8-1-2013

Pilot Supply and Demand: A Quantitative Forecast Examining Changing Industry Dynamics

Nicholas Lounsberry

PILOT SUPPLY AND DEMAND: A QUANTITATIVE FORECAST EXAMINING CHANGING INDUSTRY DYNAMICS

by

Nicholas A. Lounsberry

Bachelor of Science, The University of Texas at Austin, 2011

A Thesis

Submitted to the Graduated Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Grand Forks, North Dakota

August

2013

This thesis, submitted by Nicholas A. Lounsberry in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.

____

James Higgins, M.S.

____

Kent Lovelace, M.S.

____

Elizabeth Bjerke, Ph.D.

This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the Graduate School at the University of North Dakota and is hereby approved.

____

Wayne E. Swisher, Ph.D.

Dean of the Graduate School

____

DATE

PERMISSION

Title Pilot Supply and Demand: A Quantitative Forecast Examining Changing Industry Dynamics

Department Aviation

Degree Master of Science

In presenting this thesis in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the library of this University shall make if freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my thesis work or, in his absence, by the Chairperson of the department or the dean of the Graduate School. It is understood that any copying or publication or other use of this thesis or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my thesis.

Nicholas A. Lounsberry

July 15, 2013

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The aviation industry is constantly changing; therefore, it becomes critical to understand the historical and current state of the industry in order to progress into the future. The creation of Public Law 111-216, along with new flight time/duty time regulations and accelerating retirements, is creating a demand within the industry that the pilot labor supply may not be able to accommodate. This study produces a Pilot Labor Supply Forecast through analysis of current industry dynamics. Through a step-wise interactive linear regression, models were created and used to predict the number of new CFI's being created, based upon the yearly percentage change in flight costs, the number of new pilots hired at major airlines, and a previously unknown interaction between the two. A Flight Cost Forecast as well as a Pilot Demand Forecast was created through this analysis. This study found that between 2012 and 2032, flight costs are expected to increase by approximately 11.468% based on 2012 dollars, and 111,971 pilots will be needed at major airlines by 2032. However, the CFI Labor Supply Forecast approximates the creation of only 52,117 CFI's during the same time period. There will be an apparent shortage of pilots at the major airlines within this forecast period, which will cause problems in the aviation industry's current structure. This study provides a tangible analysis to determine how the pilot labor supply has changed since previous forecasts, and provides the framework for continuing improvement as the aviation industry transforms.

CHAPTER I

INTRODUCTION

Statement of the Problem

The airlines have historically relied heavily on the military for their pilot supply; however, this has been changing in the last two decades. An increasing number of people are becoming pilots through civilian flight schools as well as colleges and universities (Bureau of Labor Statistics, 2012). These trends are creating industry dynamics that affect the pilot labor supply. No matter which path is taken, all pilots must obtain specific certificates before being allowed to fly for hire. The Commercial Pilot Certificate has traditionally been the minimum requirement by which airlines could hire pilots; however, most airlines set their minimum hiring standards well above those minimum hours. On August 1, 2010, the 111th Congress enacted Public Law 111-216, also known as the Airline Safety and Federal Aviation Administration Extension Act of 2010 (Government Printing Office, 2010). Under this Congressional Act, all pilots that fly for a Part 121 carrier, as defined in the Federal Aviation Regulations, will be required to hold an Airline Transport Pilot (ATP) certificate. Pilots will need 1500 hours and the ATP certificate to even be considered for employment at both the major and regional airlines, whereas previously pilots needed a minimum of 250 total hours to apply. As the dynamics of the industry change, airlines are becoming increasingly worried about where they will obtain their future pilots. Regional airlines will be further impacted because they traditionally hire low time pilots who usually have not yet obtained their ATP Certificate. The new Public Law 111-216 will have an effect on the pilot supply for the airlines, and may lead to a shortage in the future.

Purpose of the Study

The aviation industry is constantly changing, and due to Public Law 111-216, airlines are beginning to worry about the future supply of qualified pilots. This study seeks to produce a current forecast for the number of qualified Certified Flight Instructors. The results aim to show industry trends as well as create a forecast for Certified Flight Instructors as the pilot labor supply.

Significance of the Study

This study aims to provide a comprehensive analysis into the future of the pilot labor supply in the aviation industry. Upon completion, this analysis is expected to help answer some crucial unknowns, which include what factors affect the pilot labor supply, the addition of any new factors, what has changed about the forecasted pilot labor supply, and whether the number of new Certified Flight Instructor Certificates accurately forecasts the future pilot supply.

If the factors affecting the pilot labor supply can be identified, then the accuracy of the forecast will increase. Also knowing these factors can help airlines and flight schools try and promote qualities that will have a positive influence on the labor supply. By understanding more about the reasoning behind the consumer decision to become a pilot, better solutions can be created to help alleviate the problems of a possible pilot shortage.

The differences between this forecast and previous ones will identify the changes in the pilot supply over time. When a forecast is produced, it can only take into account the policies, regulations, and economic impacts of that specific time. These shifting factors can cause variances between forecasts, making it important to reach conclusions. It is also important to acknowledge the different bias apparent in each forecast.

Finally, with Public Law 111-216 coming into effect in August 2013, forecasting has become extremely difficult. If this study is able to identify how this law will affect the labor supply, then airlines and flight schools may be able to adapt to the changes. The benefits of this study are numerous, and the significance of this study is to provide a tool to help promote growth and provide an outlook for the aviation industry in terms of the pilot labor supply.

Research Questions

1. Does the number of Certified Flight Instructor Certificates accurately forecast the number of future pilots qualified and available for hire by the airlines?
2. To what extent will the supply of active Certified Flight Instructors vary over short and long-term time periods?
3. Is there an interaction between previously known predictors that may significantly affect the number of Certified Flight Instructors over short and long-term time periods?

Assumptions

1. The number of Airline Transport Pilot (ATP) Certificates will increase at a greater rate than the historical average over the next couple of years, due to the new First Officer Qualifications set forth by Public Law 111-216.
2. Certified Flight Instructors will become the new group of qualified pilots for the airlines to hire.
3. The average time to create a Certified Flight Instructor from zero flight time is 3 years.

Limitations

1. Pilot perceptions of labor supply and demand will not be included due to the scope of this study.
2. Historical flight costs will be obtained only from participating universities and flight schools through the University Aviation Association.

LITERATURE REVIEW

In order to help fully appreciate forecasting in the aviation industry, a complete understanding of previous forecasts and trends should first be accomplished. This literature review aims to provide the knowledge of forecasts currently available to provide more reliability and validity to the forecast produced in this study. There are three areas that need to be explored before creating a current pilot labor supply forecast: Global Aviation Industry Forecasts, Aircraft Manufacturer Forecasts, and Pilot Labor Supply Forecasts. These areas range from broad to specific to help narrow down the intricacies within each forecasting area.

Global Aviation Industry Forecasts

Worldwide Training Capacity and the ICAO Forecast

Worldwide pilot supply and demand needs to be considered due to differences in the global dynamics when compared to those found in the U.S. The International Civil Aviation Organization (ICAO) created a forecast on pilot requirements for 2010-2030, which included worldwide as well as regional forecasts. They estimated that the number of "professional pilots" was 462,286 in 2010, and the North American region contained 63%, or 290,211, of the total number of pilots (ICAO, 2011). This forecast uses pilot training capacity to determine each regional surplus or shortage in the labor supply. According to ICAO, North America dominates in the training capacity at 63% when compared to the other regions. The results indicate that North America will have a surplus of 17,206 pilots between 2010 and 2030, based solely on training capacity.

The ICAO forecast, while predicting that there will be a shortage of 8,146 pilots worldwide, does not address any other factors besides pilot training capacity. This can be an issue when analyzing training conducted in North America for airlines from other regions. Even though North America has the most training capacity, pilots are not necessarily remaining in the region to fly commercially; therefore, error exists in the projected pilot supply. This ICAO forecast does not include this assumption when determining the supply of pilots. North America does contain a large portion of training capacity, and other forecasts show a shortage of pilots for the region rather than a surplus when the training of foreign pilots is taken into account.

As with all forecasts, there are some constraints and limitations that cause some inaccuracy. ICAO provides that the changing of the age limit for flight crews from age 60 to 65 will "be temporary and other measures will be required to address said shortfalls in the long term" (ICAO, 2011). They do not believe that this amendment will benefit the shortfall of pilots in the long run; however, it does have an effect on the long term forecast. Another limitation of this forecast comes from the recognition of pilot licenses obtained in countries that are not the pilots' home country. ICAO states that there is a "migratory flow" of pilots from those countries that have more training capacity to those that do not, and find that there is not enough "reliable data and political willingness" needed to include this as a factor in their forecast (ICAO, 2011).

When split into a country focus for the United States, ICAO recognizes Public Law 111-216 as a factor in determining the pilot forecast for the North American region. Since an ATP Certificate requires 1,500 flight hours and will be required to fly for a 121 carrier, there will be a "limit of first officers" (ICAO, 2011). Along with this new law, ICAO also notes that there will be a period of accelerating retirements, which will worsen the shortage. By using training capacity as the main predictor, the results of this forecast greatly differ from others, e.g. Lovelace and Higgins (2010), but it provides a global perspective. ICAO does identify weaknesses in their forecast, and they accept the associate risk. While their forecast does address the U.S., it does not include many important factors that affect the pilot labor supply. These weaknesses can be used to further increase the accuracy of future forecasts.

FAA Aerospace Forecasts

As the U.S. agency for regulating the aviation industry, the Federal Aviation Administration (FAA) provides many services to help promote safety and growth. Every year they produce a forecast for the projected growth for the industry. Developed from econometric models that use emerging trends from different industries, the FAA is able to forecast the future capacity and fleet size for U.S. commercial operators (Federal Aviation Administration, 2012).

The methodology used by the FAA is blended, and it is also subject to limitations and assumptions. One assumption was that "there will be sufficient infrastructure to handle the projected levels of activity." This may also be a limitation due to the reality that the aviation industry may not actually have the infrastructure needed, however, this falls outside the scope of the study. The forecast also does not assume "further contractions of the industry," which they identify as "bankruptcy, consolidation, or liquidation" (Federal Aviation Administration, 2012). While this assumption does need to be made in order to produce a forecast, it can create unforeseen errors. With airlines consistently going bankrupt, consolidating, and liquidating due to the recent recession and financial pressures, it is problematic to assume that these factors will not affect the forecast. The FAA forecast does accept the risk associated with the assumptions and provides a useable model to further the accuracy of this research.

Results from the FAA's model show both a short-term and a long-term forecast for the demand of both mainline and regional carriers between 2012 and 2032. For the purpose of this study, only the long-term forecast will be analyzed, since the short-term forecast only takes into account the calendar years of 2012-2013. When looking at U.S. carriers that fly internationally, the FAA was able to analyze the International Revenue Passenger Miles (RPM), which can predict growth for international travel, as shown in Figure (1).

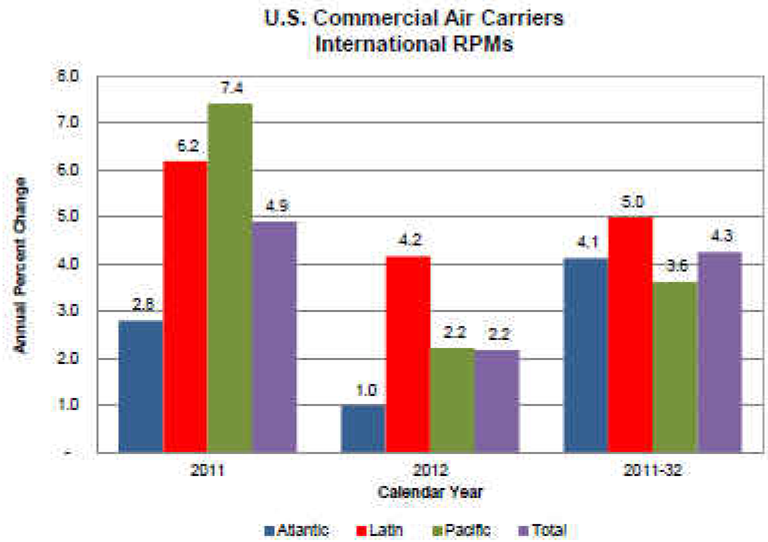

Figure 1. FAA U.S. Commercial Air Carrier's International RPMs

The FAA predicts a 4.1% growth per year for international passengers between 2011 and 2032, which means that there will be a demand for more aircraft. This also means that more pilots will be necessary to staff these aircraft. There have been 552 aircraft that have left the U.S. market since 2007, and the commercial fleet is projected to decrease by 97 aircraft in 2012. The short-term forecast follows the characteristics of the recession, yet the long-term forecast shows growth (Federal Aviation Administration, 2012). These differences may be due to the methodologies used for each forecast. The long-term forecast uses results based upon econometric models, whereas the short-term forecast uses published monthly schedules, capacity, and projected demand. Overall, there seems to be growth anticipated in both the demand for air travel and for aircraft. This indicates that the pilot demand could increase, and the FAA's forecast illustrates where the government believes issues could arise.

A true pilot labor supply forecast was not created by the FAA due to unknown circumstances. There appears to not be defined predictors for the pilot supply, which could be why there was none produced. Their forecast was based on econometric models, and the methodology was not revealed to the public. Overall, the FAA Aerospace Forecast does not provide the information needed to accurately predict the pilot labor supply moving forward, but rather gives an industry-wide perspective of predicted growth.

Aircraft Manufacturer Forecasts

To put together a pilot labor supply forecast, it is important to determine the staffing requirements that airlines will need in the future. This drives the number of pilots needed to fly each aircraft, which in turn affects the number of new pilots hired. In order to determine staffing demand at U.S. airlines, the number of aircraft they are actively operating needs to be established. Manufacturers produce some of the best fleet forecasts, since they provide aircraft for the airlines. The two main manufacturers for large transport aircraft are Boeing and Airbus. While both show an increase in the active number of aircraft in the market, it should be kept in mind that there is the possibility of bias in both reports. In the end, both manufacturers are businesses, and certain agendas may be present in the results of each forecast.

Boeing

The aircraft manufacturer Boeing created a Current Market Outlook that provides a "long-term forecast of air traffic volumes and airplane demand" (Boeing, 2012). This forecast helps "airlines, suppliers, and the financial community make informed decisions," as well as show where Boeing feels the industry is headed. Trends in staffing requirements and market expansion have also been provided through their analysis.

In the last decade, the airline industry has had some setbacks, advancements, bankruptcies, and in some cases prosperity. Even through all of the ups and downs, the demand for air travel has continued to grow by approximately 5% every year (Boeing, 2012). They are also expecting around 34,000 new airplanes to be introduced into the market by 2031.

The Boeing forecast is focused on the future demand for aircraft in the market. It is beneficial to examine the factors of Boeing's forecast for comparisons, and to determine if they chose significant factors. Boeing predicts market growth through revenue passenger-kilometers (RPK), which is the number of revenue paying customers multiplied by the distance traveled. Two factors that they take into account are Gross Domestic Product (GDP) and a time-varying function f(t) which they created. The relationship is shown below in Equation (1):

$$RPK(growth) = GDP(growth) + f(t) \qquad (1)$$

RPK has historically outpaced economic growth by the time-varying function, which typically centers around 2 percent (Boeing, 2012). This suggests a possible positive relationship between economic growth and the demand for pilots. If the economy grows, RPKs increase, which means that airlines must purchase more aircraft to keep up with the increased demand for air travel. There would be a need for pilots to fly the new aircraft, increasing the demand for pilot labor. This is illustrated through one of the predictors in the forecast by Lovelace and Higgins (2010), which is the number of new pilots hired at major airlines; however, neither ICAO nor the FAA consider any predictors such as these. This study by Boeing is still not a true pilot labor supply forecast, since it is showing the predicted growth for aircraft sales rather than pilot supply and demand.

