Journal of Air Transport Management 53 (2016) 165–176

Contents lists available at ScienceDirect

Journal of Air Transport Management

journal homepage: www.elsevier.com/locate/jairtraman

Drivers of operational efficiency and its impact on market performance in the Indian Airline industry

Haritha Saranga [a,*], Rajiv Nagpal [b]

[a] Indian Institute of Management Bangalore, Bannerghatta Road, Bangalore, 560076, India
[b] Tata Motors, Dharwad, India

A R T I C L E I N F O

Article history:
Received 8 February 2015
Received in revised form
2 March 2016
Accepted 3 March 2016
Available online 16 March 2016

Keywords:
Indian Airline Industry
Operational efficiency
DEA
Market performance
GLS
Tobit

A B S T R A C T

India is considered to be one of the toughest aviation markets in the world, due to high fuel prices, overcapacity and intense price competition. It is therefore important to identify critical drivers of performance, which enable the airlines to survive and succeed in this emerging market with huge growth potential. In the current empirical study, we investigate the linkages between various performance drivers, operational efficiencies and market performance. An extensive data collection using primary and secondary sources enabled us to gather data on all the airlines operating in India, both private and public, for the period 2005–2012, on a variety of important parameters. We carried out a two-stage empirical analysis, which involved estimation of operational efficiencies during the first stage using Data Envelopment Analysis, and determination of performance drivers during the second stage using a two-way random effects GLS regression and also a Tobit model. Our findings suggest that while some of the structural and regulatory factors have an undesirable impact on airline performance, the low cost carriers in India have managed to achieve significant operational efficiencies. In addition, we find that, while cost efficiency is driven by a variety of factors, it is the technical efficiency which brings in better market performance through pricing power in the Indian airline industry.

1. Introduction

India is touted as one of the toughest aviation markets (Bloomberg Business, 2015), due to expensive taxation (Economic Times, 2012) and highly price-sensitive customers. High fuel prices (50% more than the price in West Asian and European countries (BS reporter, 2011)), overcapacity and intensive price competition, exacerbated by the recent global recession have resulted in continued losses for majority of airline operators, with one of them, the Kingfisher airlines[1], shutting down operations in 2012 and the state owned carrier Air India being bailed out (India Today, 2012) by the Indian government with infusion of huge cash flows ($263.3 million in 2010–11)[2]. The total debt of major airlines in India is currently estimated to be $13 billion[3]. This scenario in India is more or less similar to other countries, wherein airlines have suffered from high levels of competition and economic pressure, with high volatility in fuel and foreign exchange rates adding to their financial woes (Merkert and Hensher, 2011).

Despite these setbacks however, one or two successful airlines have emerged in the recent past with consistently good performances and have demonstrated the potential for profitability in the Indian airline sector. Indigo airlines, the most profitable airline in India, is well known for its sharp focus on key deliverables (Business Standard, 2012) like on-time performance, low fares, and consistent on-board and ground service[4], despite being a low cost carrier (LCC) that made its entry into the airline industry a mere 8 years ago. While the case of Indigo substantiates the desirability of LCC strategy from the cost efficiency perspective as already documented by other studies in the literature (Barros and Peypoch, 2009; Merkert and Hensher, 2011), it also raises questions about there being more to the LCC strategy than just *low cost* benefits. As the ability of airlines to price their services based on additional frills that are less valued by customers decreases significantly in the face

* Corresponding author.
E-mail addresses: harithas@iimb.ernet.in (H. Saranga), rajiv.j.nagpal@gmail.com (R. Nagpal).

[1] http://en.wikipedia.org/wiki/Kingfisher_Airlines.
[2] http://indiatoday.intoday.in/story/government-clears-financial-bailout-package-for-air-india/1/184294.html.
[3] http://www.thehindu.com/todays-paper/tp-opinion/for-indian-carriers-season-of-new-hope/article4748696.ece.
[4] http://www.business-standard.com/article/companies/a-tale-of-two-airlines-kingfisher-vs-indigo-112022100014_1.html.

http://dx.doi.org/10.1016/j.jairtraman.2016.03.001
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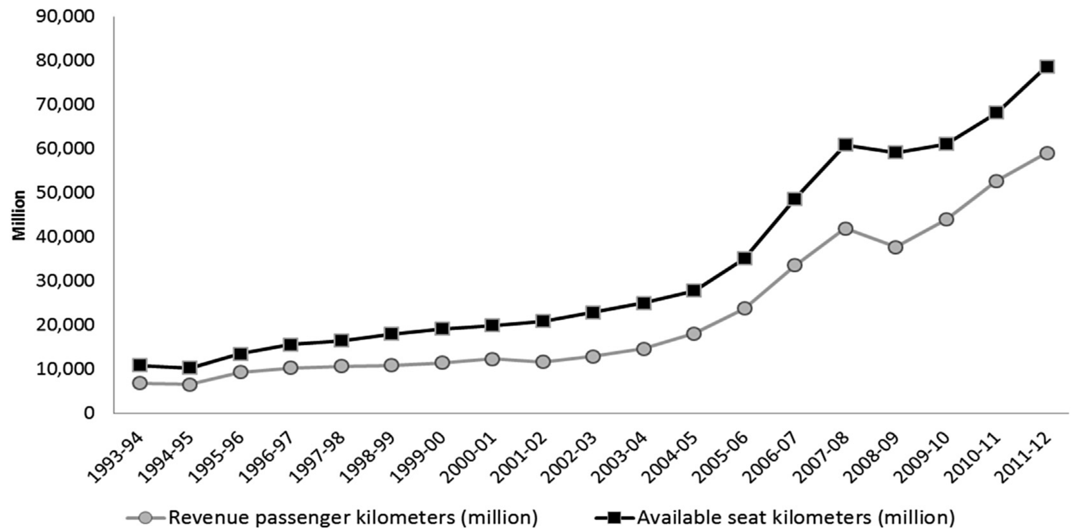

Fig. 1. Growth in RPK and ASK in Indian scheduled domestic carriers[8].

of intense price competition and over capacity, the need to identify drivers of yield has assumed greater prominence. One needs to be cautious of the fact that, better operational efficiencies do not automatically lead to superior financial performance in the airline industry (Scheraga, 2004). Therefore, given the tremendous pressure on airlines from the financial viability point of view and the inflection point (Financial Times, 2015) the Indian airline industry is currently at crossroads and there is an imminent need to identify not only the drivers of operational efficiencies, but their relationship with financial and market performance.

The continued losses of major airlines and the lack of large capital flows to sustain these airlines had forced the Indian government to open aviation sector to foreign entry in late 2012[5]. With airline seat per capita currently being only 0.07 in India, as compared to developed economies such as the US at 2.49, Australia at 3.35, developing countries like China at 0.29, Brazil at 0.68, Turkey at 0.44 (CAPA - Centre for Aviation, 2012), India's commercial aviation sector has a huge potential for growth. Ailing existing players (such as the Jet airlines) are forming new partnerships[6], and new players (e.g., the Tata Group[7]) have made entry into the industry by taking advantage of the growth potential of the Indian market and the availability of foreign capital. However, the industry analysts are uncertain about the impact of the increased capacity on the performance of existing and new players in an already ailing industry. While the cost of air travel is likely to come down in the short run, the survivability of airlines in the long run however will depend on whether they will be able to deliver services valued by the Indian customers at an affordable price and still remain profitable.

Our objective in this empirical study therefore is to investigate the driving factors of operational efficiencies and their impact on market performance in the Indian airline industry. Using primary and secondary data collected from the airlines and other sources, we examine the relative efficiencies of Indian operators of both domestic and international airline services during the seven year period 2005–06 to 2011–12, from technical and cost efficiency perspectives. We develop a theoretical framework that links various structural, executional and regulatory drivers to operational efficiencies of airlines in India. We use a standard two-stage approach (Banker et al., 1984)) to evaluate the operational efficiencies of the airlines and to identify the factors that drive these efficiencies. In the first stage, the Data Envelopment Analysis (DEA) is used to evaluate the *technical and cost efficiencies* and in the second stage, panel data based regression models are used to identify factors driving these efficiencies. Our results indicate that while there are multiple factors that drive operational efficiencies in the Indian airline industry, the operational efficiencies in turn drive market performance. Our findings therefore have significant implications for both existing players and new entrants, as they provide rare insights into successful strategies in one of the most challenging airline industries in today's emerging markets.

