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The Opening Address at the ATRS 2003 Conference, Toulouse, France

By
Professor Tae Hoon Oum,
President, Air Transport Research Society, and
UPS Foundation Chair in Transport and Logistics,
University of British Columbia, Canada
July 11, 2003

Distinguished guests, ladies and gentlemen! It gives me a great pleasure to welcome all of you to the ATRS World Conference being hosted jointly by Groupe ESC (Toulouse Business School) and the ENAC (Ecole Nationale de Aviation Civile).

Today and tomorrow, in addition to the Opening and the Closing Plenary sessions, 112 papers will be presented on virtually all aspects of air transport and related topics.

2003 is a particularly challenging year to air transport policy makers, aviation executives and researchers as most of the major network airlines are experiencing unprecedented level of financial difficulties in the 100-year history of aviation. But I am reminded of Mr. Georges Clemencau, the French Leader during the first World War. He said "our country advances ONLY through crisis and in tragedy". Likewise, I am confident to predict that air transport industry will also advance through these crises. Airlines are succeeding in restructuring their service networks, and streamlining their operations to an unprecedented level, and start to listen to what their customers and markets are telling them more closely. Most major network carriers in the United States and Canada have achieved a unit cost reduction of about 25% via their recent restructuring efforts. They will be coming out of these crises with resounding success in order to serve the rising demands for efficient and cost effective services. Now, I believe it is turn for the airports and air traffic control systems to do a restructuring comparable to what airlines have been doing in recent years. In this regard, I am particularly happy to see many papers and presentations in this conference are focusing the airports and air traffic control systems.

As a final note, on behalf of the ATRS, I would like to express sincere appreciation to Mr. Herve Passeron, Director of Groupe ESC-Toulouse, and Mr. Gérard Rozenknop, Director of the ENAC, and above all, Professor Sveinn Gudmundsson for their tremendous efforts to organize this conference so successfully. I also like to express our appreciation to AirBus Industries, City of Toulouse, Toulouse Chamber of Commerce, Aeroport Toulouse-Blagnac, and EQUIS for their active participation in this program and for their financial supports.

I look forward to a stimulating conference in the next couple of days.
Thank you very much.

The Air Transport Research Society (ATRS)
World Conference
July 10-12, 2003 Toulouse, France

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The ATRS held its World Conference in Toulouse, France, in July 2003.

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DEVELOPING PASSENGER DEMAND MODELS FOR INTERNATIONAL AVIATION FROM/TO EGYPT: A CASE STUDY OF CAIRO AIRPORT AND EGYPTAIR

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ABSTRACT

This research is concerned with developing passenger demand models for international aviation from/to Egypt. In this context, aviation sector in Egypt is represented by the biggest and main airport namely Cairo airport as well as by the main Egyptian international air carrier namely Egyptair. The developed models utilise two variables to represent aviation demand, namely total number of international flights originating from and attracted to Cairo airport as well as total number of passengers using Egyptair international flights originating from and attracted to Cairo airport. Such demand variables were related, using different functional forms, to several explanatory variables including population, GDP and number of foreign tourists. Finally, two models were selected based on their logical acceptability, best fit and statistical significance. To demonstrate usefulness of developed models, these were used to forecast future demand patterns.

Key Words: Passenger, International Flights, Demand Models, Cairo Airport, Egyptair

1. INTRODUCTION

The main aim of this research is to develop demand models for passenger aviation from/to Cairo airport. In pursuing this objective, the research starts by drawing a conceptualisation of the main factors affecting passenger demand for international air transport from/to Egypt. In addition, another conceptualisation is drawn portraying the factors influencing the selection of Egyptair, as a potential international carrier, by passengers. Following this a data collection exercise is conducted, whereby historical data, spanning over the 11 years 1990 to 2000, concerning aviation demand variables as well as other explanatory variables thought to affect this demand is collected and compiled from several sources.

Demand variables include number of international flights (scheduled or unscheduled) as well as number of passengers using international Egyptair flights (scheduled or unscheduled) originating from or attracted to Cairo airport. Demand variables are historically plotted in an effort to determine the most proper and representative ones. On the other hand, a number of explanatory variables affecting demand are also selected, namely population, Gross Domestic Product (GDP), number of foreign tourists, GDP/Capita, number of Egyptian pilgrims, number of Egyptian immigrants, as well as number of Egyptians working abroad. A correlation matrix is then computed to obtain values of Pearson correlation coefficient showing the extent of relation between demand variables and the selected explanatory variables. The matrix demonstrates the collinearity between population and pilgrims as well as between GDP and GDP/capita. In addition the matrix shows the illogical negative sign of correlation coefficients relating demand to other explanatory variables such as number of Egyptian immigrants or Egyptians working abroad. Based on these analyses, it is decided to develop demand models relating air passenger demand to population, GDP and number of foreign tourists.

These dependent and independent variables are utilized to calibrate single as well as multiple variable models, using different functional forms, in an effort to represent changes in air passenger demand. All of the calibrated models are subjected to a number of logical and statistical tests. To establish goodness of fit and statistical significance of the calibrated models two statistical indicators are computed namely the R^2 and the F-statistic. Finally, models including population and number of foreign tourists as independent variables are selected as being the most logical and statistically significant models. The research concludes with a demonstration of the usefulness of the selected models in terms of ability to predict future passenger demand levels.

