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Analysis of Demand for Air Travel in Lebanon

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Abstract

Aviation demand forecast is a very important tool that is essential in the planning and development processes in the aviation business. It is related to identifying infrastructure requirements in order to plan medium and long term investments.

In general, forecasting in developing countries suffers from the lack of data. For instance, data on GDP can be calculated; however, financial data is almost non-existent. This is partly due to the fact that liberalization and privatization in aviation is not there yet, therefore, governments either do not wish to reveal financial information, or simply do not reveal that data as there are no shareholders worrying about their returns. Looking at the case of Lebanon, data is very scarce to the extent that almost all data used had to be derived, or estimated.

This research aims to determine the factors affecting demand for air travel in Lebanon. This is approached using an econometric model with two sets of variables in an attempt to identify the underlying drivers of demand for air transportation.

It has been concluded that economic activity and security are the main factors driving demand. However, we recommend additional research on the topic taking into account the findings of this study.

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Glossary

AACO	Arab Air Carriers Organization
ACAC	Arab Civil Aviation Commission
ACI	Airport Council International
ASK	Available Seat Kilometer
ATK	Available Tonne Kilometer
BEY	Rafic Hariri International Airport, Beirut
BSP	Billing Settlement Plan
CAA	Civil Aviation Authority
CIA	Central Intelligence Agency
CPI	Consumer Price Index
CRS	Computer Reservation System
EIU	Economist Intelligence Unit
FTK	Freight Tonne Kilometer
GDP	Gross Domestic Product
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IMF	International Monetary Fund
MEA	Middle East Airlines, Air Liban
PLF	Passenger Load Factor
RevPAR	Revenue per Available Room
RPK	Revenue Passenger Kilometer
RPM	Revenue Passenger Mile
UNWTO	United Nations World Tourism Organization
VRF	Visiting Relatives and Friends

Introduction

Lebanon is a Middle Eastern country located on the east cost of the Mediterranean Sea. It is the third smallest Arab country after Bahrain and Comoros with an area of 10,452 km^2. In 2008, the country's population was estimated at 3.97 million, with a yearly growth rate of 1.154%. Literate citizen consisted 87.4% of the total population, and education expenditures consisted 2.4% of GDP. The overall GDP of Lebanon at the official exchange rate was estimated around USD28.02 billion, with a yearly real growth rate of 4.4%., and GDP per capita was USD11,100 in 2008. The services sector contributed about 75.5% of the GDP. Although the country is blessed with large volumes of water and fertile soil, which make Lebanon ideal for agriculture, this sector contributed by only 5.1% of GDP. The remaining 19.1% was attributed to industrial activities (CIA, 2009).

Even though Lebanon faced many fallbacks during the past thirty years, the services sector has always been an important contributor to the economy. Fueled by "the abundance of natural scenery, historic sites, hotels, bars, night clubs, restaurants, seaside and mountain resorts, outdoor sport facilities, international cultural festivals" (Britannica, 2009), and well established banking, health, and education institutions, Lebanon attracts tourists and Arab citizen seeking to enjoy the environment of freedom that characterizes the country.

Tourism is an essential pillar in the services sector in Lebanon; however, the country faced in recent years many setbacks from 2005 till 2007, starting with the assassination of former Prime Minister Rafic Hariri in February 2005, the Israeli war on Lebanon in July 2006, and the internal tension that took place in 2007.

Table 1 illustrates the number of international tourists that visited Lebanon and the expenditures of those tourists during their stay.

Table 1: International Tourists Arrivals and Expenditures

Year	2003	2004	2005	2006	2007
International Tourists Arrivals (mil)	1.016	1.278	1.14	1.063	1.017
International Tourists Expenditures (b$)	2.9	3.2	2.9	3.0	3.1

Source: UNWTO

Although tourist numbers for 2008 is not yet available, the hotel occupancy reports showed that 2008 was a very good year in terms of tourism. Beirut, Lebanon's Capital, led Middle East cities in terms of RevPAR[1] that increased by 95% year-to-Novembers 2008. Table 2 illustrates hotels' occupancy rates and RevPAR for hotels in Lebanon.

Table 2: Lebanon Hotels' Occupancy and RevPAR

Year	2006	2007	2008
Hotels' Occupancy (%)	47.9%	36.6%	53.1%
Hotels' RevPAR (USD)	63	44	87

Source: UNWTO

Air transport is almost the only means of travel to/from Lebanon except from neighboring countries (Syria, Jordan) as rail-roads are underdeveloped, and distances between countries in the region are too long, making travel by car a cumbersome experience.

The purpose of this study is to investigate the determinants of the demand of air travel using a data set from Lebanon. To the best of our knowledge, there is no study looking at the

[1] RevPAR is a metric used in the hotel industry. It represents the Revenue per Available Room, which is calculated by dividing Room Revenue by the number of available rooms.

particular situation of Lebanon. Because of the importance of forecasting in the air transport industry, investigating the demand function of air travel on Lebanon should reveal some additional information on the underlying social and economic factors that affect that demand in Lebanon, which might help air transport authorities and airlines in their planning for optimal operations.

To achieve this purpose, this paper is presented in the following sequence of chapters:

Chapter 1 consists of an overview of the aviation industry on a global, regional, and country level.

Chapter 2 includes a literature review of previous studies related to our research, and in which we state our hypotheses.

Chapter 3 comprises a detailed description of data collected.

Chapter 4 discusses the econometric model applied and analyzes the results derived.

Chapter 5 consists of a conclusion that summarizes the findings of this study.

