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Modeling the Departure of Military Pilots from the Services

Marc N. Elliott
Kanika Kapur
Carole Roan Gresenz

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Preface

This study evaluates the effects of hiring by major airlines and changes in military compensation on the voluntary departure of male pilots from the Air Force, Navy, and Marine Corps. Our results should be of interest to those concerned about pilot attrition, as well as the larger defense manpower research community, and those interested in the modeling of pilot attrition. We assume that readers will have some familiarity with linear regression techniques.

This analysis was conducted between 1998 and 2000. The information on compensation and bonuses reflects the situation at the time the analysis was conducted, and some of the specific figures may no longer be accurate. Regardless, the general results about the relationship between hiring in the airline industry and military pilot retention are still relevant.

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Summary

High numbers of voluntary departures from the services by military pilots have periodically caused considerable concern among military administrators and policymakers, both recently and in previous periods of high attrition.[1] In this study, we explore some determinants of the fixed-wing (airplane) pilot attrition problem among male pilots in the Air Force, Navy, and Marine Corps[2] and the responsiveness of attrition to changes in military compensation.

We estimated a pilot attrition model that examines the impact on attrition from factors such as compensation, deployment, voluntary separation programs, and civilian airline hiring. Data sources include military personnel files and information on civilian airline hiring and compensation.

The model is simplified in order to abstract from complex modeling issues, such as the existence of multiple decision points and bonus contracts of differing lengths. We focus on voluntary attrition within a few years of the end of the initial service obligation. Although we were able to verify the insensitivity of our results to a number of specification and sample checks, our results do depend on a number of simplifying assumptions that may not be fully testable. Results from the pilot attrition model should therefore be interpreted in light of these assumptions.

This study produced several noteworthy findings, a summary of which follows:

We find that increases in major airline hiring tend to increase military pilot attrition to a great degree in the Air Force and to a lesser extent in the Navy. A difference of 2,500 total hires by the major civilian airlines (from all sources, military and non-military) represents the difference between a year with moderate hiring, such as 1986 or 1988, and a more extreme year in terms of hiring, such as 1989 (a year with many hires) or 1983 (a year with few hires). In our data, an increase of 2,500 airline hires was associated with a 35 percentage point increase in attrition among Air Force pilots and an 11 percentage point

[1]The term "attrition" as used in this report refers to a pilot's voluntary departure from military service.

[2]Note that female, warrant officer, and reserve pilots were not included in the present analysis. Small sample sizes prevented precise estimation of attrition of female pilots.

increase among Navy pilots. This finding is particularly noteworthy given the projected long-term increases in major airline hiring.

Although attrition was found to be quite responsive to bonus pay, the magnitude of the effect of major airline hiring on attrition could make counteracting a significant increase in major airline hiring a costly endeavor, particularly for the Air Force.

The significant influence of civilian major airline hiring on military pilot attrition necessitates the development of a military hiring plan that will enable the armed forces to respond to strong exogenous influences. This situation also underlines the importance of incorporating reliable forecasts of major civilian airline hiring into a military pilot hiring plan.

Both the pay profile and lifestyle offered by the major civilian airlines contrast sharply with those of their military counterparts. Although the present research establishes a strong association between the availability of major civilian airline jobs and military pilot attrition, this research cannot disentangle the contributions of major airline pay and lifestyle to this association. Future research might include survey components that would disentangle these elements of the civilian airline job. Such research might suggest ways in which the military could supplement changes in compensation in order to respond to the challenges presented by the major civilian airlines.

Acknowledgments

We are indebted to Susan Hosek for her guidance throughout this project. Reviewers John Ausink and Ron Fricker provided very helpful comments. We have also benefited from the comments of Beth Asch, Richard Buddin, Jim Hosek, Rebecca Kilburn, Harry Thie, Paul Hogan, Casey Wardynski, Megan Beckett, and Al Robbert. We are also grateful to Jennifer Kawata, Lee Mizell, and Bill Taylor for their contributions to a previous draft of this report. Defense Manpower Data Center, Kit Darby (AIR, Inc.), Micki Fujisaki, Carol Edwards, and Mark Totten helped extract and format data used for analyses in this report. Jerene Kelly, Pamela Thompson, and Nora Wolverton provided valuable help in preparing the manuscript. Gordon Lee was instrumental in organizing and editing the report. We'd also like to thank Nancy DelFavero for her excellent editing work on this report. Finally, we would like to thank our project monitor, Saul Pleeter, for his support and comments in conducting this study and preparing this report.

