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# Breakeven Passenger Traffic for Regional Indian Airports

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**Abstract**

Most of the regional airports in India are financially unsustainable because of low and fluctuating passenger traffic. Despite double-digit passenger traffic growth since past four years, most regional Indian airports are yet to achieve financial sustainability due to high fixed operating costs and low non-aeronautical revenue. The Indian government is putting special emphasis on regional air connectivity through UDAN (Ude Desh ka Aam Nagrik) scheme. However, it is difficult to ascertain whether such schemes can ensure airport profitability. This paper attempts to find the operating breakeven point in terms of annual passenger traffic for 27 regional airports over a period of three years from 2014-15 to 2016-17. The method used is simple linear regression of operating revenue and operating cost with passenger traffic. The method as well as findings have been corroborated with relevant literature. The breakeven point changes 0.8 million passengers in 2014-15 to 0.6 million passengers in 2016-17. Most regional airports in the sample have more than 0.5 million passengers per annum and this paves way for smaller and upcoming airports looking for incentive schemes to attract airlines.

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*Keywords:* airport accounts; breakeven passenger traffic; regional airports

## 1. Introduction

Strong linkages have been found between regional air connectivity and economic growth of the country (Albalate and Fageda, 2016). Hence, despite the low levels of passenger traffic at regional airports rendering them unprofitable, governments continue to support these airports. Subsidies are provided to unprofitable airports in different forms such as discounts to residents, route subsidies, traffic distribution rules imposed on airlines, state-owned airlines providing connectivity or subsidies to airports (Fageda et al, 2018). All these schemes for providing regional connectivity either

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impose burden on the passengers travelling on non-subsidized routes or, in most cases, require funds allocation from the central government. To design an appropriate scheme for regional airports, one needs to know the extent of subsidy that will be required in terms of amount as well as time. The revenue stream at an airport depends on the number of passengers and based on passenger growth in previous years, it can be easily found in how many years an airport can attain a given passenger traffic. In this paper, we compute the breakeven passenger traffic for regional Indian airports for three consecutive years. This gives the profitability position of these airports in terms of number of passengers.

## 2. The Indian Context

India is the seventh largest country in the world with geographical area of 3.2 million square kilometres. The northern borders comprise of the Himalayan mountain ranges and the western borders are formed by the Punjab plains, Thar Desert and Rann of Kutch salt marshes. The far northeast is also formed by deeply forested mountains. Below the Himalayas is the Indo-Gangetic plain, while the southern parts comprise of the Deccan plateau, the Western and the Eastern Ghats (Britannica, 2018). Thus, India has diverse geographic conditions warranting different safety measures and construction techniques for airports. The number of operational airports is 100, which is small number considering the size of the country (AAI, 2017).

In terms of population, India is the second largest country with 1.3 billion residents (Worldometers, 2018). The World Bank classifies India in the lower middle income group (World Bank, 2018). With the growing income of the middle class society and increasing affordability of air travel, air traffic in India has been showing double digit growth since past four years. Likewise, it is the fourth largest civil aviation market with 265 million passenger in 2016-17 and predicted to be the third largest by 2025 (The Economic Times, 2018). However, the number of passengers travelling by air consists of only 1% of the total passengers travelling by road, rail and air (NTDPC, 2014). This fact is also reflected in the budgetary allocation to civil aviation (Rs 52 billion) in comparison to roads (Rs 234 billion) and railways (Rs 1465 billion) in the Union Budget 2018-19 (India Budget, 2018).

Despite the small size of civil aviation in the Indian transport sector, it has received due importance from the government in the last decade. Several major airports in the country have been transferred to public private partnership (joint venture with private parties) from solely public ownership. These airports handled nearly 60% of passenger traffic in 2016-17 (APAO, 2018). In terms of traffic composition, airports can be classified as international, customs and domestic airports. There are 26 international airports, 8 customs airports, 66 domestic airports (AAI, 2017). Table 1 elucidates the types of airport management models prevailing in India.

