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An Economic and Financial Analysis of Chennai, Kolkata and Ahmedabad Airports in India

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Abstract*: *There is vigorous growth of air traffic in India in the last decade. The passenger air traffic has increased by more than 10 per cent annually during this time. As per the report of Airbus Global Market Forecast (2016-35), domestic air traffic in India is supposed to increase by fivefold in coming decade. The air traffic movement is also increasing at rapid rate globally which is increasing at the rate of 5.7 % per annum in the last decade whereas the World GDP growth in the corresponding period was only 2.6%. The passenger transport in the last decade has increased by 1.47 billion at the global level. As per the report of International Civil Aviation Organization (ICAO), India has experienced a double digit growth rate of 15.7 per cent in passenger traffic and 9.0 per cent growth rate in freight traffic which is much higher than GDP growth rate of India. The heavy air traffic in India is evident from the India's revenue passenger km which is 13th in the World with 140.4 billion. This entails creation of air traffic infrastructure for smooth movement of traffic in India. The constructions of modern airports and expansion of existing airports are important addition to air traffic infrastructure. The concept of airport cities or aero city imply development of innovative business ideas within the designated area whose cost-benefits if taken into considerations are more than the cost-benefits of its counterpart in the central business district. Major airports in India such as Delhi, Mumbai, Kolkata and Chennai, Hyderabad and Ahmedabad etc. are growth and employment drivers of Indian economy in aviation sector. There are direct, indirect and induced effects on income and output. However, the calculations are complex as it is related with backward calculation of and calculation of input-output analysis. Further all the airports do not generate the same output and employment. In some airport employment increases but output do not increase simultaneously. As a global practice, the increase in airport infrastructure requires a study of its feasibility in a cost-benefit format. This is carried out in terms of financial and economic viability study. In this study, we have carried out an economic and financial analysis of three major airports in India such as Chennai, Kolkata and Ahmedabad airports for twenty years' time period. In the cost stream, we have considered capital expenditure and on the benefits side the increase in income, employment, outputs in terms of direct, indirect, induced and catalytic terms. An attempt has been made to measures all these benefits against the cost streams through an economic and financial analysis. The feasibility of investments in airport infrastructure has been calculated in a cost-benefit format to find out the internal rate of return. The robustness of the investment has been tested by carrying out a sensitivity analysis at an increasing cost and decreasing benefits conditions and vice-versa. The calculated IRR both economic and financial are well above the 12 per cent as per the guidelines of Asian Development Bank. This justifies the investment in the above-mentioned of airport infrastructure.

Index Terms*: *Internal Rate of Return, Net Present Value,, Economic Viability, Financial Analysis, Sensitivity Analysis
***JEL Classification**: D6, R4, R42*

I. INTRODUCTION

The growth of economy depends upon a well develop transport infrastructure. Air transport is important as other modes of transport such as road, rail and water. The role of aviation industry is vital from development aspects as it helps in reducing the time of transit along with inter connectedness among the nations. The growth of aviation industry enables commerce, trades and tourism simultaneously. It generates large employment and increases the productivity and growth. This industry is expected create 82 million jobs worldwide by next decade. As per the report of ATAG (2013) it has already generated 30 million jobs in Asia Pacific Region which is 5 per cent of GDP of the region.

India has gained from development of civil aviation sector. This sector is known for its time efficient transportation services. It reduces the travel time between India cities by providing connectivity among different cities with etropolitan cities. The commerce and trade as well as business trips require efficient and seamless travel. All this is possible with development of civil aviation infrastructure. A significant change has been done in policies and procedures of Indian civil aviation sector. Now private players have been allowed to directly involve in construction and operation of airports in India. The volume of domestic passengers has increased multiple times in India due to low cost carriers and growth oriented policies of government. India is fourth largest in the world in domestic passenger volume with an annual growth of 10 per cent. As per the report of Ministry of Civil Aviation India will achieve 200 million passenger volume target by 2020. (Strategic Plan, Ministry of Civil Aviation, 2011). India has 449 airports & airstrips. Out of 134 operational airports 125 airports are managed by the Airports Authority of India (AAI). There is a plan to doubling the numbers by 2030 (AAI).

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Realizing the deficiency in civil aviation infrastructure and world class airports, Planning Commission of India increased the public investment and asked the private sector investment in this sector during 11th and 12th Five Years Plan.US$ 12.1 billion was proposed in 12th Five- Years Plan for airport infrastructure. This included construction of new airports and expansion, improvement of existing one.

There experienced high economic and financial benefits of airports expansion and operations. References are available in economic literature on such study. Many literatures are available on input-output analysis of airport expansion and operations. We have cited few of them below in our literature review section. Each airport in India is responsible for income and output generation. However in this study we selected only three major airports such as Chennai, Kolkata and ahmedabad taking consideration of past performance and future growth potentials. These airports have been expanded recently. The fifteen years growth data of aircraft movements (both domestic and international), passenger's movement and freight (in metric tonnes) of the above-mentioned three airports has been provided in *Annexure 1*. In this study, we have carried out the economic and financial analysis of Chennai, Kolkata and Ahmedabad airports only.

