FORECASTING DEMAND FOR CIVILIAN PILOTS: A COST SAVINGS APPROACH TO MANAGING AIR FORCE PILOT RESOURCES

THESIS

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APPROACH TO MANAGING AIR FORCE PILOT RESOURCES

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Abstract

The purpose of this research was to create a model that could potentially predict demand for military trained pilots in the airline industry. Specifically, this thesis sought to answer the research question addressing whether or not military trained pilots are currently more in demand or less in demand. The research questions were answered through a comprehensive literature review, collection of data relevant to airline industry growth, and regression analysis.

The Aviation Continuation Pay Bonus, offered to all eligible Air Force aviators, has risen from $12,000/year to its current value of $25,000/year. With shrinking budgets, and ever increasing costs of war, it remains important to implement cost savings measures wherever possible. Airline hiring is one of the most significant factors in an Air Force pilot's decision to leave the service. By monitoring airline industry, pilot growth and military pilot retention rates, it is possible to determine the amount of military trained pilots needed in civilian industry. Armed with this information, Air Force official could potentially revise bonus offerings and pilot production rates, ultimately saving the service money.

Results of this research show that variables such as the unemployment rate and September 11, 2001 terrorist attacks are significant in predicting airline industry growth. Also, despite current high pilot retention rates in the Air Force, the research model shows a slight increase in demand for military trained pilots from the years 2005 to 2006.

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FORECASTING DEMAND FOR CIVILIAN PILOTS: A COST SAVINGS APPROACH TO MANAGING AIR FORCE PILOT RESOURCES

I. Introduction

Overview

For many years, the total number of pilots within the Air Force has deviated from its requirements (Conetta and Knight, 1999). During the 1990's, a surplus of pilots appeared just as the post-Cold War drawdown was requiring the Air Force to reduce its end-strength. The drawdown resulted in a reduction in requirements for student pilots, which formed the beginnings of the pilot shortage just six years later. Many factors were thought to contribute to this shortage, such as the private sector's demand for military pilots and decreased production rates. In response to the shortage, the Department of Defense (DoD) implemented the Aviation Continuation Pay (ACP) bonus in 1989 (CBO, 1995). The bonus was designed to improve retention rates by offering military pilots a pay incentive that would decrease the inequity between private sector pay and military pay.

Demand for civilian airline pilots can essentially be quantified as the sum of the airline's pilot losses due to retirements and the number of pilots needed to accommodate growth in the airline industry (Taylor, 2000). RAND Corp. (Taylor, 2000) developed models to predict future pilot requirements using expected retirement numbers and expected growth of the civilian airline pilot industry. They concluded that a hiring boom, according to FY99 forecasts, would continue through at least the year 2009. This seemed to validate the need for the current DoD pilot bonus program, given that the benefits of the program (pilot retention) would most certainly outweigh the costs.

Currently, it seems the pilot retention issue has reversed course from the shortage observed in the late 1990's. Air Force pilot production has increased (Herbert, 2001) and civilian competition has decreased as a result of the September 11th attacks and a declining economy ("Airline Pilot," 2002). However, this optimism may be misplaced, given the overall historical cycle that has been observed. Current airline hiring forecasts show that the airline hiring will once again increase (Darby, 2006), while military retention of pilots may suffer given the higher operations tempo and longer deployments present in today's environment (Hebert, 2001).

The connection between Air Force pilot retention and growth in the airline industry can be seen in the graphs below. Figure 1, gathered from the Journal of the Air Force Association, depicts the cumulative retention rate for pilots and navigators.

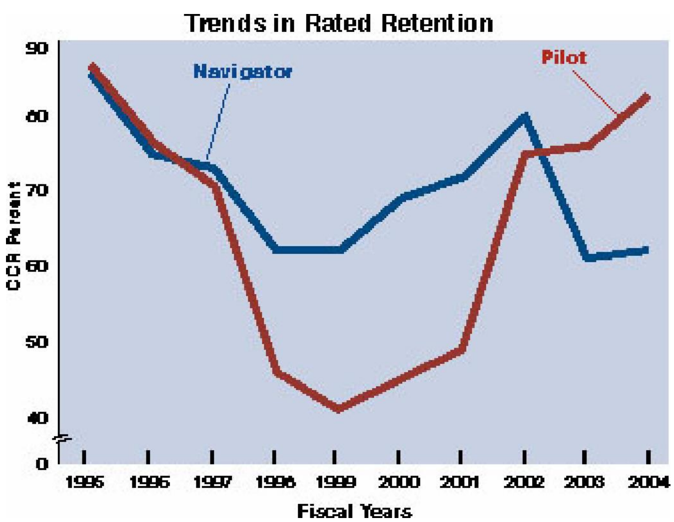

Figure 1. Cumulative Retention Rate for Air Force Pilots and Navigators

Figure 1 illustrates how the hiring boom of the mid-1990's severely affected the continuation rate for AF pilots. Air Force pilot retention went from a peak of 87 percent in 1995 to a low point of 44 percent in 1999 (Bonds and others, 2005). The trend in rated retention also shows a rapid climb in the continuation rates after the occurrence of the September 11, 2001 terrorist attacks, with rates almost back to 1995 levels.

It is easy to observe how rising growth in airline travel growth negatively affects the continuation rate by studying Figure 2 (shown below), which charts revenue passenger miles (RPM) during the same time period. RPM are a measure for an airlines traffic based on number of seats sold. They are the basic measurement of demand for air travel.