2. FACTORS AFFECTING PASSENGER DEMAND FOR TRAVELLING BY AIR FROM/TO EGYPT

A conceptualisation of the main factors affecting the demand for travelling by air from/to Egypt is depicted in figure 1. Aviation demand to/from Egypt is composed of Egyptian passengers as well as of foreign passengers. It can be represented by the number of international flights to/from Egypt or by the number of passengers using international flights to/from Egypt. Ten factors were identified as affecting the demand generated by

Egyptian nationals and attracted to other countries. Three can be grouped under socio-economic factors. These include population size, GDP, and GDP/Capita in Egypt. The increase in any of these factors is expected to generate more demand for travelling by air. One factor is related to a pillar of the Islamic religion, namely performance of Haij (pilgrimage). Each year, and according to quota, Saudi Arabia grants a number of Haij visas equivalent to 0.001 of the Egyptian population. Egyptian pilgrims travel to the holy cities of Makkah and Madina in Saudi Arabia in order to perform Haij. Haij takes place once a year during the Arab month of Zou Al-Haija. In addition, Omra another Islamic ritual and a smaller version of Haij, can be performed at any time of the year but its peak season is during the Arabic month of Ramadan. Egyptians are known to be very frequent in travelling to Saudi Arabia to perform Omra. The other sixth factors are all related to attractions abroad, including:

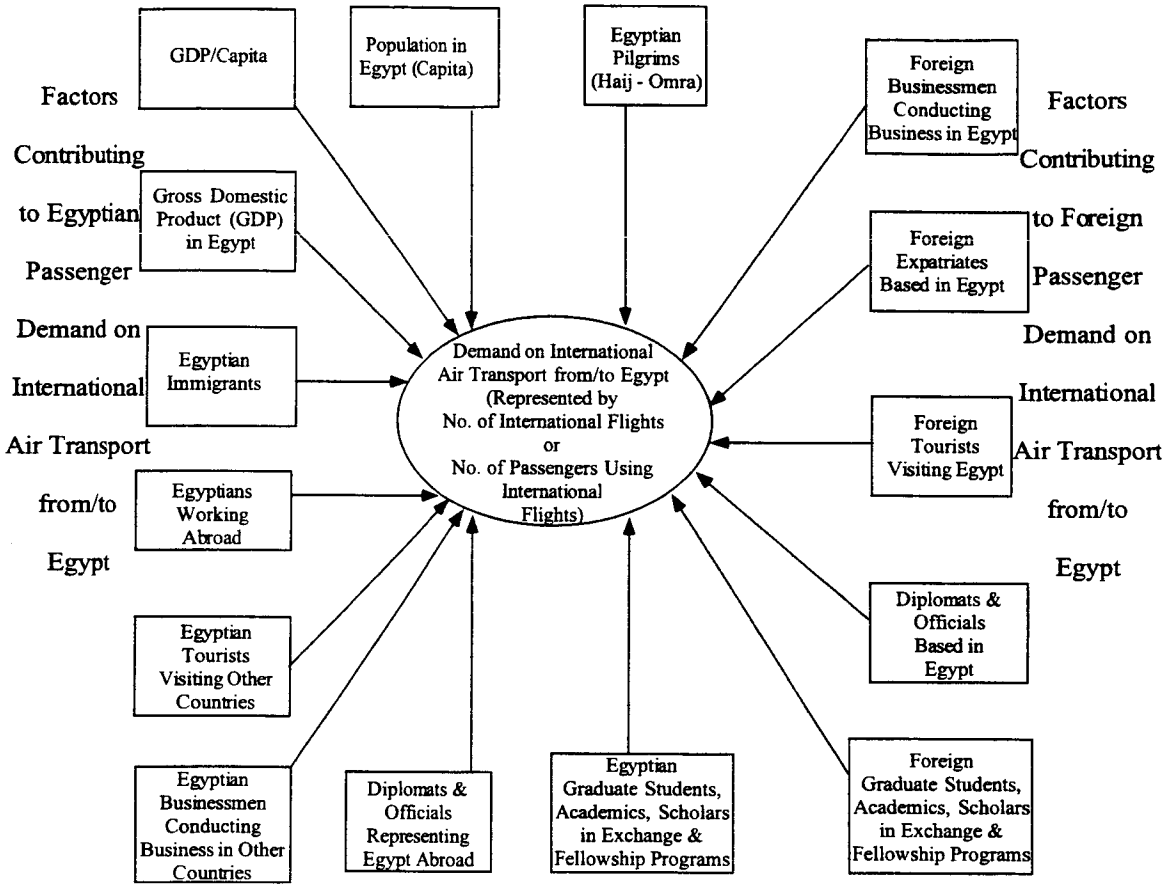
- Egyptians immigrants travelling to/from countries of immigration such as USA, Australia.
- Egyptians working abroad and travelling to/from working destinations, such as Saudi Arabia and other gulf countries.
- Egyptian tourists visiting other countries, especially in summer when lots of Egyptians travel to countries such as Turkey, UK and Greece.
- Egyptian businessmen travelling to countries to conduct business meetings and arrangements
- Diplomats and officials representing Egypt abroad.
- Egyptian graduate students, academics, and scholars travelling to other countries for higher education, research and exchange programs.

On the other hand, five factors were identified as affecting the demand generated by foreign nationals and attracted to Egypt including:

- Foreign tourists attracted to Egypt to visit historical and archaeological Egyptian heritage.
- Foreign nationals, probably expatriate, working in Egypt.
- Foreign businessmen travelling to Egypt to conduct business meetings and arrangements.
- Foreign diplomats and officials representing foreign countries and international bodies within foreign diplomatic missions based in Egypt.
- Foreign graduate students, academics, and scholars travelling to Egypt for higher education, research and exchange programs.

The most important of these five factors is the number of foreign tourists expected to visit Egypt. It is well known that the majority of foreign tourists arrive to and leave from Egypt by air.

Figure 1: Conceptualisation of Factors Affecting Passenger Demand on Air Transport from/to Egypt



3. FACTORS AFFECTING EGYPTAIR MARKET SHARE OF PASSENGER DEMAND ON FLIGHTS FROM/TO EGYPT

Some generic insights on the choice of air carrier, flight and fare classes were developed by Proussaloglou and Koppelman (1999). In this section, a conceptualisation of factors affecting the modal selection by passengers travelling on international flights from/to Egypt is shown in figure 2. The figure demonstrates the process involved in the selection of Egyptair versus other international carriers by travelling passengers. It is obvious that some passengers are by default Egyptair captive either due to their patriotic character, or due to Egyptian government regulations necessitating the use of the national carrier or due to monopoly of certain routes by Egyptair. On the other hand, the majority of passengers would have the choice of selecting Egyptair versus other alternative competing airlines. In this context, price and level of service related characteristics affecting the utility of

competing airlines govern passengers' mode choice. Such characteristics could include factors such as promotions, safety and security records, comfort, convenience, regularity, punctiality, schedule coverage, luggage safety, crew hospitality and friendliness, onboard entraintment facilities, designated airport facilities, etc.