II. REVIEW OF LITERATURE

A study by *Oxford Economics (2012)* on Heathrow airport concluded that it benefitted UK economy in bringing more FDI, export, and tourism beside employment generation. Total 8,000 jobs were created by flights from Heathrow.

*Airport Council International and York Aviation (2004)*on a study on the economic impact of 59 airports in Europe found that 1.4 million jobs were created by airports in Europe in 2001. It further reported that approximately 2,100 induced/indirect jobs and 1, 100 jobs regionally were generated for every 1,000 on-site jobs by European airports.

The Economic Impact of Edinburgh Airport published by Scottish Empire and BAA Edinburgh (2009) reported the creation of 5,340 jobs vide the total economic impact of the airport calculating approximately 3,530 on–site jobs and 290 off-site jobs. Simultaneously 850 jobs a gross value addition of £16.3 million were created by indirect impact and 680 jobs with gross value £20.4 million were created through induced impact leading to a total addition of gross value of £81 million.

A study by *Wilbur Smith Associates (2010)*carried out an input-output analysis of the impact of the aviation sector for North Dakota in the US. It concluded that the airport generated9,792 jobs, with 5,796 jobs through direct and indirect impact and 3,996 jobs through secondary or induced impact. It further generated economic activity of US$ 1.1 billion value adding 3.3 per cent to the estimated GDP.

*Port Authority of New York and New Jersey (2005)*emphasized on creation of 5.5 per cent non-farm jobs in the area, totaling approximately 485, 670 jobs due to the pooledeffect of aviation investment, operation and tourism. Out of this 278,890 jobs were part of the direct impact on the aviation industry which contributed US$ 35.9 billion of economic activity with general output impact ofUS$ 57 billion.US$ 57 billion in economic activities were added with 20.5 billion in wages.

A study on *the reaction of aviation industry in business cycle in USA by the U.S. Department of Transportation, Federal Aviation Administration (2011)*found that civil aviation sector accounted for raising the total output to US$ 1.3 trillion in 2009 with 5.2 per cent GDP in USA. It generated more than 10 million jobs with wage -income of US$ 394.4 billion in 2009.

The report of National Council of Applied Economic Research (NCAER 2012) on Delhi International airport concluded that civil aviation sector in Delhi contributed 0.18 per cent of GDP to national economy in 2009-10 generating 120.1 billion jobs, the induced impact of tourism and investment contributed 0.45 per cent of GDP with a gross value addition of INR 294.7 billion. It further highlighted that Delhi airport's aviation sector contributed 64,000 direct jobs, 452,000 indirect jobs and 1,061,000 induced jobs to the country's economy.

III. OBJECTIVE:

The objective of this paper is to

- Measure the economic feasibility of the Chennai, Kolkata and Ahmedabad airports for a time horizon of fifteen years beginning 2017-18,
- Evaluate the commercial viability of the above-mentioned airports in a commercial format for time period of 15 years.

IV. METHODOLOGY AND APPROACH

Economic viability of the project is being assessed within the broad framework of "Cost-Benefit Analysis", generally used for appraisal of public investment projects. In economic evaluation, benefits are computed for the economy as a whole rather than for an individual entity that has made the investment. In case of financial analysis the profits become the major factor for evaluation whereas in economic analysis the benefits to the economy are the main criteria for evaluation. The commercial viability will be measured by taking into consideration financial price of the airport infrastructure. The economic analysis involves comparison of project costs and benefits in economic terms under the "with" and "without" project conditions and determination of the Economic Internal Rate of Return (EIRR) of the project using discounted cash flow technique. This shows the return which the society could expect from the proposed investment during the project life, i.e. the benefit period. The feasibility of the project is determined by comparing the EIRR with the current accounting rate of return of 12%. This represents the opportunity cost of capital and is considered an appropriate minimum criterion for economic viability by World Bank airport infrastructure.

The main steps followed are:

i) Estimation of capital and maintenance costs (both regular and periodic) at economic prices and financial price

ii)Estimation of aero-income, non-aero income and other income

iii) Estimation of economic and commercial benefits

iv) Comparison of annual streams of costs with benefits and estimation of EIRR& FIRR

The project is further subjected to sensitivity analysis by assessing the effects of adverse changes in the key variables on the base EIRR& FIRR. This helps to gauge the economic strength of the project to withstand future risks and uncertainties.

4.1 Project Cost and Scheduling

The total project cost is estimated as ₹200.56 Crore for Chennai airport, ₹158.14 Crore for Kolkata airport and ₹38.77 Crore in Ahmedabad.