A forecast specifically analyzing the North American region has also been produced by Boeing. They expect "modest growth," in the region, and forecast that 7,300 new airplanes by 2031 will be needed to meet the demand (Boeing, 2012). This may have an effect on the pilot labor supply forecast through staffing requirements of the major airlines, which is affected through the growth of the U.S. fleet size. GDP will not be used in the forecast produced in this study because it is accounted for through the staffing ratios. One limitation of the Boeing forecast is the time-varying function. They do not share how it was determined, nor do they provide the function and how it is used. It can therefore be assumed that it is proprietary information and not available for use.

Boeing has provided an excellent global and regional outlook on the aircraft market; however, there is some bias in the report. As a manufacturer, they want to stay in business, so naturally they will forecast an increase in the demand for aircraft. This information will be applied to the pilot labor supply forecast created in this study only as needed. If these results prove to be erroneous due to the assumptions made, then that will be reflected in the methodology. Overall, Boeing's forecast appears to provide accurate, reliable information that is helpful in forming a forecast for demand.

Airbus

As a manufacturer, Airbus has created a "Global Market Forecast" for 2012-2030, which looks to predict the demand for aircraft in all regions of the world. They note that "even allowing for some of the most difficult periods aviation has faced...[it] has still managed to grow more than 50%" (Airbus, 2012). This is similar to the Boeing forecast, and Airbus also believes that Europe and North America is still the key for this future growth within aviation. It is this predicted growth that will have an effect on the pilot demand through airline staffing requirements.

Airbus forecasts that worldwide, 28,198 new passenger and freighter aircraft will be needed by 2031, and that the demand for air travel will double (Airbus, 2012). Economic growth will be a key driver for air traffic growth, which can then be related to the demand for aircraft and ultimately pilots. This demand may have an effect on the pilot labor supply through different factors, such as how many new commercial pilots were hired at major airlines in a year. Much like the forecast produced by Boeing (2012), Airbus (2012) determines the number of new aircraft slated to enter the market by 2030, given that the industry remains relatively constant.

One factor Airbus found that causes economic growth is urbanization, which is the "state of being urbanized," or the physical growth of a city due to people moving in from rural areas (Merriam-Webster, 2012). They state that "propensity to travel and urbanization are correlated," which indicates they were able to show a significant relationship between the two variables (Airbus, 2012). This all ties into characterizing pilot demand through aircraft staffing needs, and it is difficult to determine whether or not this part of the forecast accurately portrays those needs. However, Airbus (2012) does remark that North America currently has the oldest fleet out of all of the regions. This leads to the belief that the airlines in North America will be looking to replace their fleets, which will require some time to accomplish. If airlines are purchasing new aircraft, they have to phase them into their current fleet. It is this merging that will require more pilots to fly the additional aircraft. Airbus also forecasts a 48% increase in new aircraft for the region. Not only will airlines need to replace their current fleets, but they will also have to purchase more aircraft to keep up with the demand for air travel.

Manufacturer Forecast Conclusions

Overall, both Boeing (2012) and Airbus (2012) forecast an increase in demand for air travel and aircraft. This directly relates to the pilot staffing requirements for airlines, which means that pilot demand should be increasing. By using the forecasts provided by the manufacturers, an updated demand for pilots can be applied to future labor supply forecasts, making them more accurate. Inconsistencies are found between the forecasts in the specific number of new aircraft and growth within the industry.

The Airline Monitor

The Airline Monitor Commercial Aircraft Market Forecast provides a comprehensive analysis of the aircraft manufacturer market, as well as an inclusive forecast for 2012-2035. This forecast includes all major aircraft manufacturers, and aims to provide a balance between the economy, aviation regulation, retirements, current orders, and the manufacturers' future plans (The Airline Monitor, 2005). While the exact methodology is not provided, the advantage in this forecast over those produced by the manufacturers is that the bias is mostly removed. The Airline Monitor does not sell aircraft for a business, and this eliminates the need to predict more growth for the industry making them unbiased.

An advantage to The Airline Monitor's forecast is that they can include all of the manufacturers predicted growth, and also adjust for purchase competition between airlines. Neither Boeing (2012) nor Airbus (2012) addresses the competition between the two. It is important to conduct a comprehensive forecast because it captures the industry dynamics better than any individual entity.

One of the risks in The Airline Monitor's forecast is that they do not provide their methodology, and therefore open themselves up to criticism. It is impossible to determine what interactions take place in their forecast, as well as what factors were significant. Even though there are some risks apparent in this forecast, it is still the best option when determining pilot demand. The Airline Monitor forecast provides the necessary data to define the pilot demand and staffing ratios needed to complete the pilot labor supply forecast.

Pilot Labor Supply Forecasts

In order to fully understand labor forecasting, previous forecasting methods should be analyzed to see what could improve upon the current aviation forecast. One of the first aviation related labor supply forecasts to become publicly available was produced by Lovelace and Higgins (2010), which created a baseline upon which this study expands. The main goals were to determine factors affecting pilot supply, produce a pilot supply forecast, determine the impact of the Federal Aviation Administration's

(FAA) NPRM regarding ATP requirements for First Officers on the pilot supply, and to provide some mitigation strategies to help with these problems. Their forecast is the main basis of this research, and it is a goal to improve its accuracy and determine other factors that may now affect the forecast.

Lovelace and Higgins (2010) identified two main entrance barriers that predicted the labor supply for their model. The first predictor was hiring at major airlines, and the second predictor was flight training costs. Both of these predictors went into a stepwise multiple regression model to produce the number of new commercial pilots in two years. The model is identified in Equation (2):

$$Y = 1.28(X) - 153(Z) + 7868 \quad (2)$$

The variable Y is the number of new commercial pilots in 2 years, X is the number of new commercial pilots hired at major airlines, and Z is the percent change year-over-year in flight training costs. There was significance in the risk reward model where R^2=.57, F(2,19)=12.61, p<.001. The results of the model are shown in Figure (2):

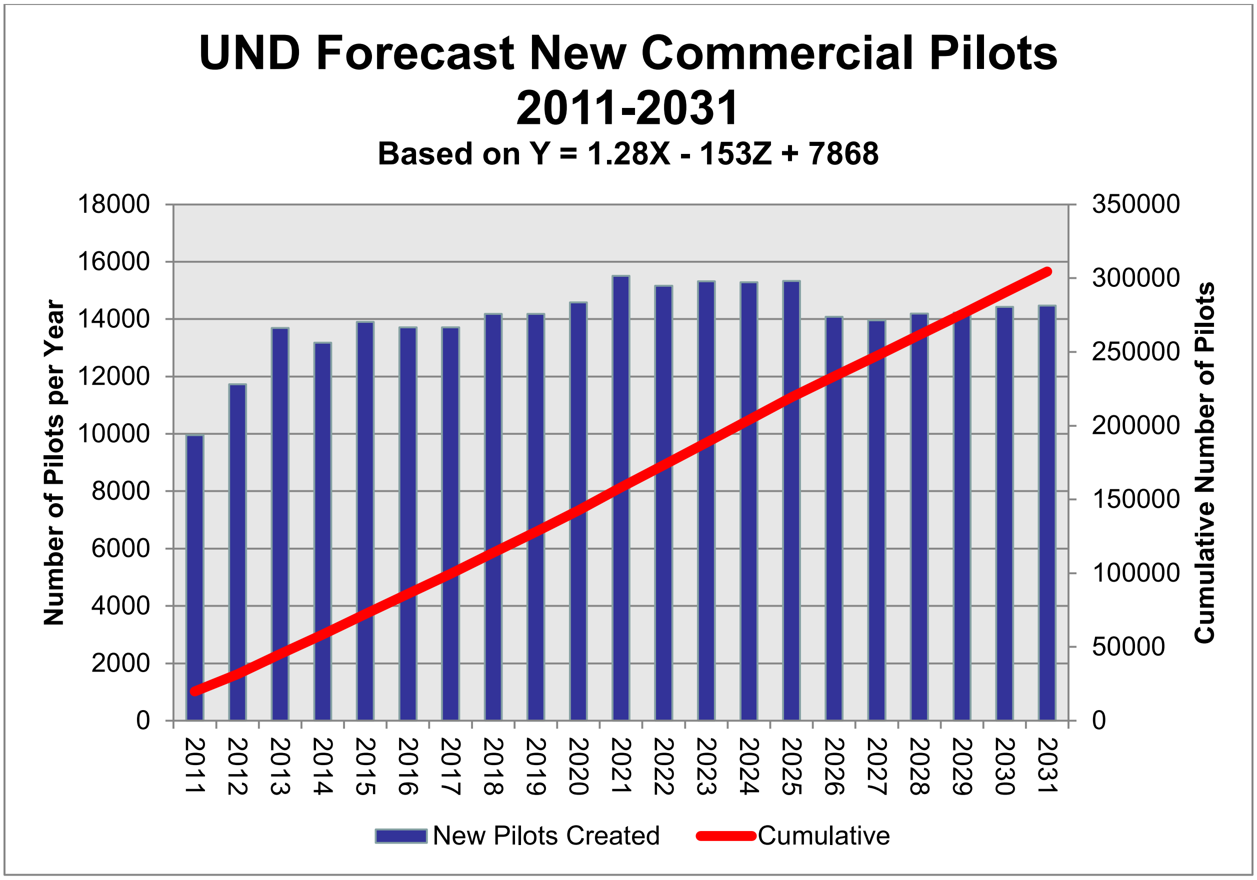

Figure 2. UND Forecast for New Commercial Pilots between 2011-2031

The first predictor was the number of new pilots hired at major airlines, and it is "based almost exclusively on number of aircraft in service" (Lovelace and Higgins, 2010). Major airlines included in the study were American, United, Delta, Southwest, Northwest, Continental, FedEx, UPS, JetBlue, American West, AirTran, Alaska, ATA, ABX Air, and US Airways. In order to find the demand for pilots, they first found the number of pilots per aircraft required by the type of operation: legacy and major airlines, regional jet operators, regional turboprop operators, fractional operators, and corporate/business operators. Using manufacturer and FAA forecasting models for the number of aircraft, the forecasted pilot demand could be found through the staffing ratios, or the number of pilots needed per aircraft.

The second predictor was the percentage change of flight training costs year-by-year, which was found through the Aircraft Owners and Pilots Association (AOPA) and the University of North Dakota (UND). The percentage change per year was taken versus the actual dollar amount due to the differences in primary aircraft training costs. By using this method, a normalized predictor can then be input into the model. An advantage to this method is that the normalized flight costs will only change when the entire market changes. This is important because it provides an overall measurement of the flight training market.

The forecast information for the percentage change in the U.S. aircraft fleet comes from the FAA Aerospace Forecast Fiscal Years 2012-2032 (Federal Aviation Administration, 2012). In this forecast, the FAA shows that even though there has been a decrease in the U.S. aircraft fleet in 2012, the next two decades will provide an approximate 2.1% increase annually. This growth means that with an increasing number of aircraft, more pilots will be needed to fly them; therefore, it can be assumed the pilot demand will increase.

Along with a forecasted increase in the U.S. aircraft fleet, pilot demand will additionally depend on retirements and other attritions in the industry. Lovelace and Higgins (2010) took the pilot retirements between 2012 and 2030 from the FAA U.S. Civil Airmen Statistics Table 12 (2010), and created a graph to show that by 2030, there will be 129,383 mandatory retirements. The pilot attrition forecast was created for those pilots who leave the industry for reasons other than retirement. Approximately 138,414 pilots will leave the industry due to reasons other than retirement by 2030 (Federal Aviation Administration, 2010). This number is actually higher than the mandatory retirements, which is not explained by Lovelace and Higgins (2010). The Long Term Forecast of New Pilots Required from 2011-2030 is defined in Table (1):

Reason	New Pilots Required 2011-2030
Retirement	129,383
Aircraft Additions	40,917
Other Attritions*	138,414
Total	308,714

*Using a low rate of 2.50%

Table 1. Pilot Attrition Forecast for 2011-2030, Lovelace and Higgins (2010)

Ultimately, the goal of this model is to determine whether there will be a shortage of pilots in the foreseeable future. The pilot supply was found through the model, whereas they determined the pilot demand through the FAA forecasts. The forecast predicted that "between 2012 and 2031, there will be a 38,178 pilot shortfall" (Lovelace and Higgins, 2010). This includes all commercial operations such as the airlines, corporate, charter, and other areas. Figure (3) shows the UND Forecast Pilot Shortfall for 2012-2031.

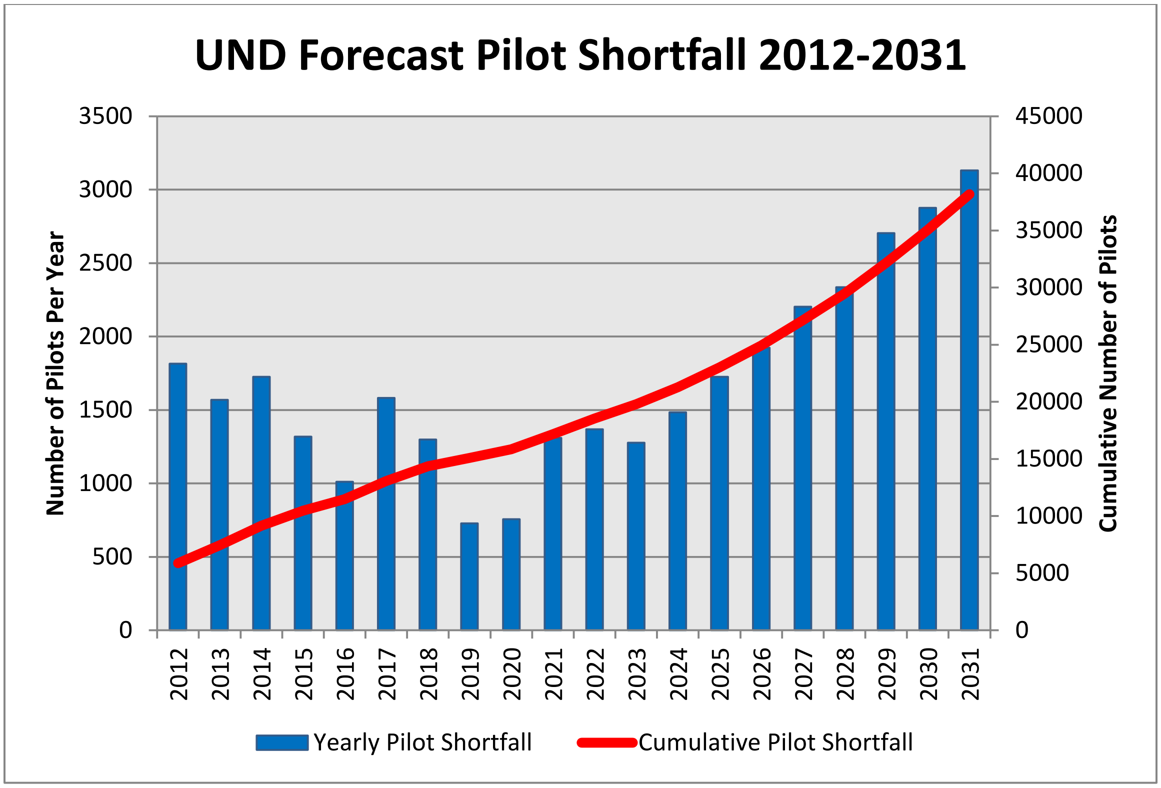

Figure 3. UND Forecast Pilot Shortage for 2012-2031

Some limitations are present in this forecast, including the effects of the Airline Safety and Federal Aviation Administration Extension Act of 2010, also known as Public Law 111-216. Dramatic changes have occurred since the forecast was produced, such as the new Flight Crew Screening and Qualifications requirements put forth by Public Law 111-216. The Airline Safety and Federal Aviation Administration Extension Act (2010) will require all pilots flying for part 121 carriers to hold an ATP Certificate. A response to Public Law 111-216 by the Aircraft Owners and Pilots Association (2012) notes that the "proposed rule will add cumbersome requirements for pilots seeking a career in the airline industry." Lovelace and Higgins (2010) believe the increased cost of flight training and foreign predation will affect the forecast. It is these limitations that will be considered in this analysis. By using a risk and reward model, an accurate pilot supply forecast has been produced; however, with sweeping changes occurring in the aviation industry, their forecast can be improved.

