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RANKING COMPANIES IN INDIAN AVIATION SECTOR BASED ON EFFICIENCY: AN ANDERSON PETERSON SUPER-EFFICIENCY MODEL

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ABSTRACT

The Indian aviation industry, an integral part of Indian transport network, plays a crucial role in connecting people, economies, and cultures. Indian aviation industry is highly competitive and its operational efficiency is of paramount importance to sustain profitability, to enhance customer satisfaction, and to maintain a competitive edge of the industry. The primary objective of the current study is to explore the concept of super efficiency on six major airline companies operating in India covering both the full service and low-cost carriers using secondary data drawn from various sources from the financial year 2004-05 to 2018-19. Super efficiency is an advanced DEA tool that extends beyond conventional efficiency measures. It provided the opportunity to conduct a more refined analysis of airline efficiency. Furthermore, the super efficiency score derived from the analysis is utilised for the ranking of decision-making units (DMUs) that are efficient in conventional terms. With a view to achieving these objectives, the current study employs a robust methodological approach, utilizing a dataset comprising various performance indicators from select airline companies. The research finds that Go Air is the most efficient airline in analysing airline efficiency through the lens of super efficiency. However, Air India is ranked first based on super efficiency scores of the aviation companies in different years.

Keywords: *Aviation Industry, Efficiency, Data Envelopment Analysis, DMUs, Super Efficiency.*

1. Introduction

The Indian aviation industry constitutes a critical component of the country's transportation infrastructure. The industry started its first commercial flight in 1911 and experienced noteworthy progress in the post-independence era with the nationalization of airlines in 1953. Reforms in Indian airline industry in 1990 marked the turning point for private carriers and also paved the way for the low-cost carriers (LCCs) to enter the market. Entry of private players and LCCs transformed the industry dynamics. Currently, the Indian aviation market is one of the fastest-growing aviation industries in the world, powered by swelling middle class and escalating disposable incomes. Nevertheless, in spite of its development, the industry faces numerous challenges, including financial instability, infrastructure constraints, and regulatory hurdles. Under this situation, the improvement of operational efficiency has become the primary objective for all airlines to survive and maintain their existence (Cui & Yu, 2021). Efficiency refers to the way organizations use their resources to produce and deliver services (Chen,

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2007). Thus, productivity and efficiency are very important in the operating performance of each airline. A study on airline efficiency helps to analyze the airline's ability to maximize its performance while minimizing resource consumption (Forsyth et al., 1986). A classical Data Envelopment Analysis (DEA) model determines the efficient DMUs, but it does not suggest any way to rank the efficient DMUs. This shortcoming of the classical DEA Model can be bypassed by the solution given by Anderson & Peterson (1993). They suggested ranking the DMUs by removing the conditional limits of efficiency to 1 and termed it as 'Super Efficiency'. Super-efficiency (SE) implies the possible capabilities of a DMU in increasing its inputs and /or reducing its output without becoming inefficient (Mehdiloozad & Roshdi, 2014). In this study, 6 airlines from India are evaluated against one another based on their operational efficiency over a period of 15 years from 2005 to 2019. This study investigates the super efficiency scores of the selected airlines across cost, size, and ownership structures including budget and full-service, private and state-owned, large and small, operating in the country and offering scheduled services on domestic and international routes. The current study takes a step in that direction by systematically studying the impact of operating and administrative costs and the number of employees on the super efficiency of airlines. The research aims to identify the most efficient airline companies by analyzing their super efficiency scores. An attempt has been made to rank the airline companies according to the super efficiency scores.