Table 1: Prevailing airport management models in India*

| Type of management model | Joint venture (JV) with private parties | Joint venture with state government | Central government | Jointly owned with Defense (Civil Enclaves) | State government ownership |
|---|---|---|---|---|---|
| Definition | 26% stake of the Airport Authority of India (AAI) and 74% stake of consortium of private parties. Profit or revenue sharing with AAI. All airside and landside operations are managed by the JV except for Air Navigation Services (ANS) | Owned by AAI and operated by a special purpose vehicle (SPV) formed by the state government (of Maharashtra) | Owned and operated by AAI | Jointly owned and operated by AAI and the Ministry of Defense. The range of operations managed by Defense varies from airport to airport. Terminals are usually managed by AAI. | Owned by the state government but airside operations managed by AAI |
| Examples | Delhi, Mumbai, Bengaluru, Hyderabad, Kochi | Nagpur | Chennai, Kolkata, Mangalore, Patna | Pune, Leh, Jammu, Vishakhapatnam | Lengpui |
| Percentage of passenger traffic handled in 2016-17 | 56.6% | 0.7% | 34.8% | 7.8% | 0.1% |

*Privately owned airports have not been included in the table, as scheduled operations at such airports started only after 2016-17 under the Regional Connectivity Scheme.

The classification of small and regional airports varies from country to country and how and when an airport changes from small or regional to large is not clearly defined (Wiltshire, 2018). The definition of regional airports is diverse in literature as well (Fageda et al, 2018). Hence, airports with less than 10 million passengers per annum have been defined as regional airports in the present paper.

Looking at the economic regulation of airports, the Airports Economic Regulatory Authority (AERA) monitors the performance and regulates the charges of airside operations for airports with more than 1.5 million passengers per annum, irrespective of their management model (AERA, 2015). For the remaining airports, charges are set annually by AAI based on its cross-subsidization model, as most airports in the country are financially unsustainable.

Based on the charges levied, typical revenues earned by Indian airports are divided into the following heads: ANS revenue, airport services – aeronautical revenue, airport services – non-aeronautical revenue, airport lease revenue, security revenue and other revenue. The ANS revenue consists of collections from route navigation facility charge and terminal navigation landing charge. This category of revenue is collected by AAI even at JV airports. The airport services – aeronautical revenue consists of landing, housing and parking charge, passenger service fee – facilitation component, and user development fee. These two categories of revenue form the aeronautical revenue. The airport services – non-aeronautical revenue consists of oil throughput charges, ground handling, extension of service hours, royalty on Common User Terminal Equipment, trading concessions, rent and services, car parking, commercial passes, NOC for height clearance, porterage, restrooms, consultancy, cargo revenue and miscellaneous non-aeronautical revenue. Airport lease revenue is generated only at JV airports. The security revenue consists of passenger service fee – security component. Other revenue consists of interest income, interest and penalty, profit on sale of fixed assets, employee related recoveries, income from training institute and miscellaneous revenue.

The expenses incurred by the airport operator are divided into the following heads: employee expenses, repair and maintenance, operational expenses, security expenses, prior period adjustment, interest on borrowings, depreciation, provision for bad and doubtful debts, other expenses and overhead expenses. Employee expenses consist of pay and allowances, other staff costs, contribution to provident fund, provision for retirement benefits and guarantee fee. Repair and maintenance consists of civil, electrical, vehicle, equipment, electronic and infrastructure repair and maintenance. Operation expenses consist of consumption of stores, electricity and water, rent rates and taxes, municipal tax, upkeep expenses, horticulture expenses, insurance, advertisement and publicity and meteorological service charges. Security expenses consists of payments to the Central Industrial Security Force and State Police. Overhead expenses consists of regional headquarter overheads and central headquarter overheads.

To understand the nature of these revenues and expenses the details of an international airport, a domestic airport and the average of sampled regional airports (all owned and operated by AAI) for the year 2016-17 are presented in figures 1 and 2.

