The second section discusses the development of a conceptual framework and model. Data and empirical results are detailed in Section 3, while conclusions along with implications and limitations of the study are presented in Section 4.

2. CONCEPTUAL FRAMEWORK & MODEL DEVELOPMENT

This section outlines the basis of a framework for enhancing airline operational cost effectiveness, aiming to identify factors that affect an airline's operational expenses. Cost efficiency involves choosing inputs at a specific level in order to reduce costs or expenses (Merkert & Hensher, 2011). The enhancement of cost efficiency in airlines relies on the integration of innovative technology, airline strategies, and efficient use of resources within the current aviation landscape. This research focuses on using expense/revenue passenger kilometers as an indicator of airline operational cost efficiency. Consequently, factors affecting operational cost efficiency will be developed with this as the central focus. The following overview outlines these dependent and independent variables:

To achieve maximum operational cost efficiency, it is crucial to explore options for minimizing operational expenses in airlines. The ratio of operational expense to revenue passenger kilometers is used as a measure of an airline's operational cost efficiency. Operational costs encompass aircraft maintenance, airport charges, ticketing, promotional advertising, capital depreciation, and flight operations. Among these costs, flight operations make up the largest portion with fuel costs accounting for 35% to 40%. Therefore, reducing operational expenses would indicate lower expenditure on items such as fuel consumption and maintenance which implies higher operational cost efficiency.

In a general sense, the payload denotes the weight carried by an aircraft and indicates how much of the aircraft's capacity is being used. A higher load factor leads to lower operational expenses per revenue passenger kilometer, which in turn signifies greater cost efficiency in operations. The majority of previous studies (Baltagi et al., 1995): (Chua et al., 2005); (Zuidberg, 2014), A negative connection was found between payload and total operating expense for airlines. Additionally, higher load factors lead to lower air ticket prices, improves the airline's ability to make a profit and stay competitive ((Mantin & Wang, 2012); (Tsikriktsis, 2007).

Thus, a payload is anticipated to have an inverse relationship with the operational expense/RPK of Indian airlines. Stage Length (L) refers to the distance traveled by an aircraft from take-off to landing (Oum et al., 2000). The average stage length is calculated by dividing the distance flown by the number of aircraft departures. This is an important factor in determining costs reflects on the optimization of routes and network configurations (Merkert & Hensher, 2011). An extension of the flight's stage length could result in a higher fuel consumption, as it would necessitate carrying additional fuel for the journey (Park and O'Kelly, 2014) and an increase in other related expenses. Nevertheless, several researches have noted a detrimental correlation between the average stage length growth and cost per unit (Baltagi et al., 1995), (Tsoukalas et al., 2008) The stage length reflects the cost savings achievable by operating on longer flight routes (Saranga & Nagpal, 2016). Hence, we anticipate that a longer stage length for an aircraft will have an adverse impact on the operational expenses per revenue passenger kilometer of Indian airlines. "An extended stage length results in reduced operating cost per revenue passenger kilometer." Aircraft Size (S)- Various earlier investigations have shown that larger aircraft with more seats are more cost-effective than smaller ones. (Morrell, 2009); (Nicol, 1978); (Ryerson & Hansen, 2013);(Zuidberg, 2014). Hence, it is concluded that aircraft with a greater number of seats are cost-effective and have an inverse relationship with operational expense per revenue passenger kilometer. "Larger aircraft usage decreases operating cost per RPK." Aviation fuel prices (C) - Historical data indicates that increased jet fuel prices negatively affect air travel demand and aviation fuel consumption, leading airlines to focus on conserving fuel by adjusting other factors (Zuidberg, 2014); (Ryerson & Hansen, 2013). As a result, the high cost of jet fuel is seen as an indirect factor in driving operational efficiency. However, several studies have shown that elevated fuel prices lead to higher overall operational expenses for airlines ((Olsthoorn, 2001). Thus, there is an anticipated connection between the cost of fuel and operational expense per revenue passenger kilometer."Higher aviation fuel prices result in increased operating costs per RPK." Ownership (O) - Internal factor related to organization ownership (Oum et al., 2000), but has an influence on its performance (Demsetz & Villalonga, 2001). Before 1994, India only had state-owned air services. The abolishment of the 'Air Corporation Act 1953' on March 1, 1994 opened the Indian aviation market to non-state-owned airlines (Cao et al., 2015) It has been noted that private airlines have better economic performance than state-owned Chinese airlines. Therefore, based on this observation, changing the ownership of an airline from state to private is expected to result in a negative correlation with operational expense/RPK.

