THE DETERMINANTS OF DOMESTIC AIR TRANSPORT DEMAND IN ETHIOPIA

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This is to certify that the thesis prepared by Amanuel Sofany, entitled: *The determinants of Domestic air transport demand in Ethiopia* and submitted in partial fulfillment of the requirements for the degree of Master of Science in Economic Policy analysis complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ABSTRACT

The Determinants of Domestic air transport demand in Ethiopia.

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The main objective of this study is to investigate the determinants of Domestic air transport demand in Ethiopia during the period 2000/2001-2013/2014. The Autoregressive Distributed Lag Approach to Co-integration and Error Correction Model are applied in order to investigate the long-run and short-run relationship between the domestic passengers and its determinants. The finding of the Bounds test shows that there is a stable long run relationship between number of Domestic revenue passenger, income, airfare, price of competing services (Buses), road length and population.

The empirical results reveal that income, price of competing services and population are found to have positive impact on the domestic air transport. However, Yield has negative impact on the domestic air transport. In the short run, the coefficient of error correction term is -0.62 suggesting about 62 percent annual adjustment towards long run equilibrium. This is another proof for the existence of a stable long run relationship among the variables. The estimated coefficients of the short-run model indicate that population, income and airfare are the main contributor to the domestic air transport demand.

This study has also an important policy implication. The findings of this study imply that domestic air transport demand can be improved significantly when the price of competing service, population and income increases and airfare decreases. Hence the governmental organizations (Ethiopian Civil aviation authority, Ethiopian Airports Enterprise & Ethiopian Airlines) should have an integrated plan to optimize the benefit obtained through the development of the national economy and the population growth.

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List of Acronyms

ADF: Augmented Dickey Fuller

AIC: Akaike Information Criterion

ARDL: Autoregressive distributed lag

ATAG: Air Transport Action Group

EAL: Ethiopian Airlines

EAE: Ethiopian Airports Enterprise

ECAA: Ethiopian Civil Aviation Authority

ASK: Available Seat Kilometer

ATK: Available Tone Kilometer

BCCA: Boeing Commercial Airplane Company

CPI: Consumer Price Index

CSA: Central statistical agency

ECM: Error correction model

EU: European Union

GDP: Gross Domestic Product

ICAO: International Civil Aviation Organization

IATA: International Air Transport Association

IOCC: integrated operation control center

KPSS: Kwiatkowski Phillips Schmidt Shin

LCC: Low Cost Carriers

LF: Load Factor

MoFED: Ministry of Finance and Economic Development

OLS: Ordinary Least Square

O&D: Origin and destination

PAX: Passengers

PP: Phillips Perron

RPK: Revenue Passenger Kilometer

SBC: Schwarz Bayesian Criterion

TWA: Transcontinental and Western Airlines

UNESCO: United Nations Education Scientific and Cultural Organization

CHAPTER 1 INTRODUCTION

1.1. Background of the Study

Air transport, just like any other mode of transport, plays a crucial role in the economy of a country. It provides a necessary supporting role to international, regional, economic growth and local prosperity. It also enhances the quality of life by improving access to jobs, education, health care, markets as well as social and leisure activities (Daw, 2013).It also provides world-wide transportation network, which makes it essential for doing business globally as well as enhancing tourism.

A proper management of air transport industry is therefore necessary to enhance decisions about current and future development within the industry. These include activities such as airport development plans, investment decisions and etc. Plans cannot be properly carried out without knowing the level of demand for the service provided and the determinants associated with it. Analyzing and forecasting the current and future demand for air transport is a key element in planning its operations (ATAG, 2007, Wells 2005).

The demand for air transportation in Ethiopia originates from the large size of the country about twice the size of France. The Distance by Air from Moyale, near the Kenyan Border in the South, to Axum, in the North, is About 1240Km, and the Distance from the Western border of Gambela to Jijiga near the Western border of Somalia is about 1064 Kms. The big size of the country, the large size of the population and its wide dispersion as well as the roughness of the terrain makes air transport fitting and important (Lovink, 1997).

There has been a growth in passenger demand due to economic development of cities in different parts of the country. Many economic activities were seen in regions such as Amhara, Oromia, Southern nations, nationalities and peoples, Tigray, Addis Ababa and Dire Dawa. The four international airports in Ethiopia are found in Tigray, Amhara regions and on the two administrative cities of Addis Ababa and Dire Dawa, these are Bole, Dire Dawa, Ginbot 20 & Alula Aba Nega international airports.

In 2002, domestic passenger traffic stood at 545,793. It rose to 828,236 in 2010 and 1,718,839 in 2014. Not only this, but also the cargo and mail transportation through air had been on regular demand. All these are indications of increasing demand for air transport services in the country. In order to accommodate future demand for air transport services in Ethiopia, it is important to plan for it. This will greatly assist the aviation industry.

1.2. Statement of the problem

Air transport is considered as a vital corridor for international passenger and freight flows. The presence of an efficient air transport service increases economic competitiveness among countries by facilitating access to the world market and enhancing regional integration. It also eases labor mobility and tourism. In 2015 alone, nearly 3.6 billion passengers were carried by the world's airlines. Nearly 63 million jobs are supported worldwide in aviation and related tourism. Of this, 9.9 million people work directly in the aviation industry. While air transport carries around 0.5% of the volume of world trade shipments, it is over 35% by value – meaning that goods shipped by air are very high value commodities, oftentimes perishable or time-sensitive (ATAG, 2015).

Air transport sector can also be described as Ethiopia's ambassador at large serving to link Ethiopia with the rest of the world. Its status both within Africa and around the world has been increasing from time to time, and it has assumed a special status among African countries as the airline to be relied upon, as has been expressed at various forums. Recently the Ethiopian airlines cater to 93 destinations internationally; the number of passengers increased from 636,005 in 1994/95 to 5,854,887 in 2013/14 showing an enormous progress in terms of demand by the passengers. In addition to this, the airline is also be selected by passengers in terms of customer service, safety, and better network in Africa.

While the benefits of air transport are widely known, non-physical barriers continue to impede air transport service expansion among some countries. These barriers mainly stem from restrictive regulatory arrangements which dictate how the service is rendered. Owing to this trade deterring impact of restrictive regimes, there has been a general move towards liberalization in the world (Megersa, 2013)

In the case of Ethiopia, the air transport sector was moderately opened to private investors by the FDRE investment proclamation No. 37/1996. The restrictive provisions of this proclamation permit only Ethiopian nationals to invest in this sector using aircraft of maximum loading capacity of up to 20-passenger or cargo capacity up to 2700kg. However, the proclamation plays no significant role in enhancing the capacity and competition in the overall domestic passenger air transport service, so none of the private airlines can operate on the scheduled operation. They are operating on the non-scheduled (charter operation) indicating that Ethiopia has been less successful in developing its domestic air services. Moreover, the country shows no sign of effective domestic liberalization of the air transport market. Ethiopian Airlines holds near-monopoly on domestic routes and enjoys strong support from the government in negotiating new air service agreements.

Despite the fact that Ethiopian airlines is a regional leader in air transportation in terms of extensive network across the continent and a safety record up to international standards, the domestic air transport plays a relatively minor role. As tourism becomes more important for the country, it may be necessary to devote greater attention to developing domestic services.

Developing the domestic service for example in terms of liberalizing the air transport service as said above , building airports at different locations may not be adequate to bring the expected change on the issue. It is therefore indispensable to support the domestic air transport service through identifying the factors that affects its demand and forwarding the possible solutions.

So far, little researches were conducted on the domestic air transport in Ethiopia. Eyob (2001) tried to identify the determinants of domestic air transport in Ethiopia by using Johansson cointegration techniques. The general gap in his study is, he did not incorporate population as a factor a part from the difference in the methodology employed in this research. As it is known the growth of the population has a direct impact on the use of the domestic air transport. The main purpose of this study is therefore first to identify the determinants of scheduled domestic air transport demand in Ethiopia and Second, to filling the gap in the limited literature of the domestic air transport sector.

1.3. Objective of the study

1.3.1. General Objective

The general objective of this study is to analyze the Determinants of Air transport Demand in Ethiopia.

1.3.2. Specific Objectives

The specific objectives of the study are:

- To examine the patterns of the domestic air transport demand in Ethiopia.
- Identify the top air ports that serves the domestic air passengers in Ethiopia
- Identify Passenger per aircraft in the available airports in Ethiopia
- To determine the factors that affects the domestic air transport demand in Ethiopia.

1.4. Significance of the Study

The study is significant in identifying the major determinants that affect the domestic air passenger demand of the country by bringing empirical evidence using time series data analysis. In addition, the study is also significant in that it incorporates additional important variable (i.e. population) determining the air transport performance of the country which have not been incorporated in other previous or recent studies in Ethiopia. Furthermore, the study uses very recent data for empirical analysis. In general, identifying the determinants of domestic air transport demand will help to provide information to the policy makers to enable them to come up with the appropriate policy regarding the growth of the sector and the economy as a whole and will help broaden the understanding of determinants of air passenger demand.

1.5. Limitation of the study

The major limitation of this study is that data is available only from 2000/01 and after. To overcome this problem, I disaggregate the yearly data on quarterly basis. The other limitations of the study include: difficulty to get relevant data on the related topic and unavailability of enough literature on Ethiopian aviation industry. The study also doesn't include the non-scheduled (charter operation) services as there is no organized data in Ethiopian Civil aviation authority.

1.6. Organization of the paper

The paper is organized as follows: chapter one discusses the introduction part and chapter two presents the overview of Ethiopian domestic air transport. Chapter three presents the theoretical and empirical literature reviews while Chapter four provides the model specification and estimation procedures. Chapter five presents results and findings of the study and finally Chapter Six presents Concludes and forward the policy implications.

CHAPTER 2 OVERVIEW OF ETHIOPIAN DOMESTIC AIR TRANSPORT

2.1 History of Civil Aviation in Ethiopia

History of aviation in Ethiopia goes back to 1929 when French made airplane, Potez 25, flown by a French pilot Andre Millet landed in the western side of Addis Ababa enrooted from Djibouti. This was 26 years after the first attempted flight by the Wright brothers and two years after the famous flight across the Atlantic by Captain Lind Burg. Although Millet piloted the first aircraft which marked the history of aviation in the country, soon came with his successors with other types of airplane after one month time- in the month of September (ECAA, 2016).

In 1930, five sweater airplanes like Farman-192 and others were purchased by the government for postal, security and other government services between the towns of Dire Dawa, Djibouti, Debremarkos, and Gondar. In the same year, the first maintenance technicians and flying school established in Jigjiga, eastern Ethiopia. Gaston Vidal, a French instructor, established the first pilot training School in the town of Jigjiga which produced Mishka babichief and Asfaw Ali who were certified to be the first Ethiopian pilots. Mishka made his first solo flight on September 01, 1930 followed by Asfaw Ali only after thirteen days. Very soon Bahiru Kaba and Tesfamikael Haile were also added to the number. What is remarkable of that time was that W/ro Mulumebet Emiru also turned out to be one of the first Ethiopian female pilots. The school at Jigjiga was not only limited to the pilot training, but also added aircraft maintenance. Maintenance work was also began at Janmeda (Addis Ababa) and Dessie. From 1926-1936 new domestic routes were opened to Gefersa, Bishoftu, Janmeda and Akaki, and the country had also acquired twenty airplanes until the occupation of Italy (ECAA, 2016).

ECAA(2016) also described that in 1944, the Ethiopian government was invited by the United States of America to attend the Chicago conference of December 7, 1944. This made Ethiopia one of the few African nations to sign the convention of the International Civil Aviation Organization. This same year, another major step was taken by the Government of Ethiopia and the Civil Aviation Authority was founded. One year later in 1945, Ethiopian Airlines was founded with six-second world surplus DC-3/c-47 airplanes. In 1951, through the technical assistance provided by the International Civil Aviation Organization, aviation school was opened in Addis Ababa. The first 60 trainees of the school were trained in Communication, Navigation, Aircraft, Metrology, and Radio operation and maintenance.

Finally, today ECAA runs 4 international and 10 Domestic airports. Besides, the authority provides efficient service in constructing, controlling and administering airports and the air space of the country. Bole international airport of Addis Ababa was one of the 3 major international air ports (Johannesburg, Nairobi and Addis Ababa) in Sub Saharan Africa handled 36% of international traffic in Africa in 2007(Njoya 2013). The national carrier Ethiopian Airlines is the fastest growing airline company in Africa which provides 93 international and 20 domestic schedules service across 5 continents.

2.2 Airlines and Domestic Destinations in Ethiopia

Domestic Destinations

The domestic air transport in Ethiopia starts when the first scheduled flight of Ethiopian airlines took place to Cairo via Asmara in Douglas C-47 sky train on 8th April 1946 from Addis Ababa. Following the successful inaugural flight to Cairo via Asmara, a regular weekly service was established. Following that a domestic service to Jimma has proceeded. As the demand for air transport service necessitated new systems of airport in the country, ECAA built three new international airports in Addis Ababa (Bole), Dire Dawa and Asmara, as well as one domestic airport at Jimma with a loan of 50 million USD from the US government in 1961. These airports began to provide full-fledged airport and air navigation services required by modern jet aircrafts (Abraham, et al, 1979).

There are 61 airports registered by IATA in Ethiopia, of which 4 international and 16 domestic airports are on service but the remaining 41 airports are not on service due infrastructure problem (Njoya, 2013). Among those airports only 14 airports are being administered by ECAA, the regulatory agency.