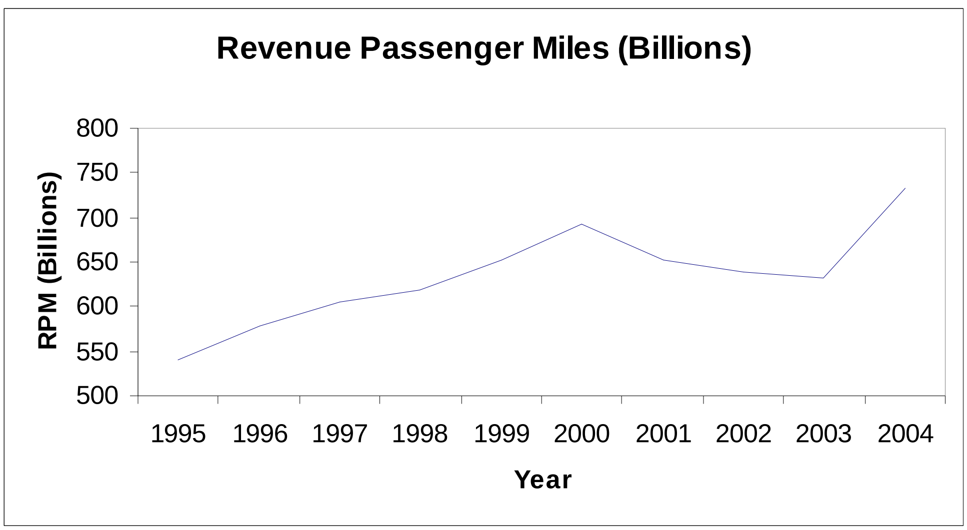

Figure 2. Air Travel Demand Growth, 1995-2004

Problem and Methodology

In 1997, a study was conducted that reported nearly one-quarter of all pilots in the DoD were selected to fill non-flying positions (GAO, 1997). However, all eligible pilots in the Air Force may receive ACP regardless of their position. The Air Force greatly exceeds the other services in the number of ACP contracts awarded and value of those contracts. This great difference in contract value (approximately $58,125 per AF pilot in 1995; $33,333 per Navy pilot in 1995), can be attributed to the above mentioned fact that all eligible pilots in the AF may receive the ACP. The reason the Air Force chooses this method is that they want to treat all of their pilots equally, and not just award the ACP to those pilots in aircrafts with critical shortages (GAO, 1997). In this instance, one might argue the aviation continuation bonus was unnecessary if the AF had enough pilots to dedicate 25 percent of its flying force to non-flying positions. However, in 2000, a study performed indicated a hiring boom in the civilian industry and increased pilot attrition in the Air Force (Taylor, 2000). As opposed to the previous situation, one might argue in favor of the aviation continuation bonus during conditions that favor military aviators leaving the service. The purpose of this study is to improve forecasts of civilian pilot demand by studying some of the variables that influence air travel demand. The study goes a step further by using analysis to predict how many military trained pilots are needed in the airline industry. Armed with this information, the Air Force will have one component to the equation needed to balance pilots. Consequently, it will then be easier to implement an ideal bonus program and have a better idea of how many pilots to train.

Summary

Several factors are contributing to the Air Force's cyclical pilot retention and pilot attrition. Improvements can continually be made to existing forecasting models that will ultimately help administrators see where the Air Force stands in that cycle. With certain improvements considered, this study endeavors to build a valid model of civilian pilot demand based on RPM. The end result hopes to be a more accurate count of how many Air Force pilots to develop, and a more optimized compensation program.

The next chapter of this research effort will focus on literature that establishes the link between airline hiring and pilot attrition. Additionally, the literature will also explore which variables are potentially important to civilian demand for air travel.

II. Literature Review

The loss of just one pilot to the civilian aviation sector can translate into millions of dollars in training costs lost for the Air Force (AF) (Guzowski, 1990). This statement suggests that any sort of factors that contribute to a shortage is undesirable for the AF. However, despite a pilot shortage, according to 2006 numbers the AF has more flyers, including filled staff billets, than requirements to fly its entire inventory (Callander and Hebert, 2006). Figure 3 (shown below) depicts the amount of AF pilots require (white) and the amount of actual AF pilot inventory (black).

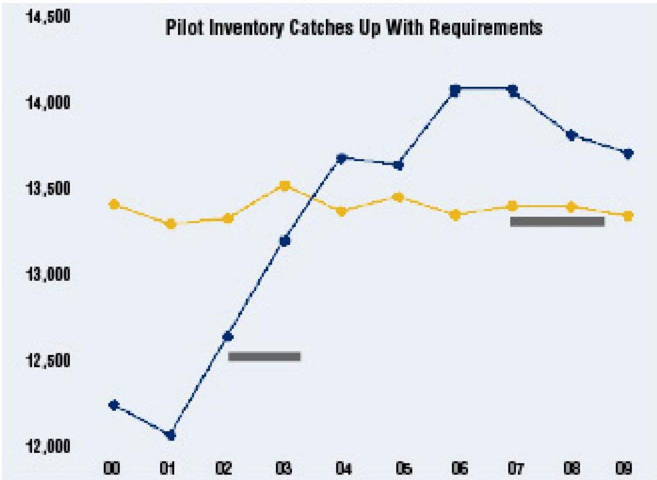

Figure 3. Amount of Pilots Required vs. Actual Amount of Pilot Inventory

The above figure shows that in mid-2003, the Air Force gained the needed pilots to fill its requirements for the next couple of years.

However the pilot situation is interpreted, it would be beneficial to understand the events surrounding pilot retention problems—from the implementation of ACP to the more recent terrorist attacks. This literature review will explore references related to pilot retention, both before September 2001 and after September 2001. In addition, this literature review will explore the changes that the airline industry experienced as a result of the September 2001 terrorist attacks on the World Trade Center.

Factor Contributing to the Pilot Shortage

During the late 1980's, Congress predicted an AF pilot shortage would occur in the years ahead (CBO, 1995).   A short time thereafter, after the first Gulf War, the AF was also preparing for a post Cold War drawdown. Part of this drawdown included sending fewer recruits to undergraduate pilot training (UPT). Figure 4 (shown below) depicts the production rate of AF pilots from 1991-2000.