Based on the information presented in the existing literature as outlined previously, we can formulate the hypothesis as follows:

Airline Operationalexpense/RPK = (P- , L- , S- , C- , O-) .....(1)

Where, P symbolizes Payload, L denotes Stage duration, S denotes Seats as an indicator of aircraft size, C represents Fuel Cost, and O refers to Ownership.

(+) or (−) signs indicate the presumed connection between the specific factor and operational costs.

The model's development is grounded on the assumption that these factors are consistent across an airline; however, this may not be feasible. Thus,,to accommodate for diversity, average values of variables (excluding ownership) are utilized in this analysis: mean seats (Avg_Seats/Km),, mean stage length (Avg_StgLn), mean payload (Avg_Payload),,and mean fuel cost(Avg_ FulPRC). Consequently,the econometric equation can be established as Eqn..2

OpEXP/RPK = α + β1Avg_Payload + β2 Avg_StgLn + β3Avg_Seats/Km + β4 Avg_ FulPRC + β5 Owshp +u ......(2)

Where,OpEXP/RPK stands for the operational cost per revenue passenger kilometer. α, β1 , β2, β3 , β4 and β5 indicate unidentified parameters and u denotes the regression residuals.

The semi-logarithmic form (log-linear) is utilized for the equation. In this form, the left-hand side of the equation is in logarithm as depicted in Eqn., and its coefficients provide valuable interpretations.

ln(OpEXP/RPK) = α + β1Avg_Payload + β2 Avg_StgLn + β3Avg_Seats/Km + β4 Avg_ FulPRC + β5 Owshp + u. .....(3)

This means that the natural logarithm of OpEXP becomes a function of the unlogged values of the independent variables on the right-hand side. In log-lin interpretations, an increase in a right-hand side variable by one unit leads to a percentage change in the left-hand side variable. Therefore, the log-lin function is ideal for demonstrating percentage changes in the dependent variable with unit variations in an independent variable. This functional form is commonly used for economic and business purposes. Since this study analyzes how airline characteristics affect its operational expense/RPK, using percentage values will provide better clarity about their respective effects.

3. DATA AND EMPIRICAL RESULTS

3.1. Data source and descriptive statistical analysis

The input-output variables' data has been sourced from the Directorate General of Civil Aviation (DGCA, 2018) Indian Government's open data platform (OGD, 2018) websites for this time period 2007 to 2008 to 2016–2017. The airlines provided this data on ICAO Air Transport Reporting Forms to the DGCA. The annual aviation fuel price information was obtained from indexmundi.com (Indexmundi, 2017). Average seats per kilometer were determined by dividing the total available seats by the kilometers flown by the aircraft. The average age of the fleet was sourced from planespotters.net (Airline Index, 2017). Although it is not utilized in the analysis, it indicates the technological standard of an airline. This study only includes passenger airlines that have been operating for more than five years. As a result, only eight eligible airlines were found, leading to a total of 80 observations as listed in Table 1. In reality, airlines have to operate under uncertain environment, This study assumes that the operations were conducted in optimal circumstances. Additionally, to account for diversity, this study used average figures such as Avg_Seats/Km, Avg_StgLn, Avg_Payload, and Avg_FulPRC.

The ownership of an airline is indicated by dummy variables: if the airline is state-owned (public), the value is zero; if it's non-state (private) owned, the value will be one. The average values of these variables are shown in Table 2, covering the period from 2007-2008 to 2016–2017 and including data from 8 airlines: Air India, Jet Airways, Indigo, Spice Jet, Air India Express, Jet Lite, Go Air and Alliance Air.Average seats/km varies across airlines, with state-managed ‘Air India’ (full-service carrier) During this time period, there has been significant variation in weight-based average payload among the different carriers. For instance, Indigo has shown the highest value at 75%, while Air India reports the lowest load factor of 60%. When it comes to average stage length, state-run airlines such as Air India Express and Air India have emerged as leaders with the longest stage lengths. The low-cost carrier Go Air possesses the youngest fleet, followed by Alliance Air and Indigo. In terms of operational expense per RPK, Alliance Air is reported as being the most expensive regional airline in this category.