Due to increasing tourist flows, domestic demand and rise in the export of high value commodities such as cut flower and meat, expanding the capacity and upgrading the standards of airports have become critical. As a result, the facilities at Bole International Airport have been upgraded significantly and some of the domestic airports were up graded to international levels.

The ECCA has developed a comprehensive National Airports Development Plan covering the period 1999-2017 including, among others, airport expansion, pilot training and aircraft maintenance. Bole International Airport is Ethiopia's major entry point by air. In 2013 the total aircraft movement in Bole was 48137. The airport has been upgraded in recent years to quite high standards, and is now able to handle up to 45 aircraft simultaneously (ECAA, 2014).

Ethiopian Airlines

Founded in 1946, Ethiopian Airlines is a 100 percent state owned airlines and serves as the country's flag carrier. The carrier is considered the fastest growing airline company in Africa and is listed as second in the top ten safest airlines in Africa ranking. Now Ethiopian Airlines operates with a fleet of 77 passenger and 8 freighter planes and offers services to 93 international and 20 domestic destinations (Ethiopian Fact sheet May 2015).Protective policies have helped the airline maintain holds a near-monopoly on domestic routes. Although government-owned, the airline is well managed, and has been able to raise its own debt and finance its own expansion without government cash which make it unusual among state owned African airlines.

Ethiopian Airlines domestic route network ranges to all parts of the country bringing regional and administrative cities within easy reach of the capital and the regions commercial centers. It plays a critical and major role in getting the cities of the different regions of Ethiopia within easy reach to Addis Ababa, the capital. Currently, the public travels within and across the nation for various reasons. While the domestic business travel is growing fast and steadily alongside the economy, the tourist market has also shown positive trends over the last few years. It is, therefore, quite fitting and consistent that the national carrier has to keep abreast with these rapid developments. On November 14, 2008, Ethiopian Airlines signed an agreement with Bombardier to purchase eight Q400 NextGen turboprop aircraft, to substitute the F-50 aircraft on the domestic market.The Q400 NextGen turboprop aircraft has an excellent range and payload capability which will permit Ethiopian the flexibility to deploy the equipment on its domestic routes within Ethiopia (EAL, 2008).The new aircraft has a passenger seat capacity of 78. The airline also uses the B737-700 equipment for certain of its domestic flight operations as required (EAL, 2008). The new 78 seater aircraft will support the ever increasing tourism market of the country and domestic business travel, which is growing fast alongside the economy.

Private Airlines

The private sector participation in the air transport sector was noted in 1962. In the period between 1962-1975, there were seven private air transport operators engaged in commercial aviation. On 16th May 1975, the Government nationalized all private aircrafts with Ethiopian registration and Ethiopian Airlines was designated custodian of the nationalized aircrafts. After that, and throughout the period of the Derg regime the air transport service was totally monopolized by one company, Ethiopian Airlines (Eyob, 2001; Helina, 2001).

In 1996 the domestic air transport sector was re-opened for private sector participation, with conditions. The FDRE investment proclamation No. 37/1996 declares the air transport industry open for investors but attaches several conditions: the investors have to be Ethiopian Nationals and can give the air transport service using aircraft with a sitting capacity of up to 20 passenger or with a cargo capacity of up to 2,700 Kg.,(Eyob, 2001).

In 2013 the investment proclamation No. 37/1996 was revised the sitting and cargo capacity of private airlines. The proclamation indicated that the max sitting capacity was 50 passengers and no limitation for cargo operations.

As can be seen in Table 2.1 the major private airline include: Abyssinia Flight Service ,Trans Nation Airways , Suhura Airways ,Amibara Aviation Service, Aquarius Aviation Plc., National Airways and Zemen Flying Service with no of Aircrafts 8,4,1 ,5,2,2, 1 respectively. All airlines are allowed 50 seats A/C of passenger and no limitation for cargo operation.

Table 2.1. Private airlines and their aircraft type and types of operation

Passenger and Cargo Domestics Air Transport Operators		
Name of Operators	No of Aircraft	Type of Aircraft
Abyssinia Flight Service	8	C-208(ET-ALD),C-179(ET-AMM),C-208B(ET-AMV,ET-AMI,ET-AOF), DA42NG(ET-APE), C-172S(ET-AQA),C-172R(ET-AQU)
Trans Nation Airways	4	TrboTrush, DCH-8(ET-AKZ,ET-ALX)& Helicopter(ET-AMR)
Suhura Airways	1	Antonov AN-26B
Amibara Aviation Service	5	Turbo thrush(ET-AHN), Schweitzer AG-CAT (ET-AJT, ET-AJV, ET-AMC), Turbo-THR(ET-API)
Aquarius Aviation Plc.	2	Aero commander 690A(ET-AQI) and Aero commander 690C (ET-AQT)
National Airways	2	ET-AQK,ET-AQR(PC-12/45)
Zemen Flying Service	1	C-208 (ET-AQJ)

Source: Ethiopian Civil aviation Authority (ECAA) 2014.

2.3 The Supply of Domestic Air Transportation Service

The private airlines in Ethiopia are presented in Table 2.1. Ethiopian Airlines and 7 private airlines operate the conventional domestic market. The private Companies have started operation since 1996. None of these private airlines are operated on scheduled services. They are giving service on the non-scheduled air transport. Ethiopian airlines were the only airline that operates the scheduled domestic market. Currently, Ethiopian airlines operate scheduled flight services to 20 domestic stations using the new Bombardier Q-400 aircraft and B737 (EAL, 2014).

From Table 2.2 below the number of domestic passengers and load factor was increasing through time. So there is a high demand of air passengers in Ethiopia but the supply was not enough. This could be better appreciated looking the average load factor its 75.81. Since 65 percent is considered as reasonable good load factor in the air transport Dogins (1999).

There is a widespread perception in civil aviation circle in Ethiopia that the domestic air transport supply, measured by available seat kilometer (ASK), is not enough to serve the existing demand. The available air transport service between different routes is seen as insufficient, leading to long wait before seats can be reserved which results in greater extra cost.

One of the major reasons for the insufficient supply of air transport services in the country is the fact that the airline is prevented from acting as a price fixer. Hence, the fare level is neither competitive nor monopoly, rather it is set by the government. Because of that, the airline was forced to incur losses in the domestic air transport services (Eyob, 2001).

Table 2.2.Capacity, Traffic and Load factor of EAL Domestic Services

Year	PAX	RPK	ASK	LF(%)
2000/01	259,623	112,956,244	169,698,339	66.56
2001/02	263,752	115,572,153	164,210,123	70.38
2002/03	276,005	116,949,523	162,733,096	71.87
2003/04	275,741	116,977,669	160,607,499	72.83
2004/05	303,674	128,739,023	173,526,338	74.19
2005/06	307,772	133,822,028	180,758,503	74.03
2006/07	305,165	133,831,625	185,810,378	72.03
2007/08	351,377	153,739,026	210,443,700	73.05
2008/09	388,666	173,967,719	225,388,862	77.19
2009/10	428,406	194,466,572	261,467,451	74.38
2010/11	468,519	213,831,954	268,233,502	79.72
2011/12	546,747	250,066,943	309,343,340	80.84
2012/13	618,864	277,686,125	354,747,396	78.28
2013/14	716,194	315,643,759	389,412,822	81.06
TOTAL/AVERAGE	5,510,505	2,438,250,363	3,216,381,349	75.81

Source: EAL, 2014.

Ethiopian had for a long time adopted a subsidized rate on its domestic flights to promote tourist destinations in the country and to encourage tourism as well as local travelers. Although the privilege was for residents of Ethiopia, later tourists that enter the country using other commercial airlines were also using the cheaper and heavily subsidized rates offered by Ethiopian to visit the tourist attraction sites in the country.

On 2014 Ethiopian airlines claims that the privilege has been abused by tour operators, impeding EAL from becoming profitable in the domestic flight service. The domestic flight service has never been profitable and this is because all passengers have been using the subsidized price. To make more profits from its services, EAL has implemented a new rate on its domestic flights. According to the PR office of EAL, there are three new tariffs that are introduced; while the fair for residents in Ethiopia will remain highly subsidized, there is an increment of 7 percent. Promotional fares higher than the subsidized fares have also been introduced for long haul passengers who have used Ethiopian Airlines to travel to Addis Ababa. The third parcel which increased significantly is on passengers that use foreign carriers to come to Ethiopia, (EAL, 2014).

2.4 The Demand for Domestic Air Transportation Service

Analyzing air travel market is an integral part of an airline's corporate plan that reflects the capacity utilization, manpower requirements and financial projections for the operating capital projects, etc. It helps make decisions regarding the development of infrastructure facilities, thereby ensures the improvement of services to air passengers. Moreover, it helps to reduce the airline company's risk by objectively evaluating the demand side of the air transport business. Analyzing of international air passenger movements should not be considered purely as rigid lines on charts which dictate airline's future. Instead, it should be used dynamically to help an airline to evaluate strategies (Boeing Commercial Airplane Company, 1993).

The rugged topography, the dispersed nature of centers of population concentration, the long distance among centers of production and the under development of land transport tend to increase the demand for air transport in Ethiopia as an alternative mode. However, it is clear that the demand for domestic air transport in Ethiopia is low because of the relatively high cost of this service as the income of the population was low.

2.5 The Impact of Air Transport on Economy

The expansion of transport infrastructure is expected to contribute to poverty alleviation directly by improving access to services, increasing personal mobility, and lowering transport costs, and indirectly through its effects on economic growth, efficiency, and employment creation. Improvements in transport facilities raise living standards, as access to basic infrastructure services (health and education) is an essential component of welfare. Moreover, most programs that target directly the basic needs of the poor depend on transport as a complementary input for their effective delivery. For the poor, the lack of affordable transport deprives them of the opportunity to take advantage of job opportunities and essential social services. And an adequate transport network reduces the risk of famine by facilitating the movement of food from surplus to deficit areas.

Air transport has traditionally experienced higher growth than most other industries. Demand for air transport is closely linked with economic development; at the same time air transport is a driver in an economy. The contribution of air transport and related civil aviation industries to local, regional or national economies includes the output and jobs directly attributable to civil aviation as well as the multiplier or ripple effect upon other industries throughout the economy (ICAO 2002). In this regard, Ethiopian Airlines provides several benefits to the country as well as to different stakeholders through the provision of different services to its customers (ECAA 2007).

Aviation provides the only worldwide transportation network, which makes it essential for global business and tourism. It plays a vital role in facilitating economic growth, particularly in developing countries. Air transport plays a meaningful role in the social and economic developments of the world economy. This mode of travel is also very capital intensive and requires heavy investments. The air transport industry has been experiencing constant changes as a result of changing economic, political and transport security environment (Ba-Fail, Seraj, and Jasimuddin, 2000).

2.5.1 Trade

The benefit that air transport has on business operations is vast. Efficient transportation system is an essential factor when considering investment opportunities. It allows greater access to international markets. Personal communication between clients becomes possible. Efficiency is improved through fast and reliable delivery of products. Inventory costs can be minimized and production interruptions are more easily prevented.

Aviation plays a greater role in overcoming geographical and political barriers. Even a small increase in air transport activity can result in major improvements and economic growth. Some of the poorest nations in the world have raw materials that are in high demand by other counties. Aviation is used to fly personal and perishable supplies to the remote camps and to retrieve the acquired resource. Ethiopia produces Flowers and meat, as these products are perishable air transport was the only way to export those products.

2.5.2 Tourism Sector

Air transport is vital for tourism. According to IATA Annual report 2013 nearly 35% of international tourists travel by air. It is a major source of income and boost to the economy for popular locations (IATA, 2013).

Tourism is now the biggest foreign exchange earner in most African countries. Although some of these nations have recognized the importance of tourism for their economy and have taken steps to set up an efficient tourism sector through liberalization, progress in the aviation sector has been slow.

Accessibility is essential for the development of any tourist destination. While mass tourism was possible by other means of transport, the great step forward was put by developments in commercial aviation. From the 1970s onwards, there has been a continuous stream of innovations and favorable conditions in air transport which have resulted in the stimulation of growth in tourism, especially in long-haul tourism (Njoya, 2013).

For many underdeveloped countries, especially for eastern African countries tourism has higher value in their national income account due to the fact that these countries have various tourist attractions cites (Nyaringo, 1964).

Ethiopia is endowed with an immense tourism potential owing to its natural, cultural and historical attraction areas. However, unlike other African countries Ethiopian tourism is still at its infant stage. The sector's share to GDP is very small (0.77% in 2008). In 2012, the country earned US $ 462 million from the tourism sector according to the Ministry of Culture and Tourism as cited in (Njoya, 2013).Among the 584,000 tourists who visited the country's historical sites in 2012, 27 percent came from Europe with a significant percentage from Germany, England, France and Italy; 18 percent from the United States; 27 percent from Africa; 9 percent from the Middle East and Asia each. According to the Ministry of Culture and Tourism, 86 percent of the 2008 visitors (330,157) arrived by air (Njoya 2013).

Since 2005, the government has embarked reforms towards promoting tourism. The first tourism development policy of the country was launched in August 2010. Accordingly, the following objectives among others have been set for the sector: (1) turn Ethiopia into a particularly preferred destination in Africa; (2) increase tourism receipt from the current US $ 250 million to US $ 3 billion by 2015 and (3) create direct jobs for 3.5 million citizens. Easy access from source markets has been recognized as one of the strategies to be used to achieve these objectives. With respect to air transport, the government has in recent years been intensifying efforts to obtain greater openness with other countries in order to create greater opportunities for Ethiopian Airlines. This has helped increase Ethiopia international traffic from 749,900 passengers in 1995 to 3,141,330 in 2013, which is a 319 percent increase with an annual average growth rate of 11 percent (Njoya, 2013).

