

Modeling Air Passenger Demand in Bandaranaike International Airport, Sri Lanka

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Abstract

Developing economies experience higher growth rates in air passenger traffic and modeling passenger demand is essential for designing and strategic planning of facilities in the airports. Research presents a demand model for forecasting air passenger traffic in Bandaranaike International Airport (BIA), Sri Lanka. Demand model is developed by using econometric modeling. Economic growth and air fare impact are included as two explanatory variables in the model. The tourist arrival growth is included since Sri Lanka is known as a tourist destination in Asia. Terrorist activity is considered as a qualitative explanatory variable. Model is developed as a semi logarithmic model including quantitative and qualitative variables after identifying the significant correlations between total air passenger demand and these explanatory variables. Research is provided the best fit model for forecasting passenger demand in BIA through analyzing data over 24 years. Demand model can be benefited to capacity utilization and passenger terminal expansion.

Keywords: Modeling, Forecasting, Econometric modeling Logarithmic model.

1. Introduction

Air Travel Demand analysis is very essential to an airport for making decisions on capacity utilization and for designing airport facilities. Forecasting air passenger demand is very important for developing infrastructure facilities and passenger services at an airport in the future. Analysis of air passenger demand helps to identify the future requirements of such facilities. BIA had handled the all international aircraft movements up to 2012. Considering the passenger traffic, it has reached to almost peak passenger demand. In 2013, BIA has handled 7.3 million of passenger movements which is a 3.2% growth. This was a significant improvement which indicated the need of terminal capacity utilization and increment. It is very clear that BIA has to increase the terminal capacity and maximize runway utilization and develop availability facilities for handling arrivals and departures of passenger flow with their baggage. BIA already has a proposal for building a new runway. So, required capacity and dimensions of such facilities can be estimated by developing a demand model for air passenger at BIA.

2. Research Problem

The research is and the objectives are entirely built on following research problems.

- How the air passenger demand can be predicted correctly and closely.
- How the air passenger demand is affected by economic factors and other factors and how to develop the best fit demand model including them as independent variables. The variable selection for modeling air passenger

demand is not differed for passenger arrivals and passenger departures because both passenger arrivals and passenger departures follow a similar trend.

In order to predict air passenger demand correctly and closely, it is very important to identify the quantitative factors and qualitative factors which affect the passenger demand. The researcher mainly concerns about the airport operator, aviation authority and air service providers in Sri Lanka in order to use the forecasting model for the development of the aviation industry. Depending on the forecast passenger demand, the stake holders in the industry will make decision in planning and designing or expanding, investing and changing operations in the future.

3. Research Objectives

The research objectives are identified as following.

- Understanding the behaviour of air passenger transport, industry view on forecasting passenger traffic and the requirement for modelling air passenger demand in BIA.
It is very important to understand the industry view on forecasting models for passenger demand and forecasting techniques used by key players in the international aviation industry. A strong air passenger forecasting model should be developed based on the requirement in the industry.
- Analyse the trends and understand the growth patterns of passenger arrivals and departures of and understand the factors affecting passenger demand BIA.
Developing a forecasting model for air passenger traffic is difficult without having a better background knowledge and understanding what factors influencing the air passenger demand and how those factors explain fluctuation of passenger arrivals and departures. Analysis of trends and growth patterns is used to include those factors in the demand model as predictor variables.
- To develop best fit demand forecasting model for air passenger demand at BIA.

4. Literature Review

The three measures of air travel activity can be recognized as passenger volume, passenger kilometres and aircraft operation. Total number of passenger trips is considered as the passenger volume while passenger kilometre is taken as Revenue Passenger Kilometres (RPK) which is the multiplication of total number of trips and the trip length. The air transport demand can be categorized in to two groups known as Micro-analysis which is identified as the aggregate concept for forecasting overall aviation activities in air transportation and Macro-analysis which is performed in more stratified basis as planning and policy analysis tools. Forecasting Origin –Destination passenger traffic (City pair Models) is recognized as a Micro-analysis (Kafani, 1983). This research provides a demand forecasting model for total air passenger traffic in BIA on annual basis. Forecasting for demand short time period will be very useful for decision making in immediate operations of the airport as well as forecasting demand for long period of time can be used for strategic planning and larger investments (Zia, 2013). Since the BIA has the peak passenger demand, a strong demand model is needed for identifying the passenger demand in the future for capacity utilization and passenger terminal expansion.