Table 3 displays the yearly mean values for these variables. It's evident from fuel prices that there have been substantial fluctuations within Indian aviation sector during this study period regarding fuel price per gallon which was at its peak at ₹174.55 per gallon during 2013–2014; corresponding to almost ₹7 per RPK in operational expense at that time too. The relation between aviation fuel price and operational expense becomes clear here based on historical data analysis. Average seats/km seems to lie within a range of 155 to 166 over this period indicating an improvement in load factors through these years reaching up to about a remarkable achievement of about a cumulative increase by around nine percent throughout '16-'17 when compared against figures from '07-'08. There also appears a gradual increase observed over time for average stage length possibly due opening new routes alongside maturation process followed by airlines."

Table 1 Indian Airlines selected for this study.

Airline	Inception Year	ICAO Code	IATA Code	Headquarters	Operations	Business Model Type
Air India	1932	AIC	AI	Delhi	Domestic + International	FSC
Jet Airways	1993	JAI	9W	Mumbai	Domestic + International	FSC
Indigo	2006	IGO	6E	Gurgaon	Domestic + International	LCC
Spice Jet	2005	SEJ	SG	Gurgaon	Domestic + International	LCC
Air India Express	2005	AXB	IX	Kochi	Domestic + International	LCC
Jet Lite	2006	JLL	S2	Kolkata	Domestic + International	LCC
Go Air	2005	GOW	G8	Mumbai	Domestic	LCC
Alliance Air	1996	LLR	9I	Delhi	Domestic	Regional

3.2. Multiple-regression analysis

To explore the connection between the dependent variable (airline operational expense) and several independent variables, a multiple regression analysis was carried out. Regression analysis is commonly used because of its broad range of applications, simplicity in estimation, and relatively straightforward interpretations (Washington et al., 2020). This approach has been widely used by researchers (Brueckner & Abreu, 2017); (Zuidberg, 2014) studying the influence of airline operating attributes on airline effectiveness. The data utilized in this research is presented in the form of panel data, referred to as time-series cross-section data. To account for specific effects at the airline level, a 'two-way random effects model' (which includes both an airline and a year dummy) is employed in this study. This model aims to address disparities among entities that impact the dependent variable. Additionally, random effects allow for time-invariant variables to serve as explanatory factors (Saranga & Nagpal, 2016). The complete model summary is provided in Table 4. According to the table, the study's model is deemed statistically significant. Additionally, it can be noted that the R-squared value of 0.809 (or 80.9%) indicates that a high percentage of operational expense/RPK can be elucidated by the chosen independent variables in this study. A graphical representation depicting model accuracy is illustrated in Fig. 1.

Multiple regression results including β coefficients as well as t-statistics are displayed in Table 5, and these relationships are also depicted in Fig. 2. The presented regression findings are based on 80 observations, as previously noted. An F-test value of 67.74 at $p < 0.01$ has confirmed that the coefficients in the regression equation are non-zero. Therefore, it can be concluded that the assumption of zero coefficients is rejected, and the multiple regression model equation fits well. This affirms that the dependent variable is significantly impacted by the model.

Fig. 2 presents a model for visualizing regression coefficients. The lines connecting dependent and independent variables are colored based on the sign of their respective coefficient (blue for positive and orange for negative), and their thickness reflects the significance of the coefficient, with thicker lines indicating smaller p-values (more significant coefficients).

The estimates strongly restates the hypothesis of the proposed conceptual framework. All regression coefficients indicate the expected signs with a statistical significance level of 1%, except for 'fuel price' which is significant at the 5% level. This suggests that all independent variables are influencing operational expense/RPK of an airline.

In the regression results, while holding other variables constant, operational expense (ln(OpEXP/RPK)) has a negative correlation with payload ($\beta1 = -0.023$, $p < 0.01$), indicating the capacity utilization of an aircraft. This demonstrates that an increase in aircraft payload reduces operational expense/RPK, supporting the findings of (Zuidberg, 2014).

Aircraft payload depends significantly on the demand for a specific air route, travelers' spending capacity, and the availability of alternative transportation options. Therefore, an airline can increase its payload by offering competitive pricing compared to other modes of transportation. Additionally, researching (Barros & Wänke, 2015) suggests that the payload can also influence the selection of aircraft size for a specific route. Similarly, the inverse correlation of average seats per kilometer ($\beta3 = -0.004$, $p < 0.01$) with operational expenses indicates that using larger aircraft reduces operating costs per revenue passenger kilometer. This finding aligns with earlier research on the relationship between aircraft size and cost. (Barros & Wänke, 2015); (Zuidberg, 2014).