2.5.3 Employment

According to ATAG 2012 report, in Africa alone aviation directly employs over 250,000 people. If we include indirect employment at suppliers to the industry, induced employment from spending by aviation industry employees and the jobs in tourism that air transport makes possible, this increases the regional figure to 6.7 million jobs. In addition, African economies derive substantial benefits from the spending of tourists travelling by air (ATAG 2012).

In Ethiopian case, one of the government policies is to curb the problem of higher unemployment level of the country. In doing that, Aviation has played a great role to fight this problem by creating a vast employment opportunity to be employed in the air transportation sector (ECAA, 2011). Besides, Aviation industry has created employment opportunity indirectly in allied business like hotels, travel and tour agents, taxis, security service providers, temporary workers and so forth (ECAA, 2011). Therefore, it is obvious that the industry plays a significant role in curbing the higher unemployment rate problem and hence contributes in the economic growth and development of the country.

Chapter 3 LITERATURE REVIEW

3.1 Theoretical Literature

In this chapter reviews of different literatures on the determinants of air transport demand is done. In order to provide a better insight to the reader, two main groups of determinants are identified: Internal and External factors. This approach helps the reader differentiate clearly what is affecting air transport demand from different perspectives.

Table 3.1 Determinants of Air Transport Demand

Internal Factors	**External Factors**
Airfares	Economic (income, expenditure, Inflation)
On time performance	Geographic and Demographic factors
seat capacity of aircrafts and capacity	Alternative modes of transport
	Liberalization level

As we can see from the above table, the internal factors that affect the scheduled air transport demand are airfares, on time performance, seat capacity of aircrafts, and the frequency of flights. The external factors are Economic, demographic, and market structure factors. Economic factors are the most influential drivers for air transport demand and factors such as income, expenditure, and inflation can be listed in this category. Geographic and demographic factors stimulating air travel demand are population, size of the country, topographic structure of land, and urbanization level. Regulated or deregulated markets and the business model of airlines can be mentioned as components of market structure. Social factors include such factors as psychological perception of public –e.g. unfamiliarity to flying, education, and immigration. Lastly, maturity is a key notion that determines the magnitude of the relationship between the determinants of air transport and the air transport demand. In-depth analysis of these factors is conducted in the following sections.

3.1.1 Internal Factors

Airfares and prices of alternative modes of transportation (train and buses) are a crucial determinant for air transport demand (Alperovich and Machnes, 1994). Previous researches show that deregulation have generally positive effect on air transport demand by enabling lower cost and stronger competition in the market (Isthutkina and hansman 2008). Thus, passenger demand for air transportation has a tendency to increase. Dargay and Hanly (2001) argue that for the UK leisure market fares are the most salient factor prompting an increase of air travel while growth of incomes has the biggest impact on the business travel market. Referring to the outcome of the mentioned research, leisure travelers are more sensitive to price changes, however, for business travelers - prices are considerably less salient attribute.

Some alternative parameters may be mentioned instead of airfares because generally it is hard to come by average airfares for specific countries. As Alperovich and Machnes (1994) suggest, aggregate CPI or CPI of communication and transportation can be used as an alternative variable to overcome problems arising from obtaining information about airfares. Economic theory suggests negative relationship between price and demand for the most of the goods and services.

The other internal factor of air transport demand was on time performance. Suzuki (2000) studies the relationship between on-time performance and profit using an optimization model. He investigates the relationship between on-time performance and airline market share, by focusing on a sample of three air carriers providing service between Atlanta Hartsfield Airport and

Chicago O'Hare Airport. The results indicate that an air carrier's market share is likely to decrease when its on-time performance deteriorates.

Other than airfares and on time performance there are various supply conditions that affect demand such as frequency, seat availability, departure and arrival time and number of rout steps.

3.1.2 External Factors

This part explains the main external factors and their interaction with air transport demand. Economic, geographic, market structure and social factors are the main components of external factors.

A. Economic Factors

Economic activity

Air transportation generates an economic activity by creating employment and by its enabling effect. Enabling effect is defined by Ishutkina and Hansman (2008) as "The total economic impact on employment and income generated by the economic activities which are dependent on the availability of air transportation services" (P. 2). Air transportation enables access: to markets, to people, to capital, to ideas, to knowledge, to labor supply, to skills and to opportunity and resources (Ishutkina and Hansman, 2008). Air transportation and economic activity are interrelated and have reflexive effect on one another. In other words, economic activities are somewhat stimulated by air transportation, and they, in turn, generate demand for air transport services. Air transport makes markets and people closer to each other.

Income

The growth in air travel can be explained by rising incomes (Dargay and Hanly, 2001). Per capita income (or GDP), and consumer expenditure are widely discussed income types in the literature. Steiner (1967) concludes that, beside the changing habits, discretionary income is the most important factor that is causing air traffic growth. However, in some studies (e.g. Graham, 2000) GDP is referred to as an alternative measure of income together with disposable income and consumer expenditure.

Shafer and Victor argued that time and income shares allocated to travel are constant over time and space (as cited in Ishutkina and Hansman, 2008,). When the individuals' incomes increase, they do not raise the proportion of expenditures for transportation, but along with the income increase their budget for the transportation expenses automatically grows. Thus, air transportation is becoming more desirable once higher income levels are achieved by individuals, prompting them to shift from slower and cheaper means of transport to the faster ones like air travel (Ishutkina and Hansman, 2008). These statements explain why air transportation demand changes move together with income or GDP per capita growth. The disaggregate approach shows that lower income groups would have low participation in air travel, while middle income groups represent high growth, but higher income groups reflect the maturity in the air transport.

Alternatively, wealth can be a determinant of air transport demand (Alperovich and Machnes, 1994). The authors use financial and non-financial assets as determinants of wealth to understand air transport demand changes. However, wealth can be assumed as an accumulated sum of income of the individuals.

B. Geographic and Demographic Factors

Demographic Factors

Following the economic factors, demographic factors are the second most widely mentioned notion that is influencing air transport demand. Considering current growth of the world population, it is forecasted that 6 billion will double in around 70 years leading to 13 billion inhabitants on earth. This statement alone promises dynamic growth for the air transport demand. Even though, the relationship between economic factors and air transport growth becomes less inter-dependent, population changes continue to stimulate part of the growth in the air passenger demand. On the other hand, we may assume that there would be a maximum proportion of the population that uses air transportation, and when this greatest proportion is reached, air traveler/population ratio is likely to be constant and is expected to be unresponsive to the further changes in the income and airfares (Graham, 2000).

Increasing population itself has enough dominance to allow air passenger travel to grow for years. Despite the fact that population number is an important factor influencing air travel demand, there could be still substantial travel between less populated cities and remote areas with little population. Furthermore, using purely population as a determinant of air transport demand is also criticized in some researches. For instance, using the ratio of passenger volume to population is recommended to avoid problems especially such as multicollinearity that is caused by using only population number (Alperovicha nd Machnes, 1994).

Air passenger demand depends on population size and density to a certain extent. Bhadra and Wells (2005) underline this fact, ‘‘Passenger demand and the location of airport facilities are shown to be heavily influenced by the location of population and economic activities". As a result, air transportation demand concentrates on these highly populated and urbanized regions, which is also affecting the location selection of the airports.

Globalization has a significant effect on air transportation since it has triggered urbanization process. Urban areas are accommodating most crucial factors of air transport demand: high and densely populated cities, economic magnitude and necessity of being mobile. Dobruszkes *et al*. (2011) find a link between population density and proximity of airports to the densely populated areas. Moreover, due to globalization the urbanization process has prompted immigration from 0rural to urban areas (Graham, 2006).

Geographic Conditions

Various studies relate air transport demand to geographic conditions of the countries. Geographic factors such as location, size, and distances play a pivotal role in determining air transportation demand (Ishutkina and Hansman, 2008). Bhadra and Wells (2005) found that in the U.S. domestic market when the state is larger there is more demand for air travel within this state. This conclusion can be also applied in a wider sense if we think of each state as one country.

On the other hand, the countries, which have improved infrastructure of ground transportation, tend to have less than average air transportation per capita (e.g. France). Especially, high-speed trains have become an indispensible substitute for the air transportation. On the other hand, distances in a straight line between cities are not so long in some countries like Norway, for example, but it takes long time to commute by alternative modes like train or road or some regions are not connected to alternative modes (Fridstrom and Larsen, 1988). There could be two explanations of this fact either an inadequate infrastructure of alternative modes or the topographic conditions of the countries. This observation could also be applied to Ethiopian case due to poor infrastructure driveways and formidable topographic conditions in the country. These factors increase demand for air transportation. High elevated countries are more likely to have higher per capita air transportation than flat countries. Domestic air transportation demand can grow as a result of above-mentioned geographic characteristics of countries.

C. Market Structure

New business models like liberalization in domestic market, competition and bilateral agreements continue to stimulate air travel demand. All of these are result of deregulations in air transportation sector. Deregulations are the milestone of the aviation industry in many countries, and they trigger the increasing demand for air transport by letting new airlines enter the business; For instance, in Europe LCC carrier traffic stimulates major proportion of European passenger demand especially after enlargement of the EU member states (Steiner, et al., 2008). Prices decrease significantly as a result of deregulation and emerging competition (Dargay, Hanly, 2001). Consequently, more people are able to afford flying because it is no longer a luxury good.

Also, usage of alternative modes is directly related to the demand of air transportation. However, provision of alternative modes is not the only factor; also service quality and speed of these modes are important aspects influencing passengers' decision to shift from air transport to other modes (or vice versa). For instance, in Ethiopia high speed buses (like Sky, Selam Buses) have started to compete with the airways in terms of speed and quality of services. However, as it is already mentioned in the previous section topographic structure of the countries do not allow substituting flying with other more competitive (efficient) mode of transport.

3.2 Empirical Literature

In many researches, mathematical methods are used in order to explain the relationship between different factors that are mentioned in air passenger demand. Majority of these researches consists of two different approaches: demand forecast (determinants) and demand elasticity (maturity) analysis. Nevertheless, the main focus of the researches and the variables that are used by these studies significantly vary. Thus, there is a need for a brief summary of these researches and their outcomes.

Dargay and Hanly (2001) use income, airfares, foreign trade, exchange rates and domestic price levels to find out the factors that are affecting air transport demand to and from UK. In the empirical part, this research uses pooled time-series cross-section approach (panel data) with fixed effects model specification, which allows them to have country specific effects. Panel method is used for leisure trips/business trips to 20 countries and non-UK residents' leisure/business trips to and from the UK. The authors prefer to use pooled time-series cross-section approach because of the limited number of observations for time-series model. Eventually, the results clarify that fares have a negative effect on passenger demand while income has a positive effect on it in the UK air transport market. Moreover, income elasticity of UK international leisure air travelers is determined to be 0.43 in the short-run and 1.05 in the long-run which means that one unit change in the income drives number of air travel to increase by 0.43 and 1.05 units, respectively.

Study of Alperovich and Machnes (1994) focuses on deficiency of inclusion of wealth variables in the demand models for air transportation. In this research, the authors found that many time series studies have an autocorrelation problem in the error terms. The study mentions that autocorrelation problem may be the result of model misspecification in previous studies as a result of the way income is represented. Therefore, they use permanent income instead of current income as a determinant of wealth of individuals. They underline that "This practice, however, is at odds with economic theorywhich suggest that permanent rather than current income is the relevant variable which determines demand" (p. 163). Inclusion of the wealth variables (permanent income) in their time series model solved the autocorrelation problem in errors term. Their model includes airfares, financial assets, non-financial assets, average wage, CPI as determinants of passenger demand. Notwithstanding, the study tried to include percentage change in CPI, percentage change in GDP, family size, these variables appeared to have insignificant coefficients and were removed from the model. According to the results of this research, Israel international air travel income elasticity varies between 1.55 and 2.06, which means income changes have a positive effect on total passenger number.

In the similar studies made by Abed et al. (2001) and Ba-fail et al. (2001) establish time series model for the domestic and international air travel demand for Saudi Arabia. They use passenger numbers as a dependent variable and non-oil gross domestic product, consumer price index, imports of goods and services, population size, total expenditures and the total consumption expenditure as explanatory variables. In both studies, they use four different model specifications in order to see forecasting performance of each model. As a result, they found out that the model with population size and total expenditure is the best model to explain passenger demand for both domestic and international air transportation. It means that increasing population and expenditures drive the increase of international and domestic air transport demand. However, the model they built up has deficiencies. Despite the fact that they have considered different models, they do not try to create a model with more explanatory variables.

The research of Fridström and Thune-Larsen (1989) focuses on forecasting air traffic volumes in Norwegian domestic air transportation network. They use pooled cross-section time series data, and fares, travel time, income and population taken as independent variables in the model. Fares and travel times variables are used for air travel and for the fastest surface transportation mode. The results are as expected. Population and income have positive demand elasticities while time fare and travel time have negative demand elasticities. Magnitudes for population and income are 1.46 for each variable. On the other hand, fare and travel time are respectively -1.23 and -0.94 for the long run.