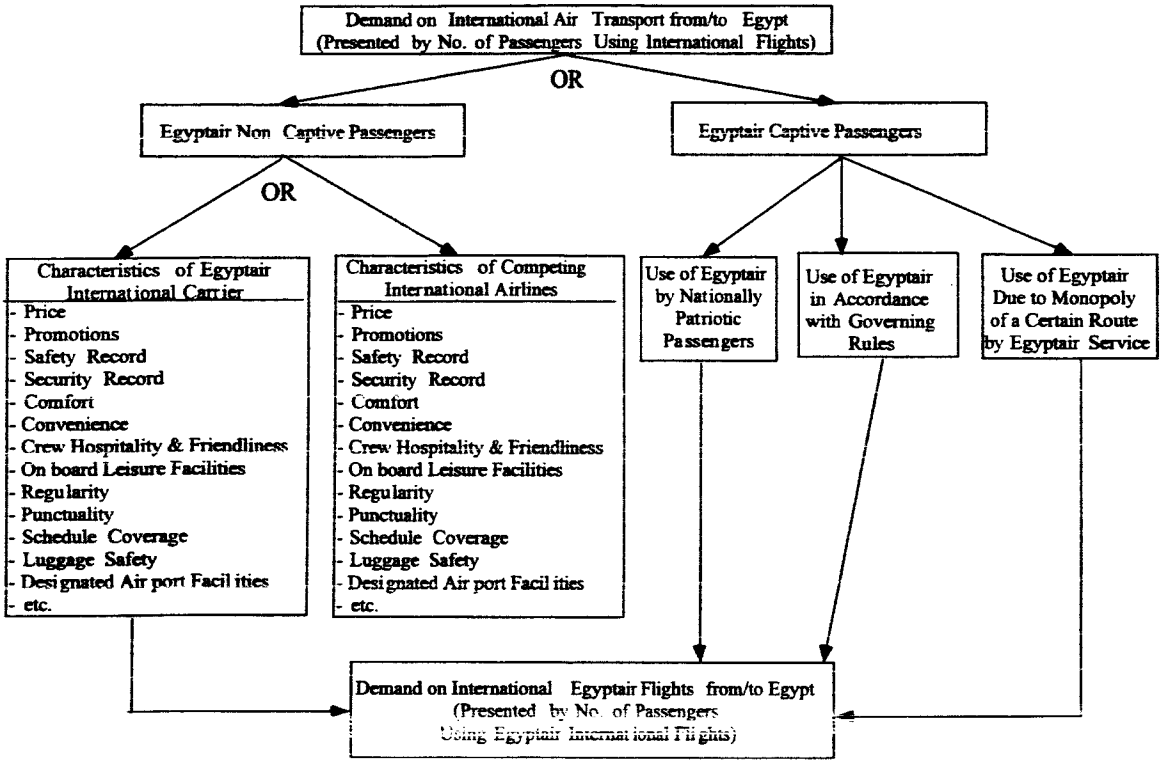


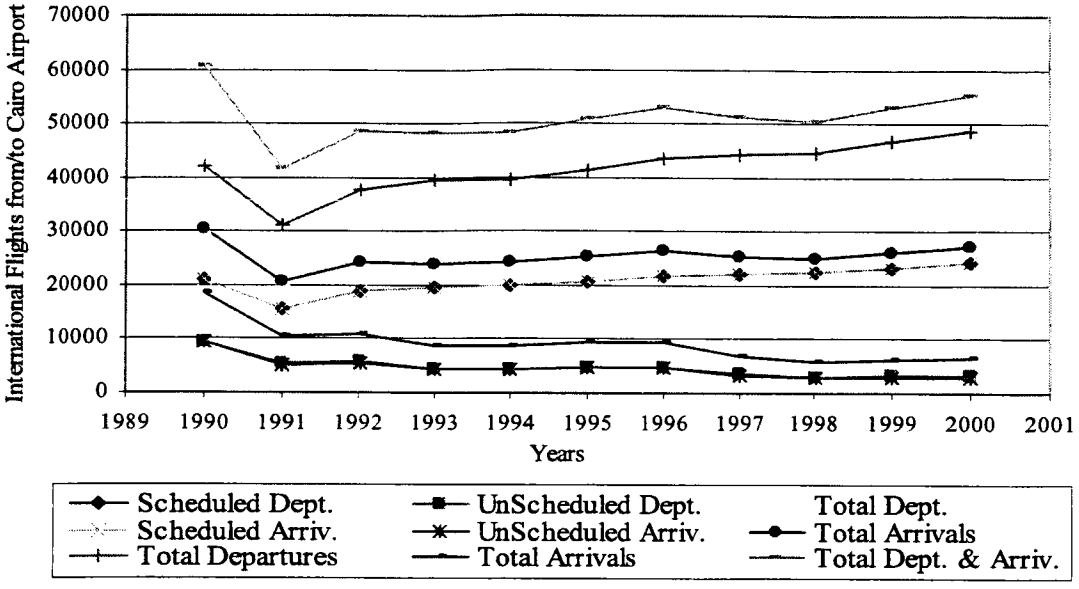
Figure 2: Conceptualisation of Factors Affecting Egyptair Market Share of Passenger Demand on International Flights from/to Egypt