Table 2 Variable Means (From year 2007–2008 to year 2016-17).

Airline	Avg_OpEXP/RPK	Avg_Payload	Avg_StgLn	Avg_Seats/Km	Ownership	Avg_Age*
Air India	6.09	60.31	1818.4	193.9	State	8.3
Jet Airways	5.44	64.2	1276.61	178	Non-State	8.1
Indigo	3.76	74.95	1012.87	180	Non-State	5.8
Spice Jet	4.25	74.06	920.79	178.9	Non-State	7.4
Air India Express	2.96	71.68	2069.13	180.7	Non-State	7.5
Jet Lite	5.46	70.17	848.88	153.9	Non-State	10.3
Go Air	4.26	74.76	928.12	174.9	Non-State	5.3
Alliance Air	13.95	63.49	638.83	53.8	State	5.5

Table 3 Yearly Variable Means (For 8 airlines selected in the study).

Airline	Avg_OpEXP/ RPK	Avg_Payload	Avg_StdLn	Avg.Seats/Km	Avg_FulPRC
2016-2017	5.74	73.43	1302.94	158	92.36
2015-2016	5.56	73.21	1287.74	155.25	88.92
2014-2015	6.49	71.9	1191.71	161.63	144.5
2013-2014	6.98	67.72	1152.74	165.13	174.55
2012-2013	6.36	67.17	1166.52	162.63	164.86
2011-2012	5.39	68.65	1154.64	165.88	147.29
2010-2011	4.78	71.28	1176.88	164	106.87
2009-2010	5.03	68.74	1169.14	160.75	86.97
2008-2009	6.39	62.37	1170.45	161.25	115.77
2007-2008	4.98	67.57	1119.25	164.13	96.39

Table 5 Regression results.

Variables	ln(OpEXP/RPK)	t-statistics
Constant	4.258**	18.49
Avg_Seats/Km	-0.004**	-5.2
Avg_Payload	-0.023**	-9.05
Avg_StgLn	-0.0004**	-5.44
Avg_FulPRC	0.002**	2.43
Ownesrship	-0.27**	-3.72
No of Observations	80	

Furthermore, the inverse correlation of average stage length ($\beta 2 = -0.0004$, $p < 0.01$) suggests that longer stage lengths reduce operational expense/RPK. These findings align with previous research studies (Merkert & Hensher, 2011); (Tsoukalas et al., 2008), Longer distances lead to reduced unit costs because of enhanced fuel efficiency. This benefit arises from less time spent idling and climbing to the flying altitude compared to shorter distance flights. However, when the payload is low, this advantage becomes a disadvantage as the aircraft still needs to lift the same amount of fuel and other expenses remain unchanged. In situations where routes have limited demand and there is minimal likelihood of a significant increase in payload, airlines may choose to use multi-stage flights. This would increase the aircraft's occupancy and utilization, leading to reduced fuel consumption per revenue passenger kilometer and lower operational expenses per RPK.

On the flip side, a positive coefficient of 0.002 for the average fuel price ($p < 0.05$) indicates the typical association (Hsu & Eie, 2013); (Zuidberg, 2014), A higher cost of fuel increases operational expenses. This is a significant concern for countries like India, which heavily rely on OPEC countries for their fuel. Changes in the global socio-economic-political landscape can disrupt airline economies due to issues such as fuel shortages and price fluctuations. To mitigate the impact of fuel price volatility, options include investing in more efficient aircraft and implementing prudent fuel hedging strategies.

The private airlines demonstrated greater efficiency compared to government-owned airlines ($\beta 5 = -0.27$, $p < 0.01$). This finding aligns with previous research on this topic. (Cao et al., 2015) and (Oum et al., 2000). State-owned firms often struggle with inefficiency due to their focus on goals other than profitability, which hinders their competitiveness in meeting financial objectives compared to non-state-owned companies. Other than this, (Backx et al., 2002) The decreased productivity of employees, reduced ratios of in-flight personnel to total personnel, and lower aircraft utilization have been cited as factors that hinder the performance of state-owned airlines. Addressing these issues could help state-owned airlines enhance their operational efficiency compared to non-state-owned airlines.