2. Past Studies and Research Gap

One of the revolutionary works in the estimation of efficiency in the airline industry using Data Envelopment Analysis (DEA) is by Schefczyk (1993). The study was undertaken on 15 large international carriers for the year 1990. The study used the Constant Returns to Scale (CRS) Model to estimate the gross efficiency of each firm. In the second stage of the analysis, a regression model was developed to analyse the relationship between profitability and performance by considering efficiency. The results of the study showed that performance had a positive correlation with profitability. DEA was introduced by Charnes, Cooper, and Rhodes (CCR) (1978). It was a generalization of the Farrell (1957) single-output/input measure of technical efficiency to the multi-output/multi-input measure case. DEA achieved the objective by constructing a single virtual output and a single virtual input by calculating optimal weights for each output and each input of a firm. Unlike other methodologies, the weights were not assigned theoretically in an arbitrary manner. Rather, these weights were optimally determined for each firm through separate linear programming problems so as to maximize the resulting efficiency of each firm. Banker et al. (1984) used CCR ratio of DEA to comprehend both technical and scale inefficiencies via the optimal value of the ratio form, as obtained directly from the data without requiring a priori specification of weights and/or explicit delineation of assumed functional forms of relations between inputs and outputs. Technical inefficiencies were identified as failures to achieve best possible output levels and/or usage of excessive amounts of inputs. Methods for identifying and correcting the magnitudes of these inefficiencies, as supplied in prior work were also illustrated in the literature. The research further introduced a new separate variable which helped to determine whether operations were conducted in regions of increasing, constant or decreasing returns to scale in multiple input and multiple output situations. Andersen & Petersen (1993) evaluated the relative efficiency of DMUs but did not allow for a ranking of the efficient units themselves. This research introduced a modified version of DEA. It was based upon comparison of efficient DMUs relative to a reference technology spanned by all other units. The procedure provided a framework for ranking of efficient units and facilitated comparison of rankings in different periods based on parametric methods. Adler et al. (2002) attempted to improve the differential capabilities of DEA and to fully rank both efficient, as well as inefficient, DMUs. Six ranking methods had been used in somewhat overlapping areas. It was found that each technique was useful in a specialist area. Hence, no single methodology could be prescribed as a complete solution to address problems related to ranking. Banker & Chang (2006) showed two alternative uses of the super-efficiency procedure. At first outliers were identified and then ranking of efficient units were done. The analysis found that correlations between the true efficiency and the estimated super-efficiency are negative for the subset of efficient observations. The paper proposed to remove outliers accurately to get a satisfactory result. Noura et al. (2011) ranked and compared efficient units through super-efficiency methods. To determine super-efficiency, the effectiveness of each unit in society was considered rather than cross-comparing the units. The inputs and outputs were grouped into desirable and undesirable, and each input and output were assigned appropriate weights. Then, the rank of each DMU was determined according to the weights and the desirability of inputs and outputs. Banker et al. (2017) is the continuation of Banker & Chang (2006) paper where it was found that super-efficiency-based procedures were effective in identifying outliers, but not in ranking efficient units. In the paper, they tried to investigate why the procedures failed to rank efficient units satisfactorily and to examine the performance of super-efficiency procedures in different 'regions' of production set. The outlier was detected using the model suggested by Banker and Grifford (BG) (1988). The analysis showed that the BG model was more effective when the noise level was high. It was concluded that the findings in Banker and Chang (2006) were robust under different DEA formulations, production functions and returns to scale assumptions. There has been a growing amount of literature in exploring the efficiency of airline industry using DEA. However, compared to other countries, the studies on efficiency in the Indian aviation sector are rather insufficient since the total market valuation remained relatively low till the early twenty-first century.

Upon examining the existing literature, it is evident that comprehensive research into the Indian civil aviation sector was scarce, partly due to dominance of Government owned airlines in Indian civil aviation space. Furthermore, there has not been a significant number of studies on the spendings of the airline companies towards employees and operations for the worldwide market, let alone for the Indian aviation sector. While a few studies, both globally as well as in India had taken an attempt to evaluate the operational efficiency of the airline companies, they failed to make a comparative analysis among efficient units based on their relative efficiencies. In light of this, the current study is conducted on Indian airlines that provide local and international aviation services. Keeping in view the gap in existing researches, the current analysis is an attempt to analyse super-efficiency of 6 select airline companies. Additionally, an effort has been made to rank the companies based on their super-efficiency scores.