Chapter 1: Overview of the Aviation Industry

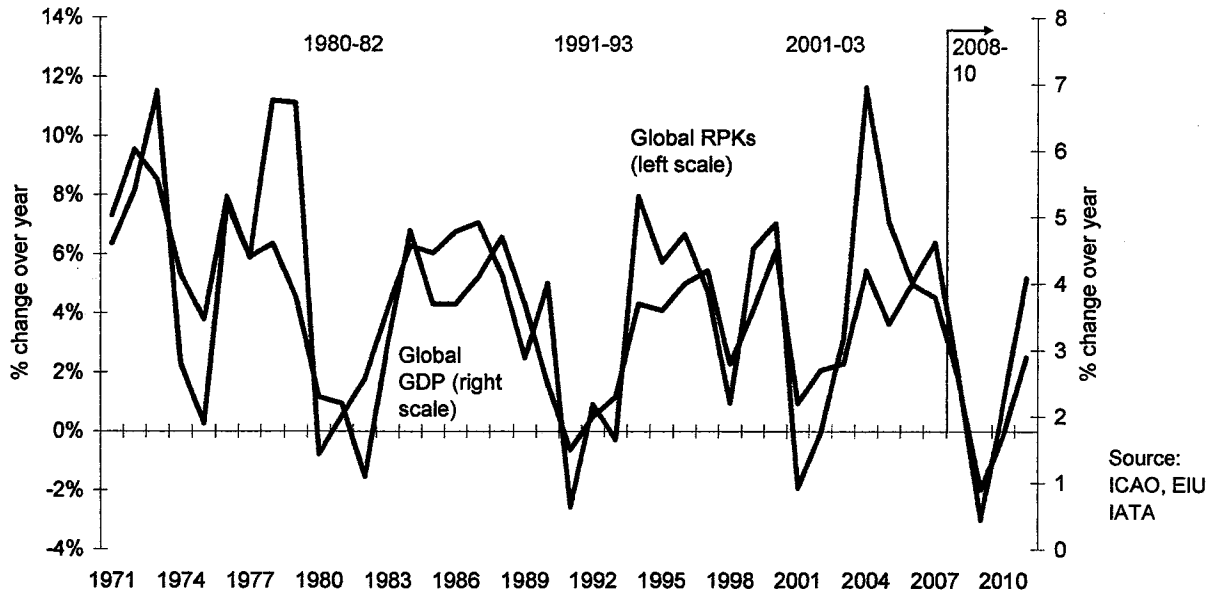
1.1 Global Aviation Industry Overview

In an interview regarding investment in the air transport industry, Warren Buffett once commented: "If a capitalist had been present at Kitty Hawk back in the early 1900s, he should have shot Orville Wright. He would have saved his progeny money. But seriously, the airline business has been extraordinary. It has eaten up capital over the past century like almost no other business because people seem to keep coming back to it and putting fresh money in. You've got huge fixed costs, you've got strong labor unions, and you've got commodity pricing. That is not a great recipe for success. I have an 800 number now that I call if I get the urge to buy an airline stock. I call at 2 in the morning and I say: 'My name is Warren, and I'm an aeroholic.' And then they talk me down."

The airline industry is known for being a cash demanding business due to the fact that global demand for air transport is highly sensitive to changes in income. It is also a cyclical business that follows the cycles of GDP. Figure 1 illustrates the relationship between traffic and GDP growth. The correlation between RPKs[2] growth and GDP growth is noticeable. In addition, the duration of the current cycle was much narrower than the duration of previous cycles. While previous cycles' duration was around ten years, this cycle only lasted for seven years.

[2] Revenue Passenger-Kilometer: it is a measure of passenger traffic. It is the sum of the products obtained by multiplying the number of revenue passengers (paying passengers) carried on each flight by the stage length.

Fig. 1 **Global growth in passenger traffic and GDP**



In 2008, the industry was hit by two major consecutive setbacks. Having returned to profitability in 2007 when airlines made a 1.1% profit margin for the first time after September 11 attacks, airlines faced in mid 2008 an unprecedented rise in jet fuel cost, when the price of jet fuel reached an all time peak of USD182 per barrel in July (AACO, 2008). Airlines were already responding to the rise in fuel costs since 2007 by introducing fuel surcharges on their flights (which constitutes a part of the fuel cost that is passed to the customer). However, in response to the largest hike of fuel prices, airlines were obliged to review their schedule, cut capacity on non-profitable routes, park old aircraft and use newer aircraft that are more fuel efficient.

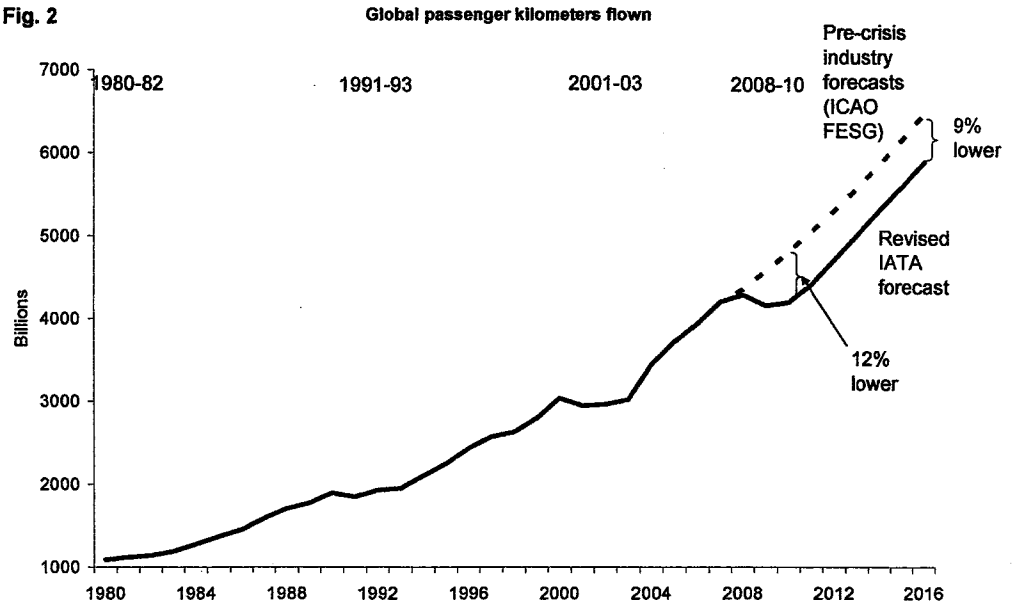
As soon as fuel pressure started to ease during the second half of 2008, airlines were faced by another, more severe setback. The financial crisis that started in the subprime mortgage market in the US that was hit by the reverse of the housing boom spread into much of the financial sector (IMF, 2008). This financial crisis extended to become a global recession which

impacted advanced economies (US, EU, Japan) much harder than emerging and developing economies.

In addition to the recession, airlines could not take full advantage from the decrease in fuel prices due to their committed hedging contracts, which were based on high market prices when all expectations anticipated that fuel prices will exceed USD200 per barrel.

As a result of this turmoil, global demand for air travel plunged deeply into its worst performance since 1970. In addition, the Bloomberg airline index in January 2009 fell to extents "showing that airlines have lost half their capitalized value over the past year" (IATA, 2009). Figure 2 shows the difference between traffic forecast before and after the crisis.

Fig. 2



Source: ICAO, IATA

Airlines responded to the fall in demand by cutting additional capacity in an attempt to keep their yields[3] at acceptable levels. However, demand was falling faster than the airlines maneuver, leading to lower Load Factors[4], and thus putting additional pressure on yields. Table 3 illustrates year-to-date 2008 airline operation results for scheduled services.

