

Determinants of Air Passenger Demand in Sri Lanka: A Case Study based on Bandaranayake International Airport

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Abstract— Air transportation plays a significant role in nations' economy providing expeditious links to the international markets. Globalization and advanced technological applications have squeezed the entire world, where by aviation industry further diminishes the existing gap by physically linking two locations. It is an all-time true that aviation provides the speediest, most convenient and efficient travel, with comparatively highest cost of all five modes. But it is evidenced by the transport statistics that, the demand for air transport is been increasing yearly, even though the cost is a problematic component. Since it is observed that, examining the determinants of air transport demand would be prudent and an effective effort in policy implementations as well as in forecasting which would be an essential requirement in corporate planning process.

The objective of this research is to determine the factors affecting air passenger travel demand in Sri Lanka and was conducted based on Bandaranaike International Airport (BIA). The focus of the research was on Air Passenger demand at BIA and not the Air Freight. Macroeconomic factors have been considered as explanatory variables. Three dependent variables as Air Passenger Arrivals, Departures and Total Movement of air passengers have been taken into consideration.

In analyzing the data set, uni-variate descriptive analysis has been carried out and hypothesis testing has been done using Pearson correlation coefficient. In doing advanced statistical modelling, three models have been fitted for total air passenger volume, arrivals and departures separately. In the process of constructing multiple linear regression model Forward Selection Method has been used.

According to the empirical findings it is proved that only five out of fourteen specified independent

variables, namely Tax Revenue, Average Exchange Rate, Tourists Arrivals, Interest Rate and FDI have a significant relationship with Total Air Passenger Movements, Air Passenger Arrivals and Air Passenger Departures and for only Air Passenger Arrivals, Government debt has become a significant factor.

Keywords— Air transportation, regression analysis, Bandaranaike International Airport

I. INTRODUCTION

The strategic geographical location of Sri Lanka in the Indian Ocean accredited it the eternal benefit of serving as one of the most important aviation hub, being close proximity to populous nations in the world. Aviation industry is reaching its prosperous stages with the booming of tourism industry after three decades of conflict period. Hence the industry focuses not only on facilitating transfer passengers but also transit passengers.

Sri Lanka aviation industry experienced an exceptional growth during last couple of years, which encompasses developing and upgrading Bandaranaike International Airport and encouraging sea plane and domestic air plane services. BIA witnessed the highest passenger numbers ever in 2012 (before Mattala Rajapaksa International Airport (MRIA) came into operation), recording an increase of 7% compared to the previous year. BIA modernization programme expects to increase its passenger handling capacity significantly in future. It is expected to double the current passenger numbers to 12 million passengers per annum, under phase II of BIA expansion project.

Continuous focus on airport infrastructure developments contributes to stimulate more foreign investments to the country. Sri Lankan

Airlines, the national carrier has expanded their fleet to cater the amplified demand from outbound and inbound passenger traffic to and from Sri Lanka. The capacity of the national carrier is expected to expand in years to come.

The low cost carriers, who entered the market recently, have induced more people to travel, offering cost efficient deals, where many airlines have to compete with them on attracting customers. This depicts a positive sign since this competition could lead to a better market place with more options available for the customer to choose from.

Nevertheless, fuelled by government long term development projects apart from afore mentioned, construction of new International airport in Mattala, development and modernization of fourteen domestic airports for internal aviation paves the way to generate more employment opportunities in aviation sector contributing national economies. Even MRIA will fulfil a long standing need of having a second international airport eliminating the disadvantage the country had by operating with a single international airport. MRIA will be a greater contributor to the country's economy enabling international trade, travel and tourism, vocational training and employment and intended to integrate with Port of Hambantota to support sea-air cargo transshipments.

Since it is in its early stages of operation, records on passenger movements or related figures are not readily available at the moment. However it is a proven fact that both these international airports are priceless gifts to Sri Lanka on its strategic grounds which can amplify the economic growth of the country.