Acronyms

ACIA-89	Aviation Career Incentive Act of 1989
ACIP	Aviation career incentive pay
ACOL	Annualized cost of leaving
ACP	Aviation continuation pay
ADSC	Active duty service commitment
ADSO	Active duty service obligation
AOCP	Aviation officer continuation pay
BAH	Basic allowance for housing
BAQ	Basic allowance for quarters
BAS	Basic allowance for subsistence
CBO	Congressional Budget Office
CNA	Center for Naval Analyses
CONUS	Continental United States
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DOPMA	Defense Officer Personnel Management Act of 1980
DOT	U.S. Department of Transportation
FAE	Final average earnings
FAPA	Federal Aviation Pilot Association
FSA	Family separation allowance
FY	Fiscal year
HDP	Hazardous duty pay

HFP	Hostile fire pay
HYOT	High year of tenure
IDP	Imminent danger pay
NDAA	National Defense Authorization Act
OCS	Officer Candidate School
PDV	Present discounted value
SSB	Special Separation Benefit Program
TCOL	Total cost of leaving
UPT	Undergraduate pilot training
VHA	Variable housing allowance
VSI	Voluntary separation incentives
YOS	Years of service

1. Introduction

High levels of military pilot attrition have periodically caused considerable concern among military administrators and policymakers, both recently and in previous periods of high attrition. Pilot attrition is not only costly to the services in terms of the lost investment in training departed pilots, but can also deplete the ranks of veteran pilots to an extent that it affects the training of their replacements. As shown in Figure 1, the level of voluntary attrition varies considerably over time.[1] This variability makes it difficult to manage pilot assignments and maintain a pipeline of properly trained and experienced pilots.

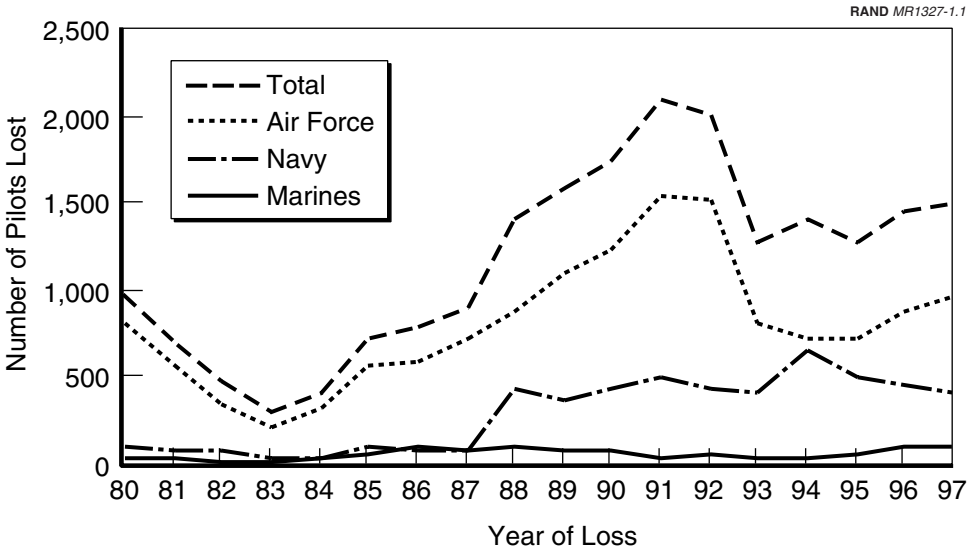

Figure 1.1—Voluntary Attrition of Military Airplane Pilots by Year of Loss[2]

This report examines the factors affecting airplane pilot attrition from the services and is especially concerned with estimating how compensation may affect attrition. In particular, the large salaries (as much as $180,000 annually) and retirement lump-sum payments (as much as $1 million) offered by major commer-

[1]The large increase in the number of Navy pilots with voluntary attrition from 1987 to 1988 reflects substantial increases in the size of Navy pilot cohorts from 1980 to 1982.

[2]Airplane pilots are very uncommon in the Army, and are therefore omitted from the figure and all analyses. As noted earlier in this report, female, warrant officer, and reserve pilots are excluded from analysis in this study.

cial airlines are often thought to greatly influence pilots' decisions near the end of their initial service obligations. Therefore, the primary focus in this study is on hiring by major airlines and the pilot compensation systems that the military has designed in response to this airline hiring.

This study began in 1998. At that time, we conducted a series of interviews with service representatives responsible for pilot management and compensation. We used those interviews to clarify the extent of the pilot attrition problem and identify important perceived influences on attrition. We then developed a brief overview of pilots' careers in the services. Institutional constraints and policies are critical to the timing of a pilot's decision to leave or stay in military service; therefore, understanding these factors is integral to understanding pilots' behavior.

Service representatives reported that their greatest attrition problems were with airplane pilots. Other aviation officers had lower rates of attrition because of lesser opportunities with commercial airlines.[3]

All the service representatives pointed to multiple causes of attrition, including dissatisfaction with aspects of a military career combined with enhanced opportunities in the civilian world, especially with commercial airlines. High operational tempo, less-enjoyable activities and missions, and the sense that military careers are likely to become less appealing in the near future were commonly reported as sources of dissatisfaction with the military.

A Fiscal Year (FY) 1996 Air Force survey of pilots in the National Guard who had left active duty service in FYs 1991 to 1996 (Roeder, 1998) revealed that commercial airline hiring and the length of Air Force bonus commitments were the most important reasons given for leaving the service. A survey the following year of Air Force aviators who had just elected to leave active duty service (Roeder, 1998) found that operational tempo and quality of life were the most common reasons cited for their decision.