Amongst many others, Graham (2000) has conducted a case study on income elasticity of UK leisure air travel market. According to this study, air travel segments in UK are facing lower income elasticities than before. For instance, according to the outcome of this study, income elasticities of international holidays decreased from 0.74 during period 1970-1988 to 0.55 during period 1984-1998. Also, R-square (explanatory power of model) of the elasticity models decreases, which means that the relationship between income and passenger numbers is diminishing. Accordingly, this leads the author to draw conclusion that the UK leisure air travel market is facing maturity.

Fredrik (2008) estimate the price elasticity of demand for domestic air travel in Sweden. Using national aggregated data on passenger quantities and fares, price elasticities of demand are estimated with an unbalanced, in terms of stationarity, yet well performing model. The analysis also includes estimates of cross-price elasticities for the main transport substitutes to air travel, rail and road. The robustness of the results is enforced by a primitive division of business and leisure travelers. The results indicate that aggregated demand for domestic air travel in Sweden is fairly elastic (-0.84) in the short-run and more elastic (-1.13) in the long-run. The robustness test of the model show that leisure travelers, as defined in the data, are more sensitive to price changes than are business travelers. Furthermore, the cross price elasticity between rail and air travel is found to be 0.44.

Morrison and Winston (1989) investigate the effects of on-time performance on customers' willingness to pay. They find that air passengers have a high value of travel time, close to $35 (in 1989 dollars) an hour. A one percentage increase in on-time performance is consequently valued at $1.21 (in 1989 dollars) per round trip on average. Morrison and Winston conclude that if the most unreliable carriers improved their on-time performance by 25 percentage points, it would have roughly the same value to passengers as a one hour reduction in travel time.

So far different determinants were considered by different researchers to determine the factors that affect the demand for air transportfor different countries. Some of the factors considered in their study were similar to the hypothetical factors included in this study.

In Ethiopian case little researches were conducted on the issue under consideration.Eyob(2001) estimated factors that affect the demand for thedomestic air passenger using Johansen maximum likely hood estimation procedure.The result indicated that airfare,income, and access to alternative means of transport are significantly affecting the domestic air passenger demand.

Generally this study tries to fill the existing gaps in terms of identifying the determinants of domestic air transport demand in Ethiopia by using ARDL model.

CHAPTER 4 MODEL SPECIFICATION AND ESTIMATION PROCEDURES

4.1 Data Source

For the purpose of analyzing the Determinants of Domestic Air transport demand, secondary data source will be used. The main data sources are Ethiopian civil Aviation authority, Ethiopian Airports enterprise, Ethiopian airlines Enterprise, Central Statistical agency, Ethiopian Roads Authority, MoEFED and Ethiopian Road transport authority.

The data was collected from different sources depending on the availability of data and interest of the study. The sources include monthly data of domestic passengers (number of passengers, RPK and ASK) and the yield is obtained from Ethiopian airlines, Number of domestic passengers and aircraft movements by airport from Ethiopian Civil aviation authority and Ethiopian airports enterprise, and Other variables like asphalt road length, price of cross country buses, population and GDP are collected from Ethiopian Roads authority, Ethiopian Road transport authority, CSA and MoEFED respectively.

This study has used quarterly data (2001-2014) for the Econometric analysis. But like several other developing countries, macroeconomic and demographic data of Ethiopia are officially only available at annual frequency. In macroeconomic model building, the frequency at which data are collected is an important consideration. Higher frequency data on macroeconomic and demographic indicators, such as GDP, road length and Population, however, are often required for econometric modeling and for an effective forecasting. Because of the availability of limited annual observations, most researchers largely use subjective methods rather than the objective ones. Further, the use of annual GDP figures with higher frequency financial time-series data also deteriorates the soundness of modeling. Non-availability of a high frequency data is one of the big hurdles faced by the researchers working with time-series data. To cope with this issue researchers suggest different econometric methods in order to convert low-frequency economic time-series data into high-frequency data. When one wants to build a quarterly model of an economy one needs quarterly observations for all variables of the theoretical model.

The statistical software Eviews has in built methods that can be used to approximate unknown quarterly time series. Due to absence of quarterly data for GDP, as most of researchers do, the quarterly data of GDP used in the study are generated from annual data using quadratic-match sum method of series conversion (Kibrom 2008).

The quarterly data of population was generated by the below formula.

Let $\boldsymbol{P_t}$ is population at time t, $\boldsymbol{K_t}$ is annual population growth at time t, and $\boldsymbol{L_t}$ is quarterly population growth at time t.

So $\boldsymbol{K_t = \frac{P_t - P_{t-1}}{P_{t-1}}}$

$$\boldsymbol{Q_{it} = (1 + L_t)^i P_{t-1}} \text{ .... } \textbf{(1)}$$

Since $\boldsymbol{Q_{4t} = P_t}$

$$\boldsymbol{Q_{4t} = (1 + L_t)^4 P_t = P_{t+1} = (1 + K_t) P_t}$$

So $\boldsymbol{1 + L_t = \sqrt[4]{1 + K_t}}$ ....**(2)**

By substituting equation 2 on 1

$$\boldsymbol{Q_{it} = \left(\sqrt[4]{1 + K_t}\right)^i P_{t-1}} \text{ .... } \textbf{(3)}$$

4.2 Variable Description

Population

The population size of a country is an essential determinant of air travel demand. Ethiopia is a predominantly rural country. Addis Ababa, which is in the middle of the country, is by far the largest urban center. Population and agricultural activity are concentrated in the central and northern areas of the country, and the far south and east are only sparsely populated. Ethiopia's infrastructure development therefore tends to be centered in Addis Ababa and to spread from there outward (Foster and Morella, 2010).

The functional relationship between population and the demand for air travel is expected to be positive.

Income

Income is an essential determinant of air transport demand, that's why air travel demand may vary from country to country and from region to region with in a country. The income level used in this model is represented by GDP of the Country.

The functional relationship between income and the demand for air travel is expected to be positive.

Air fare

Transportation cost is a significant determinant of tourism and business demand. The demand for air travel is sensitive to changes in air travel prices. Oum, Waters, and Yong (1992) point out that leisure travelers exhibit elastic demand for air travel.

The demand for air travel, depend apparently on price (fare) level. The measurement of the price of air travel is usually complicated by the presence of fare type (First, Business, Economy and Promotional, etc.). The air fare level in this study is represented by yield per passenger kilometer. Yield passenger kilometer is a measure of average fare paid per kilometer, per passenger. The relationship between air fare and demand for air transport is expected to be negative.

Road Length

In a country like Ethiopia where many places are devoid of other means of transport, there is a perception that some part of the demand for air travel may result from lack of suitable and comfortable means of land transport.

To accommodate this variable in the model the available Asphalt Road Length in kilometers through time is used as a proxy.

The relationship between the asphalt road length and demand for air travel is expected to be negative.

Price of competing Services

The demand for air transport is affected to some extent by the performance of alternative means of transport. This is because of factors such as travel time, frequency, safety and the price level. In this study, the price level is considered the most important variable to determine the substitution effect i.e., to determine the choice either to travel by bus or aircraft as there is no rail service in the country. The effect of price level of competing service on air travel demand is expected to be positive. In this study, the variable that is used as a proxy for the price level of commuting service is the fare charged by 'cross-country buses' on asphalt roads.

4.3 Model Specification

This section presents a simple model that attempts to capture some of the major determinants of scheduled domestic air transport demand in Ethiopia. These determinants include economic factors, geographic and demographic factors, and market structure of the aviation industry. Understanding characteristics and determinants of scheduled domestic air transport demand requires an empirical framework that can be applied to a relatively long time frame. In order to examine the determinants of domestic air transport demand in Ethiopia, the study considers most of these factors. Accordingly, the scheduled domestic air transport demand equation for essential variables can be specified as follows:

$$\mathbf{RDPAX = f(YLD, GDP, RDL, PPL, PCS)} \quad \textbf{(4.1)}$$

From the beginning the researcher transformed all the variables into logarithm to avoid hetroscedasticity (Gujarati, 2004):

$$LRDPAX_t = \alpha_0 + \alpha_1 LYLD_t + \alpha_2 LGDP_t + \alpha_3 LRDL_t + \alpha_4 LPPL_t + \alpha_5 LPCS_t + \varepsilon_t \quad \textbf{(4.2)}$$

Where: **RDPAX** represents number of revenue domestic passengers travels by air in the scheduled domestic air transport network, **GDP** represents gross domestic product, **YLD** represents domestic scheduled air passenger yield in real terms. This variable measures the average revenue obtained per passenger per kilometer. **RDL** stands for Asphalt road length in the country, **PPL** stands for population of the country, **PCS** is price of computing service i.e., the fare level of 'cross country' buses that serve destinations more than 250-km in Asphalt road per kilometer. **ε** stands for the error term which is normally and independently distributed with zero mean and constant variance.

It may be possible to argue that the above model for scheduled domestic air transport demand does not comprehend all the variables that affect the demand. For example, it is possible, intuitively to suggest that the demand function have to be restrictive since there are people in the country who want to travel by air but may not get the access due to lack of the service and the necessary facility in their vicinity. However, it is not possible to get sufficient data in order to estimate a restrictive demand function. Nevertheless, looking at the available data set and reviewing various empirical studies on the same area, this model is expected to give a better insight concerning the determinants of domestic scheduled air transport demand. To this end, therefore, this study attempts to model the most relevant factors in determining the domestic air transport demand in Ethiopia.

4.4 Unit Root Test

It is fundamental to test for the statistical properties of variables when dealing with time series data. Time series data are rarely stationary in level forms. Regression involving non-stationary (i.e., variables that have no clear tendency to return to a constant value or linear trend) time series often lead to the problem of spurious regression. This occurs when the regression results reveal a high and significant relationship among variables when in fact, no relationship exist. Moreover, Stock and Watson (1988) have also shown that the usual test statistics (t, F, DW, and R^2) will not possess standard distributions if some of the variables in the model have unit roots. The other necessary condition for testing unit root test when we apply ARDL model is to check whether the variables enter in the regression are not I(2), which is precondition in ARDL model.

Therefore, it is necessary to test for time series variables before running any sort of regression analysis.

Non-stationary can be tested using Augmented Dickey-Fuller (ADF) test, Phillips Perron (PP) test and Kwiatkowski- Phillips-Schmidt-Shin (KPSS) test. However, to ensure reliable result of test for stationary, the study employs both Augmented Dickey-Fuller (ADF) test and Philip-Perron (PP) tests.

The testing procedure for the ADF unit root test is specified as follows:

$$\Delta \boldsymbol{Y_t} = \boldsymbol{\alpha} + \boldsymbol{\delta T} + \boldsymbol{\gamma Y_{t-1}} + \sum_{i=1}^{\rho-1} \lambda \Delta \boldsymbol{Y_{t-i}} + \boldsymbol{\epsilon_t} \text{ -- } \textbf{(4.3)}$$

Where $\boldsymbol{Y_t}$ is a time series variables under consideration in this model at time t, T is a time trend variable; Δ denotes the first difference operator; $\boldsymbol{\epsilon_t}$ is the error term; $\boldsymbol{p}$ is the optimal lag length of each variable chosen such that first-differenced terms make $\boldsymbol{\epsilon_t}$ a white noise. Thus, the null hypothesis is that $\boldsymbol{Y_t}$ is unit root.

That is: H_0: $\boldsymbol{\gamma}$ =0; H_1: $\boldsymbol{\gamma}$ <0

If the t value or t-statistic is more negative than the critical values, the null hypothesis (i.e.H_0) is rejected and the conclusion is that the series is stationary. Conversely, if the t-statistic is less negative than the critical values, the null hypothesis is accepted and the conclusion is that the series is non-stationary, and also if $\boldsymbol{\gamma} > \mathbf{0}$**,** the series is non-stationary.

4.5 Estimation Procedure

To test the long run relationship between dependent variable (RDPAX) and independent variable (Yield, GDP, Road length, population & price of competing service), the study applies Autoregressive Distributed Lag (ARDL) Model. The study first investigates the time series properties of the data by using Augmented Dickey-Fuller (ADF) and Philip- Perron (PP) tests. The unit root tests will be used to check the stationary of the variables and to check none of the variables are not integrated of order two (I.e. I (2)), which is precondition in applying ARDL model (Pesaran *et al.*, 2001).

4.6 The Autoregressive Distributed Lag Model (ARDL)

A large number of past studies have used the Johansen cointegration and Engle-Granger causality technique to determine the long-term relationships between variables of interest. In fact, this remains the technique of choice for many researchers who argue that this is the most accurate method to apply for I (1) variables. Recently, however, a series of studies by Pesaran *et al.* (1999, 2001); Narayan (2004); have introduced an alternative cointegration technique known as the 'Autoregressive Distributed Lag (ARDL)' bound test. There are numbers of advantages of using ARDL model also called 'Bound Testing Approach' instead of the conventional Engle-Granger two-step procedure (1987), Maximum likelihood methods of cointegration (Johansen, 1988) and Johansen and Juselius (1990).

First, the ARDL model is the statistically significant approach to determine the cointegration relation in small samples as the case in this study (Pesaran *et al.*, 2001; Narayan,2004), while the Johansen cointegration techniques require large data samples for validity. A second advantage of the ARDL approach is that while other cointegration techniques require all of the regressors to be integrated of the same order; the ARDL approach can be applied whether the regressors are purely order zero [I(0)], purely order one [I(1)], or mixture of both. This means that the ARDL approach avoids the pre-testing problems associated with standard cointegration, which requires that the variables be already classified into I(1) or I(0) or mixture of both (Pesaran *et al.*, 2001).