Evaluating and forecasting the volume of passenger demand in an airport are very essential in order to reduce the airport risk and develop infrastructure facilities. Also, air passenger forecast is needed for an airport for managing airport facilities and for the utilization of passenger terminals and runway (Erma et al, 2010). In addition, modeling air passenger arrivals and departures in an airport separately can be used to identify the requirements for improving baggage handling systems. Air passenger demand is affected by various factors. The factors affecting air passenger demand can be put into two categories. The first one is external factors and other one can be known as internal factors (Erma et al, 2010). External factors include Gross Domestic Production (GDP), income level and demographic factor such as population. The wide range of explanatory variables affecting air passenger demand can identified based the previous researches. These variables are known as GDP, population, income level, exchange rate, air fare impact, travel time and aircraft movements.

GDP or income level can be identified as the one of most important predictor variables to develop the model when it represents the size of the economy and ability of the people to travel by air in the country. It is believed that jet fuel price or crude oil price will constitute a portion of air fare impact (Zia, 2013). So, the jet fuel price can be considered as an explanatory variable due to the lack of data availability of averaged airfares in the country.

The review reveals that GDP and population are highly correlated so that multi collinearity may be found in the demand model when both variables are included. The review reveals that the logical or implied causal relationship between the independent variable and predictor variables should be considered in developing demand forecasting models. Analysis of trend of air passenger traffic in BIA has proven that passenger arrivals and departures were decreased suddenly in some years due to the lower political stability resulted by terrorist activity in the country and the world.

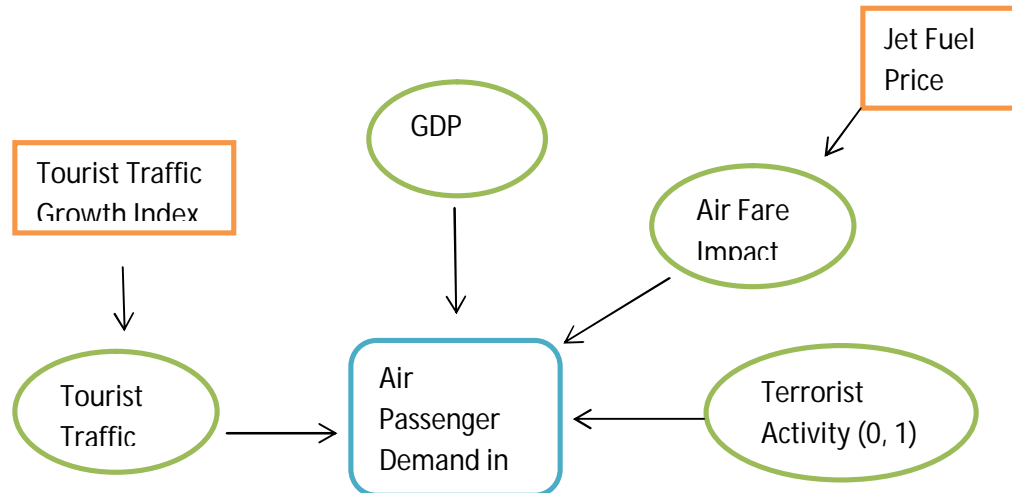


Figure 1: Factors Affecting Air Passenger Demand in an Airport

The time series Analysis and Casual methods can be identified as the quantitative methods for forecasting passenger demand. Time series analysis relies on historical data. Also, casual method can be divided into two categories which are known as Regression Analysis and Simultaneous equation model and spatial equilibrium (ICAO, 2006). Moreover, four general approaches can be used for modelling passenger demand in an airport. They can be known as Market Share forecasting, Econometric modelling, Time series modelling and Simulation modelling. The review reveals that Econometric and Time series modelling can be used often as most applicable approach to modelling air passenger demand. Further, it is explained that as the econometric model the log-log functional specification are used commonly for developing air passenger travel demand (Zia, 2013).