The effect of previous low attrition may also play an important role in the recurrent attrition problems. In 1994, the Air Force had record low attrition, partly a consequence of its “feet on the ramp” policy. The policy stigmatized and penalized those pilots who declined to accept a signing bonus that commits them to additional service by immediately eliminating their flying opportunities (and therefore limiting the recent flying experience that is important in airline hiring)

[3]For example, whereas airplane pilot attrition at the end of an initial obligation in the Air Force was greater than 40 percent in our sample, navigator attrition was 31 percent at 9 years in the Air Force and rotary-wing attrition was 20 percent at 6 years in the Army.

and giving them undesirable jobs. This policy may have resulted in the retention and accumulation of personnel with no large preference for military service and who would have otherwise left, and may have set the stage for a sudden jump in the exit rate once external opportunities improved.

A 1996 to 1997 exit survey of Marines (Middlebrook, 1998) targeted departing F-18 pilots who showed an especially high rate of attrition. They cited four main reasons for leaving: discrepancies in bonus compensation for pilots (compared with other services), overly high operational tempo, distrust of leadership at the Department of Defense (DOD) level, and favorable commercial airline opportunities. Navy representatives cited dissatisfaction with discrepancies in bonus pay among Navy pilots.

In these qualitative interviews, we identified several factors that could potentially affect pilot attrition:

- earnings opportunities in the civilian market relative to military pay
- operational tempo
- frequency of deployment
- adequacy of flying hours available to pilots
- the type of flying available (with peacekeeping missions generally viewed as being less desirable than training)
- dissatisfaction with the disparity in bonus pay among military pilots
- the length of time it takes to become fully trained (which is affected by the attrition in prior cohorts)[4]
- attitudes toward leadership in higher echelons.

As will be discussed later in this report, not all of these factors will be measurable in an empirical model. The empirical model therefore will be based only on a subset of these factors.

The primary emphasis of this report is in understanding the roles of bonus pay and civilian airline hiring in pilot attrition; other factors are used in the models primarily to help isolate the effects of these two factors of special interest.

With this background information in hand, we turned to the primary quantitative analysis of the problem and to gathering data on the career paths of pilots,

[4]This leaves fewer senior pilots who can offer training, which then limits the training newer pilots receive, which in turn affects promotion opportunities and delays the career track of newer pilots.

modeling their decisions, and estimating the model to identify crucial factors in their decisionmaking. In the following chapters, we summarize the data used in our analysis, describe our attrition model specifications, and provide results from the attrition estimation.

2. Career Paths of Pilots in the Military and Civilian Airlines

Although the career paths of aviation officers are similar in many respects to those of other officers, several aspects of their career development are notably different. This chapter outlines typical pilot career paths and calls particular attention to aspects of pilot career development that are unique to aviation officers.[1]

Military Careers

In the following sections, we describe the service obligations for the cohorts we studied and describe the sources and levels of pay for military pilots.

Active Duty Service Obligation

Following their training period, which generally takes about two years, all pilots incur an obligation of service that starts the moment training is concluded.[2] The active duty service obligation (ADSO), known in the Navy as the active duty service commitment (ADSC), is incurred through pilot training and is the amount of time pilots must serve after that training before they can voluntarily depart the services.

For the cohorts we studied, who entered service between 1977 and 1989, the length of this obligation ranged from 4.5 to 8 years for the Air Force, Navy, and Marines. The ADSO has lengthened over time, but has generally been longest in the Air Force and shortest in the Marines.

As can be seen in Figure 2.1, almost all the attrition that occurs before the standard retirement at 20 years of service (YOS) occurs near the end of the ADSO. In the example in the figure, the ADSO was six years; therefore, with two years of training, the ADSO would generally fall at 8 YOS. Note that in this representative sample, virtually all voluntary attrition occurs between 6 YOS

[1] A brief summary of military officer promotion paths and responsibilities is in Appendix A.

[2] This obligation is an extension of the initial service obligation with which most officers enter active duty.

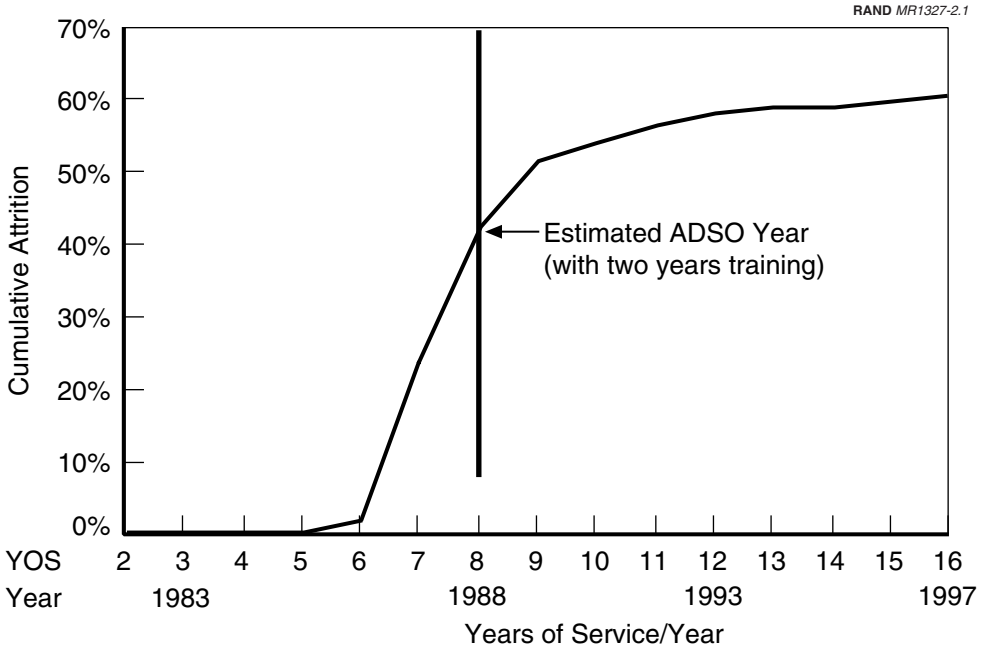

Figure 2.1—Cumulative Attrition as a Percentage of Initial Cohort Size, 1981 Air Force Entry Cohort[3]

and 10 YOS, a five-year window surrounding estimated or average ADSO for that cohort.