2. Indian Airline industry

India is currently the 9th largest aviation market with a passenger throughput of 159 million as of 2013. More than 85 international airlines operate to India and five Indian carriers connect over 40 countries. Until The Air Corporation Act (ACA) 1994 allowed private carriers to operate scheduled airline services in India, Air India and Indian Airlines, which were controlled by the Government of India, were the only two airlines operating in India. Jet Airways and Air Sahara started operations in 1994 and Air Deccan, the first low cost carrier (LCC), entered the domestic aviation industry in August 2003 after the liberalization (Hooper, 1997) of airline industry. Since then other LCCs such as Spice Jet, Go Air and Indigo have entered the market. Full Service Airlines (FSA) like Kingfisher and Paramount commenced operations in 2005. The period following the introduction of the LCCs has been one of rapid growth for the Indian airline industry. Fig. 1 below describes the growth of Indian airline industry in terms of available seat kilometres (ASK) and revenue passenger kilometres (RPK).

The number of scheduled aircraft departures has grown from 270,031 in 2003–04 to 704,554 in 2011–12 (an increase of 160%),

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[5] To enable foreign capital flows into the ailing airline industry and facilitate growth, the Indian government permitted foreign carriers for the first time to invest up to 49% in airlines in India.

[6] Jet Airways has formed partnership with Etihad Airways by selling 24% stake.

[7] Tata Group is entering the airline industry through a low cost airline (in partnership with Air Asia of Malaysian airlines) and a full service airline (in partnership with Singapore airlines).

[8] Chart created using data from the DGCA website - http://www.dgca.nic.in/reports/stat-ind.htm.

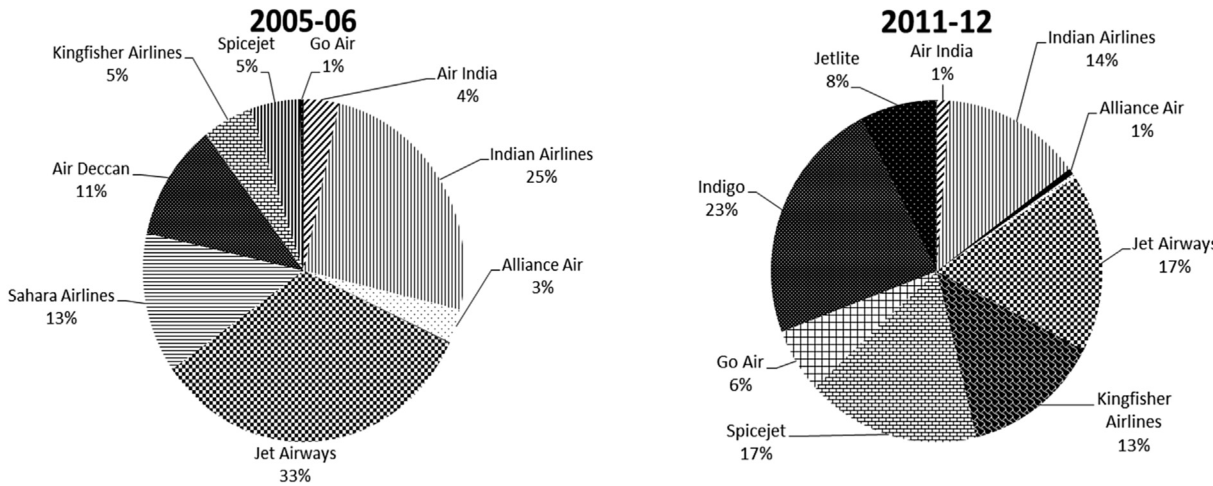

Fig. 2. Market share of various Indian carriers from 2005 to 06 to 2011–12[11].

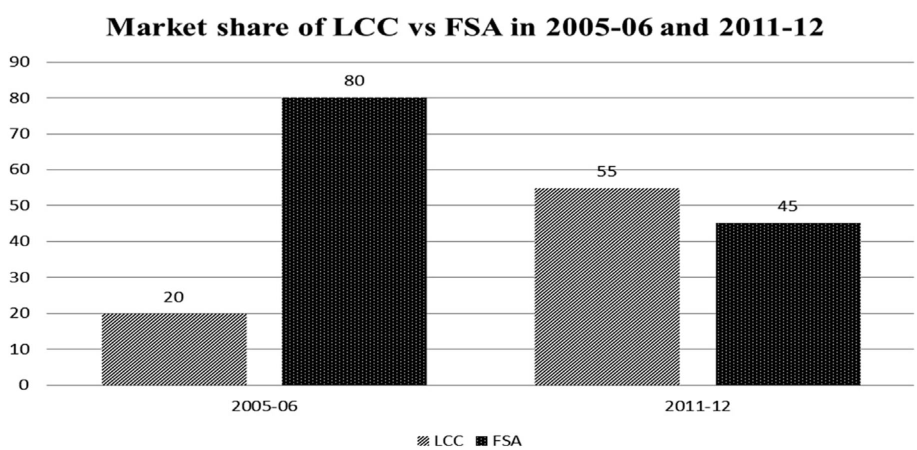

Fig. 3. Change in LCC market share between 2005–06 and 2011–12.

while the combined fleet size of all scheduled airlines increased from 162 to 355 (an increase of 119%) for the same period[9] (DGCA, 2013). For India, this growth marks a tremendous increase in airline travel. The growth in supply has been met with strong growth in demand, led primarily by the conversion of train and bus passengers to airline passengers and a reduction of fares (CIATSI, 2009) that has allowed passengers to fly more frequently. The fastest growth in scheduled passenger air traffic in India in the last two decades was witnessed during 2004–05 to 2011–12 at a compounded annual growth rate (CAGR) of 13.7% with domestic traffic clocking a CAGR of 16% and International traffic a CAGR of 11.6%[10] (DGCA, 2013).

Post deregulation, the Indian civil aviation market is seen to exhibit oligopolistic characteristics[12]. Since the introduction of the low cost carriers, the market share of Legacy carriers such as Air India, Indian Airlines and Jet Airways has decreased substantially (please see Fig. 2), giving rise to fierce price wars between airlines.

Fig. 2 describes the change in market shares (calculated using ‘domestic RPK’ of scheduled carriers) of various airlines during the seven year period between 2005–06 and 2011–12. Fig. 3 depicts the change in market share between LCCs and FSAs during our study period.

Certain policies such as, ‘preference in traffic rights’ and ‘access to government finance’[13] in favour of the national carriers did impede the growth of new private carriers to some extent. While the price competition restricted their yields, increasing fuel prices[14] (from 1.27 USD/gallon in March, 2009 to 3.27 USD/gallon in April, 2011), airport charges[15] (increased by 10% in March, 2009) and employee costs increased significantly during this period. In addition, the increased capacities in the industry resulted in reduced utilization of aircrafts, meaning, most airlines could not even manage break-even loads (RWGCAS, 2012). As a result of all these factors, profits were difficult to come by in the last decade for a majority of the airlines in the Indian aviation industry.

[9] http://www.dgca.nic.in/reports/stat-ind.htm.

[10] Calculated using data from the DGCA website - http://www.dgca.nic.in/reports/stat-ind.htm.

[11] Chart created using data from the DGCA website - http://www.dgca.nic.in/reports/stat-ind.htm.

[12] Research Study of the Civil Aviation Sector in India - http://www.circ.in/pdf/Civil_Aviation_Sector.pdf.

[13] Research Study of the Civil Aviation Sector in India - http://www.circ.in/pdf/Civil_Aviation_Sector.pdf - Section 5.7 - Preferential Treatment to Air India.

[14] http://www.indexmundi.com/commodities/?commodity=jet-fuel&months=120.