CHAPTER II

METHODOLOGY

The changing aviation environment has made it difficult to accurately forecast changes in the pilot labor supply. There are many reasons for why these changes occur, including increasing flight training costs, more foreign students coming to the U.S. for training, and the implementation of Public Law 111-216. With such a dynamic industry, it is difficult to produce a pilot labor supply forecast that encompasses all variables at a significant level. This study will examine the continuing influence of two variables that have previously been determined to be predictors for the pilot labor supply. It will also attempt to determine if an interaction between these variables significantly adds to the accuracy of the forecast.

Data Sample

This study collected data from sources that did not include any subject participation. Specific data was obtained through sources that were not being actively studied as a part of this research. None of these sources were compensated for their time or resources, and their involvement was strictly voluntary. Data gathered that was incomplete or missing parts was excluded. There were no demographic questions asked of the participants, and non-essential information was also excluded from this study.

Data Sources and Collection Method

In this study, data was collected using reliable and valid sources. Two predictors were used in the supply model: flight cost percentage increase year-over-year and the number of pilots hired at major airlines. This section provides the methods and sources used to determine these two predictors.

Flight costs were collected using data provided by the University Aviation Association (UAA). UAA reported the data on a semi-regular basis, reporting data in the years 1989, 1994, 1999, 2003, and 2008. Some of the flight costs were reported as an hourly rate to rent an aircraft; however, most of the costs were reported as overall flight cost for a particular certificate or rating. This data required participation by the universities involved in UAA, and all information was de-identified prior to collection to protect the sources.

The number of New Pilots Hired at Major Airlines was gathered through the Future & Active Pilot Advisors website (fapa.aero). This data included the number of pilots hired at those airlines defined as Major Airlines, which included: AirTran Airways, Alaska Airlines, America West, American Airlines, Continental Airlines, Delta Air Lines, JetBlue, Northwest, Southwest Airlines, United Airlines, US Airways, ABX Air, ATA, FedEx, and UPS.

Data was then gathered from the FAA Airmen Statistics and airlinepilotcentral.com to determine current and future staffing ratios for the pilot demand. This data consisted of the number of active aircraft and pilots for all major airline carriers, as well as the predicted growth in the future. Once this model was formed, the past and future number of pilots hired at major airlines was determined and used in the supply model.

A total airline fleet forecast was used from The Airline Monitor to gather the number of pilots needed for future additional aircraft. The pilot attrition rate for the industry was determined using the FAA Airmen Statistics. Data on the number of future retirements was provided by the Airlines For America (A4A). All three sets of data were used in the pilot demand forecast.

This study included only quantitative methods, which allowed for the separation of perceptions from the forecast. Throughout the study, no human subjects were used for analysis, including those involved in providing resources. None of the data measured human performance, and no survey was conducted.

Study Design & Data Analysis

Upon completion of the data collection, analysis was conducted and conclusions formed. Specific results can be found in Chapter III of this document, as well as the overall model results. This study focuses on two predictors in the regression model: Flight Costs and New Pilots Hired at Major Airlines. Since these variables have historically had an effect on the pilot supply, it is reasonable to include them in this research. The researcher then determined whether the interaction between these two variables significantly affected the pilot supply, and the results were produced.

A Pilot Demand Forecast and Flight Cost Forecast were created in order to generate the Pilot Supply Forecast. The pilot supply depends on the number of new pilots hired, and the best forecasted data comes from the pilot demand model. Once this was complete, the Pilot Supply Forecast was created.

Data collection from the sources included a variety of methods for obtaining and processing the data. Upon completion, the data was converted into Microsoft Excel format for further analysis. Certain statistical analysis required the use of SPSS Version 20, and the data was converted from Microsoft Excel.

The quantitative data was imported into Microsoft Excel and SPSS and analyzed using significant values set at the 0.05 alpha level (2-tailed). When required, the data was sorted or excluded. If the collected data was excluded, the reasons were noted and justified in the results and discussion sections. Data was review to ensure reliability.

Validity and Limitations

No survey was conducted in this research, and the data was not collected through interviews or observations. Data sources were reviewed by the sitting committee. When collecting data from human sources, there was an opportunity for the sources to review the data. The researcher had subject matter experts (SMEs) review the data that came from publicly available sources for reliability and validity.

There were several limitations within the study that need to be noted. Since no survey was administered as a part of the research, there was no reason to keep the data anonymous. During the study, there was an attempt to separate the bias when the source was known; however, some data required the source to be identified, but only when essential.

Due to the constantly changing dynamics of the aviation industry, it is impossible to conduct follow-up research without completely recreating the model. This forecast represents the industry at one point in time. Even though the reliability of the forecast is high, major changes and decisions made in the industry can ultimately cause this forecast to become inaccurate. This only becomes a limitation if some unforeseen future change causes significant fluctuations in the predictors, but nonetheless needs to be considered.

CHAPTER III

RESULTS

Pilot Certificate Trends

Before analyzing the pilot supply, it is important to understand historical trends in pilot certification. These trends will allow a better overall perspective of the pilot supply, which only adds to the validity of the forecast. The data was gathered from the FAA US Civil Airmen Statistics Tables 1 and 17 from 2011, 2002, and 1999, and includes the total and new yearly number of Private Pilots, Commercial Pilots, Certified Flight Instructors, and Airline Transport Pilots. Results are shown in Figures (4) – (7):

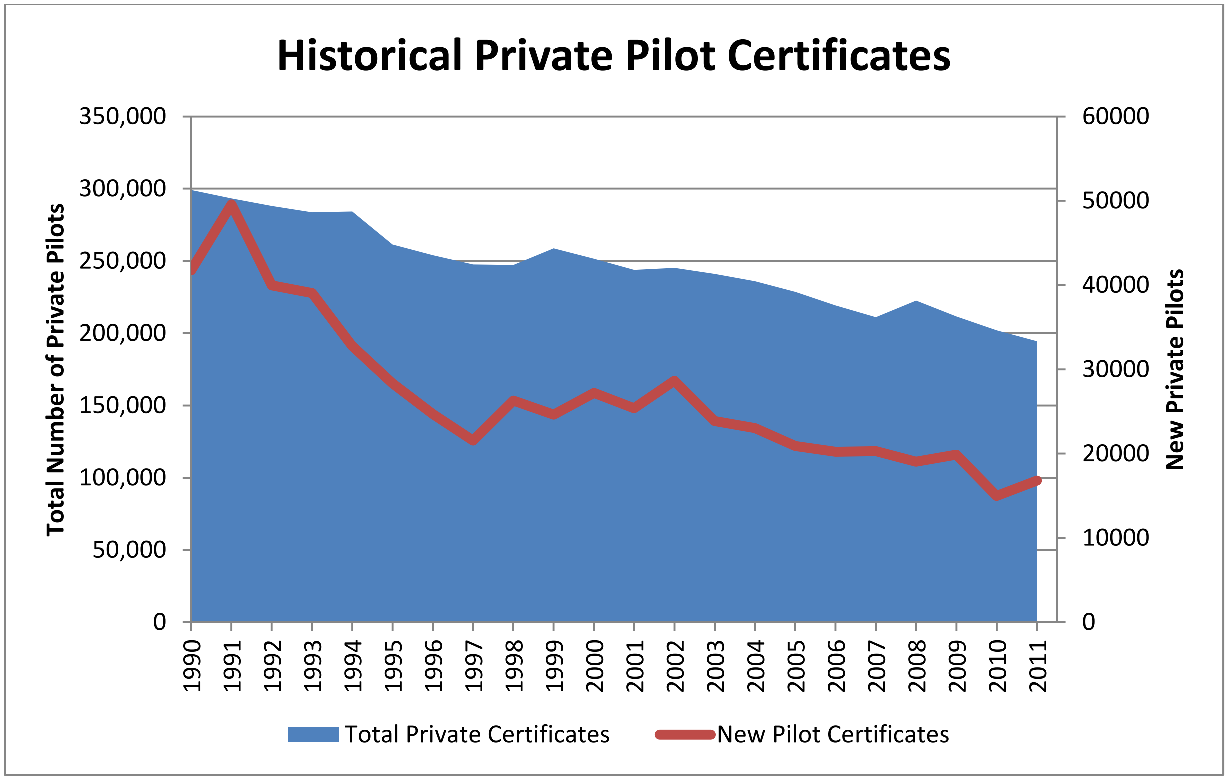

Figure 4. Historical Private Pilot Certificates

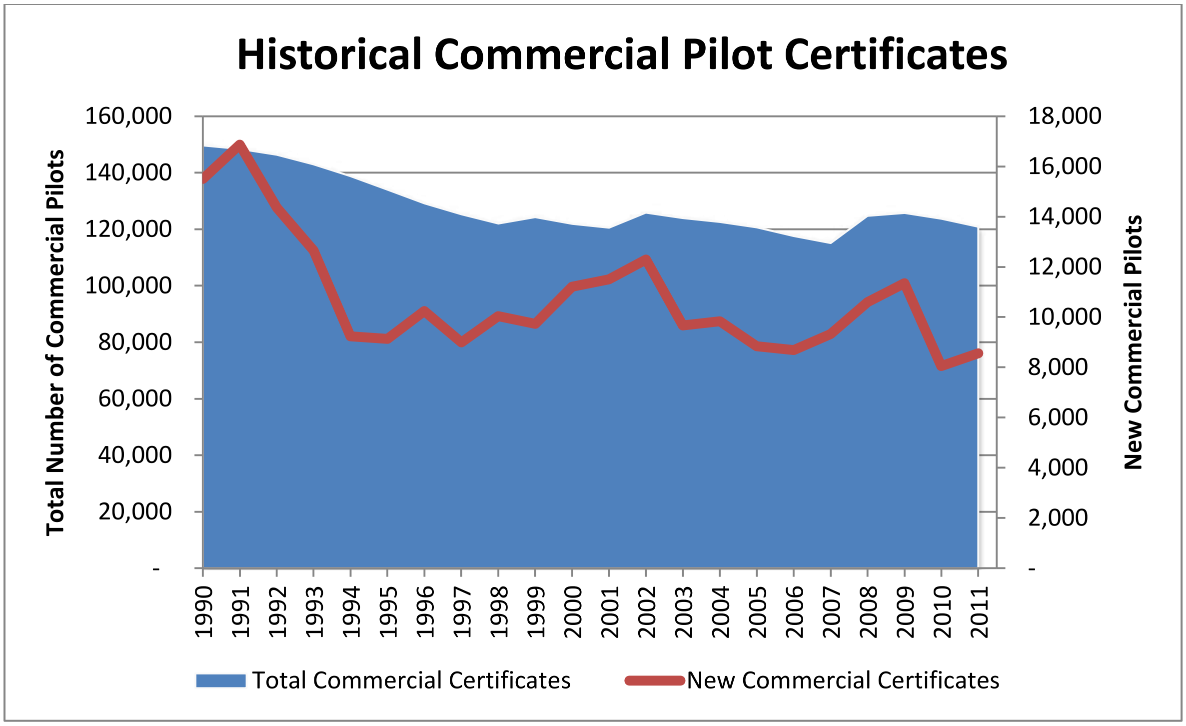

Figure 5. Historical Commercial Pilot Certificates

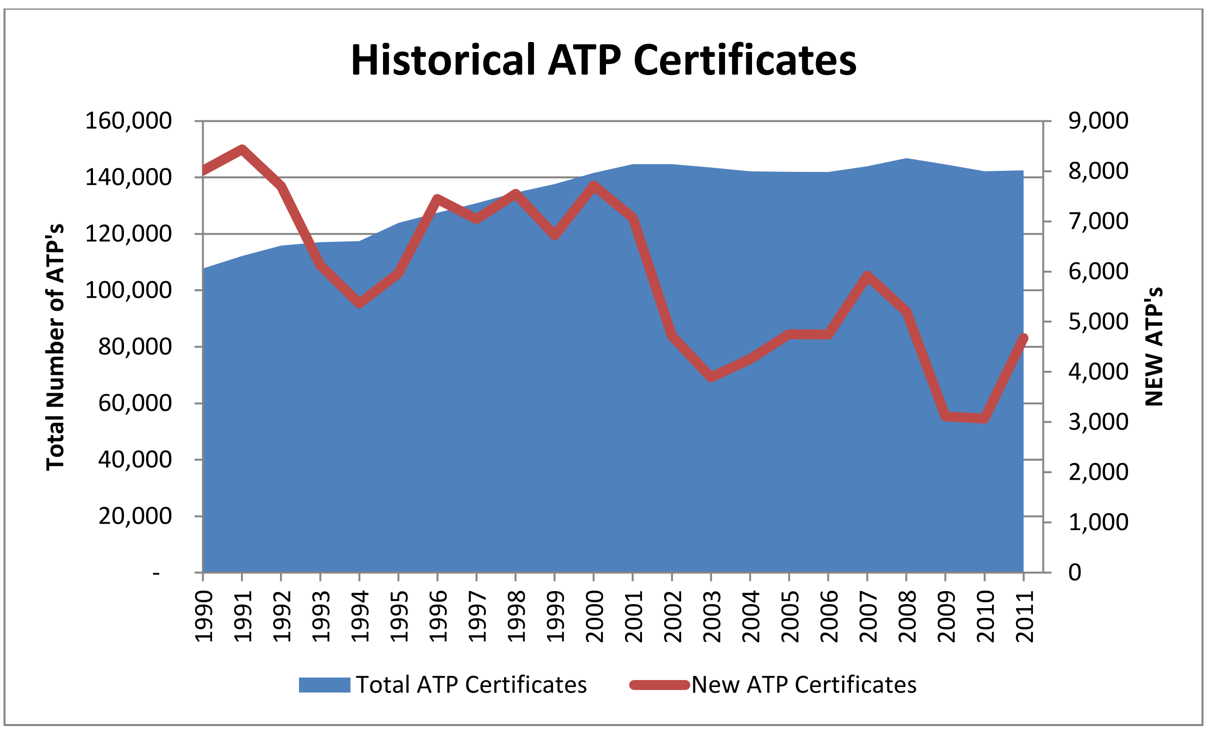

Figure 6. Historical ATP Certificates

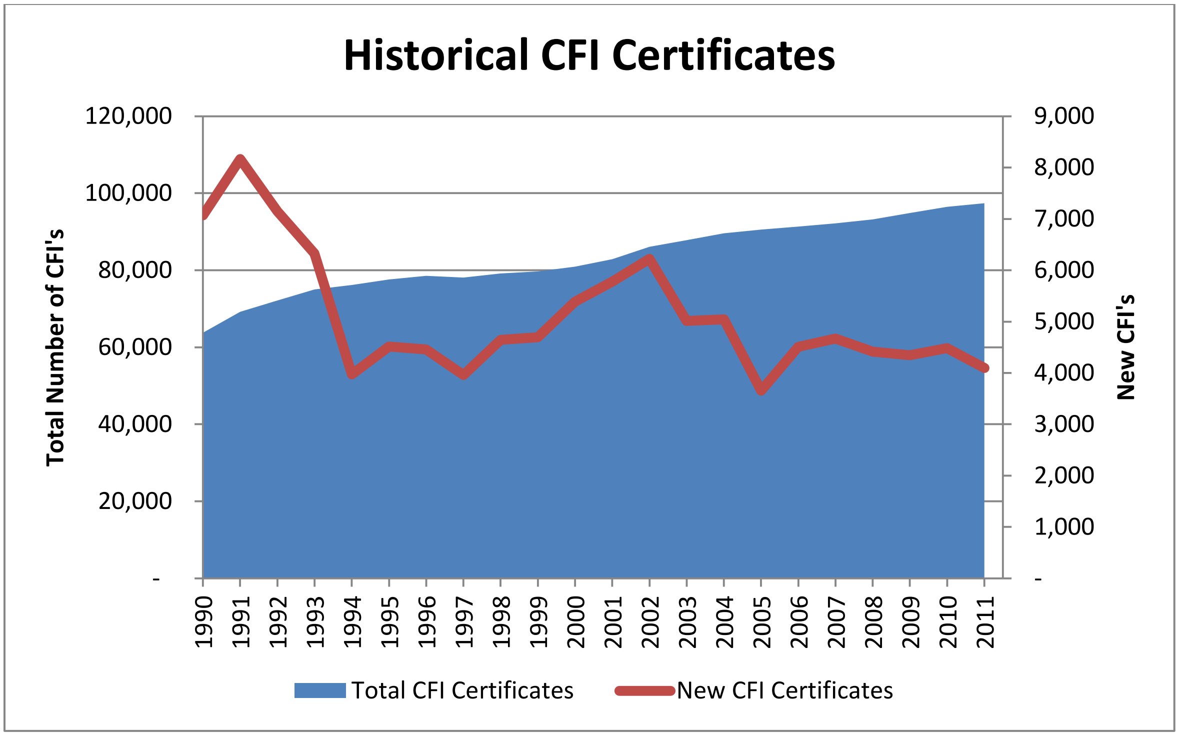

Figure 7. Historical CFI Certificates

The results allow for identification of trends in pilot certificates. Through the analysis of these trends, forecasting assumptions can be made to help increase the accuracy. It is important to analyze both the total number of each type of certificate issued, as well as the number of new certificates issued each year. The total number of certificates helps show the population change as a whole. It can be seen from Figures (4) and (5) that the total number of Private Pilot and Commercial Pilot Certificates has been decreasing since 1990. Since previous forecasts have studied the Commercial Pilot, this would indicate that the supply of pilots is decreasing; however, this forecast will examine the CFI's, which have been increasing since 1990. How this affects the pilot supply is analyzed later in this study. From Figure (6), it is also apparent that the total number of ATP certificates is increasing.