Earnings of Aviation Officers

Like other officers, aviation officers are entitled to Basic Pay, Basic Allowance for Subsistence (BAS), and Basic Allowance for Housing (BAH). BAH replaces the former Basic Allowance for Quarters (BAQ) and Variable Housing Allowance (VHA).[4] Officers' earnings also may include special types of pay for particular circumstances.

Not all pilots receive all the possible types of pay. For example, extended time away from home yields a Family Separation Allowance (FSA), and subjection to hostile fire or service in an area defined as being hostile results in the payment of Imminent Danger Pay (IDP), formerly known as Hostile Fire Pay (HFP) or Hazardous Duty Pay (HDP). These components currently sum to a total

[3]Note that cumulative attrition reaches an asymptote at the proportion of the cohort that stays until retirement.

[4]Whereas VHA existed for all officers in our sample, it should be noted that this form of pay no longer exists.

compensation of approximately $53,000 for undeployed officers at the end of the initial obligation. In addition, aviation officers are entitled to the same retirement benefits as other officers. Table 2.1 illustrates these pay components (in 1997 dollars) for an undeployed, male, married, fixed-wing pilot with a rank of O3 from the 1987 Air Force cohort, completing ADSO in 1995.

One of the most important features of the military retirement system is its "cliff vesting." Military members receive no retirement benefit if they leave before YOS 20; after 20 years of service, service members are entitled to the full retirement benefit. The actual benefit varies by entry (accession) cohort, but is the same for all officers within a cohort.[5] Cliff vesting is responsible for the very low rate of voluntary attrition in the years immediately prior to 20 YOS.

Table 2.1

Compensation for Undeployed, Male, Married O3, 1987 Air Force Cohort, Without Aviation Pays (in 1997 Dollars)

Basic Pay	39,206
BAS	1,847
BAQ	7, 382
VHA	657
Tax advantage	3, 845
Total	52,937

Pilots are also potentially eligible for two other types of pay. The first is commonly known as "flight pay" and formally known as Aviation Career Incentive Pay (ACIP). ACIP was first instituted in 1913 and since then has undergone a series of changes. ACIP varies by YOS but not by rank, and ranges from a low of $125 per month for pilots with little aviation experience to a maximum of $650 per month for pilots with 6 to 18 YOS.[6] ACIP decreases among those with more than 18 YOS, declining over time from $585 to $250 per month.

The maximum amount of flight pay is designed to coincide with the end of the initial ADSO when pilots must make a decision about whether to stay in the military or leave (Riebel, 1996). The amount of ACIP is fixed in dollar terms and is not indexed to inflation. Therefore, the actual value of ACIP erodes over time with inflation. For instance, ACIP payments were set in 1981 and not changed

[5]Retirement benefits vary depending on whether entry was before September 8, 1980, between September 8, 1980, and August 1, 1986, or after August 1, 1986. The retirement benefit provisions are outlined in Ausink (1991).

[6]As of late 2001, the maximum ACIP had been increased to $840 per month.

again until 1991. From 1981 to 1989, the value of ACIP decreased about 30 percent (U.S. Congressional Budget Office, 1989).[7]

To receive ACIP, pilots must "meet their gates," that is, they must have a minimum number of years of flight experience at certain checkpoints. Specifically, at YOS 12, officers must have 8 years of operational flying to receive ACIP through year 18; at YOS 18, officers must have 10 years of operational flying to receive ACIP through year 22, and must have 12 years of operational flying to receive ACIP through year 25.[8] Only pilots who remain in operational flying positions continue to receive ACIP after YOS 25. The hypothetical officer in Table 2.1 would receive $8,215 in ACIP, for a total compensation of approximately $61,000 at ADSO.

The second type of pay to which only aviators have access is Aviation Continuation Pay (ACP). ACP was instituted in 1989 and is a bonus used to entice aviators to remain in the service after they meet their initial ADSO.[9] Aviators must sign a contract committing to additional service to receive this bonus. Aviators must be at or below the grade of O6, have completed the ADSO associated with their undergraduate aviator training, and have at least 6 years of aviation service but not more than 14 years of commissioned service to be potentially eligible for the bonus. Each service decides on the specifics of ACP implementation. Table 2.2 summarizes the current features of the bonus system by service.

The services have changed their implementation of ACP somewhat over time, and recently service-wide provisions regarding ACP have been changed. In particular, the maximum bonus that the services are allowed to offer for a long-term contract increased from $12,000 to $25,000 annually (although no service has implemented more than a $22,000 bonus), and the maximum bonus allowed for a short-term contract rose from $6,000 to $12,000. The new provisions also granted authority for a three-year contract.