5. Demand Models

5.1 Model Specification

Following the review above, GDP is included as the primary explanatory variable in the passenger demand model. The second explanatory variable is jet fuel price (JFP). It is believed that jet fuel price will capture at least some of the variations in airfare over the years. The third explanatory variable is the tourist traffic growth index (TGI) in Sri Lanka. Terrorist Activity is included as the fourth explanatory variable which is a qualitative (dummy) variable. Following the literature, the log-log multiple regression form with a dummy variable is used. Thus, the parameter estimates represent the elasticities of passenger demand with respect to the variables.

$$\ln PASS = \beta_0 + \beta_1 \ln GDP + \beta_2 \ln JFP + \beta_3 \ln TGI + \beta_4 T \quad (1)$$

PASS – Total Passenger Demand in BIA

GDP - GDP current in USD billion

JFP – Jet Fuel Price

TGI – Tourist Traffic Growth Index

T – Terrorist Activity

5.2 Data

Data collection methods include two approaches such as Primary data collection and Secondary data collection. The most data are depended on the secondary data collection. All dependent data represent the air passenger traffic in BIA as passenger arrivals and departures. These data are collected through industrial visits and search through the data bases. The dependent data are collected from industrial visits to CAASL and annual reports of CAASL and Airport and Aviation Sri Lanka Limited (AASL).

The main data source for this research is Air Transport and Legal Affairs Section in CAASL. The independent data such as Gross Domestic Product (GDP) current in US dollars of Sri Lanka, Official exchange rates US dollars (USD) to Local Currency Units (LCU) and Jet Fuel prices in USD are collected search through Central Bank of Sri Lanka, World Bank Database and Department of Census and Statistics. The other independent variable, Tourists Growth Index data are collected from the annual reports of Sri Lanka Tourism Development Authority. Primary data collection includes of panel views and discussions with responsible managers and key players of the industry.

5.3 Model Estimation

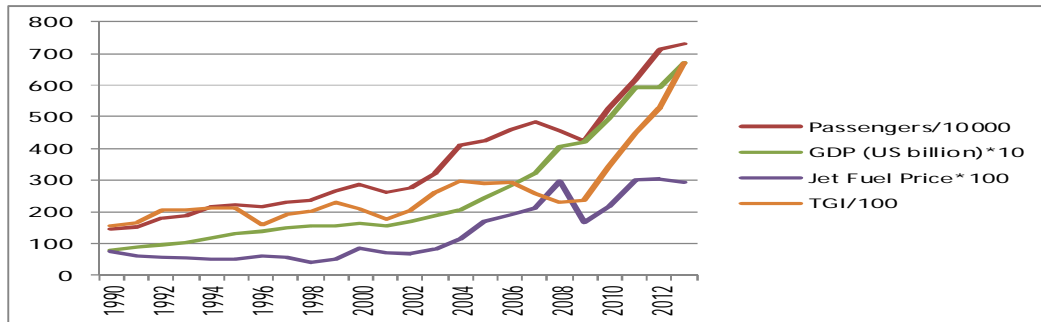


Figure 2: Historical data on Total Air Passenger Demand, GDP, Jet Fuel

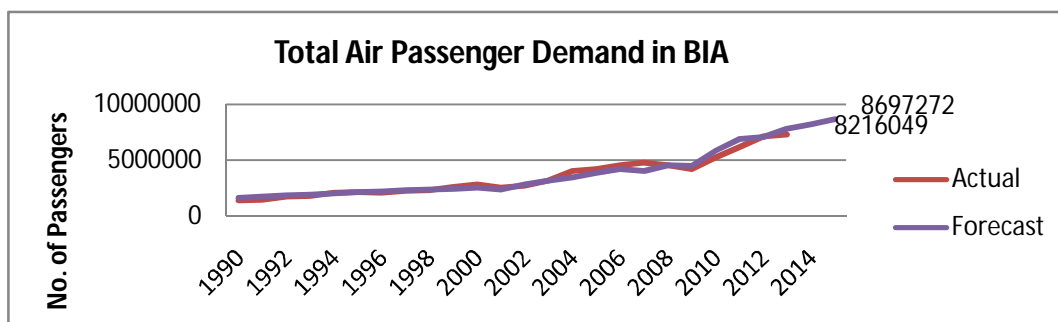
Figure 2; shows lower and steady passenger traffic growth from 1983 to 2001 because of the Sri Lankan civil war and lower economy growth. The sudden decrease of passenger traffic in 1987 and 1988 was seen by the industry due the lower political stability resulted by another political conflict. In July 2001, a devastating suicide attack on BIA by Liberation Tigers of Tamil Eelam (LTTE) greatly affected its passenger traffic to be decreased. After 2002 peace process started, the passenger traffic was increased up to 2006. There is a significant decrease of passenger demand due to the civil war which was started again between Sri Lankan government and LTTE. The tourist arrivals growth was greatly decelerated because of the lower political stability. Consequently, it has affected the passenger demand in BIA. The significant passenger growth rate was reported from 2010 after ending the civil war. The analysis of the trend of passenger demand helps to identify the factors affecting air passenger demand to be considered as economic growth, tourist arrivals and political stability.