While intuitively this seems as though the supply of pilots for the airlines is growing, there are other factors that affect the supply model. The total number of certificates for each category helps determine entire population movement; however, the rate of additional certificates also needs to be examined to fully understand trends. Between 1990 and 2011, the number of new certificates issued per year decreased for each type of certificate. Comparing the decreasing number of additional certificates to the existing total certificates allows insight into the results of changes in the aviation industry. For both Private Pilot and Commercial Pilot certificates, the total number decreased as well as the number of new certificates. This indicates that the number of new certificates is not enough to overcome attritions in the industry and sustain the population. Reasons behind these trends are outside of the scope of this research, but would provide some explanation into the decline. The CFI certificate is an additional certificate, and pilots do not need to obtain it to fly commercially. Due to this difference from the Private, Commercial, and ATP certificates, the CFI certificate should be analyzed and compared to them. There has been an increase in the total number of CFI and ATP certificates, but the number of new certificates issued per year has decreased between 1990 and 2011. With the decreasing rate of additional certificates, the attrition rate of CFI's and ATP's would need to decrease in order for the total certificates to remain steady or increase. This indicates that the total population may start shrinking due to the inability of additional certificates to compensate for the losses. Causes for the changes are not available through this data; therefore conclusions about sustainability of the population are limited. Understanding trends of the total number of each certificate as well as the rate of additional certificates provides a broader perspective of the issue of a pilot shortage.

Flight Costs

University Aviation Association Data

Historical flight costs data was provided by the University Aviation Association (UAA), which consists of more than 525 members with 105 participating flight schools and universities. The data collected includes 213 reporting universities and flight schools, all of which were de-identified. These participating schools were asked to report their flight costs for the Private Pilot, Commercial Pilot, CFI, Multi-engine Rating, Other flight costs, and Total flight costs. Data was collected for the following years: 1989, 1994, 1999, 2003, and 2008. There is not a yearly sampling, and the reporting is not consistent for every school. While some schools reported multiple years, others only have one or two years reported, and the methods they used to report their data are also not consistent. Most schools reported the flight costs as the total cost to obtain a license; however, there were some that reported the cost per hour. The hourly flight cost data points were excluded from the model. The total cost of a specific license is unobtainable in these cases, due to the different hour requirements required by each school to obtain each license. Appendix A shows the results of the UAA flight costs with the unusable data excluded. After the exclusion of the unusable data, there were 202 reporting flight schools with at least one year reported for Private Pilot, Commercial, and CFI flight costs. None of the 202 flight schools used in this analysis reported every certificate cost for all of the reporting years. The number of data points from year-to-year varied, and the number of reporting schools by certificate and year are shown in Table (2).

Table 2. Number of flight schools reporting by certificate and year

Year	Private	Commercial	CFI
1989	109	101	85
1994	115	112	105
1999	57	57	55
2003	41	41	40
2008	59	59	51

Flight Cost Interpolation and Forecasting

In order to use flight costs in determining the pilot supply model, there first needs to be a complete flight cost model. This will ensure more accuracy within the forecast, and allow for better analysis. Since only five years were reported by the UAA, the values between each reporting year need to be determined. These missing flight cost values were found using a linear interpolation method, through Equation (3):

$$y = y_a + (y_b - y_a)\frac{(x-x_a)}{(x_b-x_a)} \tag{3}$$

In Equation (3), y is the year and x is the flight cost for that year. The interpolation only took into account the two closest reported variables for y_a and y_b to ensure the most accuracy between known data. Therefore, each linear interpolation will be different between the reported years. One disadvantage of using linear interpolation is that the interpolant is not differentiable; however, the interpolation and forecast will not be adversely affected.

Once the interpolation is complete, the flight costs then need to be forecasted to 2012 to provide consistency between the predictors. This is done by using the linear interpolation equation between the years 2003 and 2008 to determine the flight costs from 2008 to 2012. Figure (8) shows the flight cost model using the original flight costs from UAA, where the interpolations are linear and no adjustments for inflations are made. After this model was created, all of the values for the Private, Commercial, and Total flight costs were adjusted year-by-year to 2012 dollars to account for inflation. This allows for a uniform method to compare flight costs over the entire time span, and will provide more accuracy in the predictor for the regression model. The CPI adjusted flight cost model is found in Figure (9).

Adjusting all of the flight costs to 2012 dollars allows a comparison of the differences between years. Used as an economic indicator and measure of inflation, the Consumer Price Index (CPI) is "a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services" (Bureau of Labor Statistics, 2011). The inflation adjustment is conducted monthly, and the yearly average can also be determined. It is the yearly average that is used in this study, since the interpolation and extrapolation were conducted on a yearly basis rather than a monthly. When comparing the two flight cost models, similarities are found in the increasing costs over the selected time period. While the original model is linear between the reported years, the adjusted model does not exhibit linearity. This is mainly due to the differences in year-to-year inflation corrections, which gives the adjusted flight costs a parabolic curve shape in Figure (9). The Flight Cost Model can be found in Appendix D.

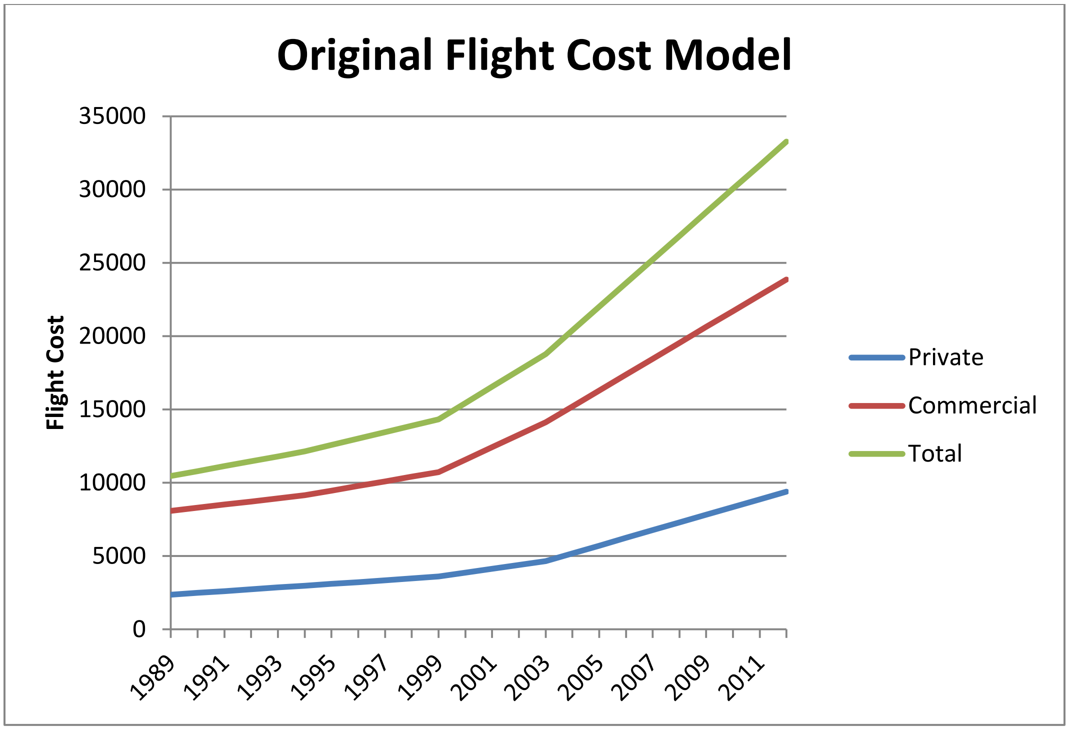

Figure 8. Original Flight Cost Model between 1989 and 2012.

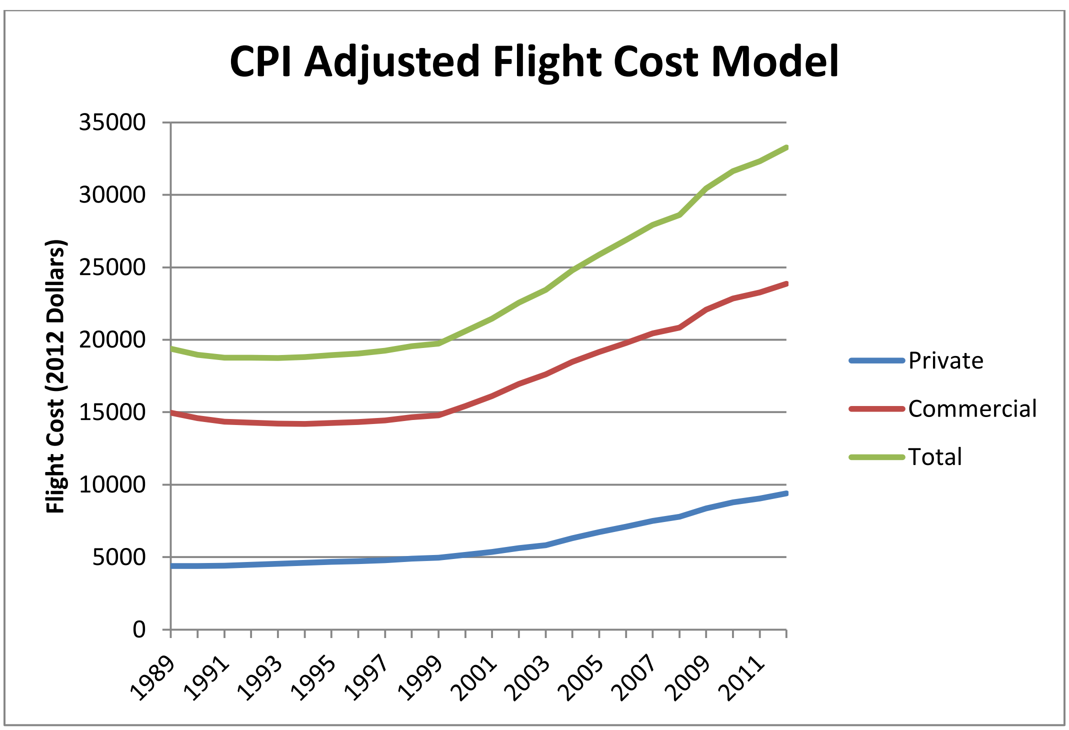

Figure 9. Flight Cost Model adjusted for inflation between 1989 and 2012.

Pilots Hired at Major Airlines

Pilots hired at major airlines is the other predictor used in the Pilot Supply forecast. The data was collected from fapa.aero, which provided the number of pilots hired by year from 1990 to 2012. For this study, major airlines studied include the following: ABX Air, AirTran Airways, Alaska Airlines, America West, American Airlines, ATA, Continental Airlines, Delta Air Lines, FedEx, Jet Blue, Northwest, Southwest Airlines, United Airlines, and US Airways. The entire list of new hires sorted by airlines and year can be found in Appendix B. Table (3) shows the total number of new hires by year.

Table 3. New Hired Pilots at Major Airlines

Year	New Hires
1990	3567
1991	2406
1992	1720
1993	547
1994	1359
1995	2369
1996	2604
1997	3414
1998	3511
1999	4721
2000	5105
2001	3408
2002	851
2003	854
2004	1199
2005	2301
2006	2443
2007	2766
2008	1299
2009	30
2010	408
2011	748
2012	553

A forecast for pilots hired at major airlines is not included. It is not feasible to predict the number of actual pilots hired in the future because there are too many uncertainties to create an accurate forecast. A more appropriate forecast produced in this study examines the pilot supply versus the demand. The pilots hired at major airlines are only introduced into the pilot supply forecast, and not the pilot demand forecast.

Interactive Independent Variable

In multiple linear regression the interaction of the independent variables with each other typically falls outside the study's analysis. The most common method is to only provide results for the effects of each predictor on the dependent variable. In this study, an interactive term is included to show the effects that the predictors have on the dependent variable when they are considered together. This means that the number of CFI's will depend not only on flight costs and number of pilots hired at major airlines, but also on a term that includes the interaction between the two. A typical two predictor multiple linear regression takes on the general form of Equation (4).

$$y = ax + bz + const \tag{4}$$

In Equation (4), y represents the dependent variable, x and z are the independent variables, and const is the constant created by the regression, also sometimes called the y-intercept. The constants a and b are values created by the model. This form of multiple linear regression allows for the determination of the effects on the outcome variable by each predictor variable independently. In some models, the interaction of the predictors needs to be analyzed to possibly increase the accuracy of the model. When this occurs, the regression equation takes on the general form of Equation (5).

$$y = ax + bz + cxz + const \tag{5}$$

The difference between Equation (4) and Equation (5) is the addition of the cxz term. In this term, c represents a value determined by the model, x and z are the same predictor variables found in the other terms of the equation. The interactive term accounts for both independent variables and their effect on the dependent variable when taken together; however, an explanation of the effect is difficult, since we cannot simply replace the variables with output data. In order to analyze the results of the interactive term, we must first understand how it was obtained and entered into the regression model.

To determine the interactive term, we need to define which variables will be used. The number of interactive terms will depend on the number of independent variables. When only two independent variable exist, such as this study, there will only be one interactive term. When more predictors are included in the equation, an interactive term will be needed for all possible combinations. For example, if there are three predictors, x, z, and w, there will need to be three interactive terms to determine the effects of the combination of xz, xw, and zw. By including the interactive term in the multiple linear regression, there is a chance that the overall model R^2 value will increase.

Centering the Independent Variables

An important step in determining the interactive variable is to center each independent variable. The benefits of centering are twofold: it centers the data around zero, and it mitigates the effects of possible multicollinearity between the two predictors. By centering around zero, previous predictors that were not able to be interpreted are given meaning. Multicollinearity is when the independent variables are highly correlated and the standard errors of the coefficients increase. The multicollinearity between the two predictor variables can be reduced through centering. This ensures that neither of the independent variables will be highly correlated in the interactive term. Centering transforms the predictors by subtracting the mean from each data case. Equation (6) shows the general form for centering, where x is the original data point, x_i is the newly centered data, and $\bar{x}$ is the mean of the specific data set.

$$x_i = x - \bar{x} \tag{6}$$

Creating the Interactive Variable

Once the independent variables have been centered, the interactive term was then created. To produce the interactive term, the two centered data sets from the predictor variables were multiplied together. The resulting data represents the predictor variable that takes into account the interaction between flight costs and pilots hired at major airlines. There is not one specific explanation for this variable, since it takes into account a potential pilot's decision based on both of the previous independent variables. Table (4) displays flight costs (Private, Commercial, and Total), pilots hired at major airlines, and the interactive terms associate for each flight cost paired with new hires.