3. Objectives

The objectives of the study are as follows:

- To estimate the super-efficiency of select Indian aviation companies *(Refer to Section 5.1)*; and
- To rank the select companies in Indian aviation sector based on their super-efficiency scores *(Refer to Section 5.2)*.

4. Research Methodology

4.1. Selection of Decision Making Units (DMUs) and Data Period

The study spans from 2004-05 to 2018-19 based on secondary data. Many airlines operated in India over this extended period of time. Only a small number of these airlines are still operating today, while the others have ceased their operations. Three national airlines - Air India, Indian Airlines, and Alliance Air, as well as three private airlines - Jet Airways, Sahara Airways, Air Decan - operated in India during 2004-05. However, as of 2018-19, Indian aviation sector comprised three national (Air India, Air India Express, and Alliance Air) and nine private airlines (Jet Airways, Jet Lite, Air Asia, Air Deccan, Air Odisha, Air Heritage, Go Air, Indigo, Spice Jet, Star Air, True Jet, Zoom Air, and Vistara) (DGCA, 2019a). Nevertheless, just six of these airlines - Air India, Jet Airways, Spice Jet, Kingfisher Airline, Indigo, and Go Air have been chosen considering convenience sampling method for the analysis based on the accessibility of financial data. Out of the chosen airlines, five are private passenger airlines, while Air India is a national carrier and public airline.

4.2. Selection of Input and Output Variables

The objective of the study is to check the efficiencies of the selected public and private airline companies. Efficiency is typically a function of input and output.

Efficiency = Output ÷ Input

With a view to estimating the efficiency of the competing units, appropriate financial or nonfinancial variables about airline companies are identified. Prior research has shown that operating and administrative expense (Jain & Natarajan, 2015) and the number of employees (Cui & Yu, 2021, Lin & Hong, 2020) are the two most important inputs for estimating efficiency. Whereas, Operating Income (Assaf & Josiassen, 2011) and Ton Kilometer (KM) available (Assaf & Josiassen, 2011, Jain & Natarajan, 2015) were selected as the output of the aviation industry. According to Cooper, et al. (2007), a number of units should be greater than or equal to the product of a number of inputs and number of outputs: $n \geq (p \times q)$, where, n = number of DMUs; p = number of inputs, q = number of outputs.

As $(p \times q)$ for the current study is four, though total DMUs for the current study is 6 fulfilling the condition and two input-two output combinations may be considered here. The data on the input and output variables for all 6 airline companies (DMUs) during the period 2004-05 to 2018-19 are collected from Handbook of India Air Transport Statistics 2018-19 published by the DGCA (DGCA, 2019). With a view to assess the efficiency of competing Indian airline companies each year, Data Envelopment Analysis (DEA) is applied (Berger & Humphrey 1997).

4.3. Data Collection

The yearly data of aforesaid input and output variables of the selected airline companies operating during the study period (2004-05 to 2018-19) are collected from Capitaline database (Capitaline, 2019) and Handbook on Indian Aviation Statistics published by the DGCA (DGCA, 2019).

4.4. Fulfillment of Conditions (Test of Isotonicity)

An isotonicity test is conducted to find out whether the relationship between inputs and outputs is erratic (Avkiran, 1999). The test is conducted to ensure the validity of the DEA model specification which encompasses the calculation of all inter-correlations between inputs and outputs. This helps to identify whether increasing amounts of inputs result in higher amounts of outputs, implying that there are positive correlations between inputs and outputs.

Table 1: Test of Isotonicity

		Operating and Administrative Expenses	Number of Employees	Operating Income	Ton Kilometer Available (mn)
Operating and Administrative Expenses	Pearson Correlation	1	0.665**	0.617**	0.631**
	Sig. (2-tailed)		0.000	0.000	0.000
	N	82	82	82	82
Number of Employees	Pearson Correlation	0.665**	1	0.800**	0.853**
	Sig. (2-tailed)	0.000		0.000	0.000
	N	82	82	82	82
Operating Income	Pearson Correlation	0.617**	0.800**	1	0.952**
	Sig. (2-tailed)	0.000	0.000		0.000
	N	82	82	82	82
Ton Kilometer (KM) available (mn)	Pearson Correlation	0.631**	0.853**	0.952**	1
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	82	82	82	82

Source: Compilation of secondary data using MS Excel, 2019

In Table 1, Pearson's correlation is calculated to test the isotonicity relationship between the selected inputs and outputs. It is apparent that the inter-correlation of all the indicators is positive and significant, indicating that the specification of the DEA model is valid.