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[7]Prior to 1991, ACIP amounts ranged from $1,500 to $4,800 per year ($125 to $400 per month). The new provisions were set forth in the Aviation Career Incentive Act of 1989 (ACIA-89), which was incorporated into the National Defense Authorization Act for Fiscal Year 1990. ACIA-89 provisions became effective October 1, 1991.

[8]Prior to implementation of the ACIA-89, the gates were 6 flying years by YOS 12 to receive ACIP through the 18th year, 9 flying years by YOS 18 to receive ACIP until year 22, and 11 flying years by YOS 18 to receive ACIP until year 25 (Heinen, 1990). A transitional system was applied for those who were assessed between 1979 and 1985.

[9]Prior to 1989, aviators in the Navy were eligible to receive AOCP, or Aviation Officer Continuation Pay. From 1981 through 1982 and in 1984 all Naval aviators were eligible for AOCP, whereas from 1985 through 1988 AOCP was targeted to communities with shortages. Aviators in the Marine Corps were eligible for AOCP in 1981 and 1984.

Table 2.2

Aviation Continuation Pay Rules by Service

	Air Force	Navy	Marines
Eligibility[a]			
Offered to all airplane pilots	□		
Targeted to a varying subset of airplane pilot communities		√	√
Term of Contract			
Long-term only			√
Long- and short-term	√	√	
Amount			
$6K to $22K, depending on contract length	√		
$10K to $19K, depending on community		√	
$12K for long term			√

[a]All services make ACP eligibility available when the O1 to O5 pilot requirements exceed O1 to O5 pilot inventory. The Air Force assesses this at an aggregate level (therefore making all airplane pilots eligible since the institution of ACP and all pilots eligible since FY 1996), whereas the Navy assesses shortages by community.

Prior to the changes, the Air Force offered annual payments to pilots ranging from $6,500 to $12,000 depending on contract length, and the Navy offered annual payments from $6,000 to $12,000 depending on community. The Marines have replaced short-term contracts with longer-term contracts. The amount of ACP offered has increased in "stair steps," with erosion in real value between those increases. Each increase has, however, greatly increased the real value of ACP from its previous high.

Table 2.3 adds ACP and ACIP (in inflation-adjusted 1997 dollars) to the non-aviation pays for the hypothetical fixed-wing pilot of Table 2.1, assuming he chose the lump-sum ACP option in the year after ADSO. Total compensation that year is approximately $99,000.

Civilian Careers

In the following sections, we describe the different commercial airline types and the salary opportunities within those groups, provide information on civilian airline hiring levels, and describe the financial implications of a pilot's career decisions.

Table 2.3

Compensation for Undeployed, Male, Married O3, 1987 Air Force Cohort, with Aviation Pays Added (in 1997 Dollars)

Basic Pay	39,206
BAS	1,847
BAQ	7,382
VHA	657
Tax advantage	3,845
ACIP	8,215
ACP (lump sum)	37,913
ACP (annual)	7,279
Total	99,065

The Commercial Airline Industry

A total of 85 commercial airlines[10] reported activities for FY 1997 to the Bureau of Transportation Statistics: 62 passenger airlines (45 with scheduled passenger service) and 23 all-cargo carriers. In addition, 102 regional, or commuter, airlines[11] reported activities in FY 1997, 97 of which were still in operation at year's end.

The *major* airlines are those with annual revenues exceeding $1 billion. The 10 passenger air carriers classified as majors include essentially all the familiar airline names. The *national* airlines are those with annual revenues between $100 million and $1 billion. This group includes most of the airlines that provide feeder service for the majors (for example, United Express, American Eagle, Delta Connection), plus most of the low-cost, low-fare startups. The *regional* category represents the very smallest of the airlines, and can be further subdivided into companies that use jet aircraft on some (or all) of their routes and those that operate propeller-driven equipment only.

The majors dominate the industry. They operate 56 percent of aircraft and employ 70 percent of pilots in all commercial aviation. The majors offer the highest salary scale, as seen by the pilot contracts representing the different airline categories. The maximum annual captain's salary can exceed $175,000 in the majors, while the maximum annual captain's salary for a selected sample of

[10]These are defined by the U.S. Department of Transportation (DOT) as carriers that operate aircraft large enough to accommodate more than 60 seats. Their activities must be reported on *DOT Form 41*.

[11]These airlines provide scheduled passenger service primarily on aircraft that are too small to accommodate more than 60 seats. They mostly report their activities on *DOT Form 298-C*, although nine of them reported for at least part of the year on *DOT Form 41*. Our examination is limited to U.S. flag carriers.

nationals is under $70,000, less than the salary of an average pilot with only four years flying experience with a major airline. A large majority of the regionals/commuters offer maximum annual salaries that are under $50,000 (AIR, Inc., 1998).[12]

These salary scales seem to imply that qualified pilots would prefer to be hired by a major airline, either immediately after leaving the service or, if necessary, after a brief period with a smaller airline to re-establish qualifications and recent flying experience (following, for example, a non-flying active duty tour). The salary scales also seem to imply that essentially no pilots would intend to remain with a regional/commuter carrier for an entire flying career. Regional/commuter pilots would probably consider their jobs as only temporary while they try to get hired by a national or major carrier. This hypothesis is confirmed by observations that regional carriers turn over between 50 percent and 100 percent of their pilots in a single year when the majors are hiring aggressively.