[15] http://www.bangaloreaviation.com/2012/04/huge-hike-in-airport-charges-and-fees.html.

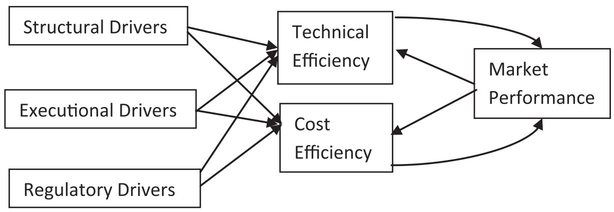

Fig. 4. Theoretical framework.

3. Theoretical framework and hypotheses development

According to Shank and Govindarajan (1993), there are two types of cost drivers in the airline industry, 'executional cost drivers', which to a large extent are determined by managerial ability and performance, and 'structural cost drivers', which involve choices with regard to the underlying economic structure of the airline. Unlike executional drivers, structural drivers once committed, are not easy to change in the short and medium term and hence can significantly constrain the performance of firms if there is misalignment with the competitive environment and/or there are unforeseen changes in the regulatory environment. The regulatory norms have also been found to be one of the significant determinants of airline performance by prior studies (Schefczyk, 1993; Scheraga, 2004). In India for example, airlines are not allowed to operate international flights, which are considered to be highly profitable, unless the airlines have been operating domestic flights for at least five years. Based on our analysis of the Indian airline industry and the significant factors affecting the operational and market performance of various airlines, we propose a theoretical framework (see Fig. 4) that links various structural, executional and regulatory drivers to operational efficiencies and in turn to market performance. Note that, while the regulatory drivers are external to the airline, the structural drivers have a long term impact and the executional drivers are more tactical in nature and therefore influence the decision making in the short term[a].

As depicted in Fig. 4 above, our theoretical framework essentially identifies and connects structural, executional and regulatory drivers that underlie operational performance measures, such as technical and cost efficiencies. In addition, while we conjecture that the market performance, i.e., Yield, or the ability to demand price premium, is one of the drivers of operational performance, the operational performance, i.e., technical and cost efficiency, is expected to drive the future market performance.

Technical efficiency considers physical measures and represents a situation where it is impossible for a firm to produce a larger output from the same inputs. Cost efficiency, as a metric of performance arises in a situation where input choices are optimal (given their prices) and maximum possible output is produced – a combination of allocative and technical efficiency.

In the current study, we investigate the impact of ***structural drivers***, such as 'economies of scale/distance', ***executional drivers***, such as 'low cost business model' and 'resource utilization' along with ***regulatory factors***, such as 'international operations' and 'average stage length' on technical and cost efficiencies of the airlines operating in India. We also study the impact of market performance or the 'ability to set the price', which is measured by 'yield', on operational performance measures such as technical and cost efficiencies, as well as their impact in turn on future market performance (see Table 1 for a detailed definition of all the variables used in the current study). Note that it is difficult to classify any given factor as a strictly structural, or executional or regulatory driver, as each factor may consist of multiple aspects that belong to different categories. For example, adoption of a low cost business model may require the airlines to operate with a single fleet of aircrafts, which is a structural decision; at the same time, the airline also needs to ensure faster turnaround times to succeed in this business model, which is an executional driver. Despite these ambiguities, we believe this classification of operational efficiency drivers into structural, executional and regulatory drivers is important, as it would allow senior managers to make better use of findings from studies such as ours, in benchmarking exercises and in forming performance improvement strategies. To help in such endeavours, we later clarify how one can delineate the various aspects of each of the critical drivers based on the focus of an airline's improvement strategy. For now, we classify the drivers based on their main characteristics and specify when a driver under consideration falls under multiple categories.

The ***average stage length*** as mentioned above represents the economies that can be obtained from flying long distances at a stretch. While increased fuel efficiency associated with flying longer sectors is likely to have a positive impact, one also needs to *factor in costs associated with cabin crew accommodation, maintenance and other essential facilities at the destinations on longer sectors* (Merkert and Hensher, 2011). Apart from being a distance measure, ***average stage length*** flown per aircraft departure has been considered as a good indicator of route and network optimisation by Merkert and Hensher (2011), who analysed the impact of fleet planning and strategic management decisions on airline efficiency using a sample of 58 of the largest passenger airlines in the world over two fiscal years 2007 and 2008. They found that while the ***average stage length*** of the airlines had a relatively small but significant negative impact on technical efficiency; it did not have a significant impact on cost efficiency.

In the Indian context, however, routes and networks operated by airlines to some extent are also influenced by the regulatory norms. Directorate General of Civil Aviation (DGCA) regulations mandate airlines to deploy a certain proportion of their capacity on routes which are less profitable but provide essential connectivity between certain cities; hence network optimization may not necessarily be entirely within an airline's control. It is therefore all the more crucial, especially for the new entrants, to understand the implications of ***average stage length*** on the performance of an airline in India. Since an airline with a higher average stage distance is expected to enjoy efficiencies from scale economies, we expect to see a positive correlation between technical and cost efficiencies and the stage distance in the Indian context.

The ***LCC business model*** was popularized by airlines such as the Southwest in the US and the Ryanair in Europe, who drastically changed the way airlines managed their business by removing services that were not valued by customers and streamlining operations towards low cost. By nature, the LCCs are expected to be more efficient, and empirical evidence from different parts of the world substantiates this conjecture through multiple methodologies (Barbot et al., 2008). The LCC model, which made air travel affordable to a greater number of people, was firmly established in the Indian market by the entry of Air Deccan in 2003. As competitive and economic pressures increased in the market, the yield from premium products decreased, and demand for low cost airlines increased. This resulted in the growth of low cost carriers as cost and efficiency rose higher on the agenda of managers than ever before. The subsequent entry of other LCCs and introduction of low cost subsidiaries by FSAs resulted in the rapid growth of LCCs in the Indian airline industry, garnering 63% of the market share by 2009. The LCC model brought with it new pricing

[a] We would like to thank an anonymous referee for pointing this out.

Table 1
Description of variables used in the study.

Variable	Description
Available Seat Kilometres (ASK)	Measures the total number of available seat kilometres (in million) per airline, by taking the sum of the products of number of passenger seats available for sale on each flight stage and the stage distance
Revenue Passenger Kilo metres (RPK)	Measure of the volume of passengers carried by an airline estimated as sum of the products obtained by multiplying the number of revenue passengers carried on each flight stage by the stage distance (in million kilometres)
Staff Strength	Total number of full time employees at year end
Operating revenue per ASK	Measure of profitability of the airline estimated as – Total operating revenue/ASK
Operating expense less employee expenditure per ASK	(Operating expense – Employee expenditure)/ASK
Employee expenditure/Staff strength	Employee expenditure/Total number of full time employees at year end
load factor	RPK/ASK
revenue hours per *aircraft*	Average daily revenue hours per aircraft (Average number of hours per day each aircraft of the fleet is flown for revenue flights)
average stage length	Average stage distance flown per aircraft departure (Total kilometres flown by all aircrafts during the year divided by the number of departures)
passengers per *departure*	Average number of passengers carried per aircraft departure (Total number of passengers carried by all aircraft divided by the number of departures)
percentage of international operations	Percentage of scheduled RPK on international routes
LCC Business Model	A dummy variable that takes value '1' if the airline belongs to LCC and '0' otherwise
Yield	Total operating revenue/RPK
operating expenses per *RPK*	Total operating expense/RPK

Note – Operating expense and operating revenue are defined as millions of dollars per Kilometre.

strategy that brought down ticket prices drastically and stimulated the pent up demand in India. The LCCs in turn were reported to have displayed strong operational performance by cutting costs through a 'no-frills' policy, rationalizing fleet structure and increasing aircraft utilization. Such a business model should have a positive impact on the technical and cost efficiencies as it appears to be a more sustainable model in a price sensitive market like India.