4.5. Super-efficiency Model

Andersen and Petersen (1993) proposed the use of the CRS super-efficiency model for ranking efficient DMUs in the DEA model as follows:

Max E_j = $$\sum_{i=1}^{n} v_{ij}\ Y_{ij}$$

Subject to the constraints $$\sum_{i=1}^{m} u_{kj}\ X_{kj} = 1$$

$$\sum_{i=1,s\neq j}^{m} v_{is}\ Y_{is} \leq \sum_{i=1,s\neq j}^{m} u_{ks}\ X_{ks}$$

Where $v_{ij}, u_{kj} \geq 0, \forall$, i, j, k

The linear programming technique is used to solve the above formulation for each DMU, allowing continuous technical efficiency score measurement with unrestricted bounds. The difference between super-efficiency and classical data envelopment analysis (CCR-DEA) models is the exclusion of DMU j in the constraint set in the equation. In CCR-DEA, DMU j is included in the equation so that the maximum score of efficiency can be restricted to one. Thereby, the outputs are maximized without restriction and in turn the ranking of efficient DMUs is made.

4.6. Analytical Tool

DEA Solver, an MS Excel based analytical package is used to estimate the efficiencies of airline companies in the individual years during the study period. In the current study, data on input and output variables of all select airline companies are taken together and super efficiency scores are calculated based on above model in each year under the study. Calculation of average super efficiency score during the study period was made using mean of Anderson & Peterson Super-efficiency score which addresses the first objective. To rank the companies based on super efficiency, mean rank is calculated based on super efficiency score which addresses the second objective. SPSS 20.0 is used to fulfil other analytical purposes.

5. Results and Discussion

5.1. Addressing to Objective 1: Estimating the Super-efficiency of Indian Aviation Companies

- **Exploring the Super-Efficiency Score**

With a view to evaluating the super-efficiency score, the constraint forcing the inputs to exceed the outputs must be relaxed for the DMU under consideration. This super efficiency technique identifies the degree to which DMUs go above the efficient frontier. This allows efficient DMUs to be ranked. However, the efficiency values of inefficient units remain unchanged from their classical DEA efficiency values. In DEA, the super efficiency score is an indicator that indicates the maximum level of efficiency that each DMU in a dataset may attain. It is employed to determine which DMUs are operating at peak efficiency, in comparison to the most efficient ones. The super efficiency score for each DMU is determined by dividing the total weights derived from the DEA model by the total weights corresponding to the most efficient units. When a DMU has a score of 1, it suggests it is exactly as efficient as the dataset's most efficient units. Higher efficiency is represented by scores closer to or greater than 1, and lesser efficiency is shown by scores closer to 0.

Table 2: Super-efficiency Scores

Year	Air India	Jet Airways	SpiceJet	Kingfisher Airlines	Indigo	GoAir	Mean
2005	1.741	1.219	0.744	0.454	-	5.321	1.8958
2006	1.732	1.16	0.508	0.661	-	5.615	1.9352
2007	2.077	1.155	0.914	0.808	0.636	2.408	1.333
2008	1.603	0.906	0.992	0.503	1.223	0.696	0.987167
2009	1.097	0.978	1.229	1.036	1.091	0.368	0.9665
2010	1.2	0.963	1.024	0.7	1.109	2.938	1.322333
2011	1.413	0.652	0.923	0.791	1.121	3.713	1.4355
2012	0.6	1.077	3.479	0.6	1.245	0.783	1.297333
2013	0.654	1.261	3.021	0.078	1.184	0.852	1.175
2014	0.725	0.992	2.876	-	1.24	0.975	1.3616
2015	0.793	1.105	0.92	-	0.96	4.071	1.5698
2016	2.053	0.947	1.105	-	0.832	0.726	1.1326
2017	1.953	0.769	0.49	-	0.694	0.652	0.9116
2018	2.004	0.699	0.479	-	0.605	0.651	0.8876
2019	2.418	1.14	0.437	-	0.474	0.674	1.0286
Mean	1.470867	1.001533	1.276067	0.625667	0.954923	2.029533	**1.226432**