Table1: Capital Expenditure of Airports in 2017-18

(In ₹Crore)

Sl.No.	Airports	Financial Cost	Economic Cost
1	Chennai	200.56	170.48
2	Kolkata	158.14	134.42
3	Ahmedabad	38.77	32.95

Source: Airport Authority of India

The project cost consists of two main components e.g. capital cost and maintenance cost. Economic analysis requires the conversion of financial costs into economic costs to take care of distortions in prices due to market imperfections. Taxes and duties are removed from financial prices as these are not real costs to the economy, but are only transfer payments. All financial costs have been converted into economic costs by applying a Standard Conversion Factor (SCF) of 0.85.

4.2 Operation and Maintenance Cost

Maintenance costs are recurring costs, comprising routine and periodic maintenance components. The routine maintenance involves day-to-day repairs and maintenance of airport infrastructure facilities. We have taken the maintenance cost of 1.33 per cent in the base year and have increased the cost by 0.5% in each successive year. The annual maintenance cost of the project in financial and economic terms is summarized in **Table 2**.

Table 2: Maintenance Cost

(In ₹ Crore)

Sl. No.	Maintenance Cost Chennai Airport		
	Year	Financial	Economic
1	2017-2018	2.67	2.27
2	2018-2019	2.68	2.28
3	2019-2020	2.69	2.29
4	2020-2021	2.71	2.30
5	2021-2022	2.72	2.31
6	2022-2023	2.73	2.32
7	2023-2024	2.75	2.34
8	2024-2025	2.76	2.35
9	2025-2026	2.78	2.36
10	2026-2027	2.79	2.37
11	2027-2028	2.80	2.38
12	2028-2029	2.82	2.40
13	2029-2030	2.83	2.41
14	2030-2031	2.85	2.42
15	2031-2032	2.86	2.43
16	2032-2033	2.87	2.44
Total	*2017-2032*	*44.32*	*25.57*

(In ₹ Crore)

Sl. No.	Maintenance Cost Kolkata Airport		
	Year	Financial	Economic
1	2017-2018	2.10	1.79
2	2018-2019	2.11	1.80
3	2019-2020	2.12	1.81
4	2020-2021	2.13	1.81
5	2021-2022	2.15	1.82
6	2022-2023	2.16	1.83
7	2023-2024	2.17	1.84
8	2024-2025	2.18	1.85
9	2025-2026	2.19	1.86
10	2026-2027	2.20	1.87
11	2027-2028	2.21	1.88
12	2028-2029	2.22	1.89
13	2029-2030	2.23	1.90
14	2030-2031	2.24	1.91
15	2031-2032	2.26	1.92
16	2032-2033	2.27	1.93
Total	*2017-2032*	*34.94*	*20.16*

(In ₹ Crore)

Sl. No.	Maintenance Cost of Ahmedabad Airport		
	Year	Financial	Economic
1	2017-2018	0.52	0.44
2	2018-2019	0.52	0.44
3	2019-2020	0.52	0.44
4	2020-2021	0.52	0.44
5	2021-2022	0.53	0.45
6	2022-2023	0.53	0.45
7	2023-2024	0.53	0.45
8	2024-2025	0.53	0.45
9	2025-2026	0.54	0.46
10	2026-2027	0.54	0.46
11	2027-2028	0.54	0.46
12	2028-2029	0.54	0.46
13	2029-2030	0.55	0.47
14	2030-2031	0.55	0.47
15	2031-2032	0.55	0.47
16	2032-2033	0.56	0.47
Total	*2017-2032*	*8.57*	*4.94*

Calculated by Author

4.3 Project Benefits

The economic benefits of the airport infrastructure are the changes brought out by development of airports in the economy. It will increase aircraft movements (both domestic and international), passenger's movement and freight (in metric tonnes). Three types of income are generated from development of airport infrastructure.

Aero income: Advertisement, duty free duty paid, food and beverages, service car park, telecom, car rental, bank ATM, Forex and other services

Non-aero income commercial: Ground handling, bridge mounted equipment, flight kitchen, land and space, courier X-ray, cargo revenue share, cargo screening and otherOther income

The benefits considered for economic evaluation are "*with project*" situations.

The cost-benefit streams of airport infrastructure project consider the followings for economic analysis

Table 3: Cost-Benefit Streams

Sl. No.	*Cost*
1	Capital cost of airport infrastructure
2	Operation and maintenance Cost
	Benefits
1	Aero- income
2	*Non-aero income commercial*
3	Other income

Calculated by Author

V. ECONOMIC ANALYSIS

The cost-benefit analysis would signify whether adequate returns in terms of benefit results from making a capital investment. The appraisal is done based on the costs and benefit that would be incurred over the analysis period if no investment is made and by comparing the costs and benefits arising as a result of making an investment. The annual cost and benefit streams are used to derive the net cash flow for the project. The analysis considers 15 years of benefit period from the opening year i.e. 2017 till 2032. The viability has been established by assessing the Economic Internal Rate of Return (EIRR), Financial Internal Rate of Return (EIRR) and Net Present Value (NPV) using the discounted cash-flow technique for the LRT project in Addis. The EIRR has been compared with the accounting rate of return of 12 percent. The result is presented in **Table 4.**