The main focus of the study is to analyze the factors that affect Air Passenger demand at BIA and to identify the most significant factors that have a direct impact on the above. Macroeconomic factors have been considered as explanatory variables. Three dependent variables as Air Passenger Arrivals, Departures and Total Movement of air passengers consider under the study and are to be tested against fourteen explanatory variables to see the relationship those three dependent variables are having with each of the explanatory variable.

II. LITERATURE REVIEW

Demirsoy (2012) conducted his research on two major objectives as to investigate on the impact of different factors on air passenger demand for Turkish Air Transportation and to do a maturity analysis of the domestic Turkish air transport market. (Research explains whether Turkish domestic air transport is likely to face maturity soon) The research was lead on the basis of four questions as to, "What are the main drivers of domestic air transport demand in Turkey?", "Can economic growth or income rises in the country in the country serve as a partial explanation of air transport demand growth?", "Are there any other qualitative factors that are affecting passenger demand?" and "How are deregulations influencing the domestic market?".

The researcher carried out a comprehensive regression analysis to determine the most influencing factors to Air Passenger demand where the dependent and independent variables in the regression model were based on the theoretical and empirical literature.

Income, Population, Consumption, Expenditure, Rail-Road Passenger Numbers, High-Speed Rail-Road Passenger Numbers, Crude oil prices and several dummies have been taken as relevant independent variables and had created a preliminary model as;

$$Pax = f(I, P, C, E, R, HS, O, \text{dummies}) \quad (1)$$

Where -Pax-Passenger Number/ I-income/ P-Population/ C-Consumption/ E-Expenditure/ R- Rail passenger Number/ HS- High Speed rail passenger number/ O-Oil Prices(units of the oil price)

The study of Abdullah et al (2000) describes Domestic air travel in the Kingdom of Saudi Arabia followed by a discussion of the determinants of air travel demand in the country. An attempt was made to develop several models of demand for domestic air travel in the kingdom with different combinations of variables using stepwise regression technique.

Selection of dependent and independent variables in the study were based on theoretical and empirical literature. Oil Gross Domestic Product, Private Non-Oil Gross Domestic Product, Government Non-Oil Gross Domestic Product, Total

Oil Gross Domestic Product, Total Gross Domestic Product, Consumer Price Index, Per Capita Income, Import of Goods and Services, Exchange Rate, Population Size, Total Expenditures, Private Consumption Expenditures, Government Consumption Expenditures, Total Consumption Expenditures and Yield were the basic economic and demographic factors.

As expressed by the author, the most important step in an attempt to study the relationship between variables is to express this relationship in mathematical form, that is to formulate and specify the model with which the economic phenomenon can be explored empirically. To eliminate the problem of multicollinearity, test of correlation has been conducted and only Total Non-Oil Gross Domestic Product(X_4), Consumer Price Index(X_6), Import of Goods and Services(X_8), Per Capita Income(X_7), Population Size(X_{11}), Total Expenditures(X_{12}) and Total Consumption Expenditures(X_{15}) were considered as relevant factors to the demand for the domestic air travel in the Kingdom of Saudi Arabia.

Authors used four different specifications of the model to see forecasts performance of each model.

- Group I: (X_4, X_6, X_8, X_{11})
- Group II: (X_7, X_6, X_8)
- Group III: (X_{12}, X_6, X_{11})
- Group IV: (X_{15}, X_6, X_{11})

A sequence of regression equations were calculated using different combinations of variables in the group through stepwise regression procedure for selecting independent variables. Each step, an independent variable was either added or removed until the prediction of the dependent variable (Y) does not improve significantly.

The model, which has the total expenditure and the size of the population as the explanatory variables, was the model to represent the demand for domestic air travel in Saudi Arabia more precisely. The model explains that population growth and expenditures lead to increased domestic and international demand for air transport.