Third, with the ARDL approach it is possible that different variables have different optimal numbers of lags, while in Johansen-type models this is not permitted. Forth, the advantages of bound testing approach in the long run and short run parameters of the model in questions are determined simultaneously (Nasiru, 2012 as cited in Tsadkin, 2013). Finally, applying the ARDL technique can obtain unbiased and efficient estimators of the model (Narayan, 2004).

According to Pesaran *et al.* (2001), the ARDL modeling of unrestricted error correction model using Ordinary Least Square (OLS) can be represented as follows.

$$\Delta \mathbf{Y_t} = \boldsymbol{\beta_0} + \sum_{i=1}^{p-1} \boldsymbol{\beta} \Delta \mathbf{Y_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\alpha} \Delta \mathbf{X_{t-i}} + \boldsymbol{\delta_1} \mathbf{Y_{t-1}} + \boldsymbol{\delta_2} \mathbf{X_{t-1}} + \cup_t \ldots\ldots\ldots\ldots (4.4)$$

Where Δdenotes for first difference operation, $\mathbf{Y_t}$ is for a vector of dependent variables, $\mathbf{X_t}$ is a vector of **p** determinants of $\mathbf{Y_t}$ regressors, $\mathbf{U_t}$ is the residual term which is assumed to be white noise. Basically, the ARDL approach to co-integration (See Pesaran *et al.* 2001) involves estimation of the error correction model (ECM) version of ARDL model.

$$\Delta LRDPAX_t = \alpha_0 + \sum_{i=1}^{p-1} \beta_0 \Delta LRDPAX_{t-i} + \sum_{i=1}^{p} \beta_1 \Delta LYLD_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta LGDP_{t-i} + \sum_{i=1}^{p} \beta_3 \Delta LRDL_{t-i} + \sum_{i=1}^{p} \beta_4 \Delta LPPL_{t-i} + \sum_{i=1}^{p} \beta_5 \Delta LPCS_{t-i} + \theta_0 LRDPAX_{t-1} + \theta_1 LYLD_{t-1} + \theta_2 LGDP_{t-1} + \theta_3 LRDL_{t-1} + \theta_4 LPPL_{t-1} + \theta_5 LPCS_{t-1} \ldots\ldots (4.5)$$

Where RDPAX is number of domestic revenue air passenger at time t, YLD airline passenger yield in real terms, GDP is real gross domestic product, RDL is Asphalt road length, PPL is population and PCS is price of cross country buses, u is the residual term, which is assumed to be white noise, **p** is the optimal lag length and **L** is natural logarithm.

The bounds test is mainly based on the joint Wald test or F- test which its asymptotic distribution is non-standard[1] under the null hypothesis of no cointegration. The null hypothesis for no co-integration in the long-run among the variables in equation **(**4.5**)** is:-

H_0: $\theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = 0$(meaning no long run relationship among the variables) against the alternative one:

H_1: $\theta_0 \neq 0 \; or \; \theta_1 \neq 0 \; or \; \theta_2 \neq 0 \; or \; \theta_3 \neq 0 \; or \; \theta_4 \neq 0 \; or \; \theta_5 \neq 0$**.**

In order to test the existence of long-term relationship among the variables, equation **(4.5)** had to be estimated applying OLS. To test the significance of lagged level of the variables under consideration, the appropriate statistic is **F** or Wald test as Pesaran *et al.* (2001) proposed for bound test approach will be applied.

According to Pesaran *et al.* (2001), there are two sets of critical value bounds for all classifications of regressors' namely upper critical bound value and lower critical bound value. The critical values for I (1) series are referred to as upper bound critical values; while the critical values for I (0) series are referred to as lower bound critical values. If the calculated **F** statistic is greater than the upper bound critical values, we reject the null hypothesis of no long run relationship among the variables. If the calculated **F** statistic is less than the lower bound critical values, we fail to reject the null hypothesis of no cointegration among the variables. However, if the calculated **F** statistic is between the upper and lower bound critical values, inference is

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1

(1) Whether the variables included in the model are I(0), or I(1), **(2)**The numbers of regressors, and **(3)** Whether the model contains an intercept and/or a trend (Narayan, 2004).

inconclusive and we need to have knowledge on the order of integration of underling variables before we made conclusive inference (Pesaran *et al.*, 2001).

However, in this study we are not going to follow the bound critical value developed by Pesaran *et al.* (2001) because of the computed critical values are based on large sample size (500 and more). Rather, a relatively small sample size in this study of 56 quarterly observations, we will use the critical values developed by Narayan (2004) which was developed based on small sample size between 30 and 80 observations.

If there is an evidence of long-run relationship (cointegration) of the variables, the following long-run ARDL (P_1, P_2, P_3, P_4, P_5, P_6) model can be estimated.

$$LRDPAX_t = \alpha_0 + \sum_{i=1}^{p-1} \beta_0 LRDPAX_{t-i} + \sum_{i=1}^{p} \beta_0 LYLD_{t-i} + \sum_{i=1}^{p} \beta_0 LGDP_{t-i} + \sum_{i=1}^{p} \beta_0 LRDL_{t-i} + \sum_{i=1}^{p} \beta_0 LPPL_{t-i} + \sum_{i=1}^{p} \beta_0 LPCS_{t-i} + \varepsilon_t \qquad (4.6)$$

Here all variables are as previously defined. The orders of the lags in the ARDL Model is selected by either the Akaike Information criterion (AIC) or the Schwarz Bayesian criterion (SBC), before the selected model is estimated by ordinary least squares. We use the Akaike Information criterion (AIC) in lag selection because of its advantages for small sample size (Tsadkan, 2013) as it is the case in this study. Determination of the optimal lag length is so crucial in ARDL model, because it helps us to address the issue of over parameterizations and to save the degree of freedom (Taban, 2010) as cited in Tsadkan (2013).

In the presence of cointegration, short-run elasticity can also be derived by constructing an error correction model of the following form:

$$\Delta \boldsymbol{LRDPAX_t} = \boldsymbol{\alpha_0} + \sum_{i=1}^{p} \boldsymbol{\beta_0}\, \Delta \boldsymbol{LRDPAX_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_1}\, \Delta \boldsymbol{LYLD_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_2}\, \Delta \boldsymbol{LGDP_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_3}\, \Delta \boldsymbol{LRDL_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_4}\, \Delta \boldsymbol{LPPL_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_5}\, \Delta \boldsymbol{LPCS_{t-i}} + \boldsymbol{\gamma ECT_{t-1}} \ldots\ldots \textbf{(4.7)}$$

Where, ECT_t is the error correction term, defined as:

$$Ect_t = LRDPAX_t - [\boldsymbol{\alpha_0} + \sum_{i=1}^{p} \boldsymbol{\beta_0}\, \Delta \boldsymbol{LRDPAX_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_1}\, \Delta \boldsymbol{LYLD_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_2}\, \Delta \boldsymbol{LGDP_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_3}\, \Delta \boldsymbol{LRDL_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_4}\, \Delta \boldsymbol{LPPL_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_5}\, \Delta \boldsymbol{LPCS_{t-i}}] \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(4.8)}$$

Here Δ is the first difference operator; β's are the coefficients relating to the short-run dynamics of the model's convergence to equilibrium, and γ measures the speed of adjustment.

CHAPTER 5 RESULTS AND DISCUSSION

5.1 Descriptive Statistics

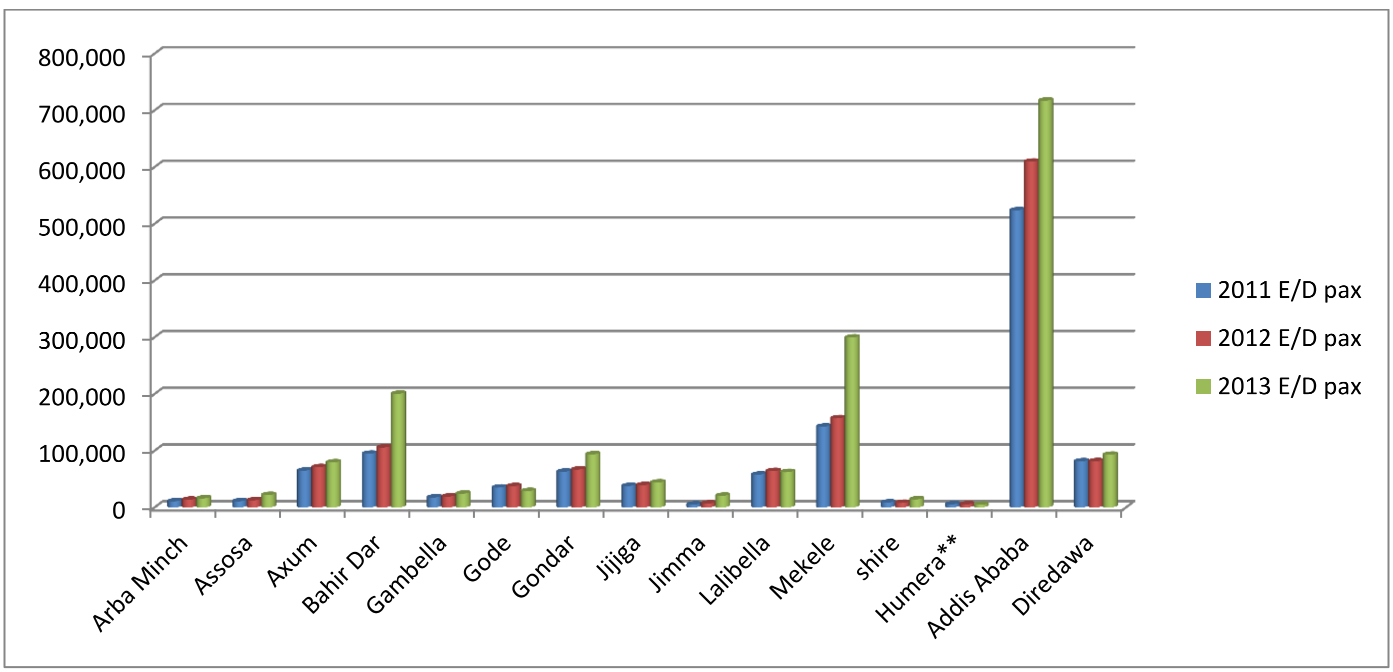
Table 5.1 below shows that the number of revenue domestic passenger was increasing. The average growth rate for the last 8 years was 12.99%.The maximum growth rate was attained in year 2011/12 (16.70%) while the minimum was attained in year 2010/11(9.36%)

Table 5.1 Domestic air passenger travel

Year	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
RDPAX	305,165	351,377	388,666	428,406	468,519	546,747	618,864	716,194
Growth rate		15.14	10.61	10.22	9.36	16.70	13.19	15.73

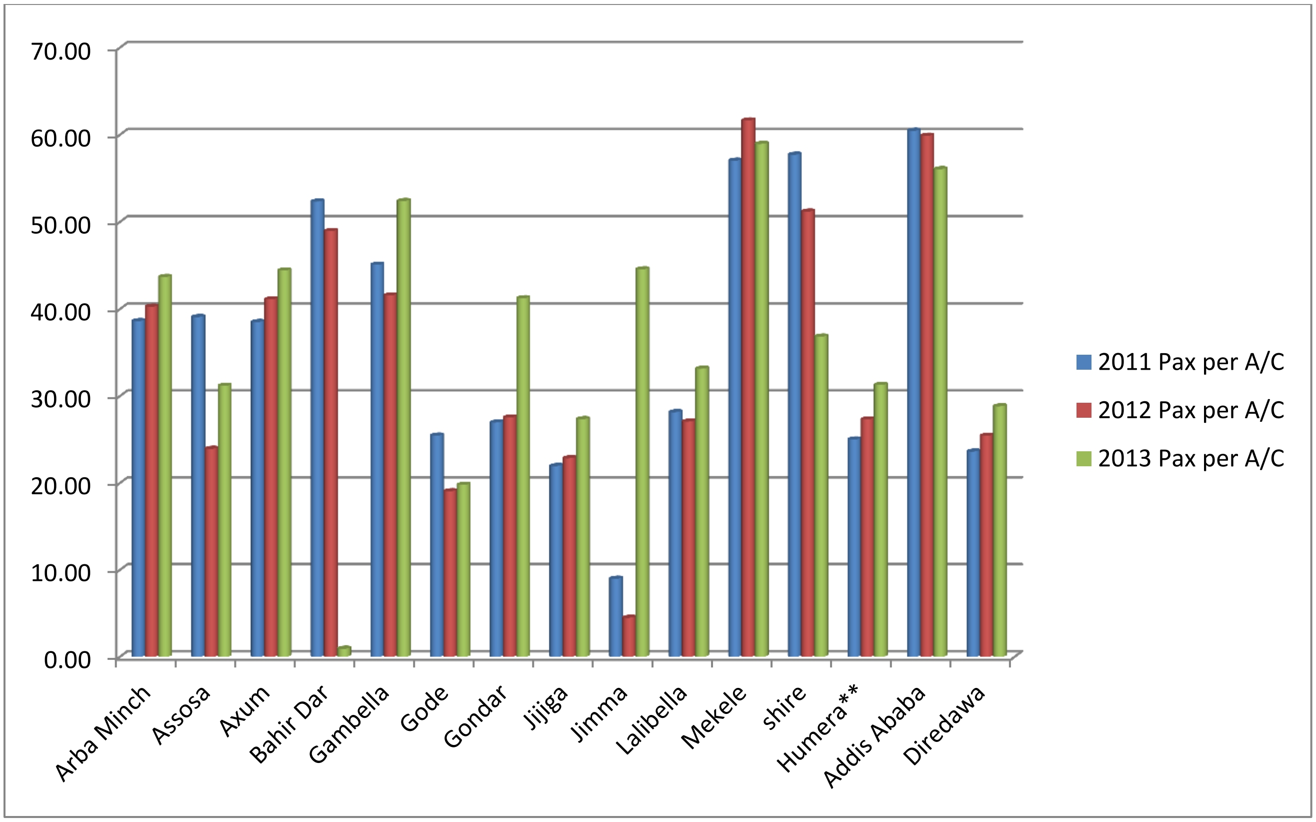
Source EAL

Figure 5.1. Enplaned and deplaned of passengers in the major 15 airports in Ethiopia



From the above figure Addis Ababa , Mekelle and Bahirdar are the three biggest airports that serves more passengers. This is associated with the increasing economic activities within these cities as they are Federal city and regional cities. Humera, Shire and Jimma are on the bottom of air transport traffic.