Table 4: Net Cashflow Statement for Chennai Airport (Economic)

Year	Cost				Benefits				Net Benefit
	Capital	Maintenance		Total Cost					
		Routine	Periodic		Aero Income	Non Aero Income	Other Income	Total Income	
2017	170.48	2.27	759.51	932.25	0.00	0.00	0.00	455.40	-476.85
2018	172.18	2.49	782.29	956.97	846.94	520.25	86.57	1453.76	496.80
2019	173.90	2.74	805.76	982.41	855.41	525.46	87.43	1468.30	485.90
2020	175.64	3.02	829.93	1008.59	863.97	530.71	88.31	1482.99	474.39
2021	177.40	3.32	854.83	1035.55	872.61	536.02	89.19	1497.82	462.27
2022	179.17	3.65	880.48	1063.30	881.33	541.38	90.08	1512.79	449.49
2023	180.96	4.02	906.89	1091.87	890.15	546.79	90.98	1527.92	436.05
2024	182.77	4.42	934.10	1121.29	899.05	552.26	91.89	1543.20	421.91
2025	184.60	4.86	962.12	1151.58	908.04	557.78	92.81	1558.63	407.05
2026	186.45	5.35	990.98	1182.78	917.12	563.36	93.74	1574.22	391.44
2027	188.31	5.88	1020.71	1214.91	926.29	568.99	94.68	1589.96	375.06
2028	190.19	6.47	1051.33	1248.00	935.55	574.68	95.62	1605.86	357.86
2029	192.10	7.12	1082.87	1282.09	944.91	580.43	96.58	1621.92	339.83
2030	194.02	7.83	1115.36	1317.21	954.36	586.24	97.55	1638.14	320.93
2031	195.96	8.61	1148.82	1353.39	963.90	592.10	98.52	1654.52	301.13
2032	197.92	9.47	1183.29	1390.68	944.91	580.43	96.58	1621.92	231.24
EIRR									**101.81%**
NPV									**₹ 206.47**

Table 5: Net Cashflow Statement for Chennai Airport (Financial)

(In ₹ Crore)

Year	Cost				Benefits				Net Benefit
	Capital	Maintenance		Total Cost					
		Routine	Periodic		Aero Income	Non Aero Income	Other Income	Total Income	
2017	200.56	2.27	759.51	962.33	0.00	0.00	0.00	455.40	-506.93
2018	202.57	2.49	782.29	987.35	846.94	520.25	86.57	1453.76	466.41
2019	204.59	2.74	805.76	1013.10	855.41	525.46	87.43	1468.30	455.21
2020	206.64	3.02	829.93	1039.59	863.97	530.71	88.31	1482.99	443.40
2021	208.70	3.32	854.83	1066.85	872.61	536.02	89.19	1497.82	430.96
2022	210.79	3.65	880.48	1094.92	881.33	541.38	90.08	1512.79	417.88
2023	212.90	4.02	906.89	1123.81	890.15	546.79	90.98	1527.92	404.12
2024	215.03	4.42	934.10	1153.54	899.05	552.26	91.89	1543.20	389.66
2025	217.18	4.86	962.12	1184.16	908.04	557.78	92.81	1558.63	374.47
2026	219.35	5.35	990.98	1215.68	917.12	563.36	93.74	1574.22	358.54
2027	221.54	5.88	1020.71	1248.14	926.29	568.99	94.68	1589.96	341.82
2028	223.76	6.47	1051.33	1281.56	935.55	574.68	95.62	1605.86	324.30
2029	226.00	7.12	1082.87	1315.99	944.91	580.43	96.58	1621.92	305.93
2030	228.26	7.83	1115.36	1351.44	954.36	586.24	97.55	1638.14	286.69
2031	230.54	8.61	1148.82	1387.97	963.90	592.10	98.52	1654.52	266.55
2032	232.84	9.47	1183.29	1425.60	944.91	580.43	96.58	1621.92	196.32
FIRR									**89.37%**
NPV									**₹ 175.28**

Calculated by Author

Table 6: Net Cash flow Statement for Kolkata Airport (Economic)

(In ₹ Crore)