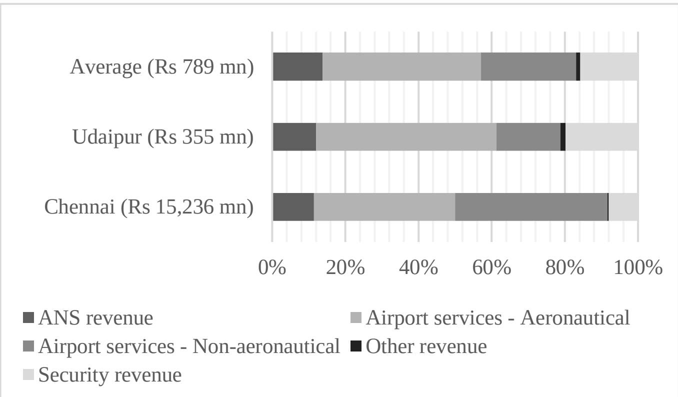


Figure 1. Percent of revenue heads in total revenue in 2016-17

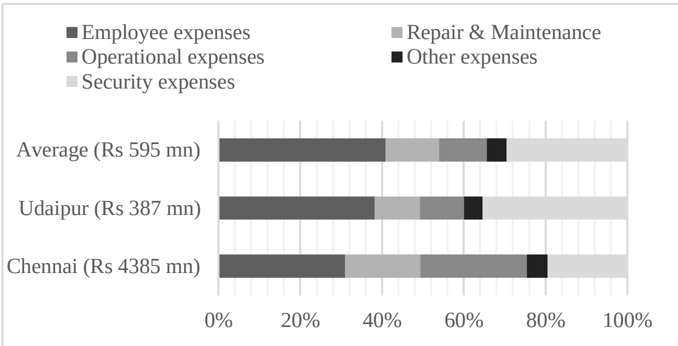


Figure 2. Percent of expense heads in total expense (excluding depreciation, interest on borrowings, prior period adjustment and provision for bad and doubtful debts) in 2016-17

From figure 1, it can be seen that small domestic airports like Udaipur receive lower than average aeronautical revenues whereas large international airports like Chennai receive nearly double the average from non-aeronautical sources. From absolute numbers, same trend can be observed for total revenue. However, similar inferences cannot be drawn from the expense heads in figure 2. Employee expenses have the highest share in the sample average, while they have the lowest share for Chennai airport. Share of employee expenses, repair and maintenance and operational expenses remains approximately same from Udaipur airport and sample average, whereas operational expenses' share nearly doubles for Chennai airport.

Looking at absolute numbers in figures 1 and 2, small airports are not in a position to earn even operating profits but medium-sized airports can achieve it. Large airports like Chennai are certainly in a profit-making position and contribute in cross-subsidizing smaller airports. There are studies that report similar observations about regional airports current accounts for Japan (Minato and Morimoto, 2011), Italy (Laurino and Beria, 2014; Merkert and Mangia, 2014), Norway (Merkert and Mangia, 2014), Spain (Vogel and Graham, 2013), Australia (Donehue and Baker, 2012), among others.

## 3. Review of Literature

The scholarly literature on remote, regional or secondary airports is scanty in comparison to large, international airports (Donehue and Baker, 2012). Such a phenomenon is obvious considering the economic importance of large airports (Baker and Donnet, 2012). Nevertheless, broad areas of research on small, regional airports pertain to their financial viability, incentive schemes to attract airlines, performance and its influencing factors, economic benefits in the catchment area, and policy initiatives to ensure regional connectivity.

Majority of studies on airport performance find that size has a positive influence on airport efficiency (D'Alfonso et al, 2015; Curi et al, 2011; Merkert and Mangia, 2014; Merkert and Mangia, 2012; Abbott, 2015; Coto-Millan et al, 2014; Li, 2014; and Coto-Millan et al, 2016). Firstly, the efficiency of airports is computed and then regression of efficiency is run with several explanatory factors such as size, share of LCC traffic, share of international traffic, ownership, tourist location, hinterland population, etc. In the above studies, size is found to be a significant positive factor showing that airports have economies of scale.