4. DEPENDENT AND EXPLANTAORY VARIABLES FOR DEVELOPING DEMAND MODELS FOR PASSENGERS TRAVELLING FROM/TO CAIRO AIRPORT

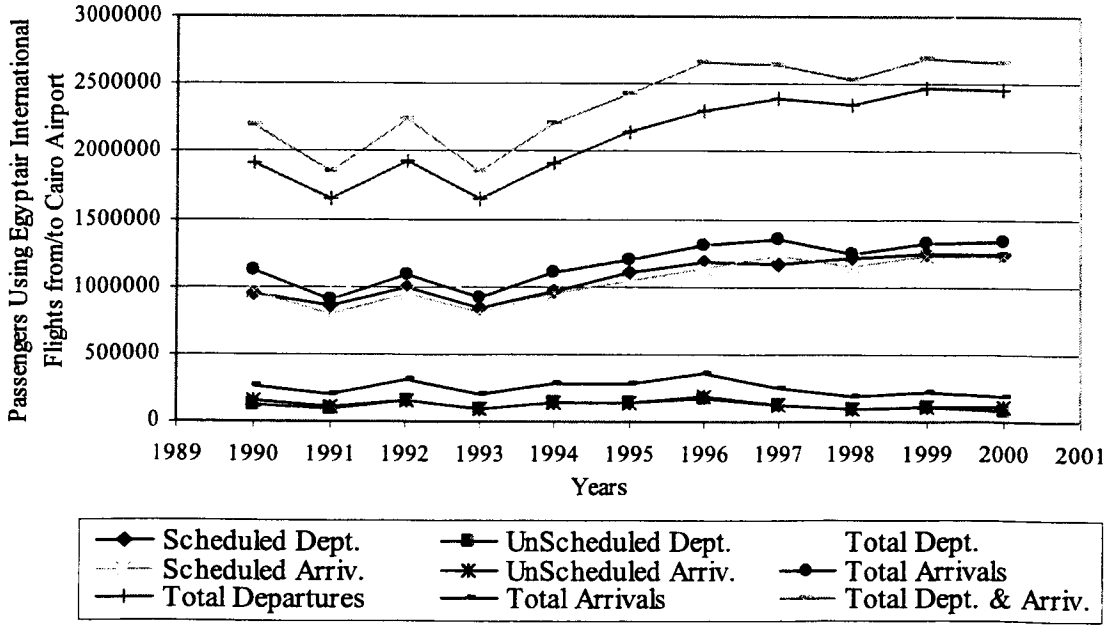
The core of the research lies in developing demand models for international flights from/to Cairo airport as well as for passengers using Egyptair international flights from/to Cairo airport. Based on the conceptualisation, depicted in figure 2, of factors affecting demand, a data collection exercise was conducted. Historical data, spanning over the 11 years 1990 to 2000, concerning aviation demand variables as well as other variables thought to affect this demand was compiled from several sources, see ECAA (2001), Egyptair (2001), NBE (2001), and IMF (2000).

In another research, a different approach was pursued in terms of developing separate models for each demand variable, see Reda, 2003.

Figure 3: Pattern of Historical Demand of International Passenger Flights from/to Cairo Airport



Figures: Pattern of Historical Demand of Passengers Using Egyptair International Flights from/to Cairo Airport



Demand variables include number of international flights (scheduled or unscheduled) as well as number of passengers using international Egyptair flights (scheduled or unscheduled) originating from or attracted to Cairo airport. Demand variables were historically plotted in an effort to determine the most proper and representative ones, see figures 3 and 4. Several observations were noted, first that demand in 1990 was relatively high, being the year just before the second Gulf war. Demand dropped significantly in 1991, due to the Gulf war and its dramatic effect on tourism and aviation sector in Egypt. In this context, it was decided to drop data points pertaining to these two years from the development of the models. The other noted observation is that generated as well as attracted demand for both scheduled and unscheduled trips are almost similar in magnitude. This demonstrates the aviation phenomenon of passengers usually using return tickets on international flights. Based on these analyses, it was decided to add total departures and arrivals of international flights from/to Cairo airport and use the sum as the dependent variable representing passenger aviation demand from/to Cairo airport. Similarly, it was decided to use total number of passengers using Egyptair international flights from/to Cairo airport as the dependent variable representing passenger aviation demand on Egyptair.

Historical data on a number of explanatory variables thought to affect demand was also compiled, namely, population, GDP, GDP/Capita, number of Egyptian Haij pilgrims, number of foreign tourists, number of Egyptians working abroad, as well as number of Egyptian immigrants. A matrix was then developed containing values of Pearson correlation coefficient and its significance in an effort to demonstrate the extent of correlation between demand variables and selected explanatory variables, see table 1. The matrix shows the collinearity between population and Haij pilgrims as well as between GDP and GDP/capita. This was expected as the number of yearly pilgrims is determined in accordance with Saudi quota being 0.001 of population of Muslim countries. In addition the matrix showed the illogical negative signs of the correlation coefficients between demand variables and number of Egyptian working abroad as well as Egyptian immigrants. Based on these analyses, it was decided to develop demand models relating demand variables to population, GDP and number of foreign tourists.

Table 1: Pearson Correlation Coefficients Between Variables Representing International Passenger Demand from/to Cairo Airport (CA) and Some Explanatory Variables

Explanatory Variables / Air Passenger Demand	Population (Capita)	GDP*	GDP/ Capita	Egyptian Pilgrims (Haij)	Foreign Tourists	Egyptian Working Abroad	Egyptian Immigr.
Total International Flights from/to CA	0.85 (0.004) Sig.	0.861 (0.003) Sig.	0.86 (0.003) Sig.	0.85 (0.004) Sig	0.903 (0.001) Sig.	-0.855 (0.003) Not Logical	-0.494 (0.176) Not Logical
Total International Passengers	0.82 (0.007) Sig.	0.804 (0.009) Sig.	0.81 (0.008) Sig.	0.82 (0.007) Sig	0.822 (0.007) Sig.	-0.922 (0.00) Not Logical	-0.651 (0.057) Not

Using Egyptair from/to CA							Logical

GDP in Current Prices Using Local Currency i.e. Egyptian Pound (L.E.) Currently 1US$ ≅ 6 L.E.
Sig.= Significant i.e. the hypothesis H_0 stating that the two variables are independent is rejected.