Year	Cost				Benefits				Net Benefit
	Capital	Maintenance		Total Cost					
		Routine	Periodic		Aero Income	Non Aero Income	Other Income	Total Income	
2017	134.39	2.10	772.81	909.30	87.71	53.86	8.96	150.53	-758.77
2018	135.73	2.31	780.54	918.58	627.98	385.75	64.19	1077.92	159.34
2019	137.09	2.54	788.34	927.97	659.38	405.04	67.40	1131.82	203.85
2020	138.46	2.80	796.23	937.48	692.35	425.29	70.77	1188.41	250.93
2021	139.84	3.07	804.19	947.11	726.97	446.55	74.31	1247.83	300.72
2022	141.24	3.38	812.23	956.85	763.31	468.88	78.02	1310.22	353.37
2023	142.65	3.72	820.35	966.73	801.48	492.33	81.92	1375.73	409.00
2024	144.08	4.09	828.56	976.73	841.55	516.94	86.02	1444.52	467.79
2025	145.52	4.50	836.84	986.86	883.63	542.79	90.32	1516.74	529.88
2026	146.97	4.95	845.21	997.14	927.81	569.93	94.84	1592.58	595.44
2027	148.44	5.45	853.66	1007.55	974.20	598.42	99.58	1672.21	664.65
2028	149.93	5.99	862.20	1018.12	1022.91	628.35	104.56	1755.82	737.70
2029	151.43	6.59	870.82	1028.84	1074.06	659.76	109.79	1843.61	814.77
2030	152.94	7.25	879.53	1039.72	1127.76	692.75	115.28	1935.79	896.07
2031	154.47	7.97	888.33	1050.77	1184.15	727.39	121.04	2032.58	981.81
2032	156.02	8.77	897.21	1062.00	1243.36	763.76	127.09	2134.21	1072.21
EIRR									**37.71%**
NPV									**₹ 957.33**

Calculated by Author

Table 7: Net Cash flow Statement for Kolkata Airport (Financial)

In ₹Crore)

Year	Cost				Benefits				Net Benefit
	Capital	Maintenance		Total Cost					
		Routine	Periodic		Aero Income	Non Aero Income	Other Income	Total Income	
2017	158.10	2.10	772.81	933.01	87.71	53.86	8.96	150.53	-782.48
2018	159.68	2.31	788.27	950.26	627.98	385.75	64.19	1077.92	127.66
2019	161.28	2.54	796.15	959.97	659.38	405.04	66.12	1130.53	170.56
2020	162.89	2.80	804.11	969.80	692.35	425.29	68.10	1185.74	215.94
2021	164.52	3.07	812.15	979.75	726.97	446.55	70.14	1243.66	263.92
2022	166.16	3.38	820.27	989.82	763.31	468.88	72.25	1304.44	314.62
2023	167.83	3.72	828.48	1000.02	801.48	492.33	74.41	1368.22	368.20
2024	169.50	4.09	836.76	1010.36	841.55	516.94	76.65	1435.14	424.78
2025	171.20	4.50	845.13	1020.83	883.63	542.79	78.95	1505.37	484.54
2026	172.91	4.95	853.58	1031.44	927.81	569.93	81.31	1579.05	547.61
2027	174.64	5.45	862.12	1042.20	974.20	598.42	83.75	1656.38	614.18
2028	176.39	5.99	870.74	1053.11	1022.91	628.35	86.27	1737.53	684.41
2029	178.15	6.59	879.44	1064.19	1074.06	659.76	88.85	1822.68	758.49
2030	179.93	7.25	888.24	1075.42	1127.76	692.75	91.52	1912.03	836.61
2031	181.73	7.97	897.12	1086.83	1184.15	727.39	94.27	2005.80	918.98
2032	183.55	8.77	906.09	1098.41	1243.36	763.76	97.09	2104.21	1005.80
FIRR									**33.56%**
NPV									**₹ 898.03**

Calculated by Author

Table 8: Net Cashflow Statement for Ahmedabad Airport (Economic)

(In ₹Crore)

Year	Cost				Benefits				Net Benefit
	Capital	Maintenance		Total Cost					
		Routine	Periodic		Aero Income	Non Aero Income	Other Income	Total Income	
2017	32.95	0.52	216.29	249.76	40.28	24.75	4.12	69.15	-180.61
2018	33.28	0.57	218.45	252.30	191.49	117.63	19.57	328.69	76.39
2019	33.62	0.62	220.64	254.88	195.32	119.98	19.96	335.27	80.39
2020	33.95	0.69	222.84	257.48	199.23	122.38	20.36	341.97	84.49
2021	34.29	0.75	225.07	260.12	203.21	124.83	20.77	348.81	88.69
2022	34.64	0.83	227.32	262.79	207.28	127.33	21.19	355.79	93.00
2023	34.98	0.91	229.60	265.49	211.42	129.87	21.61	362.91	97.41
2024	35.33	1.00	231.89	268.23	215.65	132.47	22.04	370.16	101.94
2025	35.69	1.11	234.21	271.00	219.97	135.12	22.48	377.57	106.57
2026	36.04	1.22	236.55	273.81	224.36	137.82	22.93	385.12	111.31
2027	36.40	1.34	238.92	276.66	228.85	140.58	23.39	392.82	116.16
2028	36.77	1.47	241.31	279.54	233.43	143.39	23.86	400.68	121.13
2029	37.13	1.62	243.72	282.47	238.10	146.26	24.34	408.69	126.22
2030	37.51	1.78	246.16	285.44	242.86	149.18	24.82	416.86	131.42
2031	37.88	1.96	248.62	288.46	247.72	152.17	25.32	425.20	136.74
2032	38.26	2.15	251.11	291.52	252.67	155.21	25.83	433.71	142.19
EIRR									**47.00%**
NPV									**₹ 126.95**