Table 4. Linear Regression Independent Variables

Year	Private Pilot Flight Costs	Commercial Pilot Flight Costs	Total Flight Costs	New Pilots Hired at Major Airlines	Interactive Term 1	Interactive Term 2	Interactive Term 3
1990	-0.27	-2.62	-2.09	3567	-5373.13	-6904.1	-6609.68
1991	0.62	-1.56	-1.07	2406	-858.61	-1129.26	-1079.48
1992	1.56	-0.49	-0.01	1720	682.34	959.77	903.53
1993	1.38	-0.54	-0.07	547	3095.82	4040.05	3823.34
1994	1.63	-0.16	0.27	1359	1287.84	1641.08	1567.49
1995	1.28	0.58	0.76	2369	-575.59	-408.39	-449.51
1996	1.03	0.36	0.52	2604	-1196.36	-870.54	-957.09
1997	1.5	0.9	1.05	3414	-2479.89	-1543.34	-1780.77
1998	2.11	1.53	1.68	3511	-1798.43	-764.69	-1019.58
1999	1.33	0.8	0.93	4721	-5383.48	-3335.13	-3860.35
2000	3.91	4.4	4.28	5105	1595.35	7013.51	5658.97
2001	3.92	4.37	4.25	3408	709.07	3020.11	2429.22
2002	4.78	5.17	5.07	851	-1741.47	-3856.12	-3321.24
2003	3.69	4.03	3.94	854	-384.68	-2432.18	-1911
2004	8.38	4.87	5.75	1199	-4479.55	-2508.55	-3001.3
2005	6.53	3.61	4.35	2301	649.18	317.38	401.88
2006	5.77	3.32	3.96	2443	831.94	435.11	543.02
2007	5.42	3.3	3.86	2766	1369.02	825.44	979.79
2008	3.79	1.95	2.45	1299	-326.32	95.51	-39.8
2009	7.6	5.92	6.37	30	-8713.92	-7949.9	-8197.69
2010	5.01	3.55	3.95	408	-2749.66	-2496.63	-2614.71
2011	3.05	1.78	2.13	748	444.48	390.6	363.67
2012	3.78	2.63	2.95	553	-616.76	-863.47	-848.05

Table (4) shows three different interactive terms. Interactive Term 1 is the interaction between New Pilots Hired at Major Airlines and Private Pilot Flight Costs, Interactive Terms 2 and 3 are the interaction of Commercial and Total flight costs with New Pilots Hired respectively. Some of the interactive term data takes on a negative value because the data is first centered around zero before multiplied together. Strictly analyzing the data from this table does not provide any useful conclusions, and therefore specific analysis must take place in the linear regression using these variables.

New Certified Flight Instructors

The dependent variable in the model is the number of new CFI's created, which was calculated using different methods. The CFI certificate was chosen for the dependent variable due to many reasons, including a study that showed approximately 73% of pilots flying for Part 121 regional carriers held a CFI certificate (Smith et. al, 2010). An additional follow up study showed that 87% of regional pilots surveyed held a CFI certificate (Smith et. al, 2012). It appears that the most common method to obtain flight hours to meet the minimum standards for the airlines is through flight instructing. This requires a CFI certificate, and thus the CFI becomes the new dependent variable.

Since it is unknown exactly how long it takes from the decision to enter flight training until a CFI is created, a number of combinations were used to determine the dependent variable data. Table (5) shows the different groupings of new CFI's created. CFI 1 year represents the number of new CFI's produced the same year. CFI 2 year represents the number of CFI's created two years after the recorded flight costs and new hires, which continues through the CFI 5 year variable.

Table 5. Dependent Variable (CFI's) groupings

Year	New CFIs	2 year CFI	3 year CFI	4 year CFI	5 year CFI	5%-15%-80%	5%-25%-70%	5%-35%-60%	5%-45%-50%
1990	7071	8164	7151	6328	3970	6543	6626	6708	6790
1991	8164	7151	6328	3970	4513	4483	4719	4954	5190
1992	7151	6328	3970	4513	4459	4522	4468	4414	4359
1993	6328	3970	4513	4459	3958	4443	4448	4453	4459
1994	3970	4513	4459	3958	4647	4061	4111	4161	4211
1995	4513	4459	3958	4647	4697	4534	4465	4396	4328
1996	4459	3958	4647	4697	5386	4653	4648	4643	4638
1997	3958	4647	4697	5386	5781	5246	5177	5108	5039
1998	4647	4697	5386	5781	6221	5668	5628	5589	5549
1999	4697	5386	5781	6221	5012	6113	6069	6025	5981
2000	5386	5781	6221	5012	5044	5232	5353	5474	5595
2001	5781	6221	5012	5044	3654	5098	5095	5092	5088
2002	6221	5012	5044	3654	4506	3930	4069	4208	4347
2003	5012	5044	3654	4506	4667	4405	4320	4235	4150
2004	5044	3654	4506	4667	4415	4592	4576	4560	4544
2005	3654	4506	4667	4415	4348	4457	4483	4508	4533
2006	4506	4667	4415	4348	4486	4374	4381	4387	4394
2007	4667	4415	4348	4486	4097	4462	4448	4434	4420
2008	4415	4348	4486	4097		4168	4207	4246	4285
2009	4348	4486	4097						
2010	4486	4097							
2011	4097								

Table 5. Cont.

Year	10%-10%-80%	10%-20%-70%	10%-30%-60%	10%-40%-50%	15%-15%-70%	15%-25%-60%	15%-35%-50%
1990	6594	6676	6759	6841	6727	6809	6891
1991	4524	4760	4996	5231	4801	5037	5272
1992	4640	4586	4532	4477	4704	4650	4595
1993	4416	4421	4426	4432	4394	4399	4405
1994	4064	4114	4164	4214	4116	4167	4217
1995	4559	4490	4422	4353	4515	4447	4378
1996	4618	4613	4608	4603	4579	4574	4569
1997	5243	5174	5105	5037	5172	5103	5034
1998	5633	5594	5554	5515	5559	5520	5480
1999	6094	6050	6006	5962	6030	5986	5942
2000	5210	5331	5452	5573	5309	5430	5551
2001	5159	5155	5152	5149	5216	5213	5209
2002	3929	4068	4207	4346	4066	4205	4344
2003	4475	4389	4304	4219	4459	4374	4289
2004	4550	4534	4517	4501	4491	4475	4459
2005	4449	4475	4500	4525	4466	4492	4517
2006	4387	4393	4400	4407	4406	4413	4419
2007	4465	4451	4438	4424	4455	4441	4427
2008	4161	4200	4239	4278	4193	4232	4271

The percentages represent the spread of CFI's created over a three-year period. For example, 5%-15%-80% means that within a three-year period, 5% of the CFI's were created in the first year, 15% of the CFI's were created in the second year, and 80% of the CFI's were created in the third year. Different percentage combinations were used due to not knowing exactly how long it takes for a CFI to be created from the beginning of flight training. The assumption was made that a pilot typically becomes a CFI within 3 years of the start of their flight training. Without this assumption, the number of combinations would be limitless and add a level of uncertainty to the model. The percentage combinations were determined after the regression analysis was run on the 1 year CFI through 5 year CFI variables. By determining which years were significant, the percentage combinations were created and further regression analysis was completed.

Interactive Step-Wise Linear Regression Results

An interactive step-wise linear regression was used in order to forecast the number of new CFI's created. The dependent variable was New CFI's, and the independent variables were Flight Costs and New Pilots Hired at Major Airlines, with an interactive term included. Three different variables were entered for the Flight Costs: Private flight costs, Commercial flight costs, and Total flight costs. The interactive term was used as appropriate to the corresponding flight cost variable. Regression analysis included using each combination of Flight Cost and the Interactive Term on every New CFI's variable. Table (6) shows the Adjusted R^2 value and level of significance ($p<.05$) for each regression.

Table 6. Regression R^2 Results

Private Flight Cost	R^2	Sig	Commercial Flight Costs	R^2	Sig	Total Flight Costs	R^2	Sig
CFI 1	N/A	N/S	CFI 1	N/A	N/S	CFI 1	N/A	N/S
CFI 2	0.186	0.029	CFI 2	0.147	0.048	CFI 2	0.171	0.036
CFI 3	0.372	0.003	CFI 3	0.372	0.003	CFI 3	0.372	0.003
CFI 4	0.66	0.000	CFI 4	0.625	0.000	CFI 4	0.638	0.000
CFI 5	N/A	N/S	CFI 5	N/A	N/S	CFI 5	N/A	N/S
5-15-80	0.729	0.000	5-15-80	0.708	0.000	5-15-80	0.719	0.000
5-25-70	0.739	0.000	5-25-70	0.722	0.000	5-25-70	0.732	0.000
5-35-60	0.726	0.000	5-35-60	0.712	0.000	5-35-60	0.722	0.000
5-45-50	0.691	0.000	5-45-50	0.681	0.000	5-45-50	0.690	0.000
10-10-80	0.711	0.000	10-10-80	0.700	0.000	10-10-80	0.709	0.000
10-20-70	0.722	0.000	10-20-70	0.714	0.000	10-20-70	0.723	0.000
10-30-60	0.709	0.000	10-30-60	0.705	0.000	10-30-60	0.713	0.000
10-40-50	0.675	0.000	10-40-50	0.675	0.000	10-40-50	0.682	0.000
15-15-70	0.756	0.000	15-15-70	0.701	0.000	15-15-70	0.708	0.000
15-25-60	0.747	0.000	15-25-60	0.693	0.000	15-25-60	0.755	0.000
15-35-50	0.655	0.000	15-35-50	0.663	0.000	15-35-50	0.669	0.000

The highest Adjusted R^2 value for each flight cost predictor is highlighted in Table (6). For the Private Pilot flight costs, the highest Adjusted R^2 value is 0.756, and the Adjusted R^2 values for Commercial and Total flight costs are 0.722 and 0.755 respectively. The Private Pilot flight cost model where the dependent variable was 15-15-70 for CFI's will be analyzed further, since it produced the highest Adjusted R^2 value. This regression model will henceforth be referred to as the Pilot Supply model.

Dependent and Independent Variable Correlations

Further statistical testing was conducted to gain a better understand of the relationship between the predictors and outcome variables. Pearson's r correlation test was run between the dependent variable, CFI's at 15-15-70, and the independent variables, New Hires, Private Flight Costs, and the Interactive 1 term. The correlation was also run between all of the predictors. Table (7) shows the results of the correlation.

Table 7. Variable Correlations

		CFI_15_15_70	Hires	Priv_Flt_Cost_Lin	INT_1
Pearson Correlation	CFI_15_15_70	1.000	.758	-.447	-.599
	Hires	.758	1.000	-.230	-.290
	Priv_Flt_Cost_Lin	-.447	-.230	1.000	.131
	INT_1	-.599	-.290	.131	1.000
Sig. (1-tailed)	CFI_15_15_70	.	.000	.027	.003
	Hires	.000	.	.172	.114
	Priv_Flt_Cost_Lin	.027	.172	.	.297
	INT_1	.003	.114	.297	.
N	CFI_15_15_70	19	19	19	19
	Hires	19	19	19	19
	Priv_Flt_Cost_Lin	19	19	19	19
	INT_1	19	19	19	19

All of the predictors were significantly correlated with the outcome variable at $p<.05$. The Pearson's r values for Private Flight Costs, New Hires, and the Interactive 1 term and CFI 15-15-70 were -.447, .758, and -.599 respectively. This means that both Private Flight Costs and the Interactive 1 term were negatively correlated with a medium effect size, and New Hires was positively correlated with the dependent variable with a large effect size. None of the independent variables were correlated with each other at the $p<.05$ level. This suggests that centering the variables helped relieve the possible problem of multicollinearity.

ANOVA and Model Summary

The ANOVA run through the regression analysis helped determine the significance of the model summary. Tables (8) and (9) show the ANOVA and Model Summary.

Table 8. ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4963949.230	1	4963949.230	22.965	.000[b]
	Residual	3674600.560	17	216152.974		
	Total	8638549.789	18			
2	Regression	6320578.675	2	3160289.337	21.814	.000[c]
	Residual	2317971.115	16	144873.195		
	Total	8638549.789	18			
3	Regression	6878692.264	3	2292897.421	19.543	.000[d]
	Residual	1759857.526	15	117323.835		
	Total	8638549.789	18			

a. Dependent Variable: CFI_15_15_70

b. Predictors: (Constant), Hires

c. Predictors: (Constant), Hires, INT_1

d. Predictors: (Constant), Hires, INT_1, Priv_Flt_Cost_Lin

Table 9. Linear Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.758[a]	.575	.550	464.923
2	.855[b]	.732	.698	380.622
3	.892[c]	.796	.756	342.526

a. Predictors: (Constant), Hires

b. Predictors: (Constant), Hires, INT_1

c. Predictors: (Constant), Hires, INT_1, Priv_Flt_Cost_Lin

The results of Table (8) show that all three models run by the regression were significant at $p<.05$. Each iteration of the model added or subtracted a predictor to optimize the overall model, which is an advantage of the step-wise method. This allows the regression to build and define the best model for the given predictors and outcome variable. Model 1 includes the New Hires variable, Model 2 includes the New Hires and

Interactive 1 variables, and Model 3 includes New Hires, Interactive 1, and Private Flight Costs variables. The R^2 value increased with each iteration of the model, as well as the Adjusted R^2 value. This study used Model 3, with an Adjusted R^2 of .756, for the Pilot Supply Forecast.

Model Coefficients and Equation

The output from the regression analysis provides a coefficients section that allows a model equation to be created. Table (10) displays the coefficients and the associated significance.

Table 10. Linear Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	3828.435	233.548		16.392	.000					
	Hires	.407	.085	.758	4.792	.000	.758	.758	.758	1.000	1.000
2	(Constant)	3894.245	192.407		20.240	.000					
	Hires	.343	.073	.638	4.713	.000	.758	.762	.610	.916	1.092
	INT_1	-.122	.040	-.414	-3.060	.007	-.599	-.608	-.396	.916	1.092
3	(Constant)	4210.995	225.990		18.634	.000					
	Hires	.313	.067	.583	4.689	.000	.758	.771	.546	.878	1.139
	INT_1	-.116	.036	-.396	-3.242	.005	-.599	-.642	-.378	.911	1.097
	Priv_Flt_Cost_Lin	-78.370	35.932	-.262	-2.181	.046	-.447	-.491	-.254	.943	1.061

a. Dependent Variable: CFI_15_15_70

All three models are shown in Table (10), where each new model includes an additional predictor variable. The beta values (B) represent the coefficients associated with each independent variable, including both direction and magnitude in the equation. Each variable in the model is significant at the p<.05 level, and no collinearity existed between the predictors. From the Model 3 beta values (B) in Table (10), Equation (7) was created:

$$y = .313x - 78.37z - .116xz + 4210.995 \quad (7)$$

In Equation (7), y is the number of new CFI's created, x is the number of new pilots hired at major airlines, and z is the flight costs to obtain a Private Pilot Certificate. The third term, which includes xz, is the interactive term coefficient, and the last term is the y-intercept.

Pilot Supply Forecast

Pilot Demand Forecast

A Pilot Demand Forecast was created to determine the number of pilot's needed for hire in the future. In order to determine the number of new pilots hired, the assumption is made that there will be enough pilots to meet the needs of the major airlines. Retirements were determined through data provided by Airlines For America. Pilots that will be needed due to additional aircraft was determined by using the Airline Monitor forecast and staffing ratios. New hired pilots due to attritions in the industry was obtained through analysis of the FAA's Airmen Certificate Data provided on their website. A table of pilot demand is provided in Appendix C.