Another variable that reflects resource utilization is the ***revenue hours per aircraft*** flown by the airline's fleet. The aircraft is the most expensive resource in an airline and hence should be engaged in flying passengers and earning revenue for as many hours as possible. However, due to mandatory safety checks and maintenance needs, an aircraft is grounded for many days in a year. Therefore, during the remaining part of the year when aircraft is available for use, one needs to ensure faster turnaround times through efficient scheduling of flight crew and other day-to-day operations, in order to achieve higher number of revenue hours per aircraft (Bhadra, 2009). In other words, airlines that are able to earn higher revenue hours for each of their aircraft compared to their competitors are likely to manage operating performance of their airline fleet better than others. Therefore, we expect the ***revenue hours per aircraft*** to be positively correlated to the technical and cost efficiencies of the airlines.

Percentage of international operations captures the international focus of airlines and has been found to be a significant determinant of operational efficiencies in airlines. In a study that investigates the relationship between operational efficiency and financial mobility, Scheraga (2004) used this variable as one of the explanatory variables. With the Indian government allowing FDI into the airline industry, many international airlines have expressed interest in entering Indian market, with an explicit objective to capture the market share of international travellers from India. Hence the impact of this variable on relative efficiencies of current operators would be of utmost interest to the potential entrants. However, since our current sample (in fact the entire Indian domestic airline industry) includes only domestic players (except for one airline, i.e., Air India), one needs to take into account the government regulations, which constrained the strategic route decisions of these airlines during our study period. According to the Working Group report on Civil Aviation Sector[16], the low level of utilization of international traffic rights by Indian carriers together with the restrictions on Indian private carriers to operate on International routes is causing slow growth of Indian carriers in the International segment. Even though international routes involve high operational costs, they provide opportunity for effective capital utilization and route optimization. Higher exposure to international routes also allows airlines to learn and absorb best practices from other aviation sectors and hence improve their efficiencies on all fronts. Therefore, we expect the airlines with higher percentage of international RPK to enjoy relatively higher technical and cost efficiencies.

We define airline ***yield*** as the operating revenue per passenger kilometre (operating revenue/RPK). As more than 90% of the operating revenue for all airlines consists of passenger ticket sales, yield is an indicator of the pricing power of an airline in the market. Yield is also considered to be one of the external demand related variables representing market pressure, and hence is expected to induce airlines towards better productivity and efficiency related

[16] According to the Aeronautical Information Circulars No. 08 of 2009, a domestic carrier that wishes to start international air carrier service must possess a valid permit of operation, lease or purchase at least 20 aircraft and have at least five years of domestic scheduled operations. This is unlike the United States and European Union where a carrier needs to show financial viability and operational income to implement the firm's business plan; no explicit equity or fleet requirement exists. http://civilaviation.gov.in/cs/groups/public/documents/document/moca_001680.pdf.

activities (Bhadra, 2009). In a highly price-sensitive market like India, where even FSAs end up charging the same or even lower prices than LCCs due to price wars, ability to charge a price premium is a highly coveted attribute. Mainly, the business travellers, who value their time and have scheduled meetings to attend to, are willing to pay a price premium for timely service. Achieving timely transportation of passengers to their destinations with minimum number of flight cancellations is the mark of a reliable airline in any aviation industry. Only airlines with streamlined operations, well maintained aircrafts and high technical efficiencies will be able to achieve this attribute, highly valued by frequent air travellers. Hence, we conjecture that, not only does higher yield induce airlines towards higher technical efficiency, but higher technical efficiency also results in better yield going forward. One way to test this two-way relationship is by examining the impact of lagged variables, by regressing the technical efficiency of airlines with both the current year's as well as next year's yield figures, keeping all other variables current. The relationship between yield and the cost efficiency can also be examined using a similar approach.

Operating costs incurred by airlines in flight operations, maintenance, ticketing and promotion, airport charges and capital depreciation are important factors to determine the efficiency and effectiveness of the airlines. We use the measure ***operating expense per RPK***, in order to capture the relative operating costs of airlines. With the increase in competition since 2004, many Indian carriers have aimed to cut costs and 'de-frill' their airlines in order to become more efficient in their operations. Fewer operating expenses would imply use of lesser capital and resources and therefore we expect a negative correlation between operating expense per RPK and technical efficiency of airlines.

4. Research methodology and data specification

There have been many empirical studies that investigated various aspects of airline operations and their impact on financial and market performance, especially in the context of developed countries (Scheraga, 2004; Bhadra, 2009; Merkert and Hensher, 2011; Merkert and Pearson, 2015; Barros and Couto, 2013). However, to our knowledge, there hasn't been a systematic empirical study that looks at various operational efficiencies and their linkages to performance in the Indian airline industry. One of the main reasons for this is the presence of only four airlines until the early 2000's and the lack of time series data as new players kept entering the industry one after the other (from 2003 onwards), leading to the inadequate size of airline samples from years prior to 2003. This does not allow the researcher to create a dataset of Indian airlines spread over a sufficiently large interval of time and hence perform studies similar to the ones for US and European airlines.

For the current study we managed to collect a dataset that allows us to carry out a reasonably rigorous empirical investigation to test our conjectures. We use a two stage approach to determine the factors driving various efficiencies in the Indian airline industry. During the first stage, we use DEA to evaluate technical and cost efficiencies of our sample airlines and these efficiency scores are then regressed against the structural, executional and regulatory drivers, during the second stage. This two-stage approach has been used by several authors in empirical studies of U.S and European airlines (Scheraga, 2004; Merkert and Hensher, 2011; Bhadra, 2009) in order to estimate the efficiency of airlines and to identify the drivers of these efficiencies and also in the study of airports (Merkert and Assaf, 2015). While the DEA is a commonly used technique, other methods that have been used to estimate efficiency are the B-convex model (Barros and Couto, 2013) and TOPSIS (Barros and Wanke, 2015) Below, we briefly describe the DEA and the regression models used in the current study.

4.1. Data Envelopment Analysis

DEA (Charnes et al., 1978) is a non-parametric linear programming technique used to measure the production efficiency of decision making units. DEA is considered to be an effective performance evaluation methodology mainly for the following two reasons: (i) one can make use of multiple inputs and outputs simultaneously to arrive at a single efficiency score to rank the decision making units (DMUs) under consideration and (ii) DEA does not assume a functional form for the frontier, avoiding bias resulting from subjectively assigned weights such as Analytical Hierarchy Process (AHP). This has led to the application of the methodology to a wide number of industries ranging from textile (Zhu, 2003) to software development (Banker and Kemerer, 1989). DEA calculates the relative performance of DMUs as the ratio of the weighted sum of outputs to the weighted sum of inputs. The weights are not pre-determined, but rather allocated by the model. The basic specification for envelopment models includes distance, orientation and returns to scale. We have used the radial distance function, which measures the necessary proportional improvements of relevant factors (inputs and outputs) for the DMU under evaluation to reach the frontier. A DEA production frontier can be obtained (non-parametrically) either with an input orientation or an output orientation, each of which can be assumed to be either constant (CRS) or variable (VRS) returns to scale. While the CRS model assumes that there is no advantage to scale, VRS allows for a relaxation of this assumption (Banker et al., 1984). In the Indian airline industry, regulatory constraints, budgetary restrictions and mergers may result in firms operating at an inefficient scale, hence we adopt VRS assumption.

Similar to Merkert and Hensher (2011), we too assume that airlines have a higher influence on the inputs than on the outputs (e.g., the macro-economic factors during our study period induced high consumer demand and therefore a potentially high output RPK), and hence use the input orientation. The underlying premise in an input oriented model is that the primary objective of the airline under evaluation is to gain efficiency by reducing excess inputs while continuing to operate with its current technology mix. To sum up, we specify an input-oriented VRS model with each airline acting as a separate DMU. This model assigns an efficiency score between 0 and 1 for each DMU after evaluation and a DMU is found to be efficient only if it is assigned a score of 1.