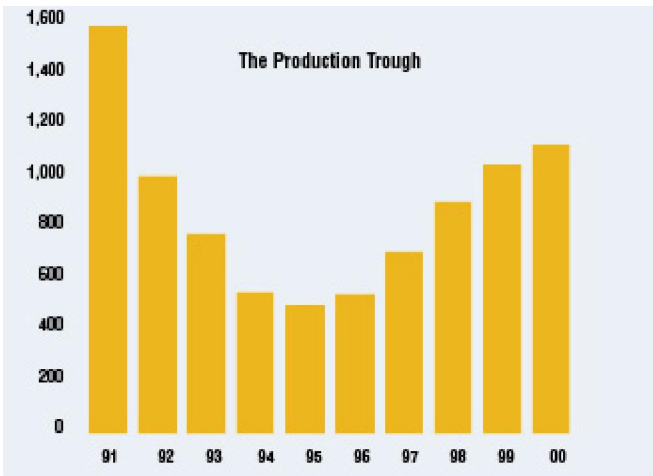

Figure 4. Pilot Production Rates (1991-2000)

The above figure, gathered from the Journal of the Air Force Association (Callander and Hebert, 2006), shows how dramatically the pilot production rates were altered as a result of the post Cold War Drawdown. This lower production rate of AF pilots and the fact that Congress anticipated a shortage around the same time period is quite paradoxical in nature.   Effects of the drawdown are believed to affect the pilot force for years to come (Callander and Hebert, 2006). Besides less pilot supply, there was one particular factor that contributed to the enormous amount of pilot attrition during this time period: airline hiring (Elliot and others, 2004).

A study conducted by the National Defense Research Institute from 1998-2000 indicated significant increases in airline hiring tended to increase the rate at which experienced Air Force pilots left the service (Elliot and others, 2004). In fact, the results show for every 2,500 incremental increase in airline hires, a subsequent 35 percent increase in Air Force pilot attrition occurs. For example, assuming a 10 percent current attrition rate, if the airlines were to hire an additional 2,500 pilots, the attrition rate would increase to 13.5 percent. Also, in times of large airline hires, a pilot can expect to make up to $180,000 a year annually, after only a few years of service. Additionally, retirement lump sums up to $1,000,000 are not uncommon (Elliot and others, 2004). From studying the previously mentioned figures, it is rational to conclude lucrative bonuses and benefits factor into the pilot attrition rate.

Fullerton (2003) conducted a similar study concerning pilot attrition. His main goals were to study the ACP's effectiveness, as well as the effects many social and economic factors have on a pilot's decision to leave the Air Force. By compiling information on every pilot in the Air Force from 1988 to 1999, and using an array of both micro and macro-level independent variables, Fullerton arrived at some interesting conclusions. First, he found that the ACP program was moderately effective at retaining pilots. Additionally, operations tempo and other quality-of-life issues, while found significant, were shown to have a smaller magnitude of influence than economic factors such as airline hiring. Airline hiring and a strong economy were found to have the greatest explanatory power in determining a pilot's decision to leave the service. Shown to be of particular importance was how (that during times of major airline hiring) the ACP was not only proven to be an effective tool for preventing pilot attrition but also saved the Air Force millions of dollars in training expenses during those periods (Fullerton, 2003).

In 2000, RAND performed another study that supports the significance of airline hiring with regards to pilot retention. However, they built a model based solely on hiring forecasts for the airlines matched against predicted retirement numbers in the pilot ranks. Their results predicted a serious problem for pilot retention because of the increase in airline hiring (Taylor and others, 2000). The RAND study also cited the fact that the Air Force polled pilots as they separated and found their reasons for leaving. The two primary responses given related to quality-of-life issues (e.g., deployments, family issues, frequent moves) and the opportunities present in the commercial aviation sector (Taylor and others, 2000:5).

Major Metrolis, an Air Force aviator, conducted an analysis in 2003 on how to manage the USAF pilot inventory. In his study, several factors regarding the connection between civilian airline hiring and AF pilot retention are mentioned. In 1998, the airlines had a peak hiring year with 14,418 new hires (Metrolis, 2003). This is another important connection between airline hiring and pilot retention, as the Air Force experienced its lowest pilot retention rate in 1999. The low retention rates of AF pilots could stem from the percentage of military pilots the airlines historically hire. The military has historically provided 85 percent of all new hires to the airlines since 1992—the AF contributes about 78 percent of those (Metrolis, 2003).

The Air Force is not the only service that stuggles with aviator retention. William Bookheimer conducted a study in 1996 that researched factors that cause Navy pilots to leave the service. In the analysis portion of the study, three variables were used to predict attrition of Navy pilots: national unemployment rate, airline hiring status, and airline-to-military pay ratio (Bookheimer, 1996). The results concluded that the airline hiring had little effect when considering the unemployment rate, and that the unemployment rate was the single biggest factor of Navy pilot attrition (Bookheimer, 1996). Bookheimer found that the national unemployment rate had a negative effect on pilot attrition; that is, in times of high unemployment, attrition was lower. This study contradicts an analysis by Levy (1995), who found that naval aviators cite family separation as the number one reason for exiting the service. Interestingly enough, Air Force pilots cite airline hiring as their main reason for leaving (Levy, 1995). During the airlines peak hiring year of 1998, the unemployment rate of 4.5 percent was the lowest it had been in over a decade.

As evidenced from the three previously cited studies, airline hiring is a huge significant factor in pilot retention issues. In the following paragraphs, the literature review will explore the effects of the September 11, 2001 terrorist attacks on AF pilot retention.

Post 9/11 Implications for Pilot Retention

In an article published by *Flying Magazine* just months after the September 11th attacks occurred, it cited the commercial airlines projected to hire 50 percent less pilots in 2002 than were hired in 2001 (“Airline,” 2002). In addition, over 7 percent of all airline pilots were on extended furlough.