Figure 5.2. Passenger per aircraft on the top 15 airports



From the above graph Mekelle, Addis ababa, Shire and Bahirdar are the largest airports by the passenger per aircraft. And Jimma, Gode, Jigjiga and Diredawa are the least airports by their passenger per aircraft. Shire airport was one of the smallest airports by their enplaned and deplaned passengers but the airport was one of the largest air ports by their passenger per aircraft. This indicates that there is a supply shortage on Shire.

Generally from figure 5.1 and 5.2, one can easily understand that there is a high demand of domestic air transport in the northern part of the country, but the demand for air transport was low in the Eastern part of the country.

5.2 Empirical Results

Unit Root Test

Many macroeconomic time series contain unit roots that are characterized by the existence of stochastic trends as developed by Nelson-Plosser (1982). Unit root test is significant in examining the stationary of a time series because the non-stationary regressor rejects many empirical results. The existence of the stochastic trend is determined by the unit root test of time series data. In this study, the unit root is tested using the Augmented Dickey-Fuller (1979) and

Phillips-Perron tests (1988).

Unlike other co-integration tests, an ARDL bounds testing approach to co-integration do not require same order of integration for all variables. However, since the bounds test is developed on basis that the variables are I(0) or I(1), prior to applying the bounds test procedure, the implementation of unit root tests might still be necessary in order to ensure that all the variables satisfy the underlying assumption. Moreover, ARDL cannot be used for I(2) variables. Hence, Augmented Dickey Fuller (ADF) and PP tests are applied to examine the order of integration.

Table 5.2: Unit Root Test (ADF and P-P tests)

Variable	With Intercept Only				Trend and Intercept			
	ADF test		P-P test		ADF test		P-P test	
	At Level	At First Difference	At Level	At First Difference	At Level	At First Diference	At Level	At First Diference
LRDPAX	4.37	-1.91	7.90***	-4.39***	1.10	-6.51***	1.11	-6.08***
LYLD	-1.08	-5.99***	-1.08	-6.00***	-3.56**	-6.00***	-2.32	-6.00***
LGDP	3.93	-4.01***	3.61***	-4.01***	-0.21	-5.06***	-0.32	-5.06***
LPPL	1.32	-7.79***	3.28**	-8.10***	-1.98	-8.21***	-1.95	-10.32***
LRDL	0.73	-5.23***	1.31	-5.16***	-1.60	-5.48***	-1.43	-6.88***
LPCS	-0.94	-5.09***	-0.97	-5.11***	-2.19	-5.02***	-2.18	-5.04***

Source: Eviews result

Note: ***, ** and * signs indicate the significance of coefficients at 1% , 5% and 10% level respectively.

The result on Table 5.2 shows that all variables are stationary in their first difference. Since there is no I(2) on both tests, so we can apply the ARDL approach (Bounds test approach of co-integration) developed by Pesaran, Shin, and Smith(2001).

Model Stability and Diagnostic Test

To check the verifiability of the estimated long run model, some diagnostic test is undertaken. The results reported in Table 5.3 indicate that there is no autocorrelation in the residual and hetroscedasticity, and the errors are normally distributed. In addition the Ramsey functional form test confirms that the model is specified well .Hence, the relationship between the variables is verifiable or valid.

Table 5.3. Long –run diagnostic tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1)= 2.5165[.094]	F(1, 31)= 2.5027[.131]
B:Functional Form	CHSQ(1)= .29198[.589]	F(1, 31)= .14317[.710]
C:Normality	CHSQ(2)= 1.7251[.422]	Not applicable
D:Heteroscedasticity	CHSQ(1)= .042173[.837]	F(1, 51)= .039939[.843]
$R^2 = 0.997$ $\bar{R}^2 = 0.996$ DW = 2.29		
A: Lagrange multiplier test of residual serial correlation		
B: Ramsey's RESET test using the square of the fitted values		
C: Based on a test of skewness and kurtosis of residuals		
D: Based on the regression of squared residuals on squared fitted values		

Source: Microfit 4.1 results

The above table indicates that the long run ARDL model estimated in this study passes all the diagnostic tests. This is because the p-value associated with both the LM version and the F version of the statistic was unable to reject the null hypothesis specified for each test. Therefore based on the result of the test:

(A) The null hypothesis of no serial correlation (Brush Cod fray LM test) is failed to reject for the reason that that the p-values associated with test statistic is greater than the standard significant level (I.e. 0.094> 0.05). Her LM test for testing serial correlation is applied because unlike the traditional Durbin Watson test statistic which is totally inapplicable when the lagged dependent variable appear as a regressors, LM test avoid such limitation of DW test.

(B) We could not reject the null hypothesis test for Ramsey's RESET test, which tests whether the model suffers from omitted variable bias or not. As the test result indicates that we can't reject the Ramsey's test, which means that the model is correctly specified.

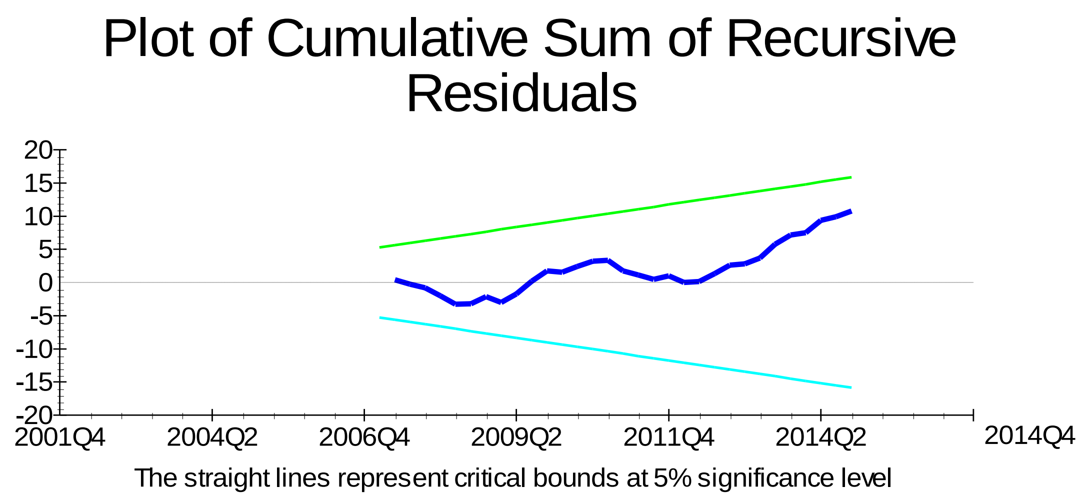
(C) The third diagnostic test is about the residual test. As the result indicates that we could not reject the null hypothesis which says that the residuals are normally distributed, for the reason, that the p-value associated with the Jaque-Berra normality test is larger than the standard significance level (i.e. 0.422>0.05).

(D) The last diagnostic test is for hetroscedasticity test. As we have seen from the above table, we can reject at 5% significant level due to its p-value associated with the test statistics are greater than the standard significance level(I.e. 0.837> 0.05).

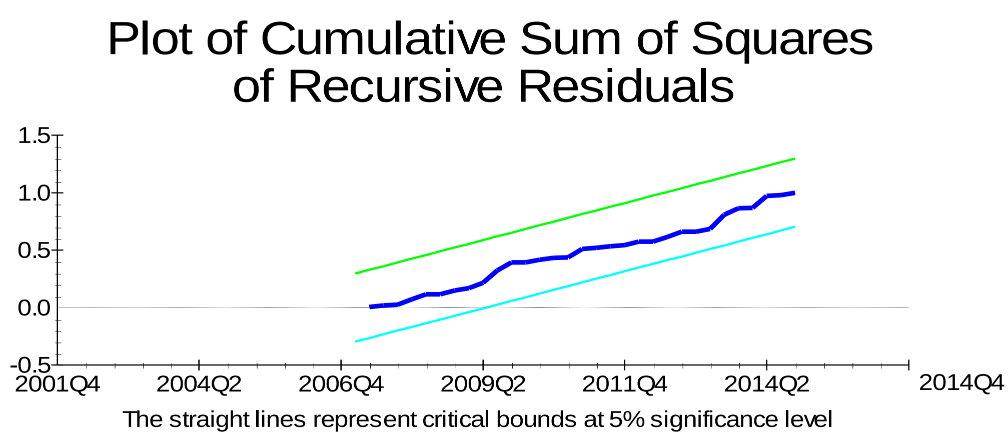
In addition to the above diagnostic tests, the stability of long run estimates has been tested by applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are recommended by Pesaran and Shin (1999, 2001).

Since the test statistics of this stability tests can be graphed, we can identify not only their significance but also at what point of time a possible instability (structural break) occurred. If the plot of CUSUM and CUSUMSQ statistic moves between the critical bounds (at 5% significance level), then the estimated coefficients are said to be stable.

Figure 5.3: Testing parameter stability using CUSUM and CUSUMSQ test



Source: Microfit 4.1 results



Source: Microfit 4.1 results

As can be seen from the figures, the plot of CUSUM test did not cross the critical limits. Similarly, the CUSUMSQ test shows that the graphs do not cross the lower and upper critical limits. So, we can conclude that long and short runs estimates are stable and there is no any structural break. Hence the results of the estimated model are reliable and efficient.

Long-run ARDL Bounds Test For Co-integration

The first task in the bounds test approach of co-integration is estimating the ARDL model specified in equation (4.4) using the appropriate lag-length selection criterion. In this paper Akaike Information Criterion (AIC) was taken as a guide and a maximum lag order of 2 was chosen for the conditional ARDL model. Then F-test through the Wald-test (bound test) is performed to check the joint significance of the coefficients specified in equation (4.4). The Wald test is conducted by imposing restrictions on the estimated long-run coefficients of passenger, airfare (Yield), income (GDP), price of computing services, road length and population. The computed F-statistic value is compared with the lower bound and upper bound critical values provided by Pesaran et al. (2001) and Naraya(2004).

Table 5.4. F-statistics of Cointegration Relationship

Lag Length	Value of calculated F-Statistics
2	7.437[0.009]

Source: Eview 7.0 result

As it is depicted in Table-5.4 above, with an intercept and trend, the calculated F statistics 7.437 is higher than the Pesaran, Shin, and Smith (2001) and Narayan (2004) upper bound critical values at 1% level of significance. This implies that the null hypothesis of no long-run relationship is rejected; rather we accept the alternative hypothesis of there is long-run relationship based on the Pesaran, Shin, and Smith (2001) and Narayan (2004) critical values at 1% level of significance. Therefore, in the long run there is cointegration relationship among the variables.

Table 5.5.the upper and lower critical values

Critical Value	Pesaran et al. (2001)		Narayan (2004)	
	Lower Bound value	Upper bound value	Lower Bound value	Upper bound value
1%	5.15	6.36	4.77	6.33
5%	3.79	4.85	3.43	4.523
10%	3.17	4.14	2.83	3.73

Source: Pesaran et al. (2001) and Narayan (2004) critical values.

Long Run ARDL Model Estimation

After confirming the existence of long-run co-integration relationship among the variables, the estimated long-run relationships between the variables are estimated and the estimated coefficients are reported in Table 5.6.

Table 5.6. Estimated long run coefficients using the autoregressive Distributed Lag Approach: ARDL (2, 0, 1, 0, 1, 0) selected based on Akaike information Criterion.

Dependent variable is LRDPAX				
Regressors	Coefficient	Standard Error	T-Ratio	Prob
LYLD	-0.0410**	0.0173	-2.3721	0.025
LPCS	0.0630***	0.020199	3.1199	0.009
LGDP	0.2960**	0.126781	2.4002	0.024
LRDL	0.00390	0.042312	0.09225	0.927
LPPL	0.1905***	0.04398	4.3316	0.000
CONS	9.0385	0.33732	26.7951	0.000

Source: Microfit 4.1 results

Note: The ***, ** and * sign indicates the significance of the coefficients at 1%, 5% and 10% significant level respectively.