Table 3: Airlines' Operations Results by Geographic Location 2008 over 2007

	RPK Growth	ASK Growth	PLF	FTK Growth	ATK Growth
Africa	-4.0%	-4.2%	70.2%	-2.5%	-7.4%
Asia/Pacific	-1.5%	1.2%	73.9%	-6.6%	-2.5%
Europe	1.8%	3.8%	76.6%	-2.8%	2.9%
Latin America	10.2%	9.2%	74.0%	-13.5%	5.7%
Middle East	7.0%	8.6%	74.9%	6.3%	8.5%
North America	2.9%	4.3%	79.8%	-1.9%	3.4%
Industry	**1.6%**	**3.5%**	**75.9%**	**-4.0%**	**1.5%**

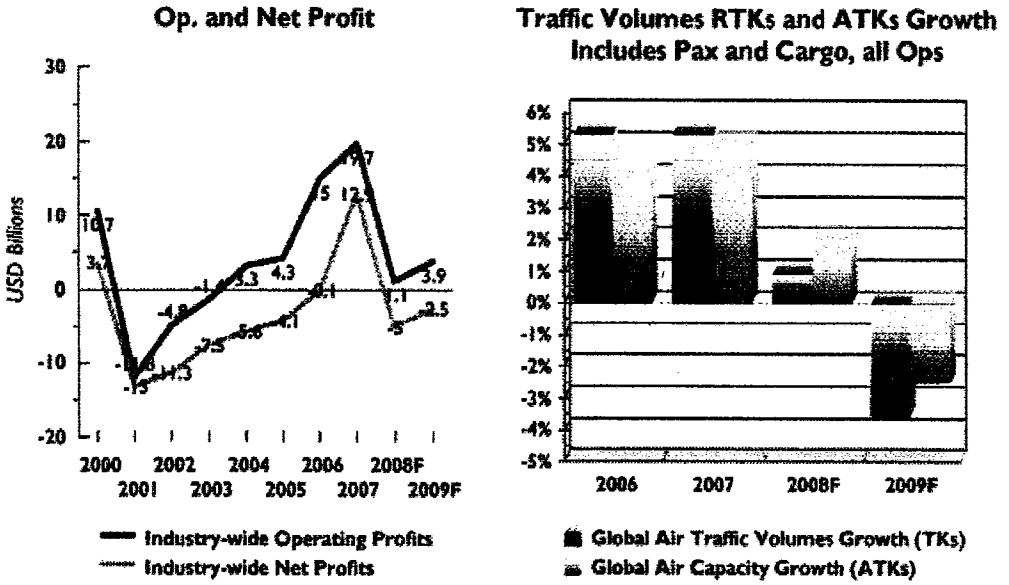
Source: IATA

[3] yield is Revenue divided by RPKs

[4] Passenger Load Factor (PLF) is a measure of capacity utilization. It calculated by dividing RPKs over ASKs, where ASKs are Available Seat-Kilometer, which is the sum of the products obtained by multiplying the number of offered seats on each flight by the stage length.

Figure 3 illustrates the operating/Net profits and absolute traffic growth in the industry.

Fig. 3 **Aviation Industry Crisis**



Source: IATA

1.2 Arab world Aviation Overview

The Arab world was more resilient to the economic crisis compared to advanced economies, attributed to higher revenues from oil during the period of peak oil prices at oil exporting countries, and to trade and financial spillovers from oil exporters at Arab oil importing countries (IMF, 2008).

In the aviation sector, Arab airlines are still heavily regulated, with governments still protecting their national carriers. As of 2008, five Arab states unilaterally adopted Open Skies[5] policies, namely Bahrain, Kuwait, Lebanon, Oman, and UAE. In addition, several Arab countries signed bilateral open skies agreements, namely Bahrain, Egypt, Jordan, Lebanon, Morocco, Oman, Qatar, Syria, Saudi Arabia, UAE, and Tunisia (AACO, 2008). Moreover, many governments recognized the benefits of privatizing airlines and launched initiatives in order to privatize their flag carriers.

Investing in air transport infrastructure has been a priority in the Arab world, with projects varying from building new airports, expanding capacity of current airports, and adding operations' infrastructure to current airports (i.e. maintenance hangars, etc...). Current investments in infrastructure in the Arab world is estimated around USD86 billion. As a result, Arab airports' collective capacity will triple in 2015, enabling the accommodation of 300 million passengers yearly.

The Arab Air Carriers Organization believes that the effect of the crisis on Arab airlines will not be as severe as the effect on other regions' carriers. This belief is backed by many arguments, mainly:

- Cost of operation in the Arab world is lower in terms of the taxation environment and human capital.

- Higher operational efficiency through operating the youngest fleet in the world.

[5] Open skies agreement is unilateral, bilateral, and sometimes multilateral agreement that liberalizes the rules for international aviation markets and minimizes government intervention — the provisions apply to passenger, all-cargo and combination air transportation and encompass both scheduled and charter services

- Infrastructure development that is expected to attract traffic from congested Europe.

- Airlines are investing in the quality of the product, and they thrive to make their customers' flying experience a unique one.

- Attractiveness and variety of touristic sites in the Arab world.

(AACO, 2008)

Figure 4 illustrates the Arab aviation market and regional distribution of traffic.