Furthermore, with the decrease in hiring during this period, the ACP acceptance rate began to rise (Metrolis, 2003). Figure 5 (shown below), depicts the ACP take-rate for the years 1989-2002.

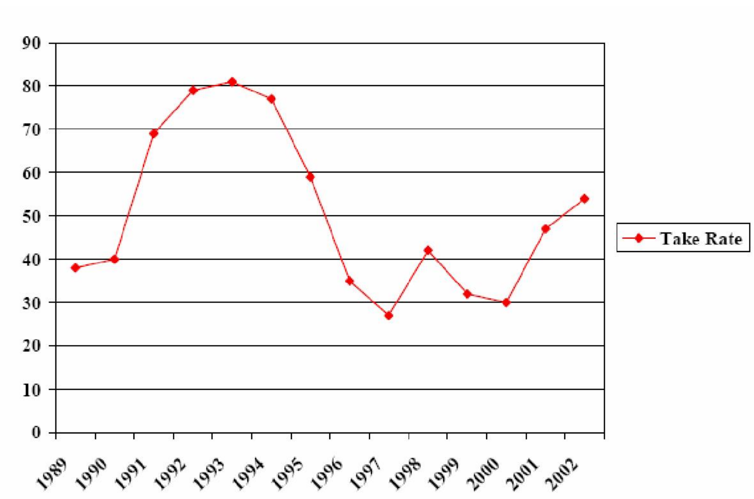

Figure 5. Aviation Continuation Pay Acceptance Rate

By observing this figure, it seems that airline hiring heavily influences the ACP acceptance rate. The ACP acceptance rate seemed to decrease during the airline hiring boom of the mid 1990's and then increase after the September 11 terrorist attacks when the airlines all but put a stop to pilot hiring. Clearly, the terrorist events and economic conditions had a profound effect on both air transportation and pilot retention rates.

Decreased demand for civilian airline pilots can be tied to a reversal of the pilot shortage. As of July 2006, the Air Force has enough pilots to fill its total requirements (Callander and Hebert, 2006). Factors such as scheduled deployments, increased bonus payments, and a sense of patriotism in the wake of the 9/11 attacks all contribute to this. However, the most obvious reason cited: the "pull" of experienced Air Force pilots to the airlines after the 9/11 attacks was all but gone (Callander and Hebert, 2006). According to the Air Force Times (February 17, 2007), fewer AF pilots left the service in FY06 (813) than in FY05 (900), showing that pilot continuation rates continue to grow.

Interesting factors loom on the horizon for both the airlines and the Air Force. The Air Force's pilot structure is now essentially balanced. Conversely, the airlines are faced with low retention rates for the simple fact its pilot force is reaching retirement age and younger age groups lack skill (Callander and Hebert, 2006). Despite the lack of airline hiring and high pilot retention rates, the ACP policy has remained unchanged since its inception, and the rates have only increased, from $12,000/year in 1989 to $25,000/year currently (DODFMR, 2006).

9/11 Terrorist Attack Effects on Airline Demand

The September 11, 2001 terrorist attacks had a profound effect on U.S. air travel. One specific research effort dedicated to this topic studied monthly time-series data from 1986 to 2003; the research analyzed how RPMs were affected by the terrorist attacks, while controlling for factors such as unemployment rate, labor force changes, seasonality differences, jet fuel prices, airline fatalities, and events such as the Gulf War in 1991 and the Iraq War in 2003 (Ito and Lee, 2003).

This study found that the 9/11 terrorist attacks produced an initial negative shock to air travel growth of 30%. Additionally, the attacks yielded a 7.4% on-going demand shock that cannot be explained by any additional seasonality or economic factors. Overall, it was found that 9/11 caused over 90% of the current weakness of the airlines in relation to its peak performance pre-9/11 (Ito and Lee, 2003).

Conclusion

A number of factors seem to contribute to an AF pilot's decision to leave the service. In the case of the AF, airline hiring seems to play a big role. Also, studies have shown that factors such as unemployment rates, and quality-of-life factors seem to influence retention decisions. Furthermore, unique events like the 9/11 attacks produced a shock that affected air travel growth which in turn influenced airline hiring. Dynamic factors such as these make managing AF pilot resources a difficult task.

Producing a model that could possibly enable Air Force management to accurately forecast the "pull" that comes from civilian aviation industry may have many favorable outcomes. First, it could lead to a consistently balanced pilot force because of the aptly managed pilot supply. The number of experienced personnel who stay could potentially increase. As a result, the Air Force will not lose millions of dollars by continually training new pilots. Secondly, during low pilot demand in the civilian sector, adjustments to ACP can be made because retention rates within the ranks increase. Which ever way the cyclical nature of civilian pilot demand swings, it is important to have an understanding of such changes in order to better manage our own pilot supply.

The third chapter of this thesis will get into specific information concerning techniques used to derive civilian pilot demand, as well as the overarching model employed to analyze all the factors relating to supply and demand forces of our AF pilots.

III. Methodology

In the literature review, the importance of airline hiring in predicting the attrition of AF pilots was investigated. In this chapter, a methodology for incorporating a forecasting model into a usable framework for future use in managing the AF pilot supply is developed. The methodology will explore regression analysis, time-series aspects, and the model used to derive how many military pilots are ultimately needed by the civilian airline industry. In addition, variables used in the analysis are discussed. The end result of the methodology is a model in which RPMs are predicted, and in turn the number of civilian pilots needed per year is derived. From here, the number of military pilots needed in the airline industry is predicted.