We consider each of the n ($j = 1,\dots n$) DMUs (i.e., airlines) use a set of m inputs x_{ij} ($i = 1,2 \dots m$) to produce s outputs y_{rj} ($r = 1,2 \dots s$). The following input oriented VRS model helps us develop a piecewise linear approximation to the efficiency frontier and the area dominated by it.

$$\theta^* = min\ \theta \tag{1}$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{io} \ \mathrm{i} = 1,2,\dots\mathrm{m}; \tag{2}$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro} \ \mathrm{r} = 1,2,\dots\mathrm{s}; \tag{3}$$

$$\sum_{j=1}^{n} \lambda_j = 1 \tag{4}$$

$$\lambda_j \ge 0\, j = 1,2,\dots n; \tag{5}$$

For DMU$_o$ under evaluation, x_{io} and y_{ro} are the ith input and rth output respectively.θ^* represents the input oriented efficiency score of DMU_o.

We use the above model to calculate both the technical and cost efficiency scores, with respective input–output variables described below, with the help of MaxDEA 6.2 software.

4.2. Input-output variables

In order to estimate the *technical efficiency* score, non-financial inputs and outputs are used in DEA. Therefore, in line with earlier studies (Barros and Peypoch, 2009; Merkert and Hensher, 2011), we use Revenue Passenger Kilometres (RPK), which measures the total number of kilometres travelled by all passengers, as the output measure. The inputs typically used in order to generate the above output are broadly classified as capital and labour. Since technical efficiency estimation requires physical inputs, we use Available Seat Kilometres (ASK) as a proxy for capital and staff strength (the number of full time employees at the end of each year) as a measure of labour. Staff includes pilots, co-pilots, cockpit personnel, cabin attendants, maintenance, overhaul, ticketing, sales personnel and other workers[17].

In order to compute the *cost efficiency* measure, we use 'operating expense less employee expenditure per ASK' (as a measure of capital) and 'employee expenditure per full time employee' (as a measure of labour) as inputs and 'operating revenue per ASK' as the output.

4.3. Regression analysis

In the second stage of the analysis we regress the first-stage DEA efficiency scores (used as the dependent variable) against the performance drivers identified in Section 3. Previous two-stage approaches (Merkert and Hensher, 2011), which use DEA in the first stage, adopted the Tobit regression with bootstrapping in the second stage as prescribed by Simar and Wilson (2000). But, John McDonald (2009), who used least squares and Tobit in the second stage, argues that the efficiency scores are not generated by a censoring data generating process but are fractional data and the Tobit estimation in this situation is inappropriate. He further argues that ordinary least squares (OLS) is an unbiased, consistent estimator, and, if heteroskedasticity is allowed for (large sample), hypothesis tests can be validly undertaken. However, one common context in which the errors from a regression model are unlikely to be independent is the time series data, where the observations are noted at different moments or intervals of time, usually equally spaced. Another possibility is that our data might be clustered in some way[18]. For example, our sample may be structured so that subsets of DMUs are from the same family (Air India and Indian airlines, Jet Airways and Jetlite) and hence we would expect that errors would be positively correlated within clusters. The OLS regression assumes that the error variances are homoskedastic, errors are uncorrelated and also normally distributed and therefore will not give robust estimates in a regression[19]. An alternative is to use the Generalized Least Squares (GLS) estimator, which gives efficient estimates by weighting individuals in terms of the size of their variances and whether their errors are correlated or not. It is a generalization of the OLS, where the errors are uncorrelated and have equal variances. For this study, we performed both the GLS and Tobit regression (with adaptive quadrature for mean and variance and fitted 25 quadrature points) and found that the estimators and their respective significance levels do not differ by a large extent between the two methods.

We used a two way random effects model (which includes a firm as well as a year dummy) in order to include firm level effects as we have reason to believe that differences across entities have some influence on the dependent variable. Random effects allow for time-invariant variables to play a role as explanatory variables. We therefore use the following model:

$$Y_{it} = \alpha + \beta X_{it} + u_i + \varepsilon_{it}$$

Where Y_{it} is the efficiency score of the individual airline i in the relevant year t, X_{it} is the independent or explanatory variable value (listed in the table below) for DMU i in year t, α is the intercept, β is the estimate for a particular variable, u_i is the between-entity error which is assumed same in every period and ε_{it} is the within-entity error which is uncorrelated across periods.

4.4. Data specification

The data for the input as well as the output variables used in the DEA and those used in the regression analysis were obtained mainly from the website of the Directorate General of Civil Aviation (DGCA) in India. These figures have been reported by the airlines on DGCA's standard data forms and are displayed on the website. Certain financial and staff strength data which was not reported on the DGCA website was obtained from the Capitaline and Prowess databases and also from company reports. The merger of Air India and Indian Airlines in 2007 led to reporting of combined financial figures for these airlines after the merger. However, the difference in the nature of operations (International and domestic) and the already low number of DMUs in each year warranted that we keep them as separate entities in our analysis. For this purpose, we estimated the proportion of operating expense of Air India and Indian airlines respectively in the combined operating expense, for the five years prior to the merger. We found that this figure was fairly consistent over the years. Hence, we used the average proportion of operating expense (over the five years before the merger) for each of the two airlines to compute the independent operating expense for each of them for years following the merger. A similar approach was used for operating revenue. All other operational and fleet related data was directly available through DGCA website, as it was reported separately for each airline during our study period.

Both technical and cost efficiency scores for each of the airlines in our sample, during our study period 2005–06 to 2011–12, were computed for each year separately. All Airlines that operated for the full 12 months (April–March) in each year were taken into consideration for this purpose. The sample changed each year because of the entry of new airlines and because of mergers and acquisitions (2007 and 2008) that took place. Thus, at the end of first stage DEA analysis, we managed to create an unbalanced panel with 72 total observations over seven years containing the efficiency score as the dependent variable and various other parameters (discussed in Section 3) as independent explanatory variables recorded over the said time period. Descriptive statistics of all the primary variables used in both stages of our empirical study are reported in Table 2 below.

5. Results and discussion

We present the results from both the stages of empirical analysis

[17] Note that the number of inputs and outputs used in DEA runs were within the DEA convention that the sample size is greater than three times the number of inputs and outputs (Dyson et al., 2001).

[18] Basic Understanding of Generalized Least Squares – isites.harvard.edu/fs/docs/icb.topic629746.files/lec16.09.pdf.

[19] http://espin086.wordpress.com/2012/07/18/the-least-squares -assumptions.

Table 2
Descriptive statistics for first and second stage analysis.

Variable	N	Mean	Std. Dev.	Min	Max
First stage DEA models					
Outputs					
Revenue passenger kilometres (million km)	72	7571.13	7281.74	21.20	30645.00
Operating revenue/ASK	72	0.08	0.03	0.03	0.19
Inputs					
Staff Strength	72	5739.92	6049.25	214.00	18219.00
Available seat kilometres (million km)	72	10780.18	10424.95	48.10	38646.00
Operating expense less employee expenditure/ASK	72	0.08	0.03	0.01	0.18
Employee expenditure/Staff strength	72	0.018	0.016	0.01	0.138
Second stage explanatory variables					
Yield (Revenue per RPK)	72	0.11	0.06	0.05	0.36
Average daily revenue hours per aircraft (hours)	72	9.50	2.22	1.70	13.70
Average stage distance flown per aircraft departure (km)	72	1227.54	786.28	437.65	3718.20
Percentage of international RPK	72	0.28	0.38	0	0.99
LCC vs FSA	72	0.54	0.50	0	1.00
Operating expense/RPK	72	0.13	0.07	0.05	0.39

Note: The operating expense and operating revenue figures are given in millions of dollars per kilometre.

in this section. While the DEA results will be presented in the subsection below, the subsequent section will discuss the regression results from the second stage analysis and the relevant findings in the context of the hypotheses posited in Section 3.

5.1. The DEA results

We have used an input oriented VRS model for computation of technical and cost efficiency scores using DEA. Note that, airlines with an efficiency score of ‘1’ lie on the frontier and are said to be efficient. Also note that Paramount airways, Kingfisher airlines, Spicejet and Go Air only commenced operations in the year 2005. According to the inputs and outputs used in the DEA, those airlines that make the most efficient use of their ASK (operating expenses) and staff (employee expenses) in generating the maximum RPK (operating revenue) are the most efficient technically (cost). As shown in Table 3, Jet Airways, Air India Express (AIE) and Paramount airways emerge to be on the technical efficiency frontier for all the years in the period under study. However, only AIE and Paramount airways turn out to be on the cost efficiency frontier as well during most of the study period. Note that while Jet and Paramount are full service airlines, AIE is a low cost airline. In addition, AIE[20] and Paramount airways[21] have a relatively small range of operations focussing on smaller regions.