Fig. 4

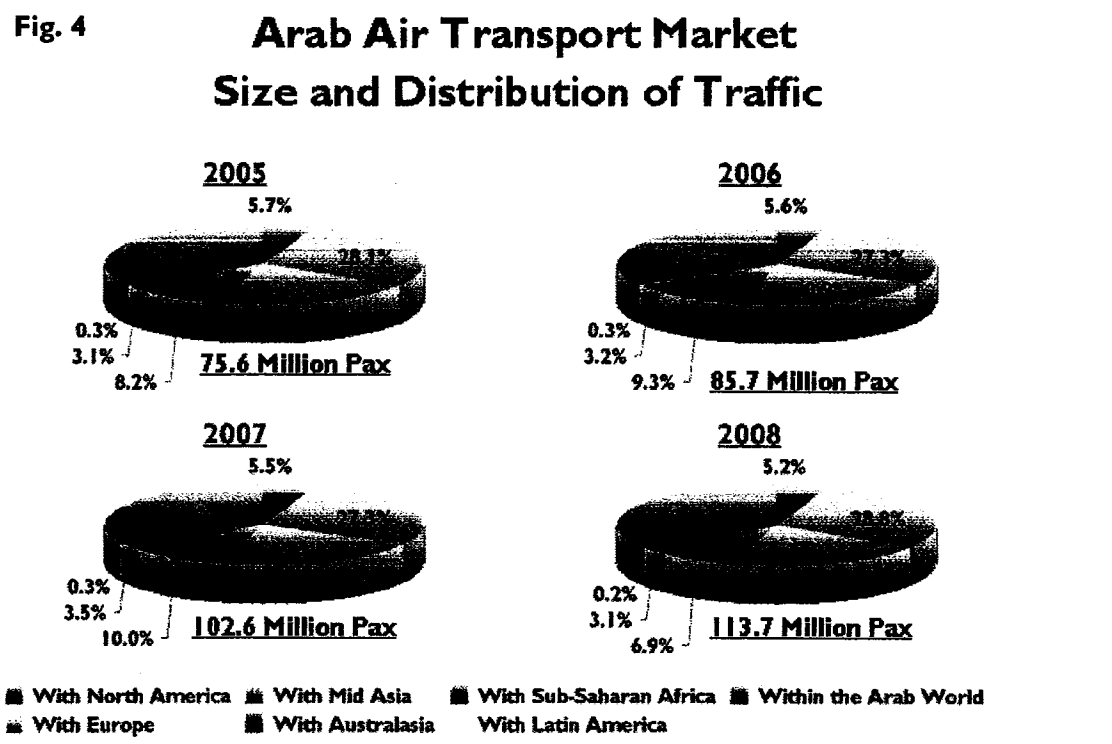
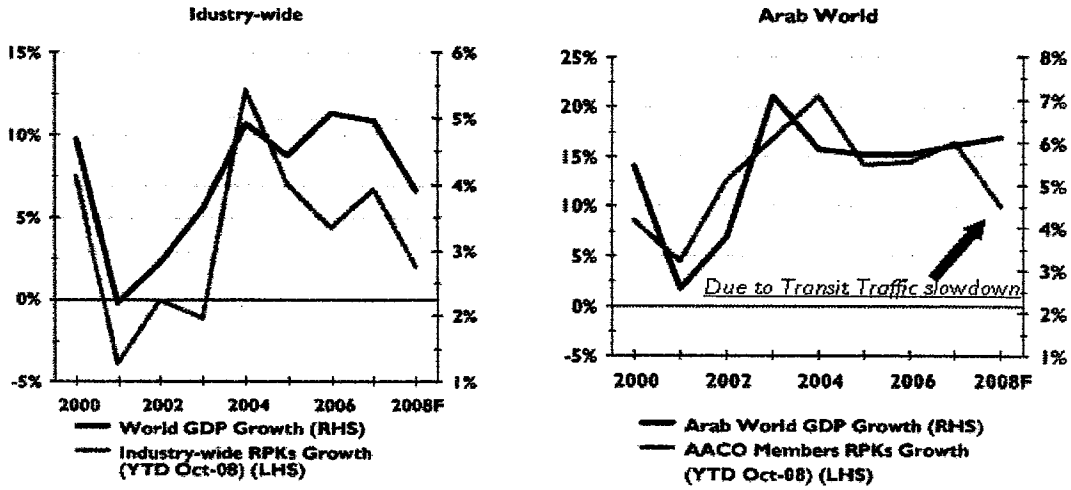


Figure 5 depicts a comparison between the Arab world and global economic and traffic performance.

Fig. 5 **Better Economic Environment**

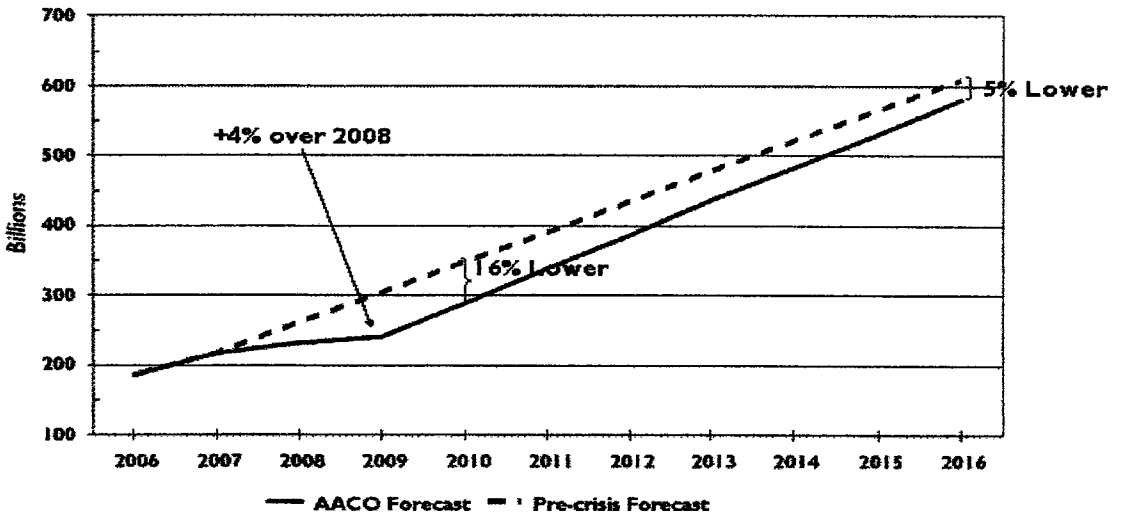
Arab World and Industry GDP and RPKs Growth



Source: AACO, IATA, IMF (Oct 08 Data)

Figure 6 presents AACO traffic forecast before and after the crisis.

Fig. 6 **AACO Members RPKs Forecast**



Source: AACO

1.3 Lebanon Aviation Overview

Before the civil war in 1975, Lebanon was considered one of the main economic hubs in the Arab world, making Beirut International Airport one of the leading air travel hubs. However, the years of warfare left Lebanon behind Dubai, Bahrain, and Larnaka in terms of business attraction. According to Lebanon Civil Aviation Authority, the number of passengers at Beirut International Airport dropped from 2.75 million passengers in 1974, to 1.39 million in1981, down to 0.22 million in 1989.

In 2000, the newly elected cabinet announced the unilaterally adoption of Open skies policy in an attempt to encourage the expansion of travel and tourism. This policy removed all restrictions on air traffic to/from Lebanon. In addition, Lebanon signed an agreement sponsored

by the Arab Civil Aviation Commission – ACAC in 1999 along with fifteen other Arab states that liberalizes international intra-regional travel in the Arab world (ICAO, 2007).

In 2001, the Lebanese government decided to restructure Lebanon's flag carrier MEA. The restructuring consisted of eliminating the overstaffing by cutting down the workforce by 40%, and reorganizing the carrier's schedules to focus on regional traffic, and few well chosen long haul destinations. These policies paid out as the carrier moved from a loss of USD44 million in 1999, to break even in 2002 for the first time since 1976. Since then, the carrier remained profitable and earned USD57.9 million in 2007 in operating profits (AACO, 2008).