Several studies have also been devoted to the influence of low-cost carrier (LCC) airlines on the performance and profitability of regional airports. Presence of LCC improves the efficiency of small airports (Coto-Millan et al, 2014). Dobruszkes et al (2017) report that regional airports are susceptible to changing business models of LCC airlines. They can face sudden increases in passenger traffic when included in an LCC route and sudden decline when LCC terminates that route. Airports with large share of LCC traffic tend to have lower unit revenues, indicating lower airport charges in order to continue capturing LCC traffic. Hence, regional airports do seek strong presence of LCCs (Graham and Dennis, 2007).

Fageda et al (2018) review the existing policies to ensure regional air connectivity. They summarize the benefits and potential risks of each type of policy, and find that there are four dimensions to be considered in analyzing these policies: transparency, amount of funds allocated, market distortions created, and incentives for efficiency and competition. For the design of incentive schemes for airlines at Italian airports, Laurino and Beria (2014) argue that there is a need for wider strategy, which promotes local development and not just air traffic. On the other hand, Fichert and Kophaus (2011) find that factors such as economic development of the region and capacity constraints can strengthen or counter the impacts of incentive schemes.

We now focus on three studies that use regression to compute breakeven passenger traffic. Vasigh and Hamzaee (1998) explore the relationship of airport operating revenues and operating expenses to passenger traffic. They report the linear and log-linear relationship for cross-sectional data of 93 US airports using OLS regression. Log-linear model is a better fit and all the coefficients have the expected sign and are highly significant. They compare and contrast the results between airports having residual, compensatory or hybrid cost agreements between airports and airlines. The operating expenses are found to be always higher than operating revenues in residual cost agreement. On the other hand, in compensatory cost agreement, a breakeven passenger traffic point was graphically calculated and was found to be 14.75 million passengers per annum. Therefore, they conclude that the nature of agreeement with airlines (or till model) plays an important role in airport profitability and capacity utilization.

Kato et. al. (2011) examine the current accounts of 41 major Japanese airports. They compute the relationship of revenues and expenses to passenger traffic using log-linear model similar to that of Vasigh and Hamzaee (1998) but add a dummy variable for management form. They compute separate breakeven passenger traffic for airports administered by central government and local government. The breakeven point, excluding depreciation, for central government airports is 2.8 million passengers per annum and for local government airports it is 1.7 million passengers per annum. The study shows that the passenger levels of most airports lie below the breakeven point. The breakeven point nearly doubles when depreciation is included the airport expenses. The important insight from the analysis is that transferring airports to local governments may not be a financially viable alternative in Japan.

Adler et. al. (2013) study the change in breakeven passenger traffic over a decade for 85 small regional airports in Europe. They use linear models for relationship of operating revenues and expenses to passenger traffic. They also compute the efficiency of these airports using data envelopment analysis. Based on the efficiency scores, they also compute the breakeven passenger traffic for airports as if they were efficient. They find that the breakeven point nearly doubles over the decade to 463,549 passengers per annum. And if the airports behaved efficiently, the breakeven point could be achieved at only 166,233 passengers per annum. This highlights the importance of efficiency benchmarking of regional airports.

## 4. Method and Data

The initial dataset comprised of 40 busiest AAI-owned airports for five years from 2012-13 to 2016-17. Out of these, Chennai and Kolkata airports do not fall into the category of regional airports because of high passenger traffic as well as high non-aeronautical revenue in comparison to other airports in the dataset. Nagpur airport, though managed largely by AAI, is a joint venture with state government of Maharashtra and presents a different financial model leading to exclusion from analysis. Ten airports are civil enclaves that are owned and operated jointly by AAI and the Ministry of Defence. Since considerable expenses at these airports are borne by defence, they report disproportionately high operating profits. Thus, they too had to be excluded from analysis. Also, Khajuraho and Vijayawada airports opened for scheduled passenger traffic only in 2014-15 and the dataset would be too small for regression without them, so the trends have been mapped from 2014-15 onwards. Therefore, the final dataset comprises of 27 regional Indian airports for three years, 2014-15, 2015-16 and 2016-17. The descriptive statistics of sample airports are illustrated in Table 3.