Calculated by Author

Table 9:Net Cashflow Statement for Ahmedabad Airport (Financial)

(In ₹Crore)

Year	Cost				Benefits				Net Benefit
	Capital	Maintenance		Total Cost					
		Routine	Periodic		Aero Income	Non Aero Income	Other Income	Total Income	
2017	38.77	0.52	216.29	255.57	40.28	24.75	4.12	69.15	-186.43
2018	39.16	0.57	218.45	258.18	191.49	117.63	19.57	328.69	70.52
2019	39.55	0.62	220.64	260.81	195.32	119.98	19.96	335.27	74.46
2020	39.94	0.69	222.84	263.47	199.23	122.38	20.36	341.97	78.50
2021	40.34	0.75	225.07	266.17	203.21	124.83	20.77	348.81	82.64
2022	40.75	0.83	227.32	268.90	207.28	127.33	21.19	355.79	86.89
2023	41.16	0.91	229.60	271.66	211.42	129.87	21.61	362.91	91.24
2024	41.57	1.00	231.89	274.46	215.65	132.47	22.04	370.16	95.70
2025	41.98	1.11	234.21	277.30	219.97	135.12	22.48	377.57	100.27
2026	42.40	1.22	236.55	280.17	224.36	137.82	22.93	385.12	104.95
2027	42.83	1.34	238.92	283.08	228.85	140.58	23.39	392.82	109.74
2028	43.25	1.47	241.31	286.03	233.43	143.39	23.86	400.68	114.64
2029	43.69	1.62	243.72	289.03	238.10	146.26	24.34	408.69	119.67
2030	44.12	1.78	246.16	292.06	242.86	149.18	24.82	416.86	124.80
2031	44.57	1.96	248.62	295.14	247.72	152.17	25.32	425.20	130.06
2032	45.01	2.15	251.11	298.27	252.67	155.21	25.83	433.71	135.44
FIRR									**42.68%**
NPV									**₹ 120.93**

Calculated by Author

VI. SENSITIVITY ANALYSIS

The robustness of the project's viability is further demonstrated by the sensitivity analysis. Because of the uncertainties surrounding many of the variables like income changes, cost changes etc. Thus a sensitivity analysis is carried out to test the economic strength of the airport infrastructure project. The variations in the following parameters have been examined, considering them to be on the conservative side:

i) Increase in cost by 15 percent
ii) Decrease in benefits by 15 percent
iii) Increase in cost by 15 percent and decrease in benefits by 15 percent

The results of the sensitivity analysis are presented in **Table 10.**

Table 10: Sensitivity Analysis of Chennai Airport (Economic)

(In ₹Crore)

Year	Cost increase by 15%	Benefits decrease by 15%	Cost increase by 15% and Benefits Decrease by
2017	-616.69	-545.16	-685.00
2018	353.25	278.73	135.19
2019	485.90	265.65	265.65
2020	474.39	251.94	251.94
2021	462.27	237.59	237.59
2022	449.49	222.57	222.57
2023	436.05	206.86	206.86
2024	421.91	190.43	190.43
2025	407.05	173.26	173.26
2026	391.44	155.31	155.31
2027	375.06	136.56	136.56
2028	357.86	116.98	116.98
2029	339.83	96.54	96.54
2030	320.93	75.21	75.21
2031	301.13	52.95	52.95
2032	231.24	-12.04	-12.04
EIRR	**68.29%**	**45.24%**	**28.32%**

Calculated by Author

The result of the sensitivity analysis shows that even in the worst case of increase in cost and decrease in benefits the projects remains economically viable.

VII. CONCLUSION

The development of airport infrastructure in Chennai with EIRR of 101.81 per cent is economic beneficial and commercially viable with FIRR of 89.37 per cent. Similarly Kolkata airport with EIRR of 37.71 per cent is socially viable and commercially beneficial with FIRR of 33.56 per cent. Ahmedabad airport with EIRR of 47.00 per cent is economically feasible and commercially beneficial with FIRR of 42.68 per cent. The sensitive analysis shows that even though the cost increases and benefits decline investment in airport infrastructure is highly beneficial.

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Annexure 1: Growth Data of Air Traffic Movements