Salary contracts are also union negotiated for virtually all carriers in each of the categories; therefore, a pilot's pay is always determined by the pilot's seniority with that specific carrier coupled with the pilot's crew position (for instance, a captain's pay is higher than that of a first officer, whose pay is higher than a flight engineer's) and aircraft type (where pay varies directly with the aircraft's size).

In a salary system that is based rigidly on seniority with a single carrier, pilots would likely be unwilling to change carriers within a category very often. When past consolidations have occurred, for example, among even the major carriers the absorbed pilots have not always received full seniority rights with the new carrier.

What position a pilot will hold on what type of aircraft depends on many factors—for example, the seniority of the pilot among all other pilots (which can depend on the retirement and attrition rates of older pilots, the influx of new pilots, and other factors); how aggressive the pilot is in seeking promotion opportunities; and changes in the fleet and crew mix over time.

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[12]The major airlines sample included American, Delta, United, Northwest, Southwest, and UPS. The national airlines sample included Reno, SkyWest, Mesa, AirTran, Atlantic Coast, and American Eagle. Neither sample was randomly selected, but both are regarded as representative. The average maximum salary for the majors was $176,757, while the majors' average four-year salary was $75,535. The average maximum salary for the nationals was $69,740. These salaries are in 1998 dollars.

Joining the Commercial Airlines: When?

Virtually all military airplane pilots ultimately work for a commercial airline upon leaving the military (Darby, 1998a). They almost always prefer major airlines to nationals/regionals. Whether airplane pilots are hired by a major is primarily a function of the level of hiring by the major airlines at the time pilots depart the military.

The number of pilots hired by the majors varied widely over the period from 1980 to 1998, from a low of 312 pilots in 1983 to a high of 5,868 in 1989 (see Figure 2.2). The civilian airlines have always relied heavily on the supply of military pilots to meet their hiring demands. The major airlines prefer military pilots to other pilots because of their specialized training on emergency procedures. Among fully qualified airplane military pilots (a status virtually all pilots achieve by ADSO), the airlines show no preferences by service, type of aircraft flown, or hours flown (Darby, 1998a).

Except in recent years, military pilots have historically made up half or more of all major airline pilots hired. The percentages of military pilots coming from the Air Force and Navy who are hired by major airlines have remained stable over time, with the Air Force providing the most pilots of any service.

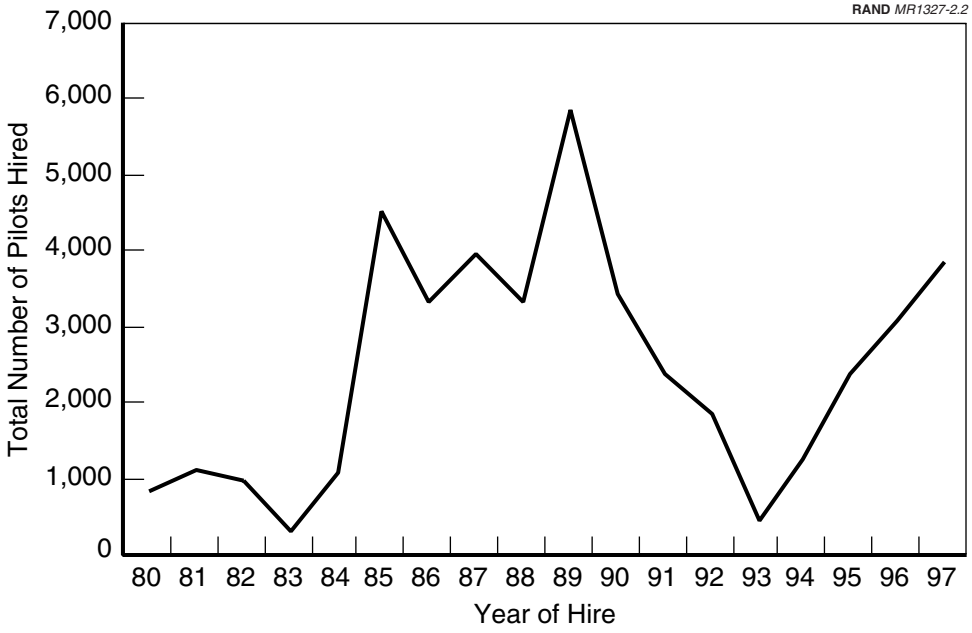

Figure 2.2—Civilian Major Airline Hires by Year of Hire

Figure 2.3 compares the services' annual losses of airplane pilots, from 1980 to 1997, with the number of pilots hired by the major airlines. The number of airplane pilot losses reflects losses from FY 1972 to FY 1998 cohorts. Airline hiring and losses from the services are positively correlated. The peak of losses in the services lags slightly behind the peak of hiring in the airlines, perhaps suggesting that individuals' decisions to leave the services reflect airline hiring in the previous year. Airplane pilot losses also have a positive correlation with total civilian pilot hires, which is expected given the large proportion of all civilian hires who formerly belonged to the military.