The rest of the models examined suffer from multicollinearity

$$Y = -2.961205 + 0.027701 X_{12} + 0.368102 X_{11}$$

- Where Y : Number of passengers in millions
- X_{11} : Population Size in millions
- X_{12} : Total Expenditures in billions

However, the model they built has several deficiencies. Despite the fact that they considered different models, they were not trying to create a model with more explanatory variables.

Another Study conducted by Poore (1993) whereby he conducted a hypothesis testing and forecasted the future demand for air transportation by air plane manufactures and aviation regulators, was reasonable and represented an implicit trend in actual experience. The tests compared forecasts issued by Airbus Industry, Boeing and International Civil Aviation Organization (ICAO) with actual data and results with the actual results of a basic model of demand Revenue passenger kilometres (RPK). The model was a combination of two equations describing RPK requires by high and low income groups respectively. Changes in Income Per Capita were found to be highly correlated to the Variations in RPKs demanded by the high-income groups. Changes in RPKs demanded by low-income groups were related to changes in population size. The model was consistent with the assumptions and conditions appropriate for regression analysis.

III. METHODOLOGY

This research is based on a comprehensive data set collected through secondary data sources and secondary data has been used over primary data since those data are readily available where it is easy to obtain and are cheaper and those may obtainable even when the primary data cannot be obtained at all. The main data sources will be Annual Reports of Airport and Aviation Sri Lanka Pvt. Ltd, Publications of Central Bank of Sri Lanka, Board of Investment and Department of Census and Statistics, Sri Lanka, Sri Lanka Tourists Board, International Air Transport Association and International Civil Aviation Organization.

In analyzing this data set, uni-variate descriptive analysis has been carried out. Hypothesis testing has been carried out using Pearson correlation coefficient as all independent and dependant variable are continuous. In doing advanced statistical modelling, three models have been fitted

for total air passenger volume, arrivals and departures separately.

In doing regression modelling variables has been selected with respect to the significance that they have shown in hypothesis testing. Forward selection method has been used in modelling.

IV. ANALYSIS AND INTERPRETATION

Total Air Passenger Movements (Y1), Total Air Passenger Arrivals (Y2) and Total Air Passenger Departures (Y3) over the period of 1976 – 2012 are represented in the Figure 1

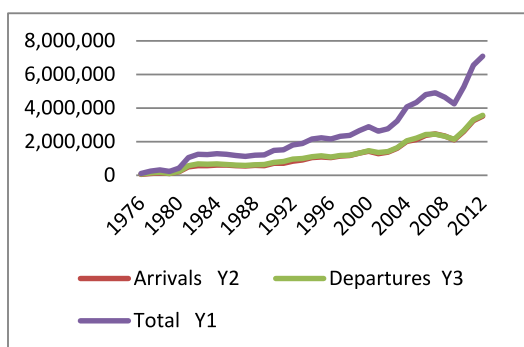


Figure 1: Trend Line for Air Passenger movements at BIA (1976 – 2012)

Data source: Airport and Aviation Sri Lanka Pvt.Ltd

The above figure shows that there exists almost a positive trend over the period, during which the study has been taken into consideration. Apart from few significant drops, it is clear that the Passenger Movement at BIA is being increased steadily in each year. The drop in year 1979 was caused due to the bankruptcy of airlines, which were closed down by the Government of J.R Jayawardene. The next perceptible drop in the year 2001, was due to a suicide attack at BIA by The Liberation Tigers of Tamil Eelam (LTTE) during the war period. In the year 2009 the drop in Air Passenger movement was due to the global economic crisis and climaxed war situation of the country.

However the drastic drop in the year 2009 was recovered in consecutive years in the number of air passenger movements. The National Aviation sector has recorded an impressive growth in 2011 as shown in the above figure. The Bandaranaike International Airport (BIA) handled 6.1 million passengers including transit passengers during the course of the year, recording an increase of 17% compared to the previous year (2010).It is also

noticeable in the above figure that both the Number of Passenger Arrivals and Departures shows a same behaviour during the period of study.