5. DEVELOPING PASSENGER DEMAND MODELS FOR INTERNATIONAL AVIATION FROM/TO EGYPT

Traditionally, econometric models are utilised in the forecast of air transport demand. Recently fuzzy models, see Profillidis (2000), models based on artificial neural networks, see Alekseev and Seixas (2002), as well as models based on scenario forecasts, see Cline (1998) were developed for the air transport passenger demand forecasting. In this section selected demand and explanatory variables were utilized to calibrate two types of econometric models. The first type is single variable models, where four functional relations, namely linear, logarithmic, power and exponential functions, were tested to obtain a best fit. This was done using SPSS software, see Norusis (1999). The result of such modelling exercise is summarised and compared in table 2 as well as being detailed in figures 5 through 10. All of the calibrated models were subjected to a number of statistical tests. To establish the goodness of fit and statistical significance of the models, two statistical indicators were computed, namely the R^2 and the F-statistic, see table 2. It is obvious from the table that number of foreign tourists visiting Egypt represents the best fitted explanatory variable and that the power function was the best non linear function in terms of simulating the dependency of annual total international flights from/to Cairo Airport on annual number of foreign tourists. On the other hand, the table also shows that the logarithmic function was the best function in terms of simulating the dependency of total international passengers using Egyptair from/to Cairo Airport on annual number of foreign tourists.

Table 2: Single Variable Models Relating Air Passenger Demand Variables to Selected Explanatory Variables

Explanatory Variables Air Passenger Demand	Population (Capita) (X)	GDP (X)	Foreign Tourists (X)
Total International Flights from/to Cairo Airport (Y)	$Y=26180e^{1E-08(X)}$ R^2 =0.73, F = 18.7 Sig. = 0.003, Sig. d.f. =7	$Y=44416e^{6E-13(X)}$ R^2 =0.74, F = 20.3 Sig. = 0.003, Sig. d.f. =7	$Y=5389(X)^{0.1485}$ R^2 =0.82, F = 32.7 Sig. = 0.001, Sig. d.f. =7
Total International Passengers Using Egyptair from/to Cairo Airport (Y)	Y=4E+06ln(X)-7E+07 R^2 =0.68, F = 14.8 Sig. = 0.006, Sig. d.f. =7	Y=774056ln(X)-2E+07 R^2 =0.68, F = 14.9 Sig. = 0.006, Sig. d.f. =7	Y=887533ln(X)-1E+07 R^2 =0.77, F = 22.9 Sig. = 0.002, Sig. d.f. =7

The previous models have a significant limitation in terms of modelling demand as a function of a single explanatory variable. These variables are either representative of

Figure 5: Exponential Model Relating Total International Flights from/to Cairo Airport as a Function of Population in Egypt

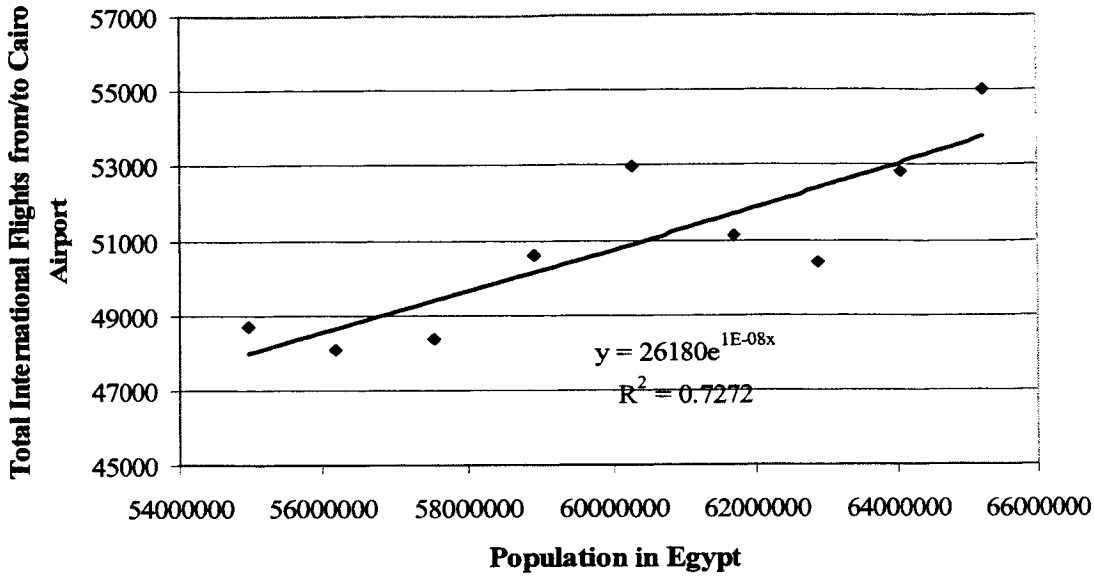


Figure 6: Exponential Model Relating Total International Flights from/to Cairo Airport as a Function of Gross Domestic Product in Egypt