Table 3: Descriptive statistics of sample airports

| Variable | Year | Number of observations | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Number of passengers | 2014-15 | 27 | 1252786 | 1113684 | 73514 | 5050433 |
| | 2015-16 | 27 | 1526665 | 1361154 | 72405 | 6480108 |
| | 2016-17 | 27 | 1850276 | 1589388 | 58861 | 7405282 |
| Operating revenue (Rs million) | 2014-15 | 27 | 523.28 | 598.69 | 27.46 | 2263.26 |
| | 2015-16 | 27 | 648.55 | 744.10 | 25.20 | 2821.40 |
| | 2016-17 | 27 | 779.65 | 866.83 | 26.00 | 3406.50 |
| Operating expense (Rs million) | 2014-15 | 27 | 490.25 | 302.66 | 119.75 | 1338.00 |
| | 2015-16 | 27 | 507.89 | 309.06 | 147.60 | 1349.40 |
| | 2016-17 | 27 | 566.35 | 373.69 | 179.70 | 1839.20 |
| Total expense (Rs million) | 2014-15 | 27 | 704.24 | 423.25 | 210.27 | 1852.83 |
| | 2015-16 | 27 | 769.54 | 522.20 | 252.50 | 2410.80 |
| | 2016-17 | 27 | 837.07 | 589.00 | 285.20 | 2599.30 |

Linear model gives a good fit; therefore, log linear model has not been included in the final analysis. The OLS regression equations for computing the relationship between passenger traffic with revenue and expenses are as follows:

$$TC_i = FC_i + VC_i \times Pax_i + \varepsilon_i \quad (1)$$

$$TR_i = P_i \times Pax_i + u_i \quad (2)$$

$TC_i$ is the total operating cost of an airport, $FC_i$ is the fixed component of the operating cost and $VC_i$ is the variable component of the operating cost which depends on the number of passengers served, $Pax_i$. Thus, eq. 1 gives the relationship between operating cost and number of passengers. $TR_i$ is the total operating revenue earned by an airport. Since there can be no revenue without passengers, eq. 2 does not contain a constant and relates $Pax_i$ to revenue by coefficient, $P_i$ (Adler et al, 2013). $\varepsilon_i$ and $u_i$ are the error terms in equations 1 and 2, respectively.

Monthly passenger traffic data has been downloaded from the official AAI website and processed into annual data for sample airports, as per the financial year from April to March. It represents the total of international, transit and domestic passengers. For domestic airports, transit passengers' data is not collected separately and they are counted twice. The total operating cost is the sum of employee expenses, repair and maintenance, operational expenses, security expenses and other expenses. Central and regional headquarter overheads should ideally be included in the total operating cost; however, they have been excluded due (i) lack of information on the overheads allocation to various airports by AAI, and (ii) presence of negative values for overhead expenses in the current dataset. Total operating revenue is the sum of ANS revenue, airport services-aeronautical revenue, airport services-non-aeronautical revenue and security revenue. Other revenue such as interest income, income from training institutes, etc. have not been included.

## 5. Results

Scatter plots in figures 3 and 4 show that there is a linear relationship of number of passengers with operating revenue as well as operating cost. All sample airports except Ahmedabad have passenger traffic less than 5 million passengers per annum.