Continuing impressive post-war performance of Sri Lanka's economy, despite the global economic downturn that is being fuelled by serious financial meltdown in Europe, a slow recovery in United States and slow economic growth in regional giants, China and India, has contributed largely to the significant growth in Air Passenger Demand in last couple of years. Especially With the end of civil war Sri Lanka Tourism has boomed to a new milestone of 1,005,605 arrivals in 2012, which is an all-time high figure in the history of the country. The reason behind the massive increase in Air Passenger Movements in year 2012 would be resulting from that.

According to the statistical results obtained for Measure of Central Tendency and Variability, on average the Total Air Passenger Movements at BIA has been approximately 2.43×10^6 with a standard deviation of 1.778×10^5 number of passengers.

Table 1. Results of Hypothesis testing for total air passenger movements

i^{th} variable	Correlation Coefficient	P-Value
1. Inflation Rate (CCPI %)	-.118**	.485
2. Per capita GDP (US\$)	-.367*	.026
3. Interest rate (%)	.425**	.009
4. Total Migration for Employment	.869**	.000
5. Fuel Price	.878**	.000
6. Unemployment rate (%)	-.905**	.000
7. Population ('000)	.906**	.000
8. Tourists Arrivals	.911**	.000
9. FDI(US\$ mn)	.921**	.000
10. Avg. exchange rate (Rs. Per US\$)	.945**	.000
11. Gov. Expenditure (US\$ mn)	.947**	.000
12. GDP (US\$ mn)	.953**	.000
13. Tax Revenue (US\$ mn)	.957**	.000
14. Government Debt(US\$ mn)	.968**	.000

Below hypotheses has been checked;

Ho: Total air passenger movements is independent from the i^{th} variable

H1: total air passenger movements is depending on the i^{th} variable

Since it can be concluded that, all explanatory variables except Inflation Rate, are highly correlated with Total Air Passenger Movements and is independent from the interest rate. Pearson Correlation Coefficient between Total Air Passenger Movement and Inflation Rate, Per Capita GDP and Unemployment Rate are negatively correlated whilst the other variables show a positive correlation.

Table 2. Results of Hypothesis testing for air passenger arrivals

j^{th} variable	Correlation Coefficient	P-Value
1. Inflation Rate (CCPI %)	-.118	.487
2. Per capita GDP (US\$)	-.367*	.025
3. Interest rate (%)	.421**	.010
4. Total Migration for Employment	.870**	.000
5. Fuel Price	.879**	.000
6. Population ('000)	.906**	.000
7. Unemployment rate (%)	-.907**	.000
8. Tourists Arrivals	.908**	.000
9. FDI(US\$ mn)	.923**	.000
10. Avg. exchange rate (Rs. Per US\$)	.946**	.000
11. Gov. Expenditure (US\$ mn)	.948**	.000
12. GDP (US\$ mn)	.954**	.000
13. Tax Revenue (US\$ mn)	.958**	.000
14. Government Debt(US\$ mn)	.969**	.000

Below hypotheses has been checked;

Ho: Air passenger arrivals is independent from the j^{th} variable

H1: Air passenger arrivals is depending on the j^{th} variable

It can be concluded that Air Passenger Arrivals is independent from Inflation Rate. Nevertheless Population, GDP, Interest Rate, Average Exchange

Rate, Government Expenditure, Total Migration for Employment, Fuel Price, FDI (Foreign Direct Investment), Tax Revenue, Government Debt and Tourists Arrivals are having a positive correlation with Air Passenger Arrivals, whereas Unemployment and Per Capita GDP are negatively correlated.