There is no any significant difference in behavior between Total passenger demand and Passenger Arrivals and Departures. The both passenger arrivals and departures follow the same trend of total passenger demand but passenger departures are always higher than passenger arrivals except 2004. In 2013, the total passenger demand is recorded as 7,311,869 including 3,621,822 of passenger arrivals and 3,690,047 of passenger departures. The air passenger demand was increased from 1990 to 2013. Considering the trend of independent variables, all the predictor variables were increased as total air passenger demand was increased over past 24 years. The uncertainty of oil price can be recognized by understanding its trend. Also, BIA has experienced downturns in passenger demand in 2001 due to the 09/11 terrorist attack and LTTE attack. The passenger demand from 2007 to 2009 was decreased because of the low political stability resulted by civil war in Sri Lanka. So, Terrorism (T) is considered as a dummy variable in the demand model.

6. Passenger Demand Forecast

6.1 Total Passenger Demand Model

$$\ln \text{PASS} = 12.2557 + 0.53611(\ln \text{GDP}) + 0.06404(\ln \text{JFP}) + 0.147(\ln \text{TGI}) - 0.10757(\text{T})$$



The demand model for forecasting passenger traffic in BIA are developed by using multiple linear regression and logarithmic regression through the analysis of collected data over past 24 years in order to select the best fit model using 95% of Confidence Interval (CI). Both passenger arrivals and departures follow a similar trend. So, factors affecting passenger arrivals and departures will be the same. For instance, increase of tourist traffic in the country will influence both passenger arrivals and departures in BIA to be increased.

6.2 Passenger Arrivals

$$\ln A - PASS = 11.6282 + 0.57811(\ln GDP) + 0.04604(\ln JFP) + 0.1212(\ln TGI) - 0.12337(T)$$

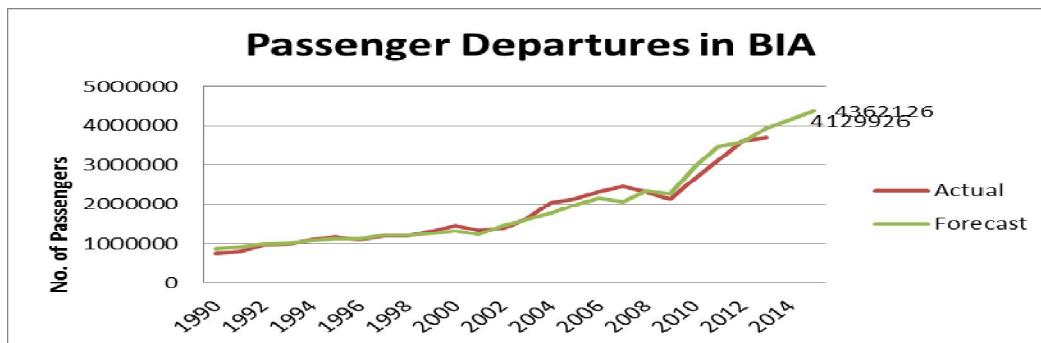
A-PASS – Passenger Arrivals in BIA



6.3 Passenger Departures

$$\ln D - PASS = 11.5036 + 0.49694(\ln GDP) + 0.08082(\ln JFP) + 0.1708(\ln TGI) - 0.09261(T)$$

D-PASS – Passenger Departures in BIA



7. Conclusion and Recommendation

It is proven through this research that need of understanding and analysis of the growth patterns of passenger traffic in order to develop a strong demand forecasting model. In achieving objectives of studying and identifying the behavior of the air passenger traffic, analyzing the trend in passenger arrivals and departures is done in order to develop a strong demand model for BIA because estimates of potential passenger demand in the airport is very essential for strategic planning. This research has explained the strong correlation between the passenger demand which is the dependent variable and country’s GDP, oil prices and growth of the tourism industry which are independent variables. The quality of an econometric model depends on the explanatory power and the ability of the independent variable. It is also important to identify the impact of political stability in the region on airport operation. As a qualitative variable, terrorism is included in the air passenger demand model. In achieving the final objective; total air passenger demand model is developed with two demand models for both passenger arrivals and departures in BIA by analyzing demand factors over past 24 years. The regression assumptions and final criteria performance and forecast demand analysis have proved that the selected demand models are the best fit demand models for total passenger demand including passenger arrivals and departures. Considering the importance of increasing forecast accuracy of the models, each model should be updated with the time.

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