Regression Analysis

For the purposes of this research effort, regression analysis was chosen as a vehicle to derive demand of air travel and number of civilian airline pilots. In regression analysis, we try to explain one dependent variable with one or more independent variables (Ashenfelter and others, 2003). For the purposes of this research, a linear relationship is assumed in the statistical model. The basic linear model is shown below:

$$Y_i = ß_0 + ß_1 X_{1i} + ß_2 X_{2i} + \dots + ß_k X_{ki} + \varepsilon_i \quad (1)$$

Essentially, this model shows that the dependent variable Y is a linear function of the independent X variables (Ashenfelter and others, 2003). Because the value of the dependent variable is not completely determined by the independent variables, an error term (ε) is built in to capture this difference. Assumptions built into this model include: errors are assumed to have a mean of 0, errors display constant variance, errors are uncorrelated across the observations, the error term is not correlated with any of the explanatory variables, the errors come from a normal distribution and that none of the explanatory variables are an exact linear function of any other explanatory variable (Ashenfelter and others, 2003).

The Ordinary Least Squares (OLS) method of regression is utilized in this research. OLS attempts to fit a line through data that minimizes the sum of squared errors (Ashenfelter and others, 2003:129).

Data

Data for this study was gathered yearly, from 1979 to 2005. Variables studied include RPMs, real disposable income, jet fuel prices, unemployment rate, 9/11 dummy variable, airline fleet capacity and number of airline pilots. The actual numbers for the data gathered can be found in Appendix A.

Dependent Variable: Revenue Passenger Miles (RPM)

Revenue passenger miles are one source of overall airline health and demand (FAA, 2001:9). As revenue passenger miles increase, airlines will adapt their services to meet the increased air travel demand (Guzowski, 1990). One such adaptation is increased fleet capacity (Darby, 2006). Fleet capacity expansion ultimately drives the need for more pilots (Guzowski, 1990). Many socioeconomic variables are attributed to the RPM fluctuation (FAA, 2001). RPM data was obtained from the Bureau of Transportation Statistics.

Real Disposable Income (RDI)

For long term forecasts, real disposable income is a direct factor in determining air travel demand (Mintz and Vyas, 1990). This figure represents an individual's power to consume (or save) his or her resources (Cromer and Julicher, 1982). The more spending power a consumer has, the more likely he or she will choose the airlines as a mode of travel over less expensive means of transportation (Mintz and Vyas, 1990). Real disposable income data was gathered from the Economic Research division of the St. Louis Federal Reserve Bank.

Unemployment Rate

Employment factors are important socioeconomic data to forecast aviation demand (FAA, 2001). This variable is related to the amount of working age individuals unemployed during a specified time period (Cromer and Julicher, 1982). As the amount of workers increases and the unemployment rates lower, one may expect to see an increase in airline activity (Guzowski, 1990). Unemployment rate data came from the Bureau of Labor Statistics.

Jet Fuel Prices (JP)

Past studies indicate as jet fuel prices rise, revenue passenger miles decrease (Mintz and Vyas, 1990). As jet fuel prices rise, jet-fuel consumption decreases, thus creating the drop in revenue passenger miles (Mintz and Vyas, 1990). Data for this variable was gathered from the Air Transport Association-Economics and Energy Division in the form of 2005 cents per gallon.

Fleet Capacity and Pilots

Fleet capacity, for purposes of this study, is defined as the number of aircraft present in the civilian airline fleet. Past studies have shown that increases in fleet capacity are a result of increase in demand for air travel, and as a result, more pilots are hired (Cromer and Julicher, 1982). Numbers of pilots is defined as the number of fulltime pilots and copilots present in the civilian airline fleet. This data was obtained from Air Transport Association-Economics and Energy Division.

In addition to the above mentioned data, a dummy variable was included to indicate when the September 11, 2001 terrorist attacks occurred. As mentioned by Ito and Lee (2003), these attacks had a profound effect on the airline industry.

Time Series Analysis

In addition to OLS, time-series components are considered because this study is gathering data over time. Specifically, it is important to identify whether the variables included in the regression are stationary. If time series data points do not contain a unit root, and are taken from the same distribution, then the series is defined as stationary (Ashenfelter and others, 2003).

The first step in finding whether a series is stationary is discerning the presence of a unit root. Consider the following autoregressive model:

$$Y_t = \alpha_0 + \varphi_1 Y_{t-1} + \varepsilon_t \quad (2)$$

This is considered an AR(1) process in which the current data is a function of the t – 1 time period. If the coefficient of the autoregressive process (φ) is equal to 1, then the model has a unit root and does not return to a steady state if shocks are applied in the series (Ashenfelter and others, 2003). Models with unit roots yield spurious regression results because the variables in the models have a tendency to trend. If variables in a model contain unit roots they could be completely unrelated, but because of the trend they will appear to be strongly related (Ashenfelter and others, 2003).

In order to determine whether a unit root is present in the variables studied, the Augmented Dickey-Fuller test was used. This test computes a tau statistic and compares it to a critical value to determine whether to reject the null hypothesis of H_0: $\varphi_1 = 1$ (Ashenfeltor and others, 2003). The critical values are -3.750, -3.000 and -2.630 for the 1, 5 and 10 percent critical value, respectively. StataCorp software was used to perform this test on variables included in the study. By observing the MacKinnon approximate p-value the software presents, which interprets the tau statistic, it was determined that the null hypothesis could not be rejected for any of the variables included in the study. The results of the Augmented Dickey-Fuller test can be found in Appendix B. One potential solution to the problem of nonstationary variables is regression in first differences (Ashenfeltor and others, 2003). This method of regression allows the coefficients of the independent variables to be estimated, while providing a stationary form to the model by subtracting the lagged left and right sides of the equation. The first difference form was used in this research to potentially solve the problem of a spurious regression.

Methodological Model

Ultimately, this model potentially predicts the number of military trained pilots needed in the civilian airline industry during the years 2005 and 2006 to see if there is an increase or decrease during this time. 2006 was chosen as the forecasted year because the number of pilots in the airline industry for 2006 will not be available until August 2007. In addition, this model is an unconditional forecast in that all values of the explanatory variables are known with certainty (Pindyck and Rubinfeld, 1991). The one exception is fleet capacity; however, an estimate for 2006 data is given by the Air Transport Association.