Source: Compilation of secondary data using DEA Solver, MS Excel, 2019

The average super-efficiency (SE) score of Air India is 1.47 i.e., greater than 1. The average super-efficiency (SE) score of Jet Airways is 1.001 i.e., greater than 1. The average SE score of Spice Jet is 1.27 i.e., greater than 1. The average SE score of Kingfisher Airlines is 0.625 i.e., less than 1. However, the airline was operational till 2013. The average SE score of Indigo is 0.954 i.e., less than 1. However, the airline started its operation from 2007. The average SE score of Go Air is 2.029 i.e., greater than 1. Average SE scores of 4 companies out of 6 companies are greater than 1. During the study period, out of 15 years, average SE score is greater than 1 for 11 years and less than 1 for remaining 4 years.

- **Company-wise Average Super-Efficiency Scores**

In this section an attempt is made to analyze the average super efficiency of the selected airline companies over the period of study. It is actually the mean of the super-efficiency scores of individual companies during the period under consideration (Table 2).

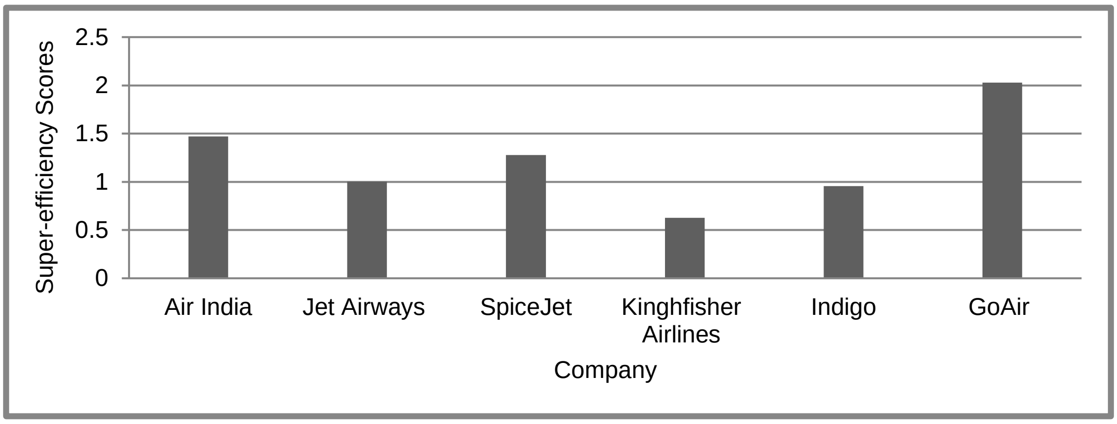


Figure 1: Company-wise Average Super-efficiency Scores during the Study Period

Source: Compilation based on Table 2 using MS Excel 2019

The super-efficiency (SE) score of Air India is greater than 1 during the period of study except for 4 years, 2012, 2013, 2014, and 2015. The highest SE score of Air India is recorded in 2019 and the lowest is in 2012. The average SE score of Air India is 1.47 i.e., greater than 1. The SE score of Jet Airways is greater than 1 during the period of study except for 8 years, 2008, 2009, 2010, 2011, 2014, 2016, 2017 and 2018. The highest SE score of Jet Airways is recorded in 2013 and the lowest is in 2011. The average SE score of Jet Airways is 1.001 i.e., greater than 1. The SE score of Spice Jet is greater than 1 only for 6 years during the period of study, 2009, 2010, 2012, 2013, 2014, and 2016. The highest SE score of Spice Jet is in in 2012 and the lowest is