Air India is among the most technically efficient airlines during the early years (2005–2007), but recedes back from the frontier for the later period. Note that the merger of Air India and Indian airlines took place in the year 2007. As seen in Figs. 5 and 6, there was a sudden drop in both technical and cost efficiencies of both these airlines. While cost efficiency began recovering during the later years, technical efficiency continued to suffer.

Some of the operational reasons contributing to the national carrier's poor performance after the merger were (i) employee–to–aircraft ratio, which was the highest among its peers at 222:1 - global average is 150:1 (Express Travel World, 2009), resulting in a surplus employee strength of almost 10,000, (ii) Fall in air passenger traffic as a result of the economic slowdown and (iii) use of a diverse fleet of aircraft (e.g., the international operations are run mostly by wide-body Boeing 777 jets, while domestic routes mostly use Airbus A320 series) which resulted in high costs of operations, maintenance and manpower. While the first two factors resulted in fall of RPK and rise in staff strength, the third factor increased the operating expenses significantly, resulting in poor efficiencies, on both technical and cost fronts. The merger however did not affect the low cost AIE and in fact seemed to have benefitted the other low cost national carrier, Alliance Air[22], both of which have regional focus and whose operations mainly involve connecting tier-2 cities with domestic hubs and/or international flights.

An examination of the LCCs over the years shows that even though LCCs such as Spicejet, Go Air and Indigo do not fall on the efficiency frontier for the entire period; their technical efficiency scores in general are consistently high and close to the frontier. However, the cost efficiency seems to be comparatively low for many LCCs, except for AIE, Alliance air and Indigo airlines. To understand the dynamics underlying these efficiency scores and the determining factors, we discuss the results from the second stage analysis below.

5.2. Regression results

In order to test our theoretical framework and the corresponding hypotheses, we carried out a series of step wise two-way random effects GLS and Tobit regressions using Stata 11 and the results are summarised in Tables 4 and 5 below. We find support for most of our conjectures, both in case of technical efficiency (please see GLS results under the Current Yield column in Table 4) as well as cost efficiency (GLS results under the Current Yield column in Table 5). We find that the structural driver, the ***average stage length***, has a significant impact (at 1% level) on technical and cost efficiencies of airlines in India. However, the regression coefficients corresponding to ***average stage length***, both technical as well as cost efficiency cases, turned out to be negative (albeit very small), indicating that, airlines with longer stage distances in fact suffer from lower efficiencies. Our finding is in line with Merkert and

[20] For example, Air India Express is a subsidiary of Air India, operating with a low cost model and focused operations between the South Indian state of Kerala, Middle East and South East Asia, where air traffic from and to India is most concentrated. Air India Express operates approximately 100 flights per week, using 180 seater Boeing 737 aircraft. http://en.wikipedia.org/wiki/Air_India_Express.

[21] Paramount airline has a business model which targeted only business passengers and provided services mainly to cities in South India using smaller Embraer aircraft of about 70 seats. The airline ceased operations when legal issues arose with the lessors of their Embraer aircraft, which lead to a gradual termination of all services as the fleet was grounded and seized by the leasing companies in early 2010. However, in 2012, Paramount won the legal battle and was set to resume services. http://en.wikipedia.org/wiki/Paramount_Airways.

[22] http://www.airindia.in/alliance-air.htm.

Table 3
The Technical and Cost Efficiencies of various Airlines in India during 2005–2012.

Airline	2005–06		2006–07		2007–08		2008–09		2009–10		2010–11		2011–12	
	TE	CE	TE	CE	TE	CE	TE	CE	TE	CE	TE	CE	TE	CE
Air India	1.00	1.00	1.00	0.96	1.00	0.85	0.85	0.74	0.81	0.74	0.90	0.82	0.83	0.84
Indian Airlines	0.95	1.00	0.98	0.91	0.98	0.88	0.89	0.79	0.87	0.86	0.83	0.83	0.87	0.93
Alliance Air	0.80	1.00	0.94	0.83	0.92	0.83	1.00	0.83	1.00	1.00	1.00	1.00	1.00	1.00
Air India Express	1.00	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	*	*	1.00	1.00
Jet Airways	1.00	1.00	1.00	0.99	1.00	0.89	1.00	0.98	1.00	0.92	1.00	1.00	1.00	1.00
Sahara Airlines	0.94	1.00	0.87	1.00										
Air Deccan	0.99	1.00	1.00	0.90	1.00	1.00								
Paramount Airways	1.00	0.77	1.00	1.00	1.00	1.00	1.00	1.00	*	*				
Kingfisher Airlines	0.72	1.00	0.88	1.00	0.93	0.94	0.89	0.70	0.91	0.81	0.98	0.90	*	*
Spicejet	1.00	1.00	0.99	1.00	0.98	1.00	0.91	0.83	0.96	1.00	*	*	0.91	0.92
Go Air	0.64	0.77	0.93	1.00	1.00	0.99	0.93	1.00	1.00	0.99	*	*	0.96	1.00
Indigo			0.95	0.94	0.99	0.93	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Jetlite					0.96	0.86	0.93	0.75	1.00	0.89	0.99	0.87	1.00	0.86

‘*’ denotes that the efficiency was not calculated for the year due to lack of sufficient data, while empty cells (for Sahara Airlines and Air Deccan) are due to the mergers of airlines into other airlines.

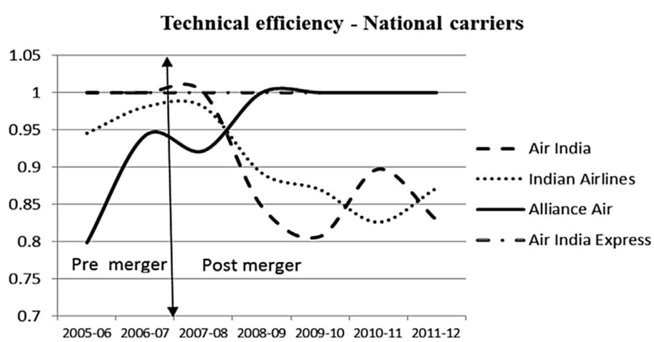

Fig. 5. Changes in Technical Efficiency of national carriers during 2005–2011.

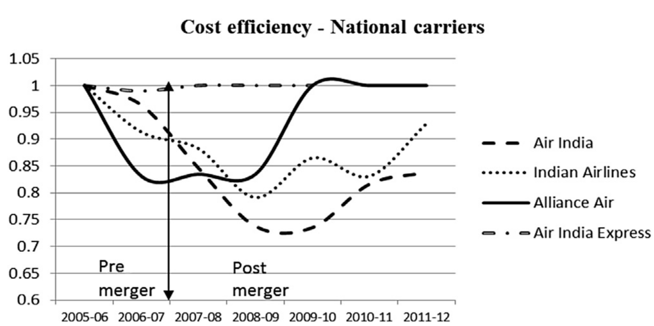

Fig. 6. Changes in Cost Efficiency of national carriers during 2005–2011.

Hensher (2011), who analysed the impact of fleet planning and strategic management decisions on airline efficiency. It seems in the Indian context too, the fuel efficiency gains from flying longer distances seem to have been offset by *costs associated with cabin crew accommodation, maintenance and other essential facilities at the destinations on longer sectors*. The negative coefficient in the case of technical efficiency indicates that the capacity deployed on long-thin routes, at times to connect Tier II/Tier III cities using large flights, is not leading to high occupancy[23] resulting in lower load factors compared to shorter routes.