The research model employs the use of the previously mentioned regression time series analysis by using OLS on the first differences of the variables. In order to find the number of military pilots needed in the private sector, a two-stage least squares approach is utilized. Two-Stage least squares uses the information in the model of an equation system to provide a unique estimate for the coefficient of a variable (Pindyck and Rubinfeld, 1991). First, consider the demand portion for RPMs:

$$RPM = f(RDI, JP, Unemployment, 9/11\ dummy) \tag{3}$$

OLS is used to regress RPM data against the explanatory variables from 1979 to 2003. Then, RPM_{2006} is found by substituting in the 2006 values of the independent variables in the resulting estimated equation.

Now, consider the supply portion for RPMs:

$$RPM = f(Fleet\ Capacity, Pilots) \tag{4}$$

OLS is used to regress RPM data against the explanatory supply variables from 1979 to 2003. After the coefficients for the explanatory variables are found, RPM_{2006} is substituted into the equation and the Pilots variable is derived algebraically as shown here:

$$RPM_{2006} = ß_0 + ß_1 Fleet_{2006} + ß_2 Pilots \tag{5}$$

Then

$$\frac{RPM_{2006} - \beta_0 - \beta_1 Fleet_{2006}}{\beta_2} = Pilots_{2006} \tag{6}$$

Once the number of civilian airline pilots is predicted for the year 2006, the number of military trained pilots needed in the airline industry is calculated, and then compared between the years 2005 and 2006 to analyze an increase or decrease. The equation used to find the number of military trained pilots is shown below:

$$(Pilots - Retirements - Civilian\ Trained\ Pilots) * 75\% = Military\ Pilots\ Needed \tag{7}$$

The number of military pilots needed in the civilian airline industry was determined by subtracting the number of projected retirements in the airline industry and the number of airline pilots hired that were trained in civilian schools from the number of predicted airline pilots found in equation 6. This figure was then multiplied by 75%--this is the assumed rate of the historical percentage of how many pilots present in the airline industry who come from a military background (Hansen and Oster, 1996).

By analyzing the increase or decrease of demand for military pilots in the civilian airline industry, Air Force officials could gain a greater understanding of pilot retention within the AF. Gaining this understanding could have cost savings implications as a result of more accurately monitoring AF student pilot supply and better managing the Aviation Continuation Pay bonus.

IV. Results

Revenue Passenger Miles Model

For this model, a modified version of the Center for Transportation Research's (Mintz and Vyas, 1990) 1990 model was utilized for its simplicity and predictive power. The equation derived from the Center for Transportation Research is displayed below, where DPI represents real disposable income, and JP represents jet fuel prices:

$$RPM = 0.212(DPI) - 0.12(JP) - 262.344 \tag{8}$$

This model reported an R-squared of 0.985 and a Durbin-Watson statistic of 1.789, indicating that serial correlation was unlikely. Also, the t-statistics were significant at the one percent level for DPI and at the 10 percent level for JP. There were no standard errors reported in this research. However, it appears that the data used was non-stationary. The results would yield a spurious regression (Enders, 2004), in which the results have a high R-squared and the t-statistics look significant, but all results would be without economic meaning due to the non-stationarity.

For this research, the same values were used with the addition of an unemployment rate variable and a dummy variable to control for the effects of the September 11, 2001 terrorist attack. In addition, the variables were regressed in their first-differenced form in order to remove the trend which existed in the previous model. The data was gathered yearly from 1979 to 2005. The data points for 2004-2005 were left out of the regression so that the base year 2005 could be predicted using within sample observations that were not used to establish the baseline model.

The results of the regression can be seen in Table 1 below:

Table 1. Results of Revised Revenue Passenger Miles Model Regression

Dep Variable = Revenue Passenger Miles (billions), n =24			
Variable	**Coefficient**	**Std error**	**P>t**
Real Disposable Income	0.0084321	0.0414288	0.799
Jet Fuel Price	0.0011383	0.2549353	0.996
Unemployment Rate**	-9.5046540	4.1737460	0.035
9/11/2001 dummy***	-52.4671300	15.7728300	0.004
constant**	16.1878500	7.4766310	0.043

** Significant to the 5% level
*** Significant to the 1% level

The regression results had an R-squared of 0.54 which indicates that this model explains slightly over half of the variance. Only two of the four variables were significant to below the five percent level. Essentially, this model shows the variables used in the 1990 transportation research are not significant.

The unemployment rate variable indicates that for every positive one percent change in the rate there is a corresponding negative nine billion change in revenue passenger miles. This makes intuitive sense in that as more people on a national scale are unemployed, there will be less opportunity to use flying as a means for transportion. Furthermore, the September 11th dummy variable showed significance to below the one percent level. The results for this variable indicate that for the year the event occurred there was a subsequent drop of approximately 52 billion revenue passenger miles. Again, the sign on this variable is logical as the terror attacks led people to believe that flying was unsafe.

The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity was performed to find whether the errors exhibit constant or non-constant variance. The test failed to reject the null for constant variance. The test yielded a chi-square test of 0.19 and a p-value of 0.6611. Because this research is utilizing the OLS method to derive the estimators to be used in the forecasts, non-heteroskedastic errors will ensure that these estimators are both unbiased and the best linear unbiased estimators (BLUE) (Ashenfelter and others, 2003).

In addition to testing for heteroskedasticity, this research also tested for serial correlation of the errors. This is to be sure that the errors are not correlated with each other, which could lead to incorrect results using OLS (Ashenfelter and others, 2003). A Durbin-Watson test statistic for serial correlation was estimated. At 2.04, this statistic indicates unlikely serial correlation of the errors, as it is well above the critical upper limit for 24 observations (1.775) containing four independent variables (Ashenfelter and others, 2003).