Recently, Lebanon's aviation sector was hit by many political and military setbacks. Beirut International Airport remained out of operations for several weeks, after bombing its runways at the onset of the 2006 war. In addition, the number of tourists declined considerably as political instability and lack of safety were the headlines of the past four years.

Chapter 2: Empirical Background

In this chapter, we present a summary of previous studies related to estimating the determinants of the demand for air travel in Lebanon, and our main hypothesis.

2.1 Review of previous studies

While numerous studies were conducted on the aviation sector in the Middle East, few scholars' work was focused on analyzing demand for air travel in individual countries. This scarcity of studies was an additional driver to develop this research. Some of the interesting studies which helped shade some light on the demand for air travel on a national level were research conducted by Alperovich, and Manchnes (1994), Ba-Fail, Abed, and Jasimuddin (2000), and Ba-Fail, Abed, and Jasimuddin (2001). These studies will be considered in this research along with some other publications that are relevant to the topic at hand.

Alperovitch, and Manchnes (1994) investigated the significance of customers' wealth (customers' assets) in defining demand for air travel, and tested the elasticity of price and income in the demand model. The authors used an econometric model comprising twenty yearly observations. The model considered the ratio of passengers to total population as the independent variable, which is modeled as a function of price, income, and a variable measuring "the price of domestic goods which compete for income" (Alperovich and Manchnes, 1994). The price used was an index comprising air fare, and all goods demanded in the national market and consumed by passengers during their journeys. The income was divided into three components: current income (real average income per employee), financial assets per capita, and non-financial assets

per capita. The authors concluded that including consumer wealth (per capita financial and non-financial assets) in the air travel demand function is necessary as it showed to be more significant to the model than current income. They found as well that air travel is highly elastic with respect to income, and highly inelastic with respect to price.

Ba-Fail, Abed, and Jasimuddin (2000) employed an econometric model using 24 yearly observations to identify drivers of demand for domestic travel in the Kingdom of Saudi Arabia. The authors developed four sets of variables based on correlation between the dependent variables. They found a high correlation between domestic air travel and economic growth. All four models turned out to deliver significant results, however, three models suffered from multicollinearity[6] problems, noting that multicollinearity is somehow acceptable in developing an air travel demand model as the goal of the study is to use "the model to predict future data of the dependent variable" (Ba-Fail, Abed, and Jasimuddin, 2000). As a result, the authors argued that the model that is best fit to estimate domestic air travel in the Kingdom is the model where the number of passengers on domestic routes is explained by population size and total expenditures.

Ba-Fail, Abed, and Jasimuddin (2001) developed further an econometric model to explain demand for international travel in Saudi Arabia. Testing this model with data used in their previous study, they were once more unable to reject the prediction that international passengers and economic activity are strongly related. In the course of their empirical work, the authors used a correlation matrix in order to classify the

[6] Multicollinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly correlated.

explanatory variables into four demand models depending on correlation between them. After testing the four models, no one failed to capture the strong relationship between international passengers and economic activity. However, three of the four models were in the end rejected because the explanatory (independent) variables exhibited strong correlations. The authors selected the model that did not suffer from multicollinearity. That model explained international number of passengers in terms of population size and total expenditures, revealing the same explanatory variables as the study conducted to model domestic demand for air travel.

With regards to other studies, an article relevant to the purpose of this research was published in The Travel and Tourism Competitiveness Report 2008 by Pearce, B., about the drivers of air travel demand. Pearce discussed price sensitivity for passengers traveling for leisure, and used a case study conducted by UK CAA about the paradox in price elasticity, where passengers are usually concerned about the airfare they are buying (which is one of the factors behind the success of the no-frills airline model[7]), and where the demand for air travel on a national level is price inelastic. The example illustrated how a shift in price for one destination affects demand for that destination, and how it shifts part of the traffic to another destination. Thus, the aggregate change in air travel is lower than the aggregate price increase percentage; therefore, the author concluded that demand for air travel is elastic to price on individual routes (city-pairs), however, the aggregate demand on national or regional level is price inelastic. Pearce

[7] No-frills airline is an alternative term to Budget airline, which uses charter and/or scheduled flights to offer bargain-basement fares. Budget airlines usually land at and take off secondary airports, do not provide in-flight meals or refreshments, and may not even offer numbered seat allocation. Their ticket prices are fixed, and non-refundable in case of a cancellation or no-show.

explained as well how income, for which GDP is commonly used as a proxy, is the main driver for aggregate air travel demand on a national or wider scope. He concluded that "economic growth can explain virtually all of the expansion in air travel seen in the past twenty years" (Pearce, 2008).

Another study that is relevant to out topic is "Models of air transport demand" (Verleger, 1972). Verleger conducted an analysis aiming to find the most accurate model that can be used to forecast air transport demand using data sets from the USA. He started by testing a cross-sectional model that is derived from the gravity model[8]. He used a model developed by Brown and Watkins in 1966:

$$T_{ij} = aP_{ij}^{\gamma} M_{ij}^{\beta} C_{ij}^{\mu} D_{ij}^{\delta} (ET)_{ij}^{\varepsilon}$$

Where P is price, M is the product of income in city i multiplied by income of city j, C is phone calls[9] between i and j, D is distance, and ET denotes elapsed flying time between i and j. The author tested the model on all city-pairs in the US, then on city-pairs located in each consecutive area of 500 miles. He concluded that the cross-sectional model is very useful in estimating homogenous markets; however it cannot be used to analyze the entire air travel market.

[8] The gravity model is inspired by Newton's gravitational law. The model assumes that travel between two markets (in this study cities), is inversely proportional to the square of the distance between the markets (cities). The model is given by the following equation:

$$T_{ij} = a\frac{M_i * M_j}{d_{ij}^2}$$

Where T_{ij} is denotes travel between cities i and j, M_i and M_j depict the population of city i and city j, and d_{ij} is the distance between the cities.

[9] Phone calls are used to measure the interest of community in travel.

The author then analyzed demand using an aggregate model estimated by the following equation[10]:

$$RPM_t = aY_t^{\beta}(AR_t)^{\mu}\epsilon$$

Where Y_t represents per capita disposable income, AR_t denotes yield per passenger mile given by:

$$AR_t = \frac{\sum_{t=1}^{n} T_t^i F_t^i}{RPM_t}$$

Where T_t^i represents traffic on route i and F_t^i denotes the average fare on route i. After running this model for the time interval 1958-1965, the author concluded that aggregate models, "even correctly constructed, can continue to predict accurately only if demands between individual city-pairs remain relatively identical" (Verleger, 1972). The author then attempted to estimate demand using a gravity model on a point-to-point basis, which is estimating the total market by aggregating estimations of individual routes. He used different variations of the gravity model trying to estimate different variables that affect demand for air travel. He found that the model is difficult to apply due to the fact that there are many variables involved in determining demand for air travel. These variables are of route, regional, and national nature. Finally the author concluded that large cross-sectional and aggregate models fail to estimate

[10] In the equation, RPM denotes Revenue Passenger Mile, the equivalent of RPK in the US using miles instead of kilometers

demand for air travel, whereas point-to-point models are extremely complex and require further refinement.[11]

2.2 Research Hypotheses

This research will try to unveil the main factors determining the demand for air travel in Lebanon. Due to the liberalization of air travel in Lebanon that implies higher competition between airlines (in contrary to other studies conducted in Arab countries where aviation suffered from highly regulated environments), and due to the small travel market in the country researched (small population which leads to limited natural growth), we believe that economic activity will be the main factor behind growth of air travel in Lebanon.