TRAFFIC FORECAST - CHENNAI AIRPORT									
YEAR	AIRCRAFT MOVEMENTS (in Nos.)			PASSENGERS (in Nos.)			FREIGHT (in M.T.)		
	International	Domestic	Total	International	Domestic	Total	International	Domestic	Total
2017-18 (Base Year)	37834	117289	155123	5521665	14839817	20361482	312085	105702	417787
GROWTH RATE	**7.0%**	**10.0%**	**9.3%**	**8.0%**	**12.0%**	**10.9%**	**12.0%**	**12.0%**	**12.0%**
2018-19	40482	129018	169500	5963398	16620595	22583993	349535	118386	467921
2019-20	43316	141920	185236	6440470	18615066	25055537	391479	132593	524072
GROWTH RATE	**4.0%**	**7.0%**	**6.3%**	**5.0%**	**8.0%**	**7.2%**	**9.0%**	**10.0%**	**9.3%**
2020-21	45049	151854	196903	6762494	20104272	26866765	426713	145852	572564
2021-22	46851	162484	209335	7100618	21712614	28813232	465117	160437	625554
2022-23	48725	173858	222582	7455649	23449623	30905272	506977	176481	683458
GROWTH RATE	**3.0%**	**6.0%**	**5.4%**	**4.0%**	**7.0%**	**6.3%**	**7.0%**	**6.0%**	**6.7%**
2023-24	50187	184289	234476	7753875	25091096	32844971	542466	187070	729535
2024-25	51692	195347	247039	8064030	26847473	34911503	580438	198294	778732
2025-26	53243	207067	260310	8386591	28726796	37113387	621069	210191	831260
2026-27	54840	219491	274332	8722055	30737672	39459727	664544	222803	887347
2027-28	56485	232661	289146	9070937	32889309	41960246	711062	236171	947233
GROWTH RATE	**3.0%**	**4.0%**	**3.8%**	**3.0%**	**5.0%**	**4.6%**	**5.0%**	**4.0%**	**4.8%**
2028-29	58180	241967	300147	9343065	34533774	43876839	746615	245618	992233
2029-30	59925	251646	311571	9623357	36260463	45883820	783948	255443	1039388
2030-31	61723	261712	323435	9912058	38073486	47985544	823143	265660	1088803
2031-32	63575	272180	335755	10209420	39977160	50186580	864300	276287	1140587
2032-33	65482	283068	348550	10515702	41976018	52491721	907515	287338	1194853
GROWTH RATE	**2.0%**	**2.0%**	**2.0%**	**2.0%**	**3.0%**	**2.8%**	**5.0%**	**4.0%**	**4.8%**
2033-34	66792	288729	355521	10726016	43235299	53961315	952891	298832	1251722
2034-35	68127	294503	362631	10940537	44532358	55472895	1000535	310785	1311320
2035-36	69490	300393	369884	11159347	45868329	57027676	1050562	323216	1373778
2036-37	70880	306401	377281	11382534	47244378	58626913	1103090	336145	1439235
2037-38	72297	312529	384827	11610185	48661710	60271895	1158245	349591	1507836

TRAFFIC FORECAST - KOLKATA AIRPORT									
YEAR	AIRCRAFT MOVEMENTS (in Nos.)			PASSENGERS (in Nos.)			FREIGHT (in M.T.)		
	International	Domestic	Total	International	Domestic	Total	International	Domestic	Total
2017-18 (Base Year)	21831	126971	148802	2586775	17305749	19892524	60772	102551	163323
GROWTH RATE	**9.0%**	**16.0%**	**15.0%**	**10.0%**	**18.0%**	**17.0%**	**8.0%**	**7.0%**	**7.4%**
2018-19	23796	147286	171082	2845453	20420784	23266236	65634	109730	175363
2019-20	25937	170852	196790	3129998	24096525	27226523	70884	117411	188295
GROWTH RATE	**7.0%**	**9.0%**	**8.7%**	**8.0%**	**10.0%**	**9.8%**	**7.0%**	**6.0%**	**6.4%**
2020-21	27753	186229	213982	3380398	26506177	29886575	75846	124455	200302
2021-22	29696	202989	232685	3650829	29156795	32807625	81156	131923	213078
2022-23	31774	221259	253033	3942896	32072475	36015370	86837	139838	226674
GROWTH RATE	**5.0%**	**8.0%**	**7.6%**	**6.0%**	**9.0%**	**8.7%**	**5.0%**	**5.0%**	**5.0%**
2023-24	33363	238959	272322	4179469	34958997	39138467	91178	146830	238008
2024-25	35031	258076	293107	4430238	38105307	42535545	95737	154171	249909
2025-26	36783	278722	315505	4696052	41534785	46230837	100524	161880	262404
2026-27	38622	301020	339642	4977815	45272915	50250730	105550	169974	275524
2027-28	40553	325101	365654	5276484	49347478	54623962	110828	178473	289300
GROWTH RATE	**4.0%**	**5.0%**	**4.9%**	**5.0%**	**6.0%**	**5.9%**	**4.5%**	**5.0%**	**4.8%**
2028-29	42175	341356	383532	5540308	52308326	57848635	115815	187396	303211
2029-30	43862	358424	402287	5817324	55446826	61264150	121027	196766	317793
2030-31	45617	376345	421962	6108190	58773636	64881825	126473	206604	333077
2031-32	47441	395163	442604	6413599	62300054	68713653	132164	216935	349099
2032-33	49339	414921	464260	6734279	66038057	72772336	138112	227781	365893
GROWTH RATE	**4.0%**	**5.0%**	**4.9%**	**5.0%**	**6.0%**	**5.9%**	**4.0%**	**4.0%**	**4.0%**
2033-34	51313	435667	486980	7070993	70000340	77071333	143636	236893	380529
2034-35	53365	457450	510815	7424543	74200361	81624904	149382	246368	395750
2035-36	55500	480323	535823	7795770	78652382	86448152	155357	256223	411580
2036-37	57720	504339	562059	8185558	83371525	91557084	161571	266472	428043
2037-38	60029	529556	589584	8594836	88373817	96968653	168034	277131	445165