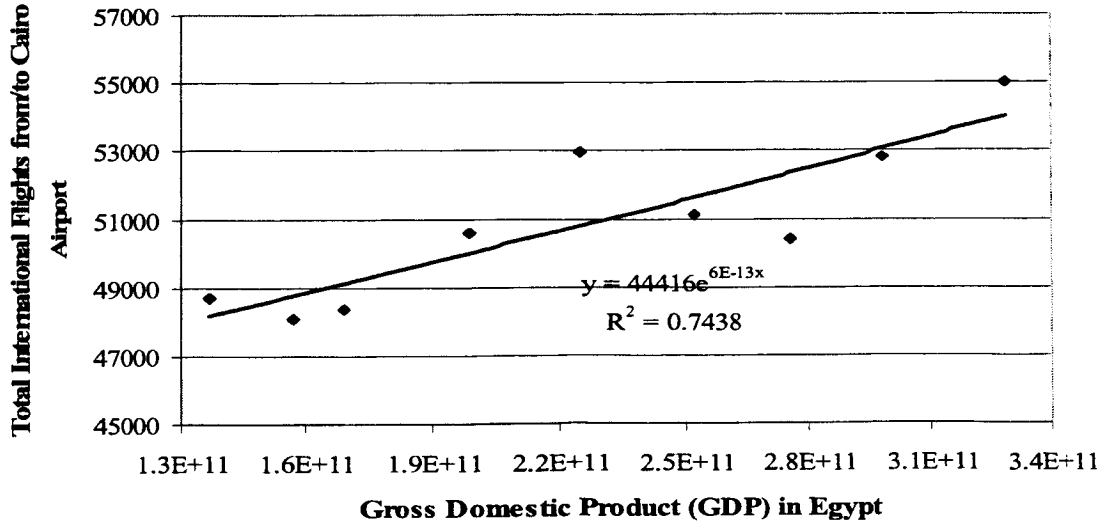


Figure 7: Power Model Relating Total International Flights from/to Cairo Airport as a Function of Number of Tourists Visiting Egypt

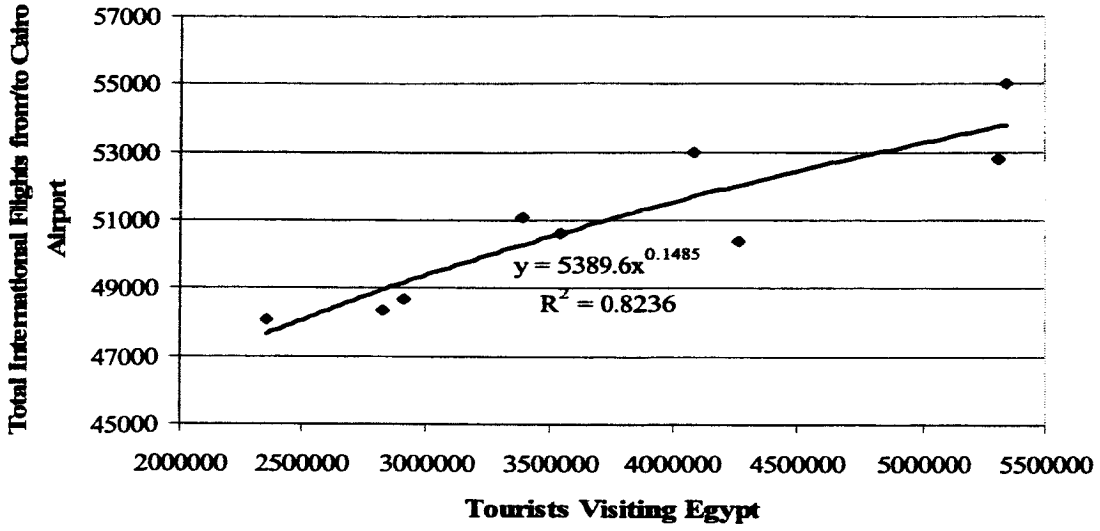


Figure 8: Logarithmic Model Relating Total Passengers Using Egyptair International Flights from/to Cairo Airport as a Function of Population in Egypt

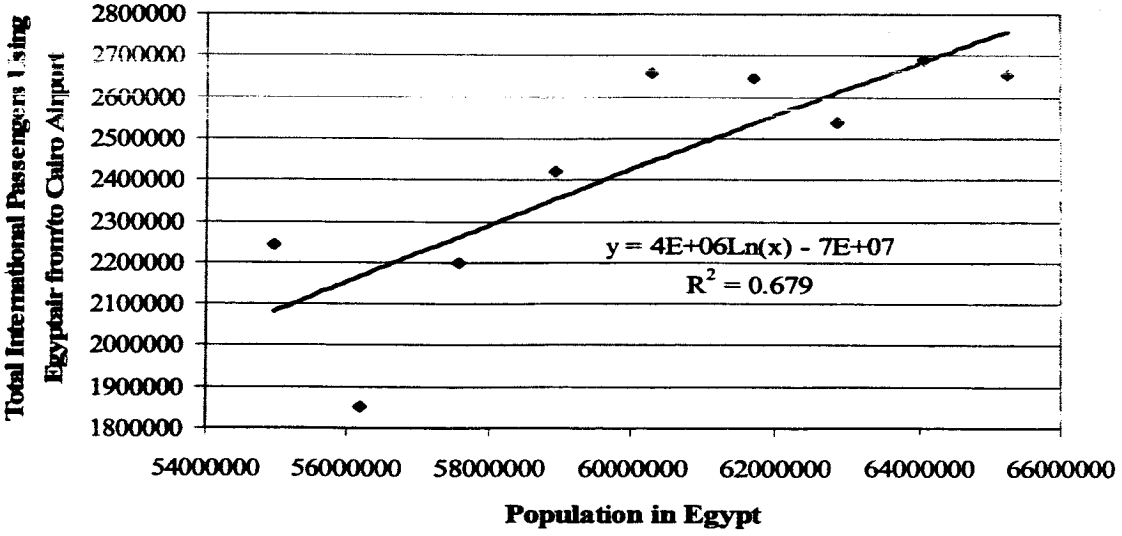


Figure 9: Logarithmic Model Relating Total Passengers Using Egyptair International Flights from/to Cairo Airport as a Function of Gross Domestic Product in Egypt