Table 3. Results of Hypothesis testing for air passenger departures

k^{th} variable	Correlation Coefficient	P-Value
Inflation Rate (CCPI %)	-.119	.483
Per capita GDP (US\$)	-.366*	.026
Interest rate (%)	.429**	.008
Total Migration for Employment	.868**	.000
Fuel Price	.877**	.000
Unemployment rate (%)	-.903**	.000
Population ('000)	.905**	.000
Tourists Arrivals	.914**	.000
FDI(US\$ mn)	.919**	.000
Avg. exchange rate (Rs. Per US\$)	.943**	.000
Gov. Expenditure (US\$ mn)	.946**	.000
GDP (US\$ mn)	.952**	.000
Tax Revenue (US\$ mn)	.956**	.000
Government Debt(US\$ mn)	.967**	.000

Below hypotheses has been checked;

Ho: Air passenger departures is independent from the k^{th} variable

H1: Air passenger departures is depending on the k^{th} variable

It can be concluded that Air Passenger Departures is independent from Inflation Rate. Except Unemployment Rate and Per Capita GDP, all the other explanatory variables show a positive correlation with Air Passenger Departures.

Model for Total Air passenger movements

Table 4. Model summary

Model	R	R Square ^b	Adjusted R Square	Std. Error of the Estimate
1	.985a	.970	.969	560035.010
2	.993c	.987	.986	373957.995
3	.996d	.991	.991	307544.833
4	.998e	.996	.996	212819.496
5	.998f	.997	.996	189689.810

Table 5. ANOVA table for Model

Model	Sum of square	df	Mean square	F	sig
Regression	3.313E14	5	6.627E13	1.842E3	.000
Residual	1.008E12	28	3.595E10		
total	3.323E14	33			

Table 6. regression coefficients

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Tax Revenues	183.083	62.852	.180	2.913	.007
Avg Exchange Rate	20217.395	2147.405	.476	9.415	.000
Tourist Arrivals	2.715	.362	.382	7.495	.000
Interest Rate	-31203.622	8461.064	-.151	-3.688	.001
FDI	1151.800	394.986	.122	2.916	.007

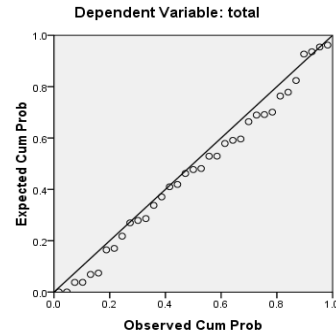


Figure 2. Normal probability plot

Model can be interpreted as follows;

Total Air Passenger Movement = 183.083(Tax revenue) + 20217.395 (Average Exchange rate) + 2.715 (Tourists Arrivals) – 31203.622 (Interest Rate) + 1151.80 (FDI)

The partial regression coefficient of Tax Revenue is 183.083, indicates that when Average exchange rate, Tourists arrivals, Interest rate and FDI held constant, as Tax revenue increased by US\$ 1 million, on average, Total Air Passenger Movements at BIA increases by 183 numbers of passengers. Where by Average Exchange rate is increased by 1% with the influence of other independent variables held constant, on average, Total Air Passenger Movements at BIA increases by 20,217 numbers of passengers. With the influence of the other independent variables held constant, if Tourists Arrivals is increased by 1 person, on average, total air passenger movements increases by 3 passenger movements. Further Total Air Passenger movements decreased, on average by 31,204 numbers of passengers, when Interest rate is increased by 1%, whilst all the other explanatory variables are held constant. With the influence of all the other explanatory variables held constant, when Foreign Direct Investment is increased by US\$ 1 million, on average, Total Air Passenger Movements at BIA, increases by 1152 numbers of passengers.