Specifically, we expect a positive relationship between the number of passengers at Beirut International Airport (BEY) and Real Gross Domestic Product (RGDP) of Lebanon. Our main argument for a positive relationship draws on economic theory that as the welfare of a nation improves (deteriorates), not only the citizens of the nation will have more (less) income to spend on leisure and other capital goods, but also visitors from other nations will be attracted (pushed away). In addition, we expect a negative relationship between fare prices and the number of passengers at BEY based on the economic argument that an increase (a decrease) in price is associated with a decrease (an increase) in the demand of a commodity (that is perceived not essential to living).

[11] It is important to mention that the author attempted to model demand for air transport in the US that is considered, with Canada, a whole region for air travel (North America). Therefore, the findings of the research should not necessarily apply on small markets such as Lebanon where travel is concentrated around one airport, and with a total demand that is by far lower than demand in North America.

In the course of our investigation, we test also the influence of population growth on the number of passengers at BEY. While we expect a positive relationship between the population growth and the number of passengers, it is hard to believe, without digging into the relationship between population growth and the economic growth, that the population growth is by itself a determinant of demand for air traffic.

Finally, looking at the Middle East region as a whole, one factor that might greatly affect the number of passengers at BEY is the political situation in Lebanon. It is well-known that terror engenders fear, and fear engenders seclusion. Ito and Lee (2004) assessing the impact of September 11 terrorist attacks on U.S. airlines' demand, found that the terror attack resulted in a negative transitory shock of over 30% of pre-September demand. Between February 2005 and June 2008 many terror attacks took place in Lebanon. These include the assassination of former Prime Minister Rafic Hariri in February 2005, and the Israeli's war of July – September 2006. Therefore, we include in our general model a dummy variable (DWAR) that measures both the impact of war and blasts on the demand for air traffic. In this respect, we will expect a negative relationship between the number of passengers at BEY and DWAR.

To test these hypotheses, we develop different models that either include all the variables or individual ones in the information set with the potential to explain the variation of the number of passengers at BEY. For simplicity, we use the maximum likelihood estimator (MLE) to identify the unknown parameters. Several statistical packages are available for this purpose. We use RATS (Regression Analysis of Time Series) to estimate all the models.

Chapter 3: Data Analysis

This chapter presents the data set and describes the variables. It is important to mention that data on air traffic and domestic affairs are not easily made public, even for research purposes. Furthermore, the complexity of the political situation in Lebanon makes it also difficult to find reliable source of data on the public sector. When these data are available, their time spans at monthly frequency do not exceed five years.

The data set used is constituted of the total number of passengers at Beirut International Airport (BEY), the real gross domestic product, the average fare, and population. The data set is obtained from various sources: the number of passengers for the time period January 2003 – December 2007 was obtained from the Lebanese Civil Aviation Authority. The population data was obtained from the Lebanese Central Administration for Statistics and from the World Bank Group. We used Imports to proxy GDP, which were obtained from the Lebanese Central Bank. We obtained CPI that we used to deflate the airfare and GDP from the Lebanese Central Bank. The average fare information was calculated based on data provided from the International Air Transport Association (IATA) for the period January 2005 – December 2007. Due to the availability of data on the average fare for a shorter period than the other variables, we used a short and long sample to estimate our model. The short sample extends from January 2005 to December 2007 for a total of 36 observations and we refer to it as Sample A. The long sample goes from January 2003 to December 2007 for a total of sixty observations and we refer to it as Sample B.

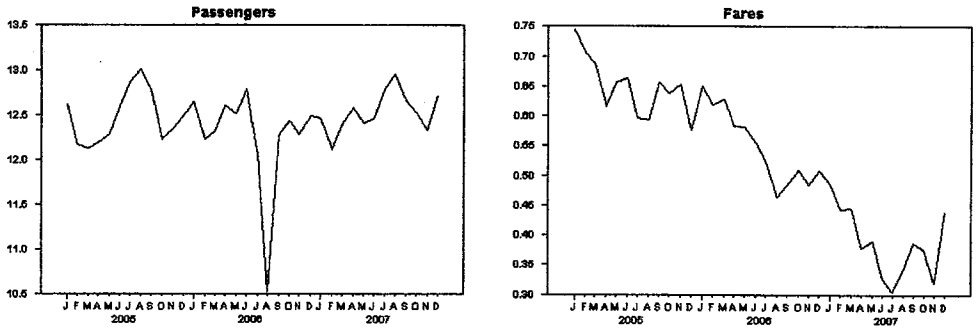
In this study, we related the number of passengers at BEY to the real average fare, the real gross domestic product (RGDP), and a dummy variable for blasts and war. The number of passengers (NOP) is the total number of departures and arrivals at BEY. Average fare represents the average of the total sum paid for air tickets by passengers originating from or arriving at BEY. It is important also to note that since airfare is taken from IATA's BSP database (Billing Settlement Plan[12]), it constitutes data for the core fares listed by airlines, and therefore that item does not include neither airport taxes nor surcharges (i.e. fuel surcharge that was introduced in 2007 upon the start of fuel prices hike, or travel agency commission in some countries). Fare data is also limited to listed airlines' fares on CRSs (Computer Reservation Systems), and hence discounted fares, direct sales fares, or any fares that are not provided to CRSs (thus provided to travel agents) by airlines are not included in this data. We adjusted the average fare for inflation using the consumer price index (CPI). We used imports as a proxy for GDP, which we adjusted for inflation using the CPI. We defined a dummy variable that takes 1 if a blast or a war occurred during the sample period and 0 otherwise. We refer this dummy variable to as DWAR. DWAR is 1 when Prime Minister Rafic Hariri was assassinated in February 2005 and during the Israeli war on Lebanon in July 2006. In addition, DWAR was set to keep a value of 1 for the two months following the blast/war event. This is because of the natural lag in reacting to events. The main reason behind this lag is the purpose for air travel used by most passengers in Lebanon. Most of air travel in Lebanon is either for tourism or VRF travel (Visiting Relatives and Friends). Customers traveling for these purposes book

[12] Billing Settlement Plan database contains all airline tickets issued by travel agencies

their tickets ahead of time due to two main reasons: First, booking ahead of time secures a lower fare for the customer. Second, this type of travel is usually associated with vacations which need to be planed ahead as well (bookings materialize usually one month after being submitted). Therefore, due to this lag, the effect of a major event will not be noticed during the same month; it will however take full effect in the following month, then traffic will begin to recover in the third month after which the effect of the event that took place will be neutralized.