3.3. Quantitative results

The quantitative findings in Table 6 provide a more compelling narrative about the results. These findings are based on regression estimates and demonstrate the impact of independent variables on operational expense/RPK.

According to Table 6, adding 20 seats to the average aircraft size could potentially result in an approximate 8% reduction in operational expense/RPK. This suggests that transitioning from Jetlite (154 seats) to Go Air (175 seats) aircraft could lead to an estimated 8.4% decrease in operational expenses. Additionally, a 10% increase in payload may reduce expenses by approximately 0.23%. For instance, if Air India were to raise its payload by 10%, equivalent to JetLite's (70%), it could lower its expenses by around 0.23%.

Moreover, extending the stage distance by 100 km will result in a 4% reduction in operational expenses per revenue passenger kilometer. If Spice Jet increases its stage distance to match that of Indigo, it would decrease operational expenses/RPK by 3.68%, which is equivalent to $92.08 * (-0.0004). Contrary to the previous findings, a rise of ₹ 10/gallon in aviation fuel costs leads to a 2% increase in operational expenses per RPK. This becomes more significant when comparing the increase in fuel prices from levels in 2012 to levels in 2013–2014, resulting in a 2% higher expenditure per RPK. Finally, ownership emerges as an important factor, with non-state-owned airlines demonstrating greater efficiency than state-owned airlines.

Table 6 Quantitative results.

Change in Dependent Variable	Impact on Operational Expense/RPK
Average Seats/Km rises by 20	8% decrease
Average Payload rises by 10 percent	0.23% decrease
Average StgLn extended by 100 km	4% decrease
Average FulPRC rise by ₹ 10/Gallon	2% increase

4. CONCLUSIONS

This study has introduced an econometric model for Indian airline expenditures, utilizing a limited number of influential variables for the period from 2007 to 2016–2017. This period was marked by intense competition and significant fluctuations in fuel prices. The econometric model utilized multiple regression analysis to elucidate operational cost efficiency. The findings of this research establish a connection between the operational expenses of an airline and its operating features (seats, stage length, payload, ownership) as well as market conditions (fuel prices). These results corroborate previous studies' conclusions (Barros & Wänke, 2015); (Morrell, 2009); (Zuidberg, 2014),operating a larger aircraft and increasing payload can improve operational cost efficiency by lowering the expense per RPK. However, in current market conditions with fluctuating demand on certain routes, maintaining high average payload remains difficult. To take advantage of GDP growth, airlines need to create personalized offers to attract more passengers in areas with low demand. Additionally, longer stage length appears to be advantageous in reducing expense per RPK, as indicated by the research conducted on this topic (Tsoukalas et al., 2008). However, increasing the duration of flights is challenging because it relies on the routes that are authorized by the Government of India. Airlines may consider alternatives such as mergers and code-sharing to reduce their costs. The primary factor that contributes to an increase in airlines' operational expenses/revenue passenger kilometer is the cost of aviation fuel. This is evident from the fact that aviation fuel cost accounts for nearly 50% of an airline's total operational cost as of 2008. This highlights the importance of having a more efficient fleet and implementing better operational strategies to minimize fuel consumption, thus leading to greater cost savings (Hsu & Eie, 2013); (Zuidberg, 2014). When considering another aspect such as "ownership," it has been noted that privately owned airlines are more effective than state-owned ones. While Air India, a leading Indian airline, was previously rescued by the Government of India, efforts are now being made to privatize and revive the struggling carrier. It would be interesting to examine how privatization impacts the efficiency of state-owned airlines and its challenges for private carriers. These findings could be valuable for airline management in evaluating their current operational processes and strategies to enhance cost efficiency. Additionally, they can compare their operations with those of successful airlines as motivation to address operational shortcomings and explore new ways to improve effectiveness.

We recognize some limitations in our study. This research focuses on operational cost efficiency and only considers operational expenses. In future studies, we could include the revenue component to assess the airline's profitability. Additionally, given that different airlines' fleets consist of aircraft from various families, it would be valuable to understand how the fleet mix affects airline operational costs. Moreover, due to a limited number of observations, this study does not compare LCA's and FSC's; however, researchers may explore this comparison to gain insight into the role of business models on airlines' operational expenses per available seat kilometer. We believe that this study forms a basis for further investigations in this area.

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