Flight Cost Forecast

The Private Pilot Flight Costs need to be forecast through 2032, since it will predict the number of new CFI's created. A linear regression was run to determine the relationship between Private Pilot Flight Costs and the year. The regression produced an adjusted R^2 of .531, $p<.05$, and the following Figure (10) shows the application of the regression equation. A table of the forecast results can be found in Appendix E.

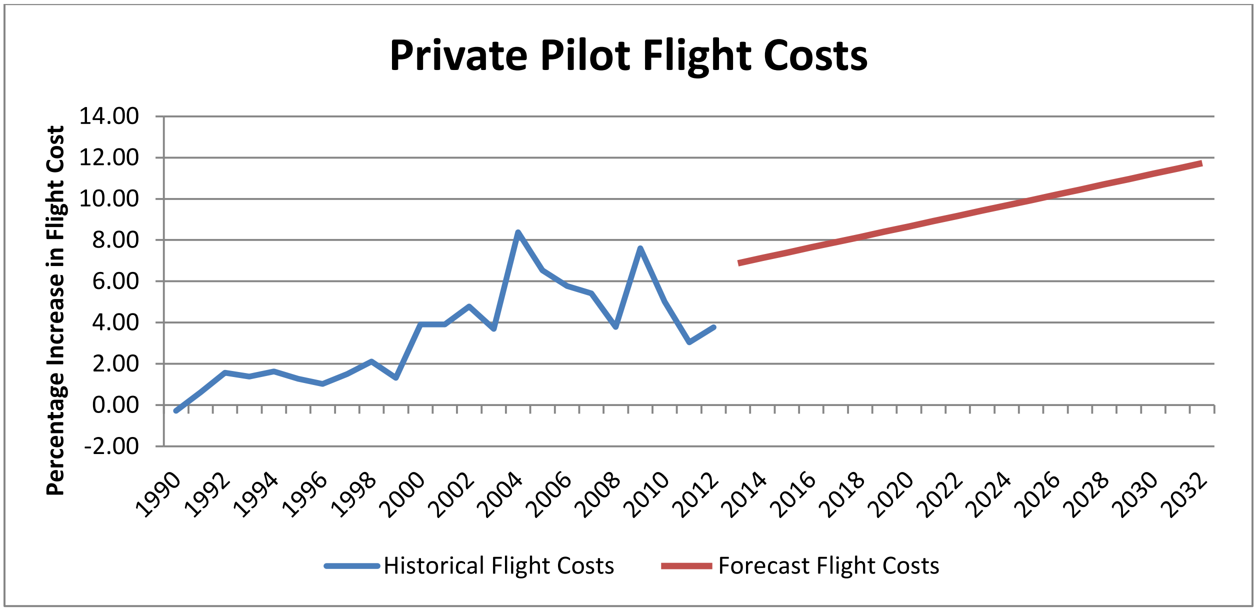

Figure 10. Private Pilot Flight Cost Forecast

Pilot Labor Supply Forecast Results

The Pilot Labor Supply Forecast was created from Equation (7) predicting the number of new CFI's from 2013 through 2032. The forecast in Figure (11) includes the number of new CFI's created yearly, as well as the cumulative number of CFI's created over the entire time period. According to the forecast, 52,117 CFI's will be created and available for hire by the year 2032.

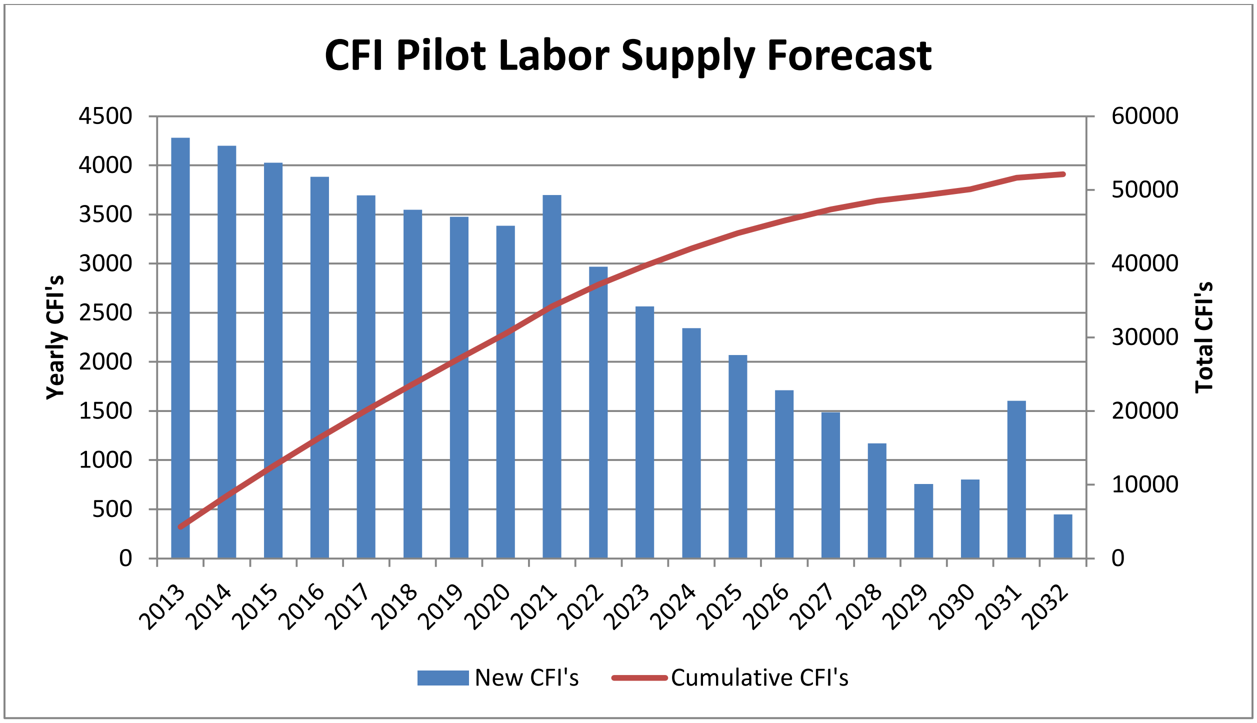

Figure 11. CFI Pilot Labor Supply Forecast between 2013 and 2032.

CHAPTER IV

ANALYSIS & DISCUSSION

Pilot Certificate Trends

Historical data trends are important because they help us understand the previous dynamics within the aviation industry, as well as give an indication where it may be headed. The results from the FAA US Civil Airmen Statistics Tables show that there has been a decrease in the number of Private Pilot, Commercial Pilot, CFI, and ATP Certificates issued on a yearly basis. Reasons for this decline are outside the scope of this study; however, other studies have attempted to determine explanations for these diminishing numbers. While the number of certificates issued yearly is decreasing, that does not mean that the total number of certificates is decreasing as well. Private and Commercial Pilot total active certificates have dropped, but total CFI and ATP certificates have increased since 1990. These trends could indicate movement of the pilot population towards the ATP and CFI certificates, or those who have previously obtained them could be holding onto their certificates longer. The reasons for these trends are unavailable from this dataset, but it does provide a historical perspective on the pilot population.

Flight Costs

Flight costs were provided by the University Aviation Association (UAA) on participating schools for the years 1989, 1994, 1999, 2003, and 2008. This data only consisted of those schools and universities that provided information for the given year. Not all participants reported every year, which causes some discontinuity in the data. The flight costs were interpolated to create a linear model through the year 2012. This method provides consistency between reported years, since it is difficult to create a forecast with only five data points for one of the predictors. Generally, the more data points you have, the better the representation of the population. The five data points are a good representation, since there has not been an extensive flight cost model created yet.

An original flight cost model was created, and then the flight costs were adjusted for inflation to 2012 dollars. This allows the flight costs to be consistent when compared, as well as provides more reliability in the overall pilot supply forecast. Typically, the adjustment for inflation increased the values of the yearly flight costs, which is expected because of the increase in inflation every year. This flight cost model includes Private Pilot, Commercial Pilot, and Total Flight Costs, which includes both Private and Commercial costs. All three models were analyzed in the regression to examine which flight cost model produced the highest R^2. The overall model created has provided more validity since it was obtained using more data points than previous research (Lovelace and Higgins, 2010); however, to provide further validity, more data points will be required. Even though the model produced in this study captures the general trends needed for proper analysis, a comprehensive flight cost model has not yet been created.

Pilots Hired at Major Airlines

The New Pilots Hired at major airlines data was obtain from the Future & Active Pilot Advisors website, fapa.aero. A list of the airlines classified as majors can be found in the results section. Defining these carriers is important because the forecast will not account for all pilots hired industry-wide, but rather just those considered major airlines. This study was not able to obtain data on new pilots hired at regional carriers or corporate flight departments, and therefore was limited. Further research will need to be conducted to determine if new regional pilots is a predictor for the pilot supply. Since previous studies have proven that new pilots hired at major airlines is a predictor of the pilot supply, this study aimed to improve upon that variable. Data points in 2010 and 2011 were included, which improved the model.

Interactive Independent Variable

This study included an interactive term in the regression in an attempt to increase the R^2 value. In the regression, the two independent variables, new pilots hired at major airlines and Private Pilot flight costs, predict the outcome variable, new CFI's created. As an independent variable changes, the dependent variable will also change, either in a positive or negative direction. An interactive term affects the relationship of the predictors with the outcome variable. The outcome variable will change with changes in the interactive term, yet a direct relationship does not exist between the two. For example in Equation (5), y will change by a magnitude of 'a' with x and 'b' with z. The interactive term, xz, will cause changes in y by the magnitude c, but it is not due to only x or z. In this study, the number of newly created CFI's will be affected by the Private

Pilot flight costs and New Pilots Hired at major airlines, as well as the interaction between them. Interactive terms typically increase the accuracy of forecasting if two or more independent variables have an effect on one another.

New Certified Flight Instructors

The dependent variable is typically a set variable in which the predictors are known and the outcome predicted; however, this analysis uses an exploratory method to determine the best possible outcome. For this study, the amount of time it takes for a person with zero flight experience to become a CFI is unknown. Due to this unknown time frame, the dependent variable will change, while the independent variables remain the same. This non-standard approach allows for some flexibility in the forecast, and does not limit the results to only those that are expected. Different percentages of when CFI's were created can be found in Table (5), which tried to identify the time frame that would allow for the highest R^2 in the regression. There is the assumption that most CFI's will be created within three years of beginning flight training, and therefore the percentages only include the first three years. This allowed more flexibility in the regression due to differences in flight training.

Interactive Step-Wise Linear Regression Results

Table (6) shows the results of the regression using the different CFI combinations for the dependent variable. The table is further divided by flight costs into the Private, Commercial, and Total. In each flight cost column, the highest R^2 is highlighted. Overall, the Private Pilot flight cost with the 15-15-70 CFI dependent variable had the highest R^2 at .756, $p<.05$. This means that 75.6% of the new CFI's created can be determined through the predictors used. Each different combination of CFI's produced a different R^2, and the optimal grouping of the dependent variable for this study was found. The CFI 1 and CFI 5 cases, those in which all CFI's were created in one year and in five years respectively, were not significant in any regression. Significance was found in the CFI 2, 3, and 4 cases; however, the R^2 value increased as the CFI combinations were used in the regression. One of the reasons why this happens may be due to the uncertainty of how long it actually takes a person to obtain their CFI Certificate. By creating these CFI combinations for the dependent variable, it helps alleviate this unknown, and provided better outcomes.

When analyzing the 15-15-70 CFI regression, all three predictors are significantly correlated to the dependent variable, $p<.05$. New hired pilots are positively correlated at .758, and Private Flight costs and the Interactive 1 term are negatively correlated at -.447 and -.599 respectively. This means that as the Private Flight costs and the Interactive 1 terms increase, the CFI 15-15-70 variable will decrease. Table (8) shows the ANOVA results. The regression used a step-wise entry method for the predictors, which created three different models. All three models were significant; however, model 3 produced the highest R^2 value. The adjusted R^2 value for models 1, 2, and 3 were .550, .698, and .756 respectively. Model 3 gives the highest adjusted R^2 value, and therefore we can predict more of the outcome variable using the associated predictors. This model is going to be used to forecast over an entire population, therefore the adjusted R^2 needs to be used. Since errors can occur when a small regression model is applied to a large population, the adjusted R^2 will be less than or equal to the R^2 value. This allows for a more conservative approach and attempts to decrease the effects of errors in forecasting.

The model equation coefficients can be found in Table (10), and Equation (7) shows the model equation used for the forecast. All of the predictors were significant in the model, and will therefore be present in the equation.

Pilot Supply Forecast

The Pilot Supply Forecast consists of predicting the future number of new CFI's created for the purpose of the supply to the airlines. This is done through using Equation (7), produced by the interactive linear regression. In order to create the forecast, the two predictors in the regression must first be forecasted forward through the desired time period.

For the New Hired pilots at major airlines, a Pilot Demand Forecast was created. This forecast, found in Appendix C, predicts the number of pilots needed using the number of retirements, pilots needed for additional aircraft, and the average attrition rate of pilots out of the industry. While the Pilot Demand Forecast is not the main focus of this study, it is an important part of the Pilot Supply Forecast. For simplicity, it was assumed that all of the demand for new pilots was met through the forecast period. This assumption is critical because it is impossible to know exactly how many pilots will be hired in the future.

Next, a Flight Cost Forecast was created for the Private Pilot flight costs. This was the second predictor in the regression, and included data through 2012. To forecast the flight costs, a regression was run on the existing data, which was then applied to generate Figure (10). The Flight Cost Forecast is linear due to the nature of the regression output. It shows an increase in the flight costs moving forward, which is consistent with the previous data. An increase in flight costs is expected, since inflation is taken into account for the previous historical data. Unforeseen factors could easily change the Private Pilot flight cost forecast, and that provides some risk to the overall forecast that is acceptable for this study. By 2032, the Private Pilot flight cost is expected to have increase by 11.468% from 2012 dollars. Since the flight cost predictor has a negative relationship with New CFI's created, a decrease is expected due to the increasing flight costs in the forecast.

Using the Pilot Demand Forecast and the Flight Cost Forecast, the Pilot Supply Forecast was created, and Figure (11) shows the results. The number of new CFI's created yearly as well as the cumulative number of CFI's is shown on this chart. Through the forecasted time period, the yearly number of new CFI's created decreases. Reasons for this decrease can only be understood through the flight costs and new pilot hires. Flight costs increase throughout the forecast, which could indicate a decrease in new CFI's year-by-year. The cumulative number of CFI's created increased over the forecast period; however, it indicates a trend towards a stagnation point, where the number of New CFI's will not continue to increase. Between the years 2027 and 2032, the number of cumulative CFI's between 47,333 and 52,117, for a total of 4,784, which is considerably low compared to earlier years in the forecast. From 2013 to 2016, approximately 4,000 CFI's are created yearly, and then the yearly CFI's created begins to decrease. These differences indicate a severe reduction in the number of new CFI's, and could cause problems with the pilot labor supply. Overall, the Pilot Supply Forecast shows a decrease in the number of new CFI's, which may not be able to replenish the current labor supply force.

CONCLUSIONS

Research Questions Conclusions

The purpose of this research was to show industry trends and create a pilot supply forecast using the CFI population. This was done through answering the three proposed research questions seen below:

1. Does the number of Certified Flight Instructor Certificates accurately forecast the number of future pilots qualified and available for hire by the airlines?
2. To what extent will the supply of active Certified Flight Instructors vary over short and long-term time periods?
3. Is there an interaction between previously known predictors that may significantly affect the number of Certified Flight Instructors over short and long-term time periods?

Research question 1 was answered through the literature review and analyzing the current state of the aviation industry. With the new Public Law 111-216 First Officer Qualification requirements of an ATP Certificate, the Commercial Pilot Certificate will no longer be the minimum requirement to fly for the airlines; therefore, a better indicator of the pilot supply is found through the CFI Certificate. Previous forecasts have used Commercial Pilots as the pilot supply, and this study attempted to account for the changing industry dynamics.