Figure 7 shows the time pattern of the total number of passengers at BEY and the average fares using Sample A.

Fig. 7 **Log of Number of Passengers and Log of Average Fares**



Both the number of passengers and the average fares show cyclical pattern with up and down waves. This is basically due to the seasonality nature of air travel, where there are two high seasons associated with Christmas and New Year (December and January) on one hand, the summer vacation during the months of July, August, and September on the other, and two low seasons in a given year. Over the three years period studied, the number of passengers dropped to its lowest level in August 2006 at

the time when Lebanon was bombarded by Israel, and Beirut airport was shut down for more than two thirds of the month (the airport reopened in 17 August to limited commercial flights to/from Amman operated by Royal Jordanian, however the Israeli air blockade was officially removed on 7 September 2006). Despite the fact that there was no air traffic between Lebanon and the rest of the world, the average fare did not drop to the same extent as the number of passengers dropped in August 2006. This is due to the fact that there was no decrease in demand, there was a disconnection of demand instead; therefore, there was neither demand nor supply of air travel for airlines to react and lower their prices. In addition, it is important to notice the downward movement of fares; this is mainly due to the liberalization of the Lebanese air travel market and adoption of Open skies policies in Lebanon on one hand, and to the introduction of the no-frill airlines concept for the first time in the region on the other. This new concept started in 2004 with Air Arabia based in the UAE, and then expanded with the establishment of may Low Cost Carriers (LCC), for example, Jazeera Airways in Kuwait, NAS and SAMA in KSA, Atlas Blue in Morocco, Royal Jordanian Express in Jordan, etc...

Figure 8 depicts the time pattern of the number of passengers at BEY and the Real GDP using Sample B.

Fig. 8 **Log of Number of Passengers and Log of Real GDP**

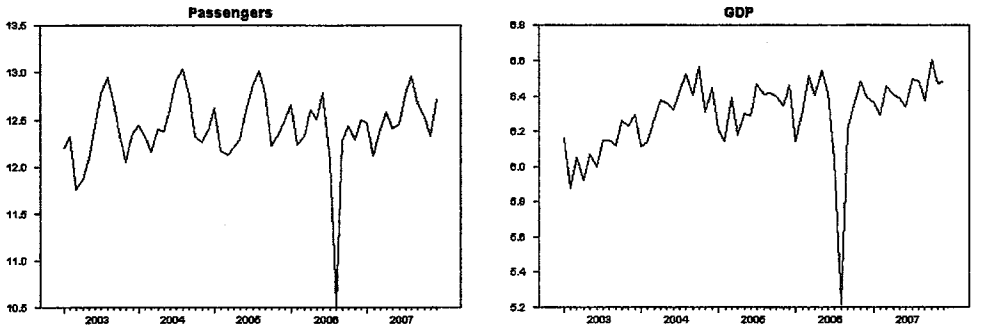


Figure 8 shows that the number of passengers at BEY moves in lockstep with Real GDP. Bearing in mind that imports serve as a proxy for Real GDP, the war of July 2006 has reduced imports to their lowest level due to the Israeli land, sea, and air blockade.

Chapter 4: Empirical Results

This chapter reports the empirical results on the determinants of air travel demand in Lebanon.

4.1 Descriptive Statistics

Table 4 reports some stylized facts of the variables using sample A. Panel A presents the main features of the data: Average, standard deviation, minimum, maximum, the autocorrelation coefficients and the Ljung-Box statistic. Panel B shows the simple correlation among the variables. Panel C shows the Dickey-Fuller unit root test statistics.

Table 4: Descriptive statistics on Sample A

	Log of Number of Passengers	Log of Real Average Fare	Log of Real GDP
	Panel A Summary Statistics		
Average	12.425	0.528	6.338
Standard Deviation	0.407	0.123	0.228
Minimum	10.515	0.305	5.217
Maximum	13.017	0.744	6.604
Autocorrelation at lag 1	0.304	0.929	0.340
Autocorrelation at lag 2	-0.106	0.894	0.009
Autocorrelation at lag 3	-0.036	0.853	-0.177
Autocorrelation at lag 20	-0.050	-0.417	0.130
Ljung-Box Statistics (20)	38.120*	276.987*	32.317*
	Panel B Correlation		
Log of number of passengers	1.000		
Log of the real average fare	-0.030	1.000	
Log of the real GDP	0.811	-0.138	1.000
	Panel C Dickey-Fuller Unit Root Test		
	T-test Statistic	Critical Value at 5%	Number of lags
Log of number of passengers	-1.093	-3.633	14
Log of the real average fare	-2.517	-3.612	12
Log of the real GDP	-3.693	-3.543	1

The data set shows that over the three years the average number of passengers is 248,932 passengers and the nominal average fare is USD248. Looking at the standard deviation, the rate at which the fare price deviates from its mean is only 12.3% compared to that of the number of passengers and GDP, which are 40.7% and 22.8%, respectively. Panel A reports also the autocorrelation pattern of the variables. The first-order serial correlation of the number of passenger, average fare and GDP are 0.304, 0.929 and 0.340, respectively. The Ljung-Box (Q) is a statistic under the null

hypothesis that autocorrelation coefficients are jointly uncorrelated up to lag 20. Looking at their Q-statistics, the three series are serially correlated. Testing the individual autocorrelation coefficients based on the rule of thumb; reject the null hypothesis if the coefficient is twice higher than $2/\sqrt{N}$, where N is the number of observations. Applying this to the whole set of autocorrelation coefficients, the first-order autocorrelation of the three series is significant.

Panel B reports the correlation among the variables. The number of passengers is positively related to the real GDP, but negatively (and weakly) related to the real average fares. The correlation between the real GDP and the real average fares is negative, suggesting an inverse relation between these variables.

Panel C reports the Dickey-Fuller test under the null hypothesis of a unit root in the series. Testing the t-statistics against the critical value, the null hypothesis that the Log of the number of passengers and the Log of the Real Average Fare contain a unit root is accepted. In contrast, the null hypothesis of a unit root in real GDP is rejected. Accordingly, there is a possibility of long-run relationships among these variables.