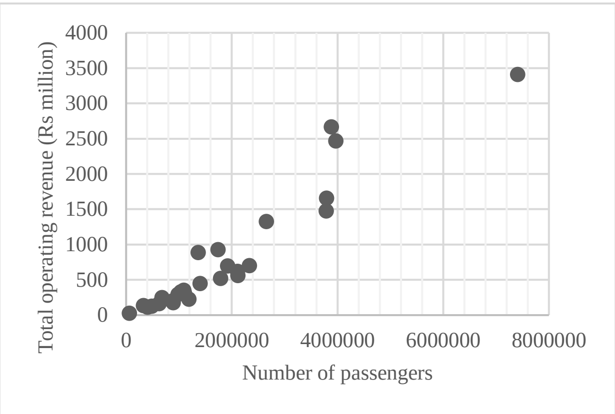


Figure 3: Number of passengers versus total operating revenue in Rs million for the year 2016-17

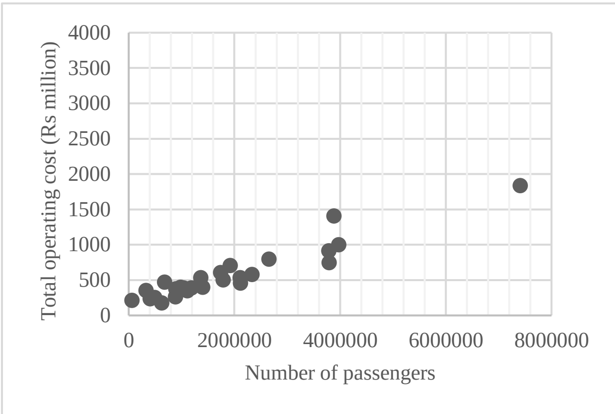


Figure 4: Number of passengers versus total operating cost in Rs million for the year 2016-17

Table 4 displays the results of OLS regression for equations 1 and 2. Eq. 1 gives the relationship between number of passengers and total operating cost. Total operating cost has been divided into fixed operating cost and variable operating cost. Fixed operating cost is the intercept of the linear equation whose value ranges from Rs 186 million to Rs 155 million for the period 2014-2017. Thus, this is the cost incurred by the airports even if there are zero passengers emplaning or deplaning. The t-test values are well above 0.05 indicating reliability of these values at 95% confidence interval. The variable operating cost is the slope of the linear equation whose value ranges from Rs 250 per passenger to Rs 220 per passenger for the period 2014-17. This value indicates the portion of cost incurred which increases as the number of passengers emplaning and deplaning the airport increases. The R-squared for Eq. 1 is more than 86% for all three years pointing towards a good fit of the regression equation.

Table 4: Results of OLS regression and breakeven passenger traffic

| Year | Fixed operating cost, Eq. 1 | | Variable operating cost (Cost coefficient of passengers), Eq. 1 | | Revenue coefficient of passengers, Eq. 2 | | R-squared for Eq. 1 | R-squared for Eq. 2 | Breakeven passenger traffic |
|---|---|---|---|---|---|---|---|---|---|
| | Value | t-test | Value | t-test | Value | t-test | | | |
| 2014-15 | 173.104 | 5.27 | 0.00025 | 12.81 | 0.000460 | 21.11 | 0.8677 | 0.9449 | 837,060 |
| 2015-16 | 186.412 | 5.41 | 0.00021 | 12.39 | 0.000464 | 18.42 | 0.8600 | 0.9288 | 735,643 |
| 2016-17 | 154.485 | 4.22 | 0.00022 | 14.70 | 0.000461 | 19.52 | 0.8963 | 0.9361 | 647,193 |

The revenue coefficient in Eq. 2 is the slope of the linear equation whose value ranges from Rs 460 per passenger to Rs 464 for the period 2014-17. The t-test values are above 0.05 and R-squared is above 92% for all three years showing very good fit of the regression equation. Therefore, all coefficients in the equations 1 and 2 are significant. The operating breakeven passenger traffic is 837 thousand (8.37 lakh) passengers for 2014-15, 736 thousand (7.36 lakh) for 2015-16 and 647 thousand (6.47 lakh) for 2016-17. Though the coefficients are not declining with each passing year, the breakeven passenger traffic is steadily and considerably decreasing from 2014-15 to 2016-17. Therefore, it can be argued that the cost efficiency of sample airports is improving year after year.