In the same manner two models for air passenger arrivals and departures has been fitted and final models are given below;

Total Air Passenger Arrivals = -24.645 (Government Debt) + 1.427 (Tourist Arrivals) + 12492.515 (Average Exchange Rate) + 574.496 (Foreign Direct Investments) -24826.777 (Interest Rate) + 217.004 (Tax Revenue)
 $R^2 = 0.999$

With the impact of Tourists Arrivals, Average Exchange Rate, Foreign Direct Investments, Interests Rate and Tax Revenue held constant, when Government Debt increases by US\$ 1 million Total Air Passenger Arrivals decreases by 24.645, which means in approximation by 25 passengers. As Tourists Arrivals increases by one person, whilst all other explanatory variables held constant, on average Total Air Passenger Arrivals increases by 1.427 numbers (approximately by 1 person). The partial regression coefficient of Average Exchange Rate, 12 492.515 emphasises that with the influence of all other explanatory variables held constant, when Average Exchange Rate is increased by Rs.1 per US\$, Total Air Passenger Arrivals increases by 12492 number of passengers approximately. Similarly Total Air Passenger Arrivals increases, on average by 574.496 (approximately by 574) passengers, when Foreign Direct Investments increases by US\$ 1 million. With the influence of all other explanatory variables held constant, when Interest rate increases by 1%, Total Air Passenger Arrivals decreases by 24826.777 number of passengers. Further, while keeping all other explanatory variables constant, when Tax Revenue is increased by US\$ 1 million, Total Air Passenger Arrivals increases by 217.004 numbers of passengers.

Total Air Passenger Departures = 94.647(Tax Revenue) + 1.445 (Tourists Arrivals) + 9695.827 (Average Exchange Rate) -14316.582 (Interest Rate) +525.995 (Foreign Direct Investments)

$$R^2 = 0.999$$

The partial regression coefficient of Tax Revenue, 94.647 articulates that with the influence of Tourists Arrivals, Average Exchange Rate, Interest Rate and Foreign Direct Investments held constant, as Tax Revenue increases by US\$ 1 million, on average Total Air Passenger Departures increases by 94.647. When Tourists arrivals increased by one person, while all the other variables held constant, on average Total Air Passenger Departures increases by 1.445, which means in reality by approximate one person. Whilst keeping all other explanatory variables constant, when Average Exchange rate is increased by Rs.1 per US\$, on average Total Air Passenger Departures increases by 9695.827, which means approximately by 9696 number of passengers. Further, the Air Passenger Departures decreases by 14316.582, when Interest

rate is increased by 1%, with the influence of Tax Revenue, Tourists arrivals, Average Exchange Rate and FDI held constant. With the impact of other independent variables held constant, the Total Air Passenger Departures at BIA, on average goes up by 525.995, which is in reality by 526 passengers approximately, as Foreign Direct Investments is increased by US\$ 1 million.

V. CONCLUSIONS

Arrivals and Departures are dependent on Population, GDP, Per Capita GDP, Unemployment Rate, Interest Rate, when the fourteen independent variables are considered, they showed a significant correlation with each of the dependent variable, under 5% level of significance, except Inflation Rate against three dependent variables. A negative correlation was shown by Interest Rate and Unemployment Rate as opposed to the all other variables. Hence through the correlation analysis it is a proven fact that, Total Air Passenger Movements, Air Passenger Average Exchange Rate, Government Expenditures, Total Migration for Employment, Fuel Price, FDI, Tax Revenue, Government Debt and Tourists Arrivals and are independent from Inflation Rate.

According to the three multiple linear regression models, the compounding effect of interest rate upon domestic air passenger demand at BIA is negative which is acceptable. The interest rate taken in the research was the interest rate for deposits. When deposit rate is increased the tendency to save money increases. Consequently consumption is decreased resulting in a decline in air passenger demand. Higher interest rates make investments better off in investing on various other industries than spending on air transport related business. Hence higher interest rate shrinks the demand for air transportation posing a negative impact.

It is recommended to carry out further research work to investigate the reasons behind the absence of Population, GDP, Per Capita GDP, Unemployment Rate, Government expenditure, Total Migration for Employment, Fuel Price and Inflation Rate in the three models, which is a debatable outcome of this research. In addition the positive relationship between average exchange rate and three dependent variables also need further investigations since this research outcome is

contradictory to general macroeconomic theories that state, increase in average exchange rate results in decrease in demand for services or products.

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