A forecast was created for New CFI's to answer research question 2. The results showed that the number of new CFI's being created on a yearly basis will decrease over the next twenty years, as well as the cumulative number of CFI's trends towards an equilibrium point. This indicates that the CFI population will not continue to grow as previous years have shown. Since the pilot supply is based upon the CFI population in this study, a conclusion can be drawn that there will be a decreasing number of available pilots for the airlines to hire.

Research question 3 was analyzed by studying the interaction between Flight Costs and New Hired Pilots at Major Airlines. The interactive term between these two predictors was found to significantly affect the CFI forecast in the regression. This newly discovered interaction helps improve the forecast, and shows that the predictors affect the regression both independently as well as when their interaction is considered.

Overall Conclusions

Building upon previous knowledge of the aviation industry, this study was able to update, adapt, and strengthen our understanding of the factors that affect the pilot labor supply. An overall decrease in the yearly number of new CFI's, combined with the cumulative trend towards overall equilibrium, suggests that problems may exist in the future supply of pilots to the airlines. While limited only to two predictors and their interaction, this study was able to significantly predict 75.6% of why changes occur in the CFI population. With the assumption that these pilots will become the new supply to the airlines, it is important to comprehend these changing industry dynamics. All of these results trend towards a pilot shortage in the future. Increasing demand and decreasing supply will eventually lead to this shortage if no actions are taken to change the current industry dynamics. As more is understood about what influences people interested in becoming pilots, more accurate forecasts can be created. Preventing a pilot shortage in the near or far future requires immediate participation at every level of the aviation industry. This Pilot Supply Forecast has been able to identify trends, and the results help support the need for change in our industry.

APPENDIX A

Original UAA Flight Costs

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
1													6,800	8,100	2,400	1,800		24,000
2	1,000						2,140	10,031	1,700	1,520		15,391						
3	1,050	5,425	800										3,500	12,000	15,000	2,000		15,000
4	1,150	7,200	800	900			1,500	6,500	2,400	1,100		11,500	2,000	9,700	2,100	1,500		16,000
5	1,176	4,710	450				2,400	3,500	2,600			7,500	2,160	6,028	1,025	1,345		
6	1,207	6,000	1,400	1,800									2,208	7,524	2,400	2,269		12,001
7	1,250	3,750																
8	1,380	6,685	905	1,725									3,475	9,775	2,785	2,345	5,950	23,830
9	1,500	5,000	1,500	800			2,250	12,640	3,725	1,050		14,890						5,000
10	1,500	6,000	1,000	1,500														
11	1,500	7,500	800	600														
12	1,500	7,500	1,000	1,500									1,760	7,680	1,500	2,000		11,078
13	1,500	8,000																
14	1,585	7,055	1,060	2,058														

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
15	1,600	7,500	800	800			3,200	10,000	1,000	1,000		12,000						
16	1,658	7,563	1,800	2,100			2,243	9,778	4,732	2,880		14,000-15,000	1,895	9,366	2,030	2,025	370	
17	1,675	5,935	1,350	1,440			1,870	6,775	1,485	1,750		8,645						
18	1,700	9,000	600	2,000														
19	1,700																	
20	1,750	6,415	575	1,650			3,500	7,000	3,500			14,000	2,800	10,000	1,000	1,500		12,800
21	1,750	9,000	1,250															
22	1,755	4,500	1,000	1,000														
23	1,800	4,500	650	850									2,962	5,842	2,650	1,875		13,335
24	1,800	5,200	650	1,200														
25	1,800	10,000					1,900	8,460	900	1,000		12,260						
26	1,800												3,500	5,000	1,800	3,800	1,200	15,300
27	1,858	5,542	1,496	2,196														
28	1,890	7,400	1,790	1,450														
29	1,900	7,500	3,000	2,800										10,878	2,388	2,605	1,483	
30	1,935	8,885	1,175				3,100	11,300	3,600			18,000						

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
31	1,940	8,430	900	1,100			1,500	1,000	600	1,000		5,000						
32	1,957	2,500																
33	1,960	9,038	1,777	2,239									3,826	12,830	2,270	2,529		19,185
34	1,965	9,757		1,210														
35	1,975	6,160	1,250	2,100														
36	2,000	1,500	200				2,000	4,000	1,500			7,500						
37	2,000	6,000	1,300	2,500									3,500	11,000	6,000	3,500		20,000
38	2,000	6,000		1,000									3,920	9,990	1,770	1,200-1,500		15,680
39	2,000	6,815	900				2,500	11,490	6,600	3,100		23,689						
40	2,000	7,000	1,500	1,500														
41	2,000	7,500	1,200	1,095			3,000	9,000	1,500	1,200		14,700	2,500	4,500				14,000
42	2,000	7,500	1,500	1,700									2,500	10,000	2,000	2,000	2,000	20,000
43	2,000	8,000	2,000	1,500														
44	2,000	8,000					2,495	7,960	1,335	2,495		15,220	3,100	3,845	1,380	2,490	8,000	18,815
45	2,000	8,000					3,000					10,000						
46	2,000	8,100	1,330	1,725			3,500	11,800	2,300	2,200		23,000	4,800	15,000	3,700	3,200		26,700

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
47	2,100	6,600	1,400	1,280			2,418	7,860	620	1,120		13,108	3,500	8,000	2,400	5,000	1,800	11,500
48	2,100	8,500	1,000	800									2,500	6,500	1,500	1,400	2,500	14,400
49	2,150	6,700	1,200	1,300														
50	2,150	9,500	2,250	1,750			1,875	8,475	1,575	2,275		14,000						
51	2,180	6,770	3,058	1,590			2,800	10,280	1,200	895		13,080						
52	2,200	5,288	912	1,140														18,500
53	2,200	7,500	600	1,200									3,500	12,270	2,600	2,900		21,270
54	2,200	9,570	785	1,635			2,900	12,030	1,375	2,195		19,780	4,365	12,962	3,035	2,470	1,514	
55	2,200	12,000					2,400					10,000						
56	2,200	13,200	1,200	1,500														
57	2,212	9,277	2,235	1,465									2,500	10,000	2,300	1,500	800	16,000
58	2,300	11,300	1,000	1,300			3,280	8,900	800	1,000-1,500		12,180						
59	2,300	11,500	2,000	1,100			4,752	15,510	3,473	3,148		26,883	2,975	11,690	2,040	1,080		17,785
60	2,324	7,288	1,126	1,610			2,730	8,196	1,293	1,774		13,993	2,089	10,741	1,582	1,753		16,126
61	2,431	7,293					2,550	7,650	1,700	1,750		10,200			1,450			13,500-14,500

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
62	2,470	8,400	1,500	2,300			2,500	10,000	1,600	2,300		16,400	3,800	13,500	3,000	4,500		20,300
63	2,490	13,908	1,698	3,025														
64	2,500	1,000	1,500	1,500														
65	2,500	3,775	1,800	1,350			2,500	5,500	2,600	1,490		10,600						
66	2,500	4,400	1,500	1,500														
67	2,500	6,000																
68	2,500	6,500	1,000	1,200									3,800	12,400	800	2,400	3,000	22,400
69	2,500	8,000	500	1,500			3,000	10,000	1,500	1,500		18,000						
70	2,500	8,120	1,892				3,054	11,901	1,913	1,876		18,744	3,590	14,007	2,970	2,520	1,980	25,067
71	2,500	8,900	1,500	1,600														
72	2,500	9,000																
73	2,500	10,000	1,500	1,500			1,972	6,525	1,334	1,742		10,239						
74	2,500	12,000	1,800	1,600			4,250	13,500	2,570	2,680		23,000	3,200	12,700	2,500	3,000		21,400
75	2,500	16,000					3,000	12,000				15,000						
76	2,500						2,550	10,050	2,024	2,375		14,975						
77	2,500																	

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
78	2,550	9,700	1,230															
79	2,600	7,500	1,700	2,660			3,600	10,484	2,000			17,588	4,800	9,000	2,100	2,400		20,000
80	2,600	10,000	3,000	2,000									3,800	11,500	2,000	3,300	2,200	19,000
81	2,675	9,945	1,555	1,350									3,830	15,595	1,295	1,870	1,105	
82	2,700																	
83	2,750	8,920	909	1,320														
84	2,800	8,000	1,800	1,900									2,911	9,384	3,937	3,880	2,473	18,705
85	2,800	8,700	720															
86	2,800	9,000	1,600	1,500									3,000	10,000	1,300	2,650		17,000
87	2,841	10,449	2,176	1,695														
88	2,945	11,285	1,915				2,500	6,000	1,200	1,000		10,700						
89	2,995	9,289	1,000	1,000			3,455	11,700	4,000	2,000		20,075						
90	3,000	3,250	1,000	2,400														
91	3,000	6,000		1,200			3,000	9,500	1,500	1,500		12,500	3,500	12,000	3,200	3,000		18,000
92	3,000	6,000																
93	3,000	8,000	1,000	1,000														15,000

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
94	3,000	8,500	1,600	2,000			2,835	4,450	1,525	2,520		9,300						
95	3,000	9,000	2,000	2,500			3,500	8,500	3,000	4,000		23,000						
96	3,000	9,500	3,000	3,000			5,000	16,000	4,000	20,000		45,000	2,800	9,000	1,800	3,700		17,200
97	3,000																	
98	3,000																	
99	3,007																	
100	3,096	7,478	1,095	3,505														
101	3,385	10,890	1,830	1,950			5,050	11,950	2,300	2,000		17,000	5,100	21,500	3,200	2,400		31,000
102	3,400	11,950	2,700	3,150			4,600	14,131	3,005	3,046		24,782	5,500	15,400	1,600	3,100		25,600
103	3,500	7,500	2,000	2,000			4,000					20,000						
104	3,500	10,500	1,200	1,500											1,340			
105	3,708	11,779	2,480	2,197			5,600	12,385	2,650			23,175	4,600	17,100	3,900	3,000	2,600	
106	3,784	8,073	1,630	1,222														
107	4,000	6,000	1,000	1,000			6,000	8,000	1,800	1,800		14,000						
108	4,459	14,324	5,478	2,649			3,375	12,400	2,073	2,525		37,515						
109	5,100	9,600	2,500	3,900			6,000	12,200	3,600	5,000		26,800						

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
110	7,250	17,375	7,200	1,275			2,900	7,950	850	2,520		12,950	2,300	13,000	1,500	1,200		18,000
111		16,000					2,500	7,500	1,500	900		10,000						
112							1,500	4,500	500	1,200		8,000						
113							1,500	5,200										
114							1,500	5,500	1,250	1,500		7,500						
115							1,700	7,760	1,700	2,000		16,000						
116							1,900	8,000	1,400	1,800		10,000						
117							1,900	8,600				10,500						
118							1,900	9,500	1,200	140		14,000						
119							2,000	7,500	1,200	1,550		9,900						
120							2,000	8,000	600	1,500		10,000						
121							2,100	8,500	1,600	2,000		13,000						
122							2,200	7,000	1,000			10,700	2,800	8,610	1,150	3,190	2,390	15,750
123							2,340	9,227	2,850	1,600		16,000						
124							2,350	4,000	750	1,665		16,956						
125							2,400	8,841	1,250	2,398		13,275						

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
126							2,400	10,300	1,070	1,385		14,155						
127							2,500	5,000	1,750	1,750		17,000						
128							2,500	7,500	1,200	1,200								
129							2,500	8,000	1,000			11,500						
130							2,500	8,000	1,200	3,100		20,900						
131							2,500	9,608	2,057	2,321		16,486						
132							2,500	9,908	1,743	1,997		16,943	2,295	11,085	850	1,450		17,355
133							2,515	17,400				19,915						
134							2,541	8,388				10,929						
135							2,600	850	1,100	1,000		13,200						
136							2,600	7,400	2,000	2,300		10,000						
137							2,600	8,400	1,800	1,800		14,650						
138							2,600	10,000	2,000	2,500		20,000						
139							2,600	11,000	2,000	1,500		14,000						
140							2,625	8,086	1,444	2,520		10,711						
141							2,650	4,250	2,050	2,350		11,300						

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
142							2,695	5,895	2,195	1,250		16,475						
143							2,700	9,990	1,800	2,210		22,000						
144							2,700	10,000	1,000	1,700		20,000						
145							2,800	8,189	1,684	1,213		12,202					165	
146							2,800	9,200	800	1,560		12,000						
147							2,810	9,305										
148							2,900	7,700	1,550	2,050		10,600						
149							2,983	17,865	2,099	2,390								
150							3,000	6,000	1,000			10,000						
151							3,000	6,500				11,000	4,500					
152							3,000	10,000	1,000	1,000		15,000						
153							3,000	10,000	1,500	1,700		? 3,000						
154							3,000	10,000	2,000	1,500		16,500						
155							3,000	11,000	2,500	3,500		20,000						
156							3,195	9,890	1,695	2,145		18,320						
157							3,200	7,200	2,300	1,500		11,000						

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
158							3,200	8,800	2,000	1,700		1,000						
159							3,250	11,411	2,137	2,300		14,806						
160							3,257	9,733	1,970	1,376		18,500						
161							3,302	9,755	2,146	2,835		18,038						
162							3,389	7,180	1,845	2,327		14,741						
163							3,400	10,800	1,000	1,500		16,300						
164							3,500	15,000	2,000	1,500		18,500						
165							3,502	13,301				20,000						
166							3,525	12,970	2,020	1,700		22,200						
167							3,592	7,107	5,021	3,930		19,669						
168							3,688	14,155	2,400	2,260		17,843						
169							3,800	10,500	2,300	1,900		17,400						
170							4,022	10,356	1,898	2,173		16,551						
171							4,150	10,950	1,700	2,300		18,300						
172							4,280	6,608	1,897	1,483		10,888						
173							4,500	5,500	1,000	2,000		13,000						

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
174							4,913	11,125	3,345			19,383						
175							5,000	10,000	2,500	1,500		19,000	5,500	13,000	3,573	1,776	1,200	28,000
176							5,134	12,340	3,150	2,350		22,974						
177									3,600	3,400		26,800					180	
178													2,408	8,655	1,006	1,179	858	14,106
179													2,769	6,476	1,292	1,070		11,607
180													3,000	8,500	2,500	2,500	2,500/1,500	14,000
181													3,170	12,450				15,620
182													3,200	11,400				14,600
183													3,200	14,000	2,900	2,800	1,600	24,500
184													3,500	9,000	2,500	2,000		
185													4,400	10,000				14,400
186													4,700	15,460	3,600	3,000		26,760
187													4,861	15,593	2,427		1,121	39,595
188													5,065	11,500	4,000	800		28,565
189													5,472	14,089	2,852	2,957	1,562	22,518

	1989 CAD*						1994 CAG**						1999 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
190													9,200	4,300	5,500		3,200	22,200
191																		21,500
192																		
193																		
194																		
195																		
196																		
197																		
198																		
199																		
200																		
201																		
202																		

	2003 CAG**						2008 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
1												
2												
3												
4										300/hr		38,000
5	2,363	10,838	1,513	2,175	555	17,443	3,520	13,900	1,430	3,195	920	22,965
6												
7												
8	4,240	11,995	3,781	2,875	7,516	25,062	5,093	14,829	4,120	3,235	2,520	29,797
9						5,000	5,000	8,000	4,000			17,000
10	2,600	2,600	2,600	2,600		20,800						
11												
12												
13												
14												
15												
16	5,920	17,119	4,050	2,670	450	26,159	8,886	23,513	4,380	3,940		40,719
17	2,500	8,500	1,720	1,700			3,180	9,645	2,155	1,925		12,825
18												
19												
20												
21												
22	2,550	5,950	1,450	1,900	4,300	16,150						
23												