in 2012. The average SE score of Spice Jet is 1.27 i.e., greater than 1. The SE score of Kingfisher Airlines is less than 1 throughout the period of study except in 2009. Although, the airline was operational till 2013. The highest SE score of Kingfisher Airline is in 2009 and the lowest is in 2013. The average SE score of Kingfisher Airline is 0.625 i.e., less than 1. The SE score of Indigo is greater than 1 during the period of study except for 6 years, 2007, 2015, 2016, 2017, 2018, and 2019. The highest SE score of Indigo is in 2012 and the lowest is in 2019. The average SE score of Indigo is 0.954 i.e., less than 1. The SE score of Go Air is less than 1 during the period of study for 9 years, 2008, 2009, 2012, 2013, 2014, 2016, 2017, 2018 and 2019. The highest SE score of Go Air is in 2006 and the lowest is in 2009. The average SE score of Go Air is 2.029 i.e., greater than 1. Thus, Go Air has the highest SE score and considered most efficient compared to its peers (Figure 1).

- **Year-wise Average Super-Efficiency Scores**

The average SE scores of all the companies taken together during the period of study are greater than 1 except in the years 2008, 2009, 2917, and 2018 (as per Figure 2). The mean SE score of all the companies taken together is highest in 2006 while it is lowest in 2018. Moreover, the mean score of all the companies taken together is also greater than 1 (1.226) signifying overall efficiency. According to the mean SE score of individual airline companies (as per Figure 1) Go Air has the highest mean SE score (2.029) and Kingfisher has the lowest mean SE score (0.625) during the period.

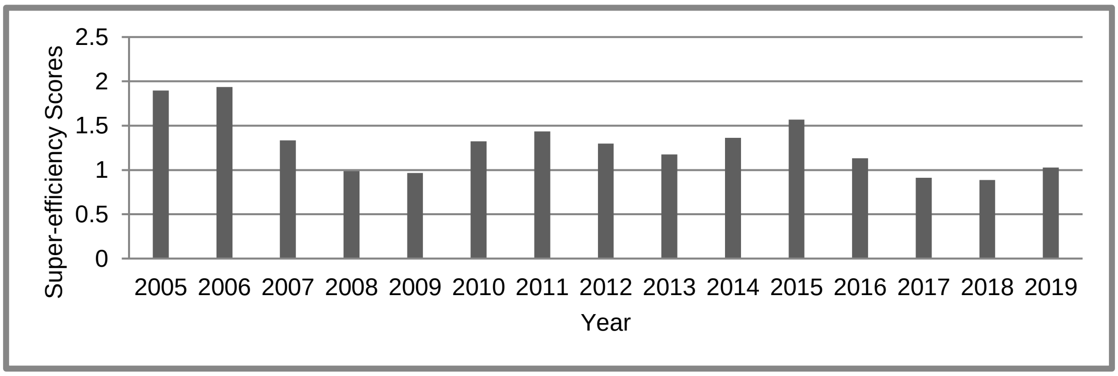


Figure 2: Year-wise Average Super-efficiency Scores during the Study Period

Source: Compilation based on Table 2 using MS Excel 2019

5.2. Addressing to Objective 2: Analyzing the rank of select companies in Indian Aviation Sector based on their Super-Efficiency Scores

- Estimating the rank of each individual company in each year during the study period based on super-efficiency scores