The above result indicates that the sign of road length is unexpected and insignificant. This is directly related with the road network available in the country to affect the air transport sector. According to Semen (2015), though there is a huge increase in road length which lets the road density to increase, the road network available in the country still lags even to sub-Saharan standard. He noted that since 1997 GC, the government of Ethiopia using the Road Sector Development Program (RSDP) has focused on rehabilitation and expansion of the main paved and unpaved roads and important regional roads. As a result the total road density has increased from 24.1 to 90.5 km per 1000 sq. km and from 0.46 to 1.1 km per 1000 population from 1997 GC-2014 GC. According to Ken, et al (2008) as sited in Semen(2015), Sub-Saharan Africa has a density of 204 kilometers of road per thousand square kilometers of land area, where one quarter are paved. The world average density is 944 kilometers per thousand square kilometers, with over half paved. Sub- Saharan Africa has a total road network of 3.6 kilometers per thousand persons, while the world average is 7.07 kilometers. This all imply that Ethiopia has such a low level of road infrastructure that even doubling it leaves the country with an insufficient network.

The airfare (proxy by yield), income (proxy by GDP, price of competing services and population have statistically significant with expected signs. As we have discussed in the theoretical and empirical literature parts, income, price of competing service and Population have positive impact on Domestic Air passenger demand. Whereas airfares have a negative impact. This could be due to the reason that Economic theory suggests negative relationship between price and demand for the most of the goods and services.

Since the coefficients of the logarithmic regression model represent elasticity of the corresponding independent variables, the effect of a percentage change in any variable on the demand can be determined. Holding other variables constant, as population goes up by 1 percent, on the average the demand for air transport will also go up by 0.19 percent. In similar vein, as the income (proxy by GDP) increase by 1 percent will be met by a corresponding increase of 0.29 percent in domestic air transport travel. Holding other things constant as the price of competing services increase by 1 percent, the demand for air transport will increase by 0.063 percent. But as the air fare increase by 1 percent, the demand for air transport will decrease by 0.063 percent holding other things constant.

Short-run Error Correction Estimates

After the acceptance of long-run coefficients of the equation, the short-run ECM model is estimated. The error correction term (ECM), indicates the speed of adjustment to restore equilibrium in the dynamic model. It is a one lagged period residual obtained from the estimated dynamic long run model. The coefficient of the error correction term indicates how quickly variables coverage to equilibrium. Moreover, it should have a negative sign and statistically significant (i.e. p-value should be less than 0.05).

Table 5.7: Error correction representation for the selected ARDL (2, 0, 1, 0, 1, 0) selected based on Akaike information Criterion.

Dependent variable is DLRDPAX				
Regressor	Coefficient	Standard Error	T-Ratio	Prob
DLYLD	-0.30152**	0.14422	-2.0907	0.045
DLPCS	-0.019941	0.02371	-0.84107	0.407
DLGDP	0.2012**	0.084082	2.3929	0.029
DLRDL	-0.0094811	0.01712	-0.55379	0.584
DLPPL	0.14772***	0.051811	2.8512	0.008
ECM(-1)	-0.6202***	0.19093	-3.2547	0.003
R^2 = 0.69343			$\bar{R}^2$ = 0.59298	
F-stat. F(7, 45) 4.4288[.001]			DW = 2.1857	

Source: Microfit 4.1 results

The equilibrium error correction coefficient, estimated -0.6202 is highly significant, has the correct sign, and imply a very high speed of adjustment to equilibrium after a shock. Approximately 62 percent of the disequilibrium from the previous year's shock converges back to the long-run equilibrium in the current year. Such highly significant Error correction term is another proof for the existence of a stable long run relationship among the variables (Banerjee, et al., 2003).

The estimated short-run model reveals that income (GDP), population and airfares are the main contributor to domestic air transport demand. When income increases by one percent, the domestic air travelers increases by 0.20 percent. In the same manner as population increase by one percent, the domestic air passengers also increase by 0.15 percent. But airfares has significant negative short run impact. When airfares increases by one percent, the domestic for air transport decreases by 0.30 percent.

But, unlike its long run significant impact, price of competing services has insignificant short run impact on the domestic air transport demand. Road length has insignificant long run and short run impact on domestic air transport demand.

CHAPTER 6 CONCLUSION AND POLICY RECOMMENDATION

6.1 Conclusion

The main objective of this study is to analyze the determinants of domestic air transport demand in Ethiopia during the specified period (2000/2001 – 2013/14). To determine the long run and short run relationship among the variables, Autoregressive Distributed Lag (ARDL) model was applied. Before applying the ARDL model, all the variables are tested for their time series properties (stationarity properties) using the ADF and PP tests. As a result, All variables are stationary (no unit root problem) at their first difference.

Next to testing for time series property, the model stability was done by testing the diagnostic testing techniques. The result revealed that no evidence of serial correlation, no functional form problem (the model is correctly specified), the residual is normally distributed and no evidence of hetroscedasticity problem. As the result of bound test (F-statistic) value is larger than the upper bound critical value both for Pesaran et al.(2001) and Narayan(2004), which indicates there is a long run relationship between the number of domestic air passenger and its determinants (GDP, yield, price of competing services, road length and population).

The empirical result showed that income and Population have positive impact on Domestic Air passenger demand during the study period and statistically significant at 5 and 1 percent significance level respectively. A one percent increase in income (GDP) results in 0.29 and 0.2 percent increase in air passenger travel in long run and short run, respectively. Likewise, a one percent increase in Population will result in 0.19 and 0.15 percent increase in air passenger travel in long run and short run, respectively.

The other finding of this study is the insignificant impact of airfares and price of computing services in air passenger travel during the study period. From this one can understand that airfares and price of computing services was not significantly harming the domestic air passenger demand during the study period.

Moreover, this study has found out that there is a high demand of air passengers in Ethiopia but the supply was not enough. This can easily be understood by comparing the average load factor for the last 14years which is estimated to be 75.81 %.

When we compare airports available in the country; Addis Ababa, Mekelle and Bahirdar airports are found to be the three biggest airports that serves more passengers. In addition Mekelle, Addis ababa, Shire and Bahirdar airports are the largest airports by the passenger per aircraft while Jimma, Gode, Jigjiga and Diredawa are the least airports by their passenger per aircraft. Shire airport was one of the smallest airports by their enplaned and deplaned passengers but the airport was one of the largest air ports by their passenger per aircraft.

6.2 Policy Recommendations

Based on the finding of the study, the following recommendation has been given.

- To properly utilize the benefit obtained from the growing population in Ethiopia, more number of airports should be built and more number of planes should be purchased giving more attention on region's magnitude. That is, giving more weight for regions which do have a crowded populations and a greater local market than for a region which holds a relatively small population. Greater regions provide a broader local market potential for products and services as well as offer a better labor force possibilities.

- Air transport development is a warming factor for remote regions due to its economic growth supporting function. And economic growth also considered to be a factor for air transport development. The effect is bi-directional. The notable economic sector that contributes significantly to the air transport sector is the tourism sector. The growth in the tourism sector has direct link to the demand for domestic passengers air transport. It is therefore recommended that this sector should be promoted through implementing the sustainable tourism master plans that brings regional integration through the promotion of trade in services and subsequently towards Continental Free Trade Area.

- Enhancing the capacity and competition in the overall domestic passenger air transport service so that the private airlines can operate on the scheduled operation
- Since the domestic air transport in not virtually deregulated it is recommended to design a detailed policy guidelines regarding price, entry, route, etc. that encourages private investors so as to create a better environment for competition and to increase the available choice of service for the public at large.
- In general the national governments should utilize some tools including giving freedom to airline sector and airport developments in order to reshape the air transport network improvements.

REFERENCES

Abed, S., Ba-Fail, A., & Jasimuddin, S.. (2001), An econometric analysis of international air travel demand in Saudi Arabia. *Journal of Air Transport Management,* 7(3), 143–148.

Abreham Goitom Ed (1979), The Ethiopian Civil Aviation Adminstration Journal. Addis Ababa Ethiopia

Aderamo, A (2010), *Demand for Air Transport in Nigeria.* Department of Geography. University of Ilorin. Ilorin. Nigeria.

Alperovich, G., and Machnes, Y. (1994), The role of wealth in the demand for international air travel. *Journal of Transport Economics and Policy*, 28(2), 163–173.

AsfawesenZenebe and AyalnehAbebe (1986), *the History of Aviation Development in Ethiopia*, Ethiopian Civil Aviation Administration, unpublished.

ATAG.(2007), *The Economic and Social Benefits of Air Transport*. Air Transport Action Group. Geneva Switzerland.

ATAG.(2012), Aviation & Environment Summit. Air Transport Action Group.

ATAG, (2015), Global Sustainable Aviation Summit. Geneva Switzerland.

Ba-fail, A.O., Abed, S.Y., and Jasimuddin, S.M. (2000), the determinants of domestic air travel demand in the Kingdom of South Arabia. *Journal of Air Transportation World Wide*, 5(2),

Bahru, Zewde (1988), *Bringing Africa Together: The Story of Ethiopian Airlines*, Ethiopian Airlines, Addis Ababa, Ethiopia.

Banerjee, A., Dolado, J., Galbraith, J., and D. Hendry (2003), *Co-integration, Error Correction, And the Econometric Analysis of Non-stationary Data: Advanced Text in Econometrics* New York: Oxford university press

Bhadra, D., & Wells, M. (2005), Air travel by state: Its determinants and contributions in the

United States. *Public Works Management & Policy*, 10, 119-137.

Boeing Commercial Airplane Company (BCAC), (1993). Airline Evaluation Seminar. London.

Civil Aviation Authority 2011, ‘An overview of Ethiopian Air Transportation’ Ethiopian Civil Aviation Authority, Addis Ababa, Ethiopia.

Cole S (1998),. *Applied Transport Economics*. London: Kegan Page Ltd.

Dargay, J., and Hanly, M. (2001), The determinants of the demand for international air travel to and from the UK. Paper presented at *the 9th World Conference on Transport Research*, Edinburgh, Scotland, May, 2001.

Demirsoy, C. (2012), *Analysis of Stimulated Domestic Air Transport Demand in Turkey*. What are the drivers? Masters Research Thesis.School of Economics.Erasmus University. Rottedam.

Dickey, D. and W. Fuller (1979), Distribution of the Estimatorsfor Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association*,74, 427-431.

Dobruszkes, F., Lennert, M., andHamme, G. V. (2011), An analysis of the determinants of air traffic volume for European metropolitan areas. *Journal of Transport Geography*, 19,755-762.

Doganis R. (1985), *Flying off course*. London: Harper Collins academic publishers Inc.

Elijah Chingosho (2012), *Importance of aviation safety to air transport and economic development*, Abuja, Nigeria.

Engle F. and Granger J. (1987), “Co-Integration and Error correction: Representation, Estimation And Testing”, *Journals of Econometrica*, Vol 55, No 2: 251-276

Eric Tchouamou Njoya.(2013), “Air Transport and Destination Performance – A case study of three African countries (Ethiopia, Kenya and South Africa)”

Erma Suryani, Shuo-Yan Chou, Chih-Hsien Chen (2009), “Air passenger demand forecasting and passenger terminal capacity expansion: A system dynamics framework”

Ethiopia Airlines press released 21 Nov 2008

Ethiopia Airlines press released 1 Sep 2014.

Ethiopian airlines fact sheet 28 Oct 2014.

Ethiopian airlines fact sheet 28 Oct 2014.

Ethiopian airlines Fact sheet may (2015).

Ethiopian Civil aviation authority (2007), unpublished.

Ethiopian Civil aviation authority (2011).

Ethiopian Civil aviation authority (2014), unpublished.

Ethiopian Civil aviation authority (2016), *History of civil aviation in Ethiopia*.Retrived on feb 2016 @ <www.ecaa.gov.et/image/history.pdf>.

Eyob Estifanos (2001), *Demand for Domestic Air Transport in Ethiopia*, Degree of Master of Science (MSc.), Department of Economics, Addis Ababa University, Ethiopia.

Foster, V. & Morella E. (2010), *Ethiopia’s Infrastructure*: A Continental Perspective, World Bank, Washington, D.C.

Fredrik Kopsch (2008), *A demand model for domestic air travel in sweden***,** Centre for Transport Studies, Royal Institute of Technology.

Fridström, L., & Thune-Larsen, H. (1989), An econometric air travel demand model for the entire conventional domestic network: The case of Norway. *Transportation Research,* 23(3), 213–223

Graham, A. (2000), Demand for leisure air travel and limits to growth. *Journal of Air Transport Management*, 6, 109-118.

Gujarati, D. (2004), *Basic Econometrics*, Fourth Edition, the McGraw−Hill Companies

Helina Teferra Ed.(2001), Tiret vol. 5 No. 2, *the MIDROC Ethiopia Group Magazine*.

ICAO 2002, Economic Contribution of Civil Aviation

IATA annual review 2013,69th Annual General Meeting, Cape Town, June 2013

Ishutkina, M. and Hansman, R. J. (2008), *Analysis of interaction between air transportation and economic activity.* A Worldwide Perspective.(Doctoral dissertation).Massachusetts Institute of Technology.

Johansen S. (1988), "Statistical Analysis of Cointegration Vectors", *Journal of Economic Dynamics and Control* Vol. 12, 231-254, North-Holland

Johansen S., and Jtiselius K. (1990), "Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*. Vol. 52, No. 2 , pp. 169-210

Kibrom Tafere (2008), *The sources of the recent inflationary experience in Ethiopia*: Degree of Master of Science (MSc.), Department of Economics, Addis Ababa University, Ethiopia.

Lovink j. (1997), "National Airports development plan" , unpublished

Marazzo, M., Scherre, R., &Fernandes, E. (2010), Air transport demand and economic growth in Brazil: A time series analysis. *Transportation Research* Part E, 46, 261- 269.