One of the executional drivers, the ***LCC business model***, is found to be positive and highly significant (at 1% level in case of technical efficiency and 5% level in case of cost efficiency), establishing that in India too, low cost airlines managed to achieve higher operational efficiencies compared to their full service counterparts. It is interesting to note that, the first of the LCCs, Air Deccan, made its entry only in 2003, with remaining LCCs entering the market from 2005 onwards. So, despite being late entrants, the low cost strategies and the business models adopted by the LCCs have helped them become highly efficient. All the LCCs in India typically use a single fleet of aircrafts (e.g., Indigo, the largest Indian airline operates the Airbus A320 series[24], while SpiceJet operates Boeing 737 and a few Bombardier aircrafts for lower demand routes[25]), which significantly reduces their maintenance and operational costs. Having a single type of aircraft in the fleet also allows the airlines to identify a suitable flight crew when aircrafts need to be replaced on short notice due to technical glitches, ensuring fewer delays and cancellations, which consequently result in happy customers. Another means through which LCCs make better use of their aircraft is by fitting higher number of seats within the aircraft, which allows them to fly a larger number of passengers with lower fixed costs[26]. Similarly, strategies such as online ticketing services, no hot-meals on board, short haul flights and point-to-point services between high-traffic routes help LCCs reduce costs and turnaround times, further adding to customer satisfaction.

The next driver, ***revenue hours per aircraft,*** is also found to have a positive and significant impact at 5% level for technical and 10% level for cost efficiency. As noted earlier, the aircraft is the most expensive resource in the airline business; therefore it is not surprising that the airlines that are able to manage higher ***revenue hours per aircraft*** on an average are able to achieve higher operational efficiencies. Therefore, the two executional drivers, the ***LCC business model*** and the ***revenue hours per aircraft*** turn out to be significant determinants of technical and cost efficiencies in the Indian airline industry.

We next look at the ***International RPK***, measured by the percentage of the revenue passenger kilometres flown by the airline on international routes, which is also found to have a positive and significant association with technical and cost efficiencies at 1% and

[23] https://www.atkearney.in/transportation/ideas-insights/article/-/asset_publisher/LCcgOeS4t85g/content/regional-aircraft-in-india-poised-for takeoff/10192?_101_INSTANCE_LCcgOeS4t85g_redirect = %2Ftransportation%2Fideas-insights%2Farticle.

[24] http://en.wikipedia.org/wiki/IndiGo.

[25] http://en.wikipedia.org/wiki/SpiceJet.

[26] e.g., majority of Air India's domestic fleet consists of A319s, whose single class configured versions, which are comparable to the LCC fleet, have just 144 seats compared with the 180–189 seats on the narrow bodies operated by the LCCs.

Table 4
Determinants of Technical efficiency in the Indian Airline Industry.

Parameters	GLS		Tobit	
	Current yield	Future yield	Current yield	Future yield
Intercept	0.813***	0.806***	0.697***	0.718***
Average stage length	(−)0.00005***	(−)0.00006***	(−)0.00013***	(−)0.00018***
LCC	0.045***	0.039*	0.108***	0.083*
Rev hrs per AC	0.011**	0.012**	0.017**	0.024***
International RPK	0.12***	0.135***	0.379***	0.442***
Yield	0.021***	0.018***	0.044***	0.025***
Operating expense	(−)0.012**	(−)0.009*	(−)0.015*	(−)0.006
Number of observations	72	58	72	58
Number of groups	12	12	12	12
R2				
Within	0.3369	0.3651		
Between	0.605	0.3899		
Overall	0.4063	0.3787		
Correlation (u_i,Xb)	0 (assumed)	0 (assumed)		
Wald chi2 (12)	40.37	28.01	34.7	25.6
Prob > chi2	0.0001	0.0032	0.0005	0.0074
Hausman test				
chi2	9.23	4.77		
Prob > chi2	0.5103	0.8542		

Table 5
Determinants of Cost efficiency in the Indian Airline Industry.

Parameters	GLS		Tobit	
	Current yield	Future yield	Current yield	Future yield
Intercept	0.899***	0.867***	0.829***	0.909***
Average stage length	(−)0.00005***	(−)0.0007***	(−)0.00005*	(−)0.00009**
LCC	0.035**	0.028	0.06**	0.048
Rev hrs per AC	0.009*	0.009	0.011	0.011
International RPK	0.068*	0.1*	0.076	0.124
Yield	0.034***	0.006	0.07***	0.009
Operating expense	(−)0.03***	(−)0.011	(−)0.058***	(−)0.17*
Number of observations	72	58	72	58
Number of groups	12	12	12	12
R2				
Within	0.4759	0.315		
Between	0.6986	0.5183		
Overall	0.5512	0.395		
Correlation (u_i,Xb)	0 (assumed)	0 (assumed)		
Wald chi2 (12)	72.47	30.03	49.84	24.83
Prob > chi2	0	0.0016	0	0.0096
Hausman test				
chi2	9.67	11.74		
Prob > chi2	0.4698	0.2284		

10% levels respectively. Although this is in general considered as a structural variable as it allows the airlines to offer services to international destinations, in the Indian context it also has a regulatory angle, akin to ***average stage length***, and we mainly focus on the regulatory aspect in the current study. This is because the Indian airline industry is still at a nascent stage, wherein the majority of airlines were less than 5 years old (the minimum stipulated time to be spent in domestic operations before becoming eligible to operate international flights) at the beginning of our study period. Since the percentage of ***international RPK*** has a significant impact on operational efficiencies, new entrants may find international services as an attractive option. However, the government regulations do not allow this, making it a deterrent for the sorely needed foreign investment in the Indian airline industry. One way that new players can overcome this entry barrier is by entering into a joint venture (JV) with one of the established players.

The ***Yield***, a determinant of market power, is found to have an extremely significant positive association (at 1% level) with the technical and cost efficiencies of airlines. As discussed in our theoretical framework depicted in Fig. 4, we conjectured that while the airlines that managed to command a higher price for their services obviously enjoy higher output for a given input, the more technically efficient airlines would also be able to command higher premium for their services. The results presented in Table 4 support these conjectures. The first column in Table 4, under the Current Yield, presents the GLS results corresponding to the relationship between current year's technical efficiency and current year's yield (which tests the impact of current year's yield on technical efficiency); whereas the second column in Table 4, under the Future Yield, presents the GLS results corresponding to the relationship between current year's technical efficiency and next year's yield. The empirical results therefore corroborate our observations in practice, that is, airlines such as Indigo, that demonstrate higher technical efficiencies through shorter turnaround times and on-time performance, also command a premium for their services, as customers value these attributes. However, the results corresponding to cost efficiency and yield are slightly different. While we find that ***Yield*** has positive and significant impact (at 1% level) on cost efficiency, based on the GLS results under the first column of Table 5, we do not find any significant association between current year's cost efficiency and next year's yield (under Future Yield column in Table 5). The results seem to suggest that, while airlines that are able to generate higher ***Yield*** are able to achieve better cost efficiency, this cost efficiency in turn is not translating into higher future ***Yield***. This is a very critical result, compelling the airlines not just to focus on the cost efficiency, but to strive for technical efficiency, which is appreciated more by the customers and thus results in higher market power and helps in generating higher revenues going forward.

We finally test the impact of ***operating expenses per RPK*** on technical and cost efficiencies, and this too turns out to be significant for both technical and cost efficiencies, with a negative coefficient as expected. This clear empirical finding further substantiates the intuition that if an airline incurs higher operating expenses than their competitors for each revenue passenger kilometre it generates, its operating efficiencies will suffer as a result. This finding therefore comes as a warning to the players in the airline industry to watch out for how much it is costing them to earn each revenue passenger kilometre and benchmark against more profitable peers.