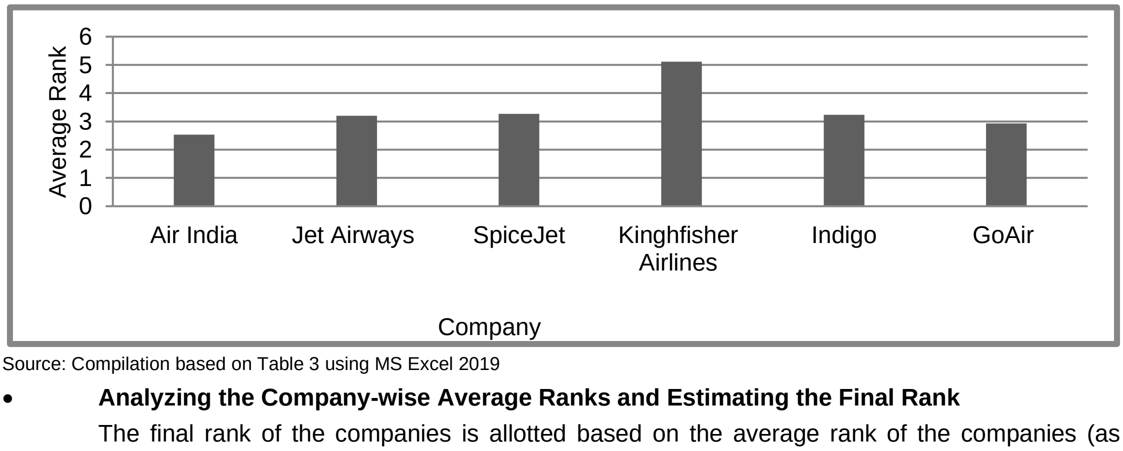
Each DMU's super efficiency score indicates how efficient it is in relation to the most efficient ones. DMUs are graded based on how efficient they are comparative to the highest performers using super efficiency scores. DEA analysis produces the super efficiency scores, and the DMUs are ranked according to these super efficiency ratings. DMUs with higher super efficiency scores are considered more efficient and are ranked higher when compared to the top performers. The top-ranked DMUs in the sample are contrasted with the other DMUs. When lower-ranked DMUs compare their results to these benchmarks, they can identify areas for improvement and best practices to follow. In the current study, the number of DMUs is small. Here, the ranking of companies is made based on their super-efficiency scores. Companies are ranked every year based on their SE score (as shown in Table 3). Year-wise ranks of the selected companies over the period of study are also determined (as shown in Figure 3). Companies having the highest SE score are ranked 1. Air India is assigned Rank 1 for the maximum number of years (2008, 2016, 2017, 2018, 2019). On the other hand, Kingfisher Airline is assigned the lowest ranks for maximum number of years.

Table 3: Year-wise Average Ranks of the Companies based on Super-efficiency Scores

Year	Air India	Jet Airways	SpiceJet	Kingfisher Airlines	Indigo	GoAir
2005	2	3	4	5	-	1
2006	2	3	5	4	-	1
2007	2	3	4	5	6	1
2008	1	4	3	6	2	5
2009	2	5	1	4	3	6
2010	2	5	4	6	3	1
2011	2	6	4	5	3	1
2012	6	3	1	5	2	4
2013	5	2	1	6	3	4
2014	5	3	1	-	2	4
2015	5	2	4	-	3	1
2016	1	3	2	-	4	5
2017	1	2	5	-	3	4
2018	1	2	5	-	4	3
2019	1	2	5	-	4	3
Average Rank	2.53	3.2	3.27	5.11	3.23	2.93