Besides the attractive salaries, pilots with major airlines enjoy a lifestyle that may compare favorably to the military in nonpecuniary ways, such as shorter workweeks and greater control over and earlier notification of work schedules and location of assignments. These factors may result in associations between hiring by major airlines and pilot attrition that are independent of the salaries offered by major airlines. Alternatively, the greater control over schedules and assignment locations may serve to increase spousal earnings opportunities (Wardynski, 2000), and therefore total family income for married pilots.

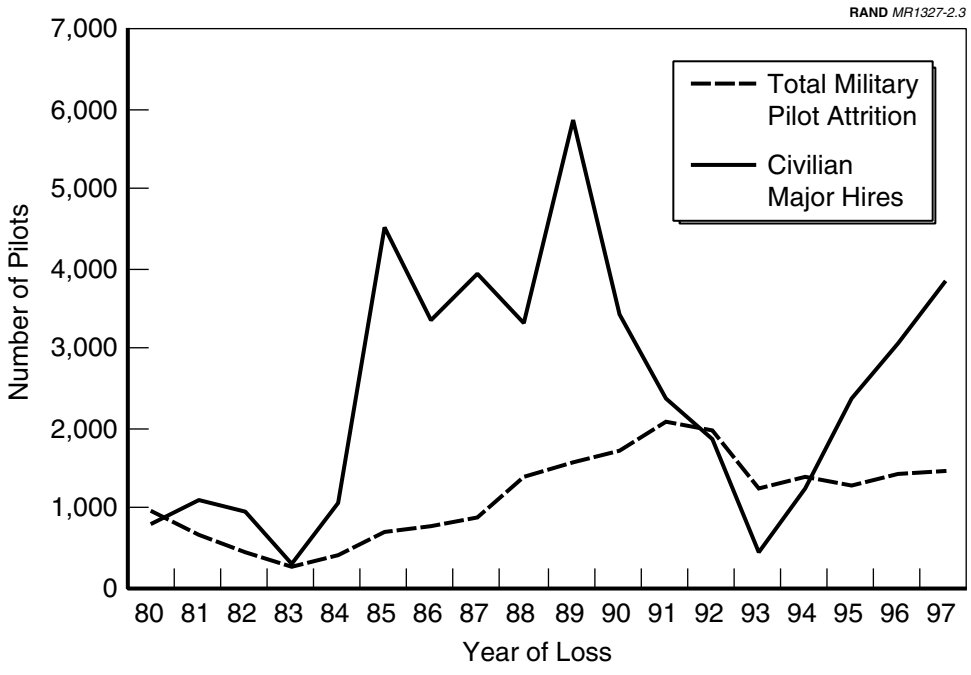

Figure 2.3—Civilian Major Airline Hires and Military Pilot Attrition by Year of Loss

The primary career decision a military pilot makes, as illustrated in Figure 2.4, is *when* to leave the military: at or near ADSO, or after an attempt to be promoted

through 20 YOS retirement.[13] During some of the period covered by our data, major civilian airlines were reluctant to hire pilots over 35 years of age, resulting in very low probabilities that someone with 20 YOS would be hired by a major airline. Gradually, however, the major airlines have eliminated this restriction (Darby, 1998a). It is possible that the reduction of age restrictions might reduce incentives to leave at the end of the ADSO.[14]

The financial outcomes associated with this career decision can differ substantially, as illustrated in Figure 2.5, which displays total annual compensation (except for major airline retirement lump sums) for three of the four decision outcomes shown in Figure 2.4. Only the last year before the end of the ADSO is displayed in Figure 2.5 because all options are identical before the end of the ADSO. The 1987 Air Force entry cohort is used as an example. The details on how these profiles are calculated appear in Chapter 3.

The line marked with circles in Figure 2.5 corresponds to a pilot's leaving the military at ADSO for a major airline. Note the very low initial salary ($25,000)

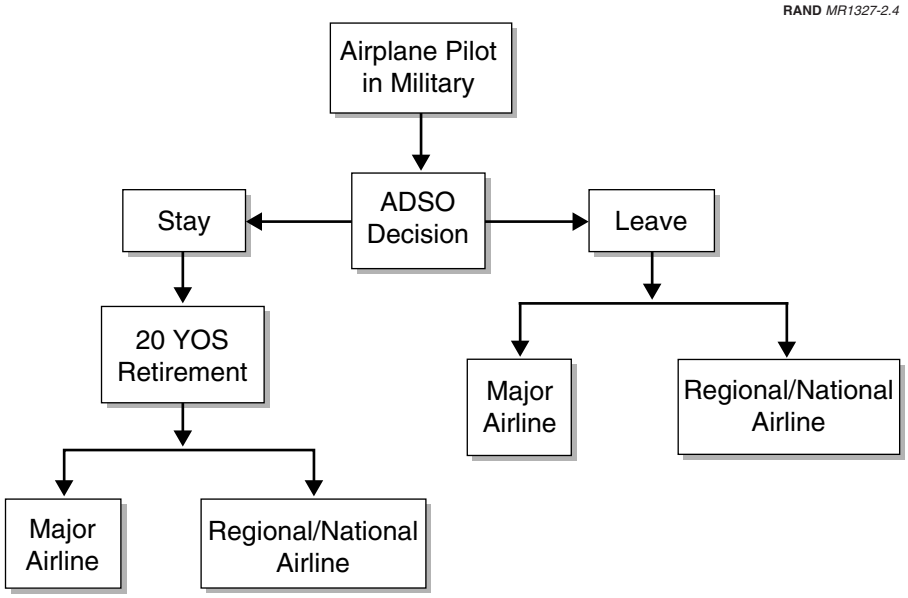

Figure 2.4—Idealized Decision Tree for Pilot Career Path

[13]This figure, and our quantitative analyses, make simplifying assumptions that (1) pilots who elect to stay in the military at ADSO are promoted to 20 YOS retirement and (2) pilots who leave the military at ADSO do not return.