TRAFFIC- FORECAST- -AHMEDABAD- AIRPORT¤									
YEAR¤	AIRCRAFT- MOVEMENTS- (in-Nos.)¤			PASSENGERS- (in-Nos.)¤			FREIGHT-(in-M.T.)¤		
	International¤	Domestic¤	Total¤	International¤	Domestic¤	Total¤	International¤	Domestic¤	Total¤
2017-18 (Base-Year)-¤	13142¤	49987¤	63129¤	1850954¤	7323471¤	9174425¤	41266¤	50367¤	91633¤
GROWTH-RATE¤	**9.0%¤**	**18.0%¤**	**16.1%¤**	**10.0%¤**	**20.0%¤**	**18.0%¤**	**20.0%¤**	**10.0%¤**	**14.5%¤**
2018-19¤	14325¤	58985¤	73309¤	2036049¤	8788165¤	10824215¤	49519¤	55404¤	104923¤
2019-20¤	15614¤	69602¤	85216¤	2239654¤	10545798¤	12785453¤	59423¤	60944¤	120367¤
GROWTH-RATE¤	**9.0%¤**	**11.0%¤**	**10.6%¤**	**10.0%¤**	**12.0%¤**	**11.6%¤**	**15.0%¤**	**8.0%¤**	**11.5%¤**
2020-21¤	17019¤	77258¤	94277¤	2463620¤	11811294¤	14274914¤	68336¤	65820¤	134156¤
2021-22¤	18551¤	85756¤	104308¤	2709982¤	13228649¤	15938631¤	78587¤	71085¤	149672¤
2022-23¤	20221¤	95190¤	115410¤	2980980¤	14816087¤	17797067¤	90375¤	76772¤	167147¤
GROWTH-RATE¤	**9.0%¤**	**9.0%¤**	**9.0%¤**	**10.0%¤**	**10.0%¤**	**10.0%¤**	**12.0%¤**	**7.0%¤**	**9.8%¤**
2023-24¤	22040¤	103757¤	125797¤	3279078¤	16297696¤	19576774¤	101220¤	82146¤	183366¤
2024-25¤	24024¤	113095¤	137119¤	3606986¤	17927466¤	21534451¤	113366¤	87896¤	201263¤
2025-26¤	26186¤	123273¤	149460¤	3967684¤	19720212¤	23687896¤	126970¤	94049¤	221019¤
2026-27¤	28543¤	134368¤	162911¤	4364453¤	21692233¤	26056686¤	142207¤	100632¤	242839¤
2027-28¤	31112¤	146461¤	177573¤	4800898¤	23861457¤	28662355¤	159272¤	107677¤	266948¤
GROWTH-RATE¤	**6.0%¤**	**5.0%¤**	**5.2%¤**	**7.0%¤**	**6.0%¤**	**6.2%¤**	**8.0%¤**	**6.0%¤**	**7.2%¤**
2028-29¤	32979¤	153784¤	186763¤	5136961¤	25293144¤	30430105¤	172013¤	114137¤	286151¤
2029-30¤	34957¤	161473¤	196431¤	5496548¤	26810733¤	32307281¤	185774¤	120986¤	306760¤
2030-31¤	37055¤	169547¤	206602¤	5881306¤	28419377¤	34300683¤	200636¤	128245¤	328881¤
2031-32¤	39278¤	178024¤	217303¤	6292998¤	30124539¤	36417537¤	216687¤	135939¤	352627¤
2032-33¤	41635¤	186926¤	228560¤	6733508¤	31932012¤	38665519¤	234022¤	144096¤	378118¤
GROWTH-RATE¤	**5.0%¤**	**6.0%¤**	**5.8%¤**	**6.0%¤**	**6.0%¤**	**6.0%¤**	**6.0%¤**	**6.0%¤**	**6.0%¤**
2033-34¤	43716¤	198141¤	241858¤	7137518¤	33847932¤	40985451¤	248064¤	152741¤	400805¤
2034-35¤	45902¤	210030¤	255932¤	7565769¤	35878808¤	43444578¤	262947¤	161906¤	424853¤
2035-36¤	48197¤	222631¤	270829¤	8019715¤	38031537¤	46051252¤	278724¤	171620¤	450345¤
2036-37¤	50607¤	235989¤	286597¤	8500898¤	40313429¤	48814327¤	295448¤	181917¤	477365¤
2037-38¤	53138¤	250149¤	303286¤	9010952¤	42732235¤	51743187¤	313175¤	192833¤	506007¤

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