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
24												
25												
26	5,000	5,000	1,800	3,800	1,200	16,800	6,000	5,500	2,800	5,000	11,000	30,300
27												
28												
29												
30	4,925	17,770	3,005	4,155	2,655	32,510	6,988	23,883	3,872	5,444		43,353
31												
32							5,500	18,500	2,500	2,500		29,000
33	4,375	14,000	2,630	3,025		21,400	5,181	18,612	4,387	4,535		32,715
34												
35												
36												
37	3,500	14,000	4,000	4,000		25,000						
38						22,000	8,800	22,000		3,500	400	38,200
39							8,800	23,700	6,900			Depends on Degree
40												
41						18,000						
42							14,000	24,000	3,000	4,500		45,500
43							8,500	25,500	3,575	4,000		38,000
44							5,605	7,957	3,278	3,957	14,203	35,000
45												
46	7,404	22,358	5,617	4,872		40,251	10,000	30,200	8,600	7,800		varies by

degree

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
47												
48	4,100	13,065	4,000	2,100	2,500	25,765	14,000	15,500				
49												
50	5,091	20,925	4,575	3,785		34,376						
51												
52												
53							6,000	22,100	2,400	4,200		34,700
54	5,691	21,760	5,215	3,203	2,049	37,918	6,652	25,662	6,360	3,895		42,569
55												
56												
57	2,500	10,000	2,300	1,500	800	16,000	7,000	14,000	7,000	1,700		28,000
58												
59	3,332	13,093	2,486	1,400		20,311	4,122	15,306	3,104	2,034		24,566
60	4,095	14,847	3,020	2,295		24,257	5,750	21,658	2,250	2,500	CFII - $955.00	29,660
61			1,450			13,500-14,500				2.2 K	Varies with Certi	24-28 K
62							8,000	25,000	5,000	5,000		31,000
63												
64												
65												
66												
67												

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
68	5,727	10,824	2,273	3,642	7,437	29,903	8,077	28,726	1,538	3,884		40,900
69												
70	6,472	19,196	2,907	2,622	1,980	33,177	8,835	31,480		*in commercial	1,860	42,175
71												
72												
73												
74							6,777	25,372	7,906	4,412	3,690	43,500
75												
76												
77												
78												
79							7,900	18,000	3,500	4,700		
80							9,800	23,800	3,900	5,700		39,750
81	4,758	16,655	1,572	2,226		24,655	6,115	22,669	1,905	2,650	8,020	31,434
82												
83												
84							5,132	22,261	7,259	9,649	9,031	53,332
85												
86	3,000	10,000	1,300	2,650		17,000						
87												
88							9,000	24,000	5,000	5,000		38,000
89												
90												

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
91	5,500	12,000	6,000	5,500		29,000				aprox. 5,500		aprox. 40,000
92												
93	5,000	15,000	2,500			20,000	6,100	15,400			9,600	31,100
94												
95							6,178	13,518	8,036	10,207	5,150	47,123
96	4,808	19,902	3,450		3,450	28,160	6,210	25,725	5,100	6,775		43,810
97												
98												
99												
100												
101	8,800	28,700	5,000	3,600		46,100	10,200	43,700	7,000	Incl		53,900
102	6,500	17,000	3,500	3,100		27,000	8,752	22,073		3,777	4,130	35,825
103												
104			1,340									26,700
105	6,228	14,672	7,391	8,629	3,248	40,168	8,416	18,968	6,602	10,821	9,193	54,000
106												
107												
108												
109							15,271	19,506	8,527	8,235		51,539
110						30,500						
111							10,200	26,700	6,200		6,300	37,500
112												
113												

	2003 CAG**						2008 CAG**					
	Private	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**	**Private**	**Commercial**	**CFI (airplane)**	**Multiengine**	**Other**	**Total Cost**
114	7,000	17,000	5,600	3,300		27,300						
115												
116												
117												
118												
119												
120												
121												
122	4,000	13,200	240	4,400		21,600	5,000	14,000	2,900	3,900		23,000
123							8,200	20,500	3,375	6,700		35,000
124							4,000	16,100	2,280	4,400		22,380
125	4,242	9,760	2,425		222		4,242	9,760	2,700	1,700	2,000	30,000
126	3,750	12,000										
127												
128	7,000	17,000	5,600	3,300		27,300						
129												
130												
131												
132							5,442	22,757	2,060	2,830		33,059
133						29,230						
134												
135												
136												

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
137												
138												
139							5,588	14,769	2,693	3,335		26,385
140												
141												
142												
143												
144							6,000	24,000	2,500	2,000		35,000
145												
146												
147												
148												
149												
150												
151												
152												
153												
154												
155												
156												
157												
158												
159												

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
160												
161												
162												
163												
164												
165												
166												
167												
168												
169												
170												
171												
172												
173												
174												
175	4,772	19,024	4,421	3,126		31,343						
176												
177							11,710	10,824	8,090	12,620	1,722	36,876
178							9,010	23,420	3,260	3,080		38,770
179												
180	4,000	12,000	3,000	2,000		21,000	4,700	11,300	3,500	3,500	9,000	32,000
181												
182												

	2003 CAG**						2008 CAG**					
	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost	Private	Commercial	CFI (airplane)	Multiengine	Other	Total Cost
183	2,430	11,500	2,100	3,000		21,297	3,350	13,000	2,500	3,400	5,351	27,601
184	4,500	15,500	1,500	1,500								
185												
186												
187												
188							8,800	19,400	5,200	12,800		41,000
189							8,430	25,660	4,880	5,240	6,093 Multi engin	37,736
190												
191	3,861	14,715	3,075	3,240	1,945	26,836						36,000
192	2,634	2,480										
193	3,960	7,700	2,490	3,713		22,793						
194	6,000	20,000		6,000	5,500		11,000	25,000		9,000	5,780	50,780
195	6,100	19,400	3,700	2,650	1,870	29,200						
196						40,000	8,000	21,500	5,000	4,000	10,000	48,000
197							3,705	15,055	3,435	3,435	CFII 3435.00	25,630
198							4,000	8,000	2,000	1,500	200	15,700
199							6,290	13,070	5,575	4,025		25,000
200							6,900	14,800				
201							8,000	18,000	2,000	3,000		32,000
202							8,400	21,000		2,000		35,000

Appendix B

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Totals
United Airlines	571	305	636	92	137	830	511	999	543	799	1032	194	0	0	0	0	0	120	115	0	0	0	0	6884
American Airlines	891	865	725	63	30	17	246	84	600	1082	1171	797	0	0	0	0	0	0	0	0	0	0	0	6571
Southwest Airlines	121	83	142	187	423	155	201	211	239	412	425	444	195	147	384	350	628	432	384	0	0	262	140	5965
Delta Air Lines	551	801	25	0	0	0	121	1027	423	430	812	420	0	0	0	0	0	392	332	0	155	0	0	5489
FedEx	271	15	21	72	99	479	387	164	173	55	216	404	210	7	159	433	315	38	0	0	0	139	152	3809
Continental Airlines	275	1	20	19	75	52	146	183	423	93	75	137	0	0	0	408	495	544	110	0	0	0	0	3056
Northwest	208	17	0	0	15	390	454	333	416	354	355	264	0	0	0	0	0	90	108	0	0	0	0	3004
JetBlue	0	0	0	0	0	0	0	0	0	20	124	121	250	216	206	498	450	434	95	30	113	275	68	2900
UPS	336	124	32	0	380	193	178	94	162	28	206	223	0	0	32	244	170	232	0	0	0	0	0	2634
AirTran Airways	0	0	0	22	39	61	26	15	75	77	96	183	84	111	190	259	263	287	81	0	140	16	0	2025
US Airways	52	0	0	0	0	0	0	0	14	1030	103	0	0	0	0	0	0	62	57	0	0	50	117	1485
America West	132	58	0	0	0	0	139	120	128	167	250	40	13	126	190	50	0	0	0	0	0	0	0	1413
Alaska Airlines	71	50	66	0	0	52	115	64	83	58	137	121	65	26	0	59	122	131	7	0	0	6	76	1309
ATA	22	11	17	45	86	34	33	80	121	62	63	52	34	221	38	0	0	0	0	0	0	0	0	919
ABX Air	66	76	36	47	75	106	47	40	111	54	40	8	0	0	0	0	0	4	10	0	0	0	0	720
Totals	3567	2406	1720	547	1359	2369	2604	3414	3511	4721	5105	3408	851	854	1199	2301	2443	2766	1299	30	408	748	553	48183

APPENDIX C

Pilot Demand Forecast

Year	Additional Aircraft	Pilots Needed	Pilot Due to Additional Aircraft	Retirements	Attritions (@ 1%)	Pilots Needed for Retirements & Attritions	Total Yearly Pilot Demand	Cumulative Pilot Demand
2012	6,670	88772		458	561	1019	1019	1019
2013	6,748	89818	1046	1018	563	1581	2600	3619
2014	6,845	91102	1284	1125	565	1690	2974	6593
2015	6,990	93031	1929	1323	566	1889	3818	10411
2016	7,152	95188	2157	1486	566	2052	4209	14620
2017	7,337	97653	2465	1680	569	2249	4714	19334
2018	7,530	100219	2566	1787	571	2358	4924	24258
2019	7,696	102432	2213	2017	574	2591	4804	29062
2020	7,839	104344	1912	2281	577	2858	4770	33832
2021	7,862	104640	296	2648	580	3228	3524	37356
2022	8,019	106731	2091	2706	584	3290	5381	42737
2023	8,222	109435	2704	2829	588	3417	6121	48858
2024	8,438	112313	2878	2846	592	3438	6316	55174
2025	8,676	115478	3165	2841	597	3438	6603	61777
2026	8,906	118535	3057	3373	602	3975	7032	68809
2027	9,129	121507	2972	3568	607	4175	7147	75956
2028	9,358	124549	3042	3763	613	4376	7418	83374
2029	9,603	127812	3263	3958	619	4577	7840	91214
2030	9,803	130476	2664	4154	625	4779	7443	98657
2031	9,871	131386	910	4349	616	4965	5875	104532
2032	10,042	133662	2276	4544	619	5163	7439	111971

APPENDIX D

Historical Flight Cost Model

Year	Private Flight Costs	Private Adjusted (2012)	%Change Private	Commercial Flight Costs	Commercial Adjusted (2012)	%Change Commercial	Total Flight Costs	Total Adjusted (2012)	%Change Total
1989	2375	4397		8088	14975		10463	19373	
1990	2496	4385	-0.27	8301	14582	-2.62	10798	18968	-2.09
1991	2617	4412	0.62	8515	14354	-1.56	11132	18765	-1.07
1992	2738	4481	1.56	8728	14283	-0.49	11466	18764	-0.01
1993	2859	4543	1.38	8941	14206	-0.54	11801	18750	-0.07
1994	2980	4617	1.63	9155	14183	-0.16	12135	18800	0.27
1995	3104	4676	1.28	9469	14265	0.58	12573	18942	0.76
1996	3228	4724	1.03	9783	14316	0.36	13012	19041	0.52
1997	3352	4795	1.50	10098	14445	0.90	13450	19240	1.05
1998	3476	4896	2.11	10412	14666	1.53	13889	19563	1.68
1999	3600	4961	1.33	10727	14783	0.80	14327	19744	0.93
2000	3866	5155	3.91	11576	15434	4.40	15442	20589	4.28
2001	4132	5357	3.92	12425	16108	4.37	16557	21465	4.25
2002	4398	5613	4.78	13274	16941	5.17	17672	22554	5.07
2003	4664	5820	3.69	14123	17623	4.03	18787	23442	3.94
2004	5190	6308	8.38	15206	18482	4.87	20396	24790	5.75
2005	5716	6720	6.53	16290	19150	3.61	22005	25869	4.35
2006	6241	7108	5.77	17373	19785	3.32	23614	26893	3.96
2007	6767	7493	5.42	18456	20437	3.30	25223	27930	3.86
2008	7293	7777	3.79	19539	20836	1.95	26832	28613	2.45
2009	7819	8368	7.60	20622	22069	5.92	28441	30437	6.37
2010	8345	8787	5.01	21705	22853	3.55	30050	31640	3.95
2011	8871	9055	3.05	22788	23260	1.78	31659	32314	2.13
2012	9397	9397	3.78	23871	23871	2.63	33268	33268	2.95

APPENDIX E

Private Pilot Flight Cost Forecast

Year	% Change Private Flight Costs
2013	6.88
2014	7.13
2015	7.39
2016	7.64
2017	7.90
2018	8.15
2019	8.41
2020	8.66
2021	8.92
2022	9.17
2023	9.43
2024	9.68
2025	9.94
2026	10.19
2027	10.45
2028	10.70
2029	10.96
2030	11.21
2031	11.47
2032	11.72

REFERENCES

Airbus S.A.S. (2012, August). Navigating the Future. Global Market Forecast 2012-2031. Art & Caractere. Blagnac Cedex, France.

Aircraft Owners and Pilots Association (2012, April). Letter Response to Docket No. FAA-2010-0100 New Pilot Certification Requirements for Air Carrier Operations.

Airlines for America. (2012). Future Retirements. [data set].

Bureau of Labor Statistics (2011). Consumer Price Index. Retrieved from Bureau of Labor Statistics website: http://www.bls.gov/cpi/

Bureau of Labor Statistics (2012). How to Become an Airline or Commercial Pilot. Retrieved from Bureau of Labor Statistics website: http://www.bls.gov/ooh/transportation-and-material-moving/airline-and-commercial-pilots.htm#tab-4 on November 15, 2012

Boeing. (2012). Current Market Outlook 2012-2031 .Retrieved from Boeing website: http://www.boeing.com/commercial/cmo/index.html

Federal Aviation Administration. (2012). Estimated Active Airmen Certificates Held. [Data file]. Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2012/

Federal Aviation Administration. (2011). Estimated Active Airmen Certificates Held. [Data file]. Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2011/

Federal Aviation Administration. (2009). Estimated Active Airmen Certificates Held. [Data file]. Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2009/

Federal Aviation Administration. (2005). Estimated Active Airmen Certificates Held. [Data file]. Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2005/

Federal Aviation Administration. (2001). Estimated Active Airmen Certificates Held. [Data file]. Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2001/

Federal Aviation Administration. (1999). Estimated Active Airmen Certificates Held. [Data file]. Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/1999/

Federal Aviation Administration. (2012). FAA Aerospace Forecasts Fiscal Years 2012-2032. 32-56.

Future & Active Pilot Advisors. (2012). Major Airline Pilot Hiring by Year. [data set]. Retrieved from http://fapa.aero/hiringhistory.asp?Gateway=Interview

Government Printing Office (2010). Public Law 111-216-Aug. 1, 2010. Airline Safety and Federal Aviation Administration Extension Act of 2010.

International Civil Aviation Organization. (2011). Global and Regional 20-year Forecasts: Pilots, Maintenance Personnel and Air Traffic Controllers. (Doc 9956). Montreal, Quebec, Canada.

Lovelace, K., & Higgins, J. (2010, March). U.S. Pilot Labor Supply [PowerPoint Slides]. Presented at the 35th Annual FAA Aviation Forecast Conference, Washington, D.C.

Merriam-Webster. (2012, November 3). Dictionary. Retrieved November 5, 2012 from: http://www.merriam-webster.com/dictionary/urbanization

Smith, G. M., Bjerke, E., NewMyer, D. A., Niemczyk, M., Hamilton, R. A. (2010) Pilot Source Study: An Analysis of Pilot Backgrounds and Subsequent Success in US Regional Airline Training Programs. *International Journal of Applied Aviation Studies.* 10. (1) 73-96.

Smith, G. M., Herchko, D., Bjerke, E., Niemczyk, M., Nullmeyer, R., Paasch, J.,

NewMyer, D. A. (2013). The 2012 Pilot Source Study (Phase III): Response to the Pilot Certification and Qualification Requirements for Air Carrier Operations. *Journal of Aviation Technology and Engineering.* 2 (2). 13-23.

The Airline Monitor. (2005). Commercial Aircraft Market Forecast. [data set]

University Aviation Association. (2012). University and Flight School Members Flight Costs Data. [data set].