Pilot Demand Model

The commercial airline pilot demand model was derived from revenue passenger miles as a function of number of pilots and fleet capacity of major airline carriers. Data was gathered yearly from 1979 through 2005. As with the revenue passenger model, the independent variables in the pilot demand model contain an obvious upward trend. The variables were regressed in their first differenced form in order to remove this trend. Results of the regression can be seen in Table 2 below:

Table 2. Results of Pilot Demand Model Regression

Dep Variable = Revenue Passenger Miles (billions), n =24			
Variable	**Coefficient**	**Std error**	**P>t**
Pilots***	0.0049552	0.0014556	0.003
Fleet Capacity	0.0138653	0.0079143	0.094
constant	6.6348720	4.0804230	0.119

** Significant to the 5% level
*** Significant to the 1% level

The regression results have an R-squared of 0.41, meaning that the independent variables explain less than half of the variation of the dependent variable. The Pilots variable was significant to below the one percent level. This model indicates that an increase of one pilot raises revenue passenger miles by 4.9 million. Also, the fleet capacity variable was significant to below the 10 percent level. An interpretation of the model would convey that an addition of one aircraft to the major airline carrier fleet would yield an increase of 13.8 million revenue passenger miles.

As with the previous model, the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity was performed and the Durbin-Watson test statistic was estimated. The heteroskedasticity test failed to reject the null for constant variance, indicating one of the assumptions of OLS holds, and results derived from this model will be viable. The test yielded a chi-squared value of 1.54 and a p-value of 0.2150. Furthermore, the Durbin-Watson statistic gained from this model was 2.50, once again showing that the errors from the regression equation were not correlated with one another.

Results Analysis

In order to start analyzing both models and arrive at a predicted amount of commercial airline pilots, utilizing the equations produced by the above regressions and in turn substituting values from the years 2005 (base year) through 2006 (forecasted year) was accomplished. The year 2005 is being used because it is the last year on file with the Air Transport Association financial filings. The 2007 report, which lists the 2006 figures, will not be available until August 2007.

In order to arrive at the number of commercial airline pilots filled by military members, this research incorporates variables such as number of pilots retiring, number of pilots hired that have no prior military experience, and a historical percentage of the number of pilots who have a prior military background. The results for the year 2005 can be seen in the Tables 3 and 4 below:

Table 3. Predicted and Actual Values for 2005 (RPMs and Pilots)

Predicted RPM (2005)	754.362 Billion
Actual RPM (2005)	778.476 Billion
Predicted Pilots (2005)	85,310 pilots
Actual Pilots (2005)	84,302 pilots

Table 4. Results Analysis for 2005

Pilots (2005)	84,302
Less: Retirements	1,501
	82,801
Less: Civilian School Pilots Hired	7,376
	75,425
Historical military %	75%
Military trained pilots needed	**56,569**

As observed from Table 3, the model this research uses slightly under-predicts revenue passenger miles, and slightly over-predicts the number of commercial airline pilots. Table 4 indicates that approximately 56,569 pilots with military backgrounds are present in the commercial airline ranks. The number of pilots retiring and number of pilots hired with civilian backgrounds was obtained from Air Information Resources, Inc (AIR, Inc). The percentage of pilots hired with civilian backgrounds was quoted to be 71 percent in 2004, according to AIR, Inc. This number was also assumed true for the 2005 figures. The figure for historical numbers of military pilots present in the airlines was assumed to be 75 percent[1].

[1] This value obtained from a volume titled *Taking Flight: Education and Training for Aviation Careers (1997)*

The results for the year 2006 can be seen in Table 5 below:

Table 5. Results Analysis for 2006

Predicted Pilots (2006)	88,415
Less: Retirements	2,418
	85,997
Less: Civilian School Pilots Hired	9,727
	76,270
Historical military %	75%
Military trained pilots needed	**57,203**

Table 5 indicates that 57,203 prior military pilots were needed in 2006--an increase of 634 personnel from 2005. The number of retirements for this year was derived from AIR, Inc's forecast of 12,092 pilot retirements over the next five years. An average was taken to arrive at the figure of 2,418 pilots retiring. Furthermore, the figure for civilian school pilots hired comes from AIR, Inc's forecast of 2006 pilots hired, with 71 percent of those coming from civilian training sources. Finally, the same historical military percentage that was used in 2005 was used again in 2006.

Discussion of Results

The results indicate an increase of 634 military trained pilots needed in the airline industry from the years 2005 to 2006, with the majority of those coming from the AF. Callander and Hebert (2006) show evidence that the pilot shortage had ended in 2004, and was all but eliminated by 2006. A conclusion could be made from these facts that the AF, with its currently high retention rates, could support that amount of personnel leaving. This begs the question of whether the ACP should continue to be offered to all AF pilots in all airframes, as it is currently. To give an insight into the costs of the ACP, the GAO quoted that the AF paid out $106.3 million in contracts from 1994-96. Additionally, using Defense Manpower Data Center pilot retention figures, 14,457 pilots who had 13 to 25 years of service were retained from the years 2003 to 2005. At the current contract rate of $25,000, if each of these pilots accepted the ACP, there would have been a total contract payout of $361.4 million during that time period.

One potential recommendation that could be looked into is to eliminate the ACP for all pilots, except those whose airframes are in a critical shortage. This cost savings measure could have an adverse effect on morale within the pilot ranks. Additionally, if the airlines were to increase its hiring rates of military personnel, this recommendation could cause more AF pilots to leave the service, once again bringing back a pilot shortage in the AF. However, based on current trends, according to AIR, Inc., the airlines are hiring largely from civilian training sources.