Source: Compilation of secondary data using DEA Solver MS Excel, 2019

Figure 3: Average Ranks of Companies during the Study Period



Source: Compilation based on Table 3 using MS Excel 2019

- **Analyzing the Company-wise Average Ranks and Estimating the Final Rank**

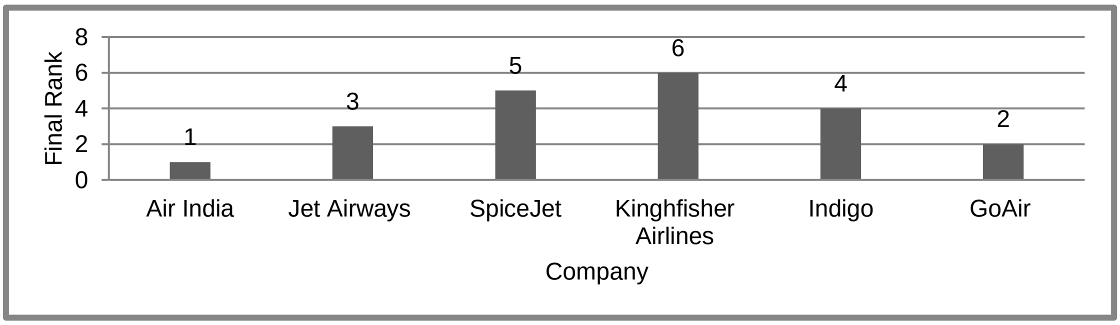
The final rank of the companies is allotted based on the average rank of the companies (as shown in Table 4). The company having the lowest average rank score (assigned based on SE score) is ranked 1 and the company having the highest average rank score (assigned based on SE score) is ranked 6th. Accordingly, Air India is Ranked 1st with an average rank score of 2.53, Go Air is ranked second with an average rank score of 2.93, Jet Airways is ranked third with an average rank score of 3.20, Indigo is ranked 4th with an average rank score of 3.23, Spice Jet is ranked 5th with an average rank score of 3.27 and Kingfisher Airline is ranked 6th with an average rank score of 5.11. Analyzing the performance of the six selected airlines and ranking them according to average SE score helped to identify the strengths and weaknesses of these airline companies. These will aid the managers in implementing appropriate improvement practices. In this study, 6 important Indian airlines are evaluated and ranked by presenting a new DEA model. The results show that Air India and Kingfisher Airlines have projected the best and the worst performance, respectively.

Table 4: Final Ranks of the Companies based on Super-efficiency Scores

Year	Air India	Jet Airways	SpiceJet	Kingfisher Airlines	Indigo	GoAir
2005	2	3	4	5	-	1
2006	2	3	5	4	-	1
2007	2	3	4	5	6	1
2008	1	4	3	6	2	5
2009	2	5	1	4	3	6
2010	2	5	4	6	3	1
2011	2	6	4	5	3	1
2012	6	3	1	5	2	4
2013	5	2	1	6	3	4
2014	5	3	1	-	2	4
2015	5	2	4	-	3	1
2016	1	3	2	-	4	5
2017	1	2	5	-	3	4
2018	1	2	5	-	4	3
2019	1	2	5	-	4	3
Average Rank	2.53	3.2	3.27	5.11	3.23	2.93
Final Rank	1 (Highest Rank)	3 (Third Highest Rank)	5 (Fifth Highest Rank)	6 (Lowest Rank)	4 (Fourth Highest Rank)	2 (Second Highest

Source: Compilation of secondary data using DEA Solver MS Excel, 2019

Figure 4: Final Rank of Companies during the Study Period



Source: Compilation based on Table 4 using MS Excel 2019

6. Managerial Implications

The Indian airline companies may consider the following suggestions for improving their super-efficiency scores:

- Instituting revenue management system;
- Improving labour efficiency;
- Reducing environmental footprint;
- Expanding network and strategic partnership;
- Ensuring regulatory compliance, and
- Improving programme methodologies continuously.

7. Conclusion

Super efficiency (SE) is one of the powerful tools of DEA and in the efficiency analysis of the airline industry. Super efficiency allows efficiency scores to exceed beyond 1. This process pushes the DMU beyond the efficiency frontier established by the remaining units and helps to further differentiate among highly efficient units. The super efficiency scores help in ranking efficient airlines, and provides deeper insights into best practices and policy implications. In the current study, the strengths and weaknesses of these airline companies have been identified by analyzing the SE score of the six selected Indian airlines companies and ranking the performance based on average SE scores. According to the study, Air India is ranked first and Kingfisher Airline is ranked last among the selected airline companies. The result of the research will help the management to take appropriate improvement practices. Improving the super efficiency of airline companies involves a combination of strategic, operational, and technological initiatives, which should be undertaken by these airline companies for their long-term sustenance. Moreover, efficiency ranking of the selected airline companies provides a clear comparative framework about their operational efficiency, which is of critical importance for the growth and development of airline industry in India.

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