## 6. Conclusions

In this paper, the relationship of annual passenger traffic with operating revenue and operating expenses was determined using simple linear regression. The data sample consisted of 27 regional airports owned and operated by the Airport Authority of India for a period of three years from 2014-15 to 2016-17. The coefficients in both the equations were found to be significant and the regression line was found to have good fit with the observed values. We find that the operating breakeven for AAI-owned regional airports has changed from 0.8 million passengers in 2014-15 to 0.6 million passengers in 2016-17. A steady decline in the breakeven passenger traffic has been observed over the three-year study period. From the declining trend, it can be inferred that the cost efficiency of Indian airports is improving over the years. There are several airports with annual passenger traffic more than the breakeven point of 0.6 million in 2016-17. This shows that the Indian airports have the potential to achieve at least operating breakeven in the short term. The findings of this paper can be used to select airports for promoting regional connectivity and also to select sites for new airports. The breakeven passenger traffic can also be used to design incentive schemes for airports to attract airlines. The capital expenses have not been included in the analysis because sample airports have become operational in different years leading to varying depreciation costs. The breakeven point would be much higher than the computed values if capital expenses are included and would give a more realistic picture of costs incurred by the airport because it is a capital-intensive business. Civil enclaves do not have a standardized demarcation costs to be borne by the defense as the degree of management control varies from one civil enclave to another. With better understanding of this joint management model, civil enclaves can also be included in future analyses. The current analysis does not take into account the operational efficiency of airports. Not all airports operate at optimal efficiency and the breakeven point can also be computed. Using the current traffic growth rate at each, the time period after which they can attain breakeven traffic can also be forecasted.

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## Appendix A. Passenger traffic at sample Indian airports from 2014-15 to 2016-17

| S. No. | Sample Airport | 2014-15 | 2015-16 | 2016-17 |
|---|---|---|---|---|
| 1 | Ahmedabad | 5050433 | 6480108 | 7405282 |
| 2 | Trivandrum | 3173427 | 3494680 | 3881509 |
| 3 | Kozhikode | 2583740 | 2305547 | 2651088 |
| 4 | Lucknow | 2541241 | 3241216 | 3968950 |
| 5 | Guwahati | 2233601 | 2779020 | 3789656 |
| 6 | Jaipur | 2197813 | 2887355 | 3783458 |
| 7 | Bhubaneswar | 1493352 | 1892832 | 2332433 |
| 8 | Coimbatore | 1429198 | 1691553 | 2104904 |
| 9 | Indore | 1353300 | 1693020 | 1784073 |
| 10 | Mangalore | 1307083 | 1673842 | 1734810 |
| 11 | Patna | 1196540 | 1584013 | 2112150 |
| 12 | Trichi | 1189218 | 1297212 | 1359447 |
| 13 | Varanasi | 1019973 | 1385969 | 1916454 |
| 14 | Raipur | 932141 | 1217295 | 1396179 |
| 15 | Agartala | 882592 | 926982 | 1183867 |
| 16 | Vadodara | 720114 | 944000 | 1103981 |
| 17 | Madurai | 687221 | 841050 | 978919 |
| 18 | Ranchi | 655010 | 736856 | 1035740 |
| 19 | Imphal | 621865 | 769015 | 886338 |
| 20 | Udaipur | 457720 | 713721 | 1089899 |
| 21 | Aurangabad | 426855 | 300920 | 326971 |
| 22 | Bhopal | 410202 | 663857 | 676015 |
| 23 | Dehradun | 384037 | 468534 | 882564 |
| 24 | Rajkot | 351016 | 419788 | 405518 |
| 25 | Tirupati | 241463 | 345121 | 486029 |
| 26 | Vijayawada | 212552 | 394056 | 622354 |
| 27 | Khajuraho | 73514 | 72405 | 58861 |