One final note pertains to the ***load factor***, which is the ratio of the revenue passenger kilometres (RPK) to available seat kilometres (ASK) and is typically used as a measure of the capacity utilization of an aircraft in the airline industry. ***Load factor*** is a structural factor that gets influenced by demand and therefore helps to capture how external market conditions influence the efficiencies of airlines over time. Previous empirical studies have found that ***load factor*** has a positive impact on operational efficiencies (Fethi et al., 2000) as well as peer group efficiency (Bhadra, 2009). In a study of the African airline industry, Barros and Wanke (2015) suggest that load factor not only impacts the cost per RPK (as flight specific costs are spread over larger revenue) but also influences the decision regarding size of the aircraft operated. We however could not include ***load factor*** in our second stage analysis, as it was found to have a high correlation with some of the other independent variables, resulting in multicollinearity related problems. Since ***load factor*** is a well-accepted measure of efficiency (in single input and single output cases) within the airline industry, we do not miss out on any insights by not including this measure in our analysis. We tested for correlations and found that ***load factor*** has a positive and significant correlation with both technical and cost efficiencies.

It is evident from the Tobit results presented in Tables 4 and 5 that, the estimates and significance levels obtained using the Tobit model are more or less in agreement with those obtained using GLS regression. The inferences drawn about the estimators of efficiency are valid for results obtained using Tobit regression as well. The result of the Hausman test (reported in the Tables 4 and 5) confirms the random effects model by accepting the null hypothesis that the individual effects are uncorrelated with the other regressors in the model. For the Tobit model, we obtained a largest relative difference of less than 0.01% between fitting 17 and 33 quadrature points upon performing a quadrature check, thus confirming reliable estimators.

6. Conclusions and managerial implications

Our empirical findings from the two-stage analysis have significant implications for airlines operating in India currently, as well as for future aspirants. There is intense competition in the industry, which is further exacerbated by the additional capacity being added by the current players and new entrants. Currently, 63% of the domestic passengers fly by LCCs, and even the remaining 27% flying by FSAs pay similar fares as LCCs (at times even lower), due to price wars and very little distinction between the services offered by LCCs and FSAs. Therefore, it is safe to assume that the Indian airline industry is characterized mainly as a low cost industry. However, the cost structure of FSAs is much higher than that of LCCs[27], resulting in huge losses for almost all FSAs and even for most LCCs (except for Indigo airlines) during the past several years. In an industry such as this, where loss-making is a norm and any profits by an airline are reported as front page news[28], one has to be extra cautious in understanding the various linkages between drivers of performance, both operational and financial. Since India is considered to be one of the most cost conscious[29] countries to operate in, whether it is automobile market or airline services, one has to pay special attention to costs and operational efficiencies, as there is very little scope to manoeuvre on the price front.

Our empirical study findings therefore provide important pointers to senior executives who are carefully scanning the Indian skies for a possible entry into this highly competitive but coveted market, mainly due to its huge population and large potential for growth. One of the critical findings from our study is the fact that technical efficiency is not just required to manage operations more efficiently and to cut-down on costs; it is also needed to gain market power. Our results indicate that airlines that have higher technical efficiencies are able to charge price premiums, as they are able to offer services that are highly valued by customers. Although this seems intuitive, the efficiency related studies mainly focus on the cost side of operations and very rarely identify the linkages with market dynamics. While our analysis finds various drivers of cost efficiency, technical efficiency seems to be the determinant of future pricing power in the Indian airline industry.

The classification of various drivers into structural, executional and regulatory factors is the other useful insight we provide to the industry practitioners. Many a time one may not have control over all performance drivers (e.g., regulatory factors), therefore it is important to identify the critical factors that are under one's control. The above classification allows airlines to first work on drivers that can be changed in the short-term (e.g., executional drivers), then focus on the ones that require long-term planning (e.g., structural drivers) and finally find ways of managing the external factors (by working with other industry players and regulatory authorities etc.).

While the variables included in the empirical study do help explain some of the differences in efficiency of various airlines, the residual efficiency is better explained by factors specific to the airlines, which are difficult to capture and include in a quantitative analysis. Based on our qualitative studies and the anecdotal evidence, we discuss below some of the factors that may explain the residual efficiency/inefficiency from the second stage analysis.

The most efficient airline based on our study, the IndiGo's experienced management team was highly cautious in its approach since before the launch of the airline as well as during its growth and consolidation stages. They had a ‘Power by the hour’ contract with International Aero Engines (IAE) as well as airframe maker Airbus that puts the onus of performance delivery on the manufacturer, ensuring that the airline does not get affected financially due to aircraft downtime[30]. IndiGo also had a sharp focus on key deliverables like on-time performance, low fares, consistent

[27] http://centreforaviation.com/analysis/indias-airlines-lcc-and-fsc-must-review-their-business-models-maybe-creating-space-for-airasiaia-128482.

[28] http://articles.economictimes.indiatimes.com/2013-12-22/news/45475783_1_aditya-ghosh-indi-go-interglobe-aviation. http://www.business-standard.com/article/companies/what-keeps-indigo-s-profit-flying-high-113100901248_1.html.

[29] http://archive.financialexpress.com/news/indian-customers-most-pricesensitive/243733.

[30] http://www.forbes.com/2010/11/03/forbes-india-how-rahul-bhatia-found-indigo-gold.html.

onboard and ground service, had lower marketing spend than other competing airlines such as Kingfisher and SpiceJet, and used word-of-mouth publicity of their on-time performance to make it a preferred airline[31] and charge higher price premiums.

One of the inefficient airlines, Kingfisher, on the other hand had a very unstable business model with many changes to its strategy since its launch in 2005 till it was forced to wind up its operations in 2012[32]. For example, while Kingfisher began as a full service airline, it purchased a low cost airline Air Deccan, in order to launch its international services before it completed the stipulated 5 years of domestic operations. Kingfisher was also very aggressive in their international flight expansions launching long-haul as well as short-haul flights in one go in the year 2008. This aggressive expansion came at a time when the industry was suffering from over-capacity and the jet fuel prices sky rocketed, which coupled with a business strategy that had lost focus contributed significantly to their operational inefficiencies, pulling them down to bottom of the table in cost efficiency during the year 2008–09.

GoAir, another low cost private airline with consistently high technical and cost efficiency, is highly focused on regional routes, connecting five metro cities in India to many tier-I and tier-II cities. This focused strategy and refusal to enter into a price war has helped GoAir to become one of the few profitable airlines in India[33]. In fact GoAir was ranked by Airbus as the "Best Performing Airline" in the Airbus A320 category in Asia Pacific/Middle East/Africa region in 2011, based on their fleet utilization and on-time performance metrics[34].

As one may note based on above examples, while some of the structural and regulatory drivers imposed certain constraints on the airlines operating in India, each individual airline had ample freedom to run their operations on a day-to-day basis and change course in a direction that best suited their competitive goals using executional drivers. Our empirical findings clearly demonstrate that executional drivers have a significant impact on both technical as well cost efficiencies of airlines in India. In addition, we also find evidence that airlines with higher technical efficiency are also able to command price premium. While the two regulatory drivers that we study also have an impact on the efficiencies, note that one of them (stage length) has a negative impact while the other (international flights) has a positive impact, indicating that airlines should not feel overly constrained by regulatory hurdles. In fact airlines like Kingfisher, who tried to circumvent the regulatory norms to begin their international operations early, could not succeed ultimately as they did not manage their structural and executional aspects well.

We therefore recommend that airlines operating in India should first focus on getting their strategic positioning right by paying close attention to structural and regulatory factors, align the operations strategy to the chosen competitive strategy and execute it well during the day to day operations.

Finally, our empirical study is one of the first attempts at investigating the operational efficiency and its linkages to market performance in the Indian airline industry. Due to the small size of the industry, fewer players and lack of detailed data, we could not consider other important factors, e.g., fleet variety, size, optimal routing, network structure etc. in this study. Future studies may investigate the impact of these factors and the foreign direct investments on airline performance with the help of a longitudinal dataset.

[31] http://www.forbes.com/2010/11/03/forbes-india-how-rahul-bhatia-found-indigo-gold.html.

[32] http://www.business-standard.com/article/companies/a-tale-of-two-airlines-kingfisher-vs-indigo-112022100014_1.html.

[33] http://www.thehindu.com/business/companies/we-will-not-sell-under-cost/article4472063.ece.

[34] http://www.breakingtravelnews.com/news/article/goair-ranked-the-best-performing-airline-by-airbus/.

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