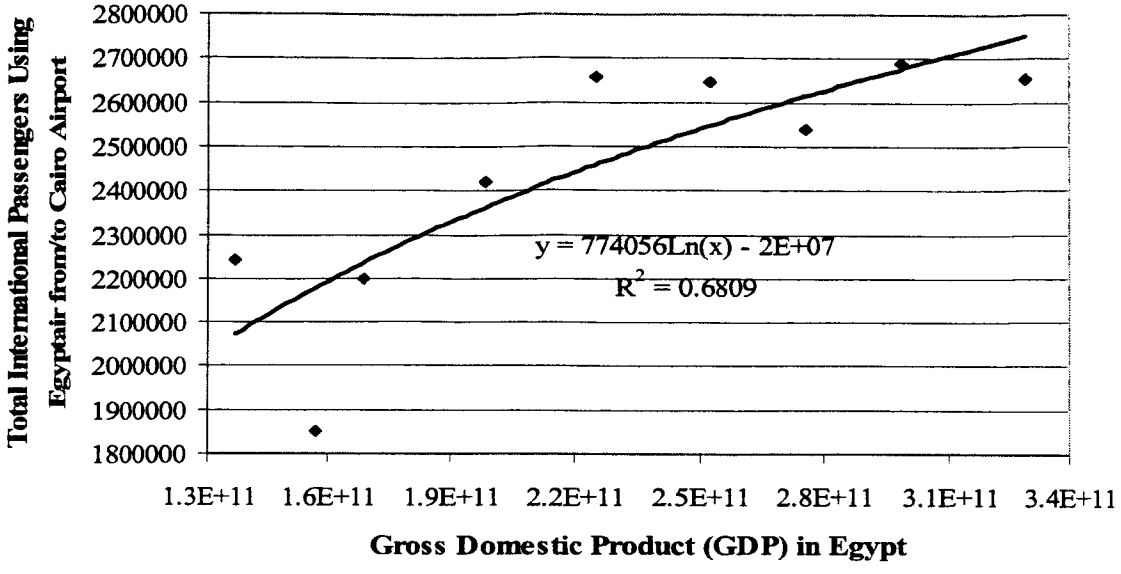
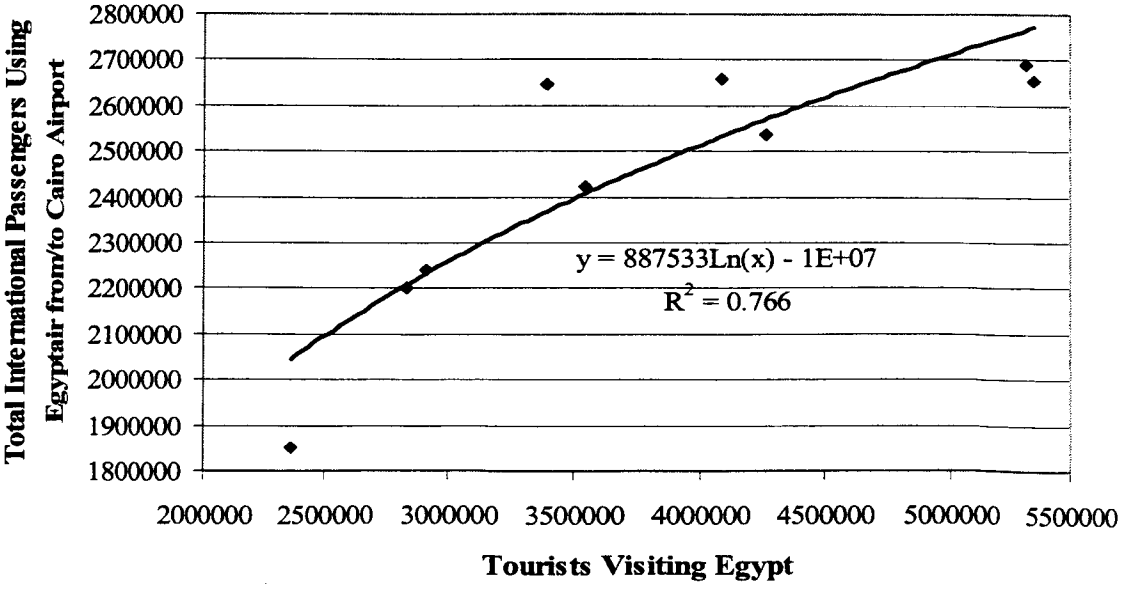


Figure 10: Logarithmic Model Relating Total Passengers Using Egyptair International Flights from/to Cairo Airport as a Function of Number of Tourists Visiting Egypt



6. APPLICABILITY OF DEVELOPED MODELS IN FORECASTING FUTURE DEMAND

In this section, the two selected models will be used to perform a short term forecasting of expected demand in terms of number of international flights as well as number of passengers using Egyptair international flights. In order to carry out such forecasts, expected future values for explanatory variables should be first obtained. In this context, two time series models were developed to simulate the changes in population in Egypt as well as in number of foreign tourists visiting Egypt with respect to time. The population model was based on an 11 points data set spanning from 1990 to 2000, while the tourists model was based on a 9 points data set spanning from 1992 to 2000. It was assumed that the second Gulf crisis did not affect the population growth but definitely affected the pattern for number of tourists visiting Egypt and that was the reason for ignoring the 1990 and 1991 data points for the tourists model. The two models took the exponential form as follows:

$$\text{Population in Egypt} = 5E{+}07 * e^{0.0219(\text{Years})} \quad \text{with 1990 as the base year}$$

$$\text{Foreign Tourists Visiting Egypt} = 2E{+}06 * e^{0.0939(\text{Years})} \quad \text{with 1992 as the base year}$$

The above models were used to forecast expected population and number of foreign tourists in 2004 and 2005. These forecasts are shown in table 4. These forecasts were then fed into the selected models displayed in table 3 and forecasts of passenger aviation demand represented by number of international flights as well as number of passengers using Egyptair were obtained, see table 4. These were averaged from annual into daily forecasts and further more into arrivals and departures, see table 4.