V. Conclusions

Importance of Findings

This research is important for a variety of reasons. First, because of ever increasing costs of war, the Air Force must allocate all of its resources in a careful manner. Although the model in this research presents an increase in the amount military trained pilots needed in the airlines, it is only a slight increase. By eliminating or modifying the amount of compensation given to those in flying status because of the perceived need for them in the private sector, the Air Force may save additional funds for more pressing costs. Second, the private sector flying industry is decreasing the amount of prior military pilots that are hired. Consider the following figure which plots the amount of pilots hired with military experience:

Figure 6. Air Information Resources, Inc Analysis of Hiring (2000-2004)

This trend is continuing, despite renewed growth in the airline industry since the 2001 terrorist attacks. Possible reasons for this include more civilian flight schools being instituted and higher retention rates in the military. This research could possibly accent the need to closely monitor both Air Force pilot retention rates and private sector hiring practices. Finally, this research, or modifications of this research, could provide a long-term ability to monitor the private aviation sector and adjust Air Force training rates accordingly. With the right amount of pilots at the right time, the Air Force could benefit from not losing valuable experience of its pilots at the wrong times.

Limitations

There are several limitations and assumptions present in this research. First, only yearly data is considered—monthly data could make the regressions more accurate and provide a larger number of observations. Second, when discussing the amount of military pilots needed, this research considers the military as a whole and not just the Air Force. Third, this research only considers revenue passenger miles and pilots from major and national commercial airlines. Freight companies and their respective data were not considered. Finally, many assumptions, such as historical percentages, were included in the data analysis.

Further Research

There are several areas of this research that can be explored further. First, different independent variables can be explored that may be significant in predicting revenue passenger miles. Second, an analysis in the increasing trend of hiring pilots from civilian school sources could be examined and how that directly relates to attrition rates of Air Force pilots. Third, an examination of the freight and cargo industry (revenue freight miles) could be accomplished. Finally, an analysis of Air Force pilot retention related to this same model is a feasible research endeavor. This research only takes into consideration all DoD pilots that leave the military for the private aviation sector.

Appendix A. Data Set of Variables Studied

Year	RPM (Billions)	RDI	11-Sep	Jet Fuel (Cents)	Unemployment	Fleet	Pilots
1979	257.010155	3811.4	0	56	5.8	2380	29936
1980	253.609483	3857.3	0	86	7.1	2403	31565
1981	248.418056	3959.15	0	102	7.6	2808	30230
1982	257.953302	4045.175	0	97	9.7	2830	28144
1983	277.097488	4177.8	0	88	9.6	3043	28108
1984	298.224551	4494.05	0	84	7.5	3816	29962
1985	331.753041	4645.45	0	80	7.2	4091	32980
1986	363.025906	4791.25	0	55	7	4063	37108
1987	403.078401	4874.575	0	55	6.2	4326	41963
1988	423.116818	5082.675	0	52	5.5	5022	43795
1989	432.593112	5225.05	0	60	5.3	5560	43671
1990	457.926286	5324.2	0	77	5.6	4275	47131
1991	447.954829	5351.65	0	67	6.8	4064	49232
1992	478.553708	5536.275	0	62	7.5	4233	51057
1993	487.878066	5594.225	0	59	6.9	4320	52086
1994	519.381688	5746.175	0	54	6.1	4415	52854
1995	540.656211	5905.875	0	54	5.6	4609	55389
1996	578.663338	6080.9	0	64	5.4	4806	57564
1997	605.573586	6295.775	0	63	4.9	5194	60434
1998	618.086598	6663.975	0	50	4.5	5301	64099
1999	652.046935	6861.65	0	52	4.2	5445	67163
2000	692.757225	7194.025	0	79	4	5647	72379
2001	651.311149	7333.325	1	76	4.7	5213	73789
2002	639.489444	7562.475	0	70	5.8	5135	68753
2003	633.092234	7729.875	0	84	6	4478	67827
2004	733.681294	8010.825	0	113	5.5	4507	81951
2005	778.476737	8104.95	0	163	5.1	4331	84302

Appendix B. Stationarity Tests

Variable	Z(t) Test Statistic	MacKinnon P-Value
RPM (Billions)	-0.793	0.8213
RDI	2.089	0.9988
Jet Fuel (Cents)	-2.095	0.2464
Unemployment	-1.457	0.5544
11-Sep-01	-4.796	0.0001
Pilots	-0.322	0.9223
Fleet	-2.114	0.2388

1st Difference	Z(t) Test Statistic	MacKinnon P-Value
RPM (Billions)	-3.613	0.0055
RDI	-4.023	0.0013
Jet Fuel (Cents)	-4.439	0.0003
Unemployment	-3.347	0.0129
11-Sep-01	-4.796	0.0001
Pilots	-2.645	0.0840
Fleet	-3.726	0.0038

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Vita

Captain Justin W. Collup graduated from Moapa Valley High School in Overton, Nevada. He entered undergraduate studies at the United States Air Force Academy, Colorado where he graduated with a Bachelor of Science degree in Business Management in May 2002. He was commissioned through the United States Air Force Academy in May 2002.

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14. ABSTRACT

The purpose of this research was to create a model that could potentially predict demand for military trained pilots in the airline industry. Specifically, this thesis sought to answer the research question addressing whether or not military trained pilots are currently more in demand or less in demand. The research questions were answered through a comprehensive literature review, collection of data relevant to airline industry growth, and regression analysis.

The Aviation Continuation Pay Bonus, offered to all eligible Air Force aviators, has risen from $12,000/year to its current value of $25,000/year. With shrinking budgets, and ever increasing costs of war, it remains important to implement cost savings measures wherever possible. Airline hiring is one of the most significant factors in an Air Force pilot's decision to leave the service. By monitoring airline industry, pilot growth and military pilot retention rates, it is possible to determine the amount of military trained pilots needed in civilian industry. Armed with this information, Air Force official could potentially revise bonus offerings and pilot production rates, ultimately saving the service money.

Results of this research show that variables such as the unemployment rate and September 11, 2001 terrorist attacks are significant in predicting airline industry growth. Also, despite current high pilot retention rates in the Air Force, the research model shows a slight increase in demand for military trained pilots from the years 2005 to 2006.

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