Mayer, R and Oster Jr. (1987) deregulation and the new Airline Entrepreneurs. London: Edwards

Megersa A.(2013), Economic Effects of Air Transport Liberalization in Africa. Swedish National Road and Transport Research Institute.

Morrison, S.A., and C. Winston (1989), Enhancing the Performance of the Deregulated Air transportation System. *Brookings Papers on Economic Activity: Microeconomics*, Vol. 1, pp. 61-123.

Narayan K. (2004)," Reformulating Critical Values for the Bounds F-statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji", Discussion Papers No 02, Monash University, Victoria, Australia.

Nasiru I. (2012), "Government expenditure and economic growth in Nigeria; cointegration Analysis and causality testing," *Journal of Academic International*, Vol 2, No 2, PP.718- 723

Nelson, C.R. and C.I. Plosser (1982), Trends and Random Walks in Macroeconomic Time Series, *Journal of Monetary Economics*, 10,129-162.

Nyaringo, Y (1964), 'The Ethiopian Airlines', Senior essay (BA Degree), Department of Economics, Addis Ababa University, Ethiopia.

Olebogeng david daw (2013), The determinants of domestic air passenger demand in the republic of South Africa. *Mediterranean Journal of social Sciences MCSER publishing*, Rome-Italy vol 4 no 13 page 389-396 (nov 2013)

Oum, T.H., Waters, W.G., Yong, J.S., (1992), Concepts of price elasticities of transport demand and recent empirical estimates.*Journal of Transport Economics and Policy* 26(2), pp.139–154.

Pesaran, M. and Shin, Y. (1999), "An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis" in S. Strom, Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch centennial Symposium, Cambridge University Press, Cambridge.

Pesaran M.H., Shin Y. and R.J. Smith (2001), "Bound Testing Approach to the Analysis of Level Relationships", *Journal of Applied econometrics*, Vol.16, pp 289-326

Phillips, P.C.B. and P. Perron (1988), Testing for Unit Roots in Time Series Regression, Biometrika, 75, 335-346

Selamawit G/egziabher (2012), “Why Ethiopian Airlines Becomes Successful and What are the Lessons for other PublicCompanies?”, MSc thesis, Addis Ababa University, Ethiopia

Semen, Bekele (2015), *Economy Wide Impact of Investment in Road Infrastructure in Ethiopia*: A Recursive Dynamic Computable General Equilibrium Approach: A Thesis Submitted to the Department of Economics in Partial Fulfillment of the Requirements for the Degree of Master of Science in Economics (Economic Policy Analysis)

Steiner, J. E. (1967), Aircraft evolution and airline growth.*Financial Analysts Journal*, 23(2), 85-92.

Steiner, S., Bozicevic, A., & Mihitec, T. (2008), Determinants of European air traffic development. Transport Problems.

Stock H. James and Waston Mark W. (1988), “Variable Trends in economic time series”, *The Journal of economic perspectives*Vol 2, No 3(summer, 1988), 147-174

Suzuki, Y. (2000), The Relationship between On-Time Performance and Airline Market Share: A New Approach. *Transportation Research Part E*, Vol. 36, pp. 139-154.

Taban S. (2010), “An examinations of governmental spending economic growth nexus for Turkey using the bound test approach“, International research journal of finance and Economics, Issue 48 (2010), pp.184-193

Tsadkan A. (2013), “The nexus between public spending and economic growth in Ethiopia: Empirical investigation”, unpublished Master thesis, Addis Ababa University

Wells, A.T. (2005), *Air Transportation.* A Management Perspective. 2nd edition. Wadsworth. USA.

APPENDICES

Appendix1: Definition of Terms related to air transport.

Aircraft Movement: a take-off, landing, or simulated approach by an aircraft at an airport.

Available seat kilometer (ASK): is a measure of an airline flight's passenger carrying capacity. It is equal to the number of seats available multiplied by the number of kilometers flown.

Available Tone Kilometer (ATK): is a measure of an *airline's* total capacity (both passenger and cargo). It is equal to the number of tonnes of capacity available for the carriage of revenue load (passenger and cargo) multiplied by the distance flown.

Deplaned Passenger: passengers off-loaded from an aircraft at an airport. Deplanements apply to connecting traffic (interline and interline transfers) as well as to traffic terminating at that point. If the number of a flight is changed during an aircraft itinerary, all traffic on the flight is reported as deplaned at the point where the number was changed, even though some passenger remained on board for the next flight stage.

Enplaned passenger: passenger boarding a plane at a particular airport. Enplanements apply to connecting traffic (interline and interline transfers) as well as to traffic boarding at that point.

Revenue passenger kilometers (RPK):is a measurement used in the aviation industry. Each kilometer a paying passenger has flown counts as an RPK. i.e the number of revenue passengers carried multiplied by the distance flown.

Yield passenger kilometer: is a measure of average fare paid per kilometer, per passenger, calculated by dividing passenger revenue by revenue passenger kilometers (RPK).

Appendix 2. Number of passenger enplaned/deplaned (E/D) passengers and aircraft movements at the Top 16 airports in Ethiopia

Year	2009/10			2010/11			2011/12			2012/13		
Airports	A/C Mov't	E/D pax	Pax per A/C	A/C Mov't	E/D pax	Pax per A/C	A/C Mov't	E/D pax	Pax per A/C	A/C mov't	E/D pax	Pax per A/C
ArbaMinch	244	6,220	25.49	280	10,816	38.63	336	13532	40.27	364	*15,904*	43.69
Assosa	454	5,943	13.09	276	10,789	39.09	523	12520	23.94	700	*21,836*	31.19
Axum	1,646	58,559	35.58	1,682	64,797	38.52	1,725	70936	41.12	1,786	*79,370*	44.44
Bahir Dar	1,972	83,044	42.11	1,807	94,589	52.35	2,158	105659	48.96	2,166	*200,248*	92.45
Gambella	424	13,100	30.90	390	17,586	45.09	460	19125	41.58	462	*24,213*	52.41
Gode	1,978	24,118	12.19	1,374	34,991	25.47	1,965	37448	19.06	1,452	*28,750*	19.80
Gondar	2,306	53,842	23.35	2,332	62,890	26.97	2,425	66793	27.54	2,268	*93,566*	41.25
Jijiga	1,638	24,485	14.95	1,716	37,689	21.96	1,716	39239	22.87	1,604	*43,888*	27.36
Jimma	888	8,152	9.18	566	5,091	8.99	1,524	6853	4.50	460	*20,504*	44.57
Lalibella	2,036	47,867	23.51	2,052	57,787	28.16	2,365	64029	27.07	1,876	*62,206*	33.16
Mekele	2,178	124,292	57.07	2,496	142,370	57.04	2,548	157089	61.65	3,162	*299,459*	94.71
Robie(Goba)*	8	4	0.50	26	86	3.31	6	121	20.17	26	*67*	2.58
Shire	0	0	0.00	150	8,658	57.72	156	7987	51.20	386	*14,227*	36.86
Humera	194	4,005	20.64	222	5,554	25.02	198	5412	27.33	152	*4,757*	31.30
Addis Ababa	8,283	416,501	50.28	8,661	523,682	60.46	10,176	609428	59.89	12791	717,055	56.06
Diredawa	3,434	57,230	16.67	3,435	81,166	23.63	3,198	81346	25.44	3218	92,789	28.83
Average	**1,730.19**	**57,960.13**	**33.50**	**1,716.56**	**72,408.81**	**42.18**	**1,967.44**	**81,094.81**	**41.22**	**2,054.56**	**107,427.44**	**52.29**

Source: Ethiopian Civil Aviation Authority year ending June 2013.

Note: E/D: Enplaned and Deplaned

A/C: Aircraft

PAX: Passenger

Appendix 3. Domestic Airports in Ethiopia

No.	***Airport Name***	***Terminal size and capacity***	***Runway***			***Airport service started since** in G.C*
			Type	size (in meter)	Capacity of Aircraft	
1	Addis Ababa Bole International Airport	Surface area 46,000m2 Handle 2,929 passenger at peak hour	Asphalt Concrete	3800x45	B747 MD11	
2	Dire Dawa International Airport	Surface area 2994.7 m2 Handle 160 passenger at peak hour	Asphalt Concrete	2700x45	B-767	1988
3	Mekelle Alula Abanega International Airport	Surface area 5250 m2 Handle 414 passenger at peak hour	Asphalt Concrete	3700X45	B-767	1998
4	Axum Atse Yohannes 4th Airport	surface area 1951.8 m2 handle 111 passenger at peak hour	Asphalt Concrete	2400X45	B-737	1998
5	Shire Airport	Temporary passenger Terminal Handle 50 passenger at peak hour	compacted volcanic gravel	2500X45	Q-400	2011
6	Humera Airport	Temporary passenger Terminal Handle 80 passenger at peak hour	Asphalt Concrete	3000X45	B-747	2009
7	Bahir Dar Ginbot 20 International Airport	surface area 9496 m2 Handle 296 passenger at peak hour	Asphalt Concrete	3100X45	B-767	1998
8	Gondar Atse Tewodros Airport	surface area 2437 m2 Handle 228 passenger at peak hour	Asphalt Concrete	2900X45	B-737	1998
9	Lalibella Airport	surface area 2477 m2 Handle 200 passenger at peak hour	Asphalt Concrete	2500X45	B-737	1998
10	Kombolcha Airport	surface area 680 m2 Handle 80 passenger at peak hour	Asphalt Concrete	2220X45	Q-400	2014

11	Semera Airport	Temporary passenger Terminal Handle 70 passenger at peak hour	compacted volcanic gravel	2400X44	Q-400	2014
12	Jimma Aba Jiffar Airport	surface area 4600m2 Handle 200 passenger at peak hour	Asphalt Concrete	2000X45	B-737	1998
13	Robe/Goba Airport	Temporary passenger Terminal Handle 50 passenger at peak hour	compacted volcanic gravel	2000X45	Q-400	1998
14	Arba Minch Airport	surface area 1528.9 m2 Handle 264 passenger at peak hour	Asphalt Concrete	2800X45	B-737	1998
15	Gambella Airport	surface area 2682 m2 Handle 200 passenger at peak hour	Asphalt Concrete	2500X45	B-737	1998
16	Assosa Airport	surface area 2400m2 Handle 200 passenger at peak hour	Asphalt Concrete	2500X45	B-737	1999
17	JigjigaGaradWilwal Airport	surface area 4910 m2 Handle 200 passenger at peak hour	Asphalt Concrete	2500X45	B-737	2000
18	Gode Airport	Temporary passenger Terminal Handle 50 passenger at peak hour	Asphalt Concrete	2300X45	B-737	1998

Source: Ethiopian Airportsenterprice (EAE) 2014

Appendix 4: Diagnostic Tests

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1)= 2.5165[.094]	F(1, 31)= 2.5027[.131]
B:Functional Form	CHSQ(1)= .29198[.589]	F(1, 31)= .14317[.710]
C:Normality	CHSQ(2)= 1.7251[.422]	Not applicable
D:Heteroscedasticity	CHSQ(1)= .042173[.837]	F(1, 51)= .039939[.843]

R-Squared .99768 R-Bar-Squared .99561

S.E. of Regression .034184 F-stat. F(17, 19) 480.9207[.000]

Mean of Dependent Variable 12.1363 S.D. of Dependent Variable .51574

Residual Sum of Squares .022202 Equation Log-likelihood 84.7412

Akaike Info. Criterion 66.7412 Schwarz Bayesian Criterion 52.2430

DW-statistic 2.2908

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A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

D: Based on the regression of squared residuals on squared fitted values

Appendix 5: Estimated long run coefficients using the autoregressive Distributed Lag Approach: ARDL (2, 0, 1, 0, 1, 0) selected based on akaike information Criterion.

Dependent variable is LRDPAX 53 observations used for estimation from 2001 to 2014				
Regressor	Coefficient	Standard Error	T-Ratio	Prob
LYLD	-0.0410	0.0173	-2.3721	0.025
LPCS	0.0630	0.020199	3.1199	0.009
LGDP	0.2960	0.126781	2.4002	0.024
LRDL	0.00390	0.042312	0.09225	0.927
LPPL	0.1905	0.04398	4.3316	0.000
CONS	9.0385	0.33732	26.7951	0.000

Appendix 6: Error correction representation for the selected ARDL(2, 0, 1, 0, 1, 0) selected based on Akaike information Criterion.

Dependent variable is DLRDPAX

53 observations used for estimation from 2001 to 2014

Regressor	Coefficient	Standard Error	T-Ratio	Prob
DLYLD	-0.30152	0.14422	-2.0907	0.045
DLPCS	-0.019941	0.02371	-0.84107	0.407
DLGDP	0.2012	0.084082	2.3929	0.029
DLRDL	-0.0094811	0.01712	-0.55379	0.584
DLPPL	0.14772	0.051811	2.8512	0.008
ECM(-1)	-0.6202	0.19093	-3.2547	0.003

R-Squared .69343 R-Bar-Squared .59298

S.E. of Regression .031477 F-stat. F(7, 45) 4.4288[.001]

Mean of Dependent Variable .049633 S.D. of Dependent Variable .059521

Residual Sum of Squares .026751 Equation Log-likelihood 83.9969

Akaike Info. Criterion 72.9969 Schwarz Bayesian Criterion 63.9901

DW-statistic 2.1857