Table 4: Applicability of Developed Models in Forecasting Future Passenger Aviation Demand from/to Cairo Airport

Forecasting Years / Forecasts	2004	2005
Population in Egypt	69444162	70981764
Foreign Tourists Visiting Egypt	6779119	7446523
Total International Flights from/to Cairo Airport (Annually)	56752	58040
Passengers Using Egyptair International Flights from/to Cairo Airport (Annually)	3071693	3201854
Total International Flights from/to Cairo Airport (Daily)	156	159
Passengers Using Egyptair International Flights from/to Cairo Airport (Daily)	8416	8772
Total International Flights from Cairo Airport (Daily Departures)	78	80
Total International Flights to Cairo Airport (Daily Arrivals)	78	80
Passengers Using Egyptair International Flights from Cairo Airport (Daily Departures)	4208	4386
Passengers Using Egyptair International Flights to Cairo Airport (Daily Arrivals)	4208	4386

The usefulness of such forecasts lies in their potential utilisation in resource planning in terms of airport capacity and sufficiency of resources as well as in terms of fleet purchase by Egyptair. Such demand forecasts can be also used as input into Cairo airport and Egyptair cost and revenue models.

7. CONCLUSIONS

The main aim of this research was to develop demand models for passenger aviation from/to Cairo airport. In pursuing this objective the research developed two conceptual frameworks, the first pertaining to factors affecting the passenger aviation demand to/from Egypt, while the second was related with factors influencing the selection of Egyptair as a potential international carrier by passengers. Historical data spanning over 11 years from 1990 to 2000 representing demand as well as other explanatory variables were collected, and compiled from several sources. These were plotted and correlated in an effort to determine which are the most representative, appropriate and suitable data points and variables to be included in models' development. Data points for the two years 1990 and 1991 were ignored due to the effect of the second Gulf crisis. Two demand variables were selected, namely total international flights from/to Cairo airport as well as total number of passengers using Egyptair international flights from/to Cairo airport. In addition, two explanatory variables were also selected to represent demand of Egyptian nationals i.e. population and GDP as well as one variable selected to represent demand of foreign nationals i.e. number of foreign tourists visiting Egypt. These variables were then used to develop several single and multiple variable models with different functional forms.

Finally two models were selected based on their logical acceptability, best fit and statistical significance. In an effort to demonstrate the applicability and practicality of the developed models, these were utilised to forecast future expected passenger aviation demand from/to Cairo airport. The usefulness of such forecasts lies in their utilisation in resource planning in terms of airport capacity and sufficiency of resources as well as in terms of fleet purchase by Egyptair. Such demand forecasts can be also used as input into Cairo airport and Egyptair cost and revenue models.

In conducting this research several issues were revealed. These will form the basis for further future research. First, several factors identified as affecting demand were not considered in the models' development due to unavailability of data. Second, the developed models are representative of Cairo airport only. Despite that Cairo international airport is the major and most dominant airport in Egypt, however other airports do exist and are currently playing important roles. For example Hurgadah airport is currently attracting direct charter flights transporting foreign tourists. In this context, the developed models should be expanded to include distribution factors of potential demand to/from other airports in Egypt. As a matter of fact a national plan for developing an integrated airport system ought to be pursued. Such direction can be guided by efforts conducted by other countries such as UK, see DETR (2000) and USA, see USDOT (1999) & (2000). Third, no mode choice models were developed to simulate the process involved in selection of

Egyptair versus other international carriers. In this context, with the availability of data, binary and multinomial logit models could be developed. Fourth, and in accordance with the viewpoint of Graham (1999), the effects of deregulation and institutional reform have to be considered in air passenger demand forecasting.

REFERENCES

Alekseev K. P. G. and Seixas J. M. (2002) Forecasting the Air Transport Demand for Passengers with Neural Modelling. In Proceedings of the VII Brazilian Symposium on Neural Networks, Pernambuco, Brazil. Institute of Electrical and Electronics Engineers.

Cline R. C. Ruhl T. A. Gosling G. D. and Gillen D. W. (1998) Air Transportation Demand Forecasts in Emerging Market Economies: A Case Study of the Kyrgyz Republic in the Former Soviet Union. Journal of Air Transport Management, Vol. 4, pp. 11- 29. Pergamon Press, UK.

Department of Environment Transport and the Regions (DETR) (2000) Air Traffic Forecasts for the United Kingdom.

Egyptair (2001) Egyptair Statistical Year Book. Cairo, Egypt.

Egyptian Civil Aviation Authority (ECAA) (2001) ECAA Statistical Year Book. Cairo, Egypt.

Graham B. (1999) Airport-Specific Traffic Forecasts: A Critical Perspective. Journal of Air Transport Management, Vol. 7, pp. 285 - 289. Pergamon Press, UK.

International Monetary Fund (IMF) (2000) The World Economic Outlook (WEO) Database. World Economic Studies Division, Research Department, International Monetary Fund.

National Bank of Egypt (NBE) (2001) Economic Bulletin. Volume 4 No. 45. Cairo, Egypt.

Norusis, M. J. (1999) Statistical Package for Social Sciences (SPSS) for Windows. Base System User Guide, Release 10.00, Spss Inc., USA.

Profillidis V. A. (2000) Econometric and Fuzzy Models for the Forecast of Demand in the Airport of Rhodes. Journal of Air Transport Management, Vol. 6, pp. 95-100. Pergamon Press, UK.

Proussaloglou K. and Koppelman F. S. (1999) The Choice of Air Carrier, Flight and Fare Classes. Journal of Air Transport Management, Vol. 5, pp. 193- 201. Pergamon Press, UK.

Reda H. R. (2003) Development of Generation and Attraction Models for Passengers Using International Flights in Egypt. Unpublished MSc Thesis. University of Westminster, UK in Conjunction with Egypt National Institute of Transport.

United States Department of Transportation (USDOT) (2000) National Plan of Integrated Airport Systems (1998-2002). Federal Aviation Administration – Report to Congress, Washington DC, USA.

United States Department of Transportation (USDOT) (2000) Field Formulation of the National Plan of Integrated Airport Systems (NPIAS). Federal Aviation Administration, Washington DC, USA.