However, since our sample period is very short (less than 5 years), running a co-integration test is meaningless (note that a co-integration test is meant for long-run relationships). Alternatively, a Vector Autoregressive (VAR) model on the first differences of non-stationary variables could be estimated to capture short-run relationships. Although using a VAR model of some order implies that feedbacks from one variable matter to the other variables, and since we do not believe that it makes

economic sense to run such a model with our variables, we would rather run a simple Ordinary Least Square (OLS) regression.

4.2 Estimates of the Empirical Model

Based on our main hypothesis presented in chapter 2 of this study, we use Sample A to estimate the following model;

$$\begin{aligned} LNOP_t = \beta_0 + \sum_{i=1}^{3} \beta_{1i} LNOP_{t-i} + \beta_2 LFARE_t \\ + \beta_3 LRGDP_t + \beta_4 DWAR_t + \varepsilon_t \end{aligned}, \qquad (1)$$

where $LNOP_t$ is the log of number of passengers at time t, t denotes monthly frequency, $LFARE_t$ is the log of the real average fare at t, $LRGDP_t$ is the log of the real gross domestic product (GDP) at t, $DWAR_t$ is a dummy variable taking 1 when either a blast or a war occurs and 0 otherwise, and ε_t is the error term.

Equation (1) includes a dummy variable $DWAR_t$ that is defined in the following ways: $DWAR_t = 1$ for February-April 2005 (associated with the assassination of Rafic Hariri), and for July–September 2006 (associated with the summer war), and otherwise $DWAR_t = 0$.

β_2, β_3, and β_4 can be interpreted as elasticity with the following expectations: $\beta_2 < 0$ because an increase in price must induce a decrease in the number of passenger travelling by air, $\beta_3 > 0$ because an increase (decrease) in real GDP should induce an increase (a decrease) in the number of passenger, and $\beta_4 < 0$ because

a blast or a war should have a negative effect on arrivals at BEY. Equation (1) includes also β_{11}, β_{12}, and β_{13} that represent feedbacks of users and that are expected to have the following sign: $\beta_{11} > 0, \beta_{12} > 0$, and $\beta_{13} < 0$ because of the seasonality of air travel demand (we assume a quarterly cyclical pattern with a negative sign on the coefficient of the third month). Table 5 reports the OLS estimates based on Sample A.

Table 5: OLS estimation based on Sample A

	MODEL 1	MODEL 2	MODEL 3	MODEL 4
β_0	15.417*	9.523*	2.346	2.420
β_{11}	0.124*	0.395*	0.154	0.143
β_{12}	-0.449*	-0.242	-0.138	-0.144
β_{13}	0.094	0.082	0.072	0.074
β_2		-0.009		0.285
β_3			1.420*	1.414*
β_4	-0.628*			-0.027
$\bar{R}^2$	0.237	0.017	0.682	0.664
F-STAT	3.488*	1.142	18.120*	11.531*
L-B(20)	58.214*	26.045	23.044	24.112

Note: The table reports the estimates of equation (1). $\bar{R}^2$ is the adjusted R-square, F-STAT is the F-statistic, and L-B is the Ljung-Box statistic at lag 20. One asterisk (*) denotes that the coefficient or the statistic is significant at 5% level, at least.

Table 5 reports 4 different models. Looking at the F-STAT Model 1, 3 and 4 are significant. However, the sign of β_2 in Model 4 is inconsistent with economic theory as a positive sign implies that price increase (decrease) leads to an increase (a decrease) of the number passengers at BEY. This suggests that demand for travel by air is either a function of extreme political events or real GDP.

Since the real average fare is unrelated to the number of passengers at BEY, we exclude it from the model of equation (2). Therefore, we estimate the following model that includes the log of population (LPOP) under the hypothesis that a growth in

population is positively related to the number of passengers at BEY. For this model, we use sample B. The average mean of the Log of population is 15.21, with a standard deviation of 1.34%. Correlation between real GDP and population is 49.9%. With this correlation that is half distant from a perfect correlation, we test a model with only population included, another model with only real GDP included and a third model with the two variables included. In doing that we took into consideration the problem of multicollinearity.

$$\begin{aligned} LNOP_t = \beta_0 + \sum_{i=1}^{3} \beta_{1i} LNOP_{t-i} + \beta_2 LPOP_t \\ + \beta_3 LRGDP_t + \beta_4 DWAR_t + \varepsilon_t \end{aligned}, \qquad (2)$$

where the coefficient associated with the log of population ($LPOP_t$) is expected to display a positive sign.

Table 6: OLS estimation based on Sample B

	MODEL 1	MODEL 2	MODEL 3	MODEL 4
β_0	11.774*	-27.797	5.116*	58.718*
β_{11}	0.404*	0.506*	0.310*	0.262*
β_{12}	-0.291*	-0.271*	-0.215*	-0.222*
β_{13}	-0.055	0.017	-0.062	-0.089
β_2		2.439		-3.463
β_3			1.096*	1.113*
β_4	-0.343*			-0.181*
$\bar{R}^2$	0.285	0.174	0.537	0.580
F-STAT	6.592	3.948	17.231	13.873
L-B(20)	19.498	10.851	28.404	41.682*

Note: The table reports the estimates of equation (2). $\bar{R}^2$ is the adjusted R-square, F-STAT is the F-statistic, and L-B is the Ljung-Box statistic at lag 20. One asterisk (*) denotes that the coefficient or the statistic is significant at 5% level, at least.

Table 6 reports the OLS estimates using Sample B. In the model of Equation (2), β_2 stands for the coefficient associated with the log of the population, not as in Table 5 with the Log of the average fare. Unfortunately, the assumption to include population instead of average fare in this research proved to be a faulty one as we obtained a wrong sign with the coefficient of LPOP.

Chapter 5: Conclusion

The purpose of this thesis was to investigate the demand function of air travel in Lebanon. To this end, we have estimated a model with the number of passengers at BEY as dependent variable, real GDP, average fare, and a dummy variable for war and blasts as independent variables. Our main finding is that air travel in Lebanon is a function of economic activity and security.

However, since passengers at BEY are of different origins, the positive relationship between real GDP and the number of passengers at BEY must be taken with caution [a possible extension of this study would be to use an indicator for the origin and travel purpose of the passengers at BEY if this data becomes available]. In contrast, the negative relationship between the dummy variable for war and the number of passengers at BEY is more robust to exogenous effects than any other variable included in our model. Hence, an important result of this study is that the number of passengers at BEY is a function of the political situation in Lebanon.

Finally, while we suggest that this study would be a good starting point for air transport authorities in planning the future of air travel in Lebanon, we hope that additional data will be available for future researchers to build on our study.

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