[14]We find little empirical evidence of this in sensitivity analysis, however.

that is expected to rapidly rise to $80,000 within 5 years and to nearly $150,000 within 10 years (upon achieving the rank of captain). Although ultimately achieving a high salary, this profile is very "back-loaded," and therefore most valued by those individuals with low real discount rates.[15]

The line marked with squares corresponds to a pilot's staying in the military until retirement at 20 YOS, then being hired by a major airline at that point. The initial "spike" in this profile corresponds to an ACP lump sum. After that, salary remains at $70,000 to $80,000 until military retirement. The salary drop upon joining the major airline is then buffered by military retirement benefits and involves only two years with pay that is less than $80,000 annually. The primary disadvantage of this profile as compared with the "major airline at ADSO" profile is the delay in reaching captain-level salaries, shorter tenure at those salaries, and the smaller civilian retirement package that results.

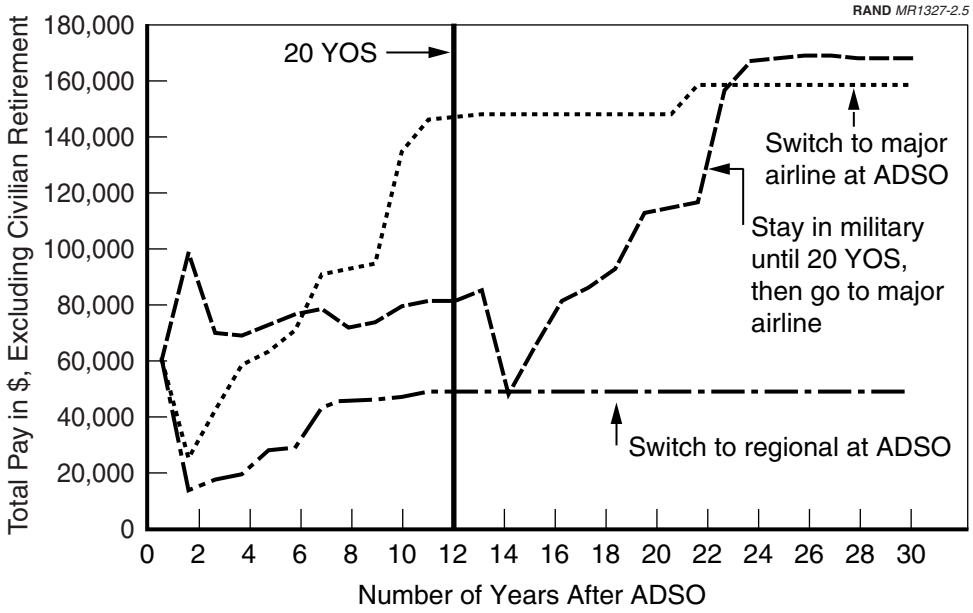

Figure 2.5—Air Force Pilot Pay Profiles, 1987 Entry Cohort[16]

[15]The *real discount rate* measures the preference for receiving money now rather than later, beyond the effects of inflation. A real discount rate of 5 percent means that one is indifferent to receiving either $95 now or $100 one year from now, in constant (real) dollars. Present discounted values incorporate real discount rates.

[16]We assume that pilots who stay in the military choose the ACP payment plan with the highest present value, namely a lump-sum equivalent to half the total value of ACP in the year after ADSO, followed by a series of annual payments for the remaining half. The dip in the pay profile six years after ADSO corresponds to the termination of these annual ACP payments.

The line marked with triangles in Figure 2.5 corresponds to the undesired outcome of a pilot's decision to leave the military at the end of the ADSO: a career in the regional airlines from that point onward. Note that these salaries never approach military pilot salaries. The fourth possibility, which is not shown, is an all-regional career after military retirement. This profile would look like the profile shown by the line marked with squares through 20 YOS, then dropping to about $40,000, and then rising to plateau to near $75,000.

In addition, the earlier a military pilot switches to a major airline, the higher the lump-sum payment he can expect to receive at retirement. Because Federal Aviation Administration (FAA) regulations require retirement at age 60, the major airlines are allowed certain tax advantages in creating retirement packages, resulting in very generous retirement benefits. In the 1987 cohort, a career with a major airline starting at the ADSO would result in a lump sum payment of more than $1,000,000, whereas a major airline career starting at 20 YOS would result in a lump sum of less than $400,000.

Finally, the strict emphasis on seniority in promotions among the major airlines provides pilots with unusually strong incentives to join the major airlines quickly upon first eligibility at the end of the ADSO.

3. Behavioral Model and Data

Supplied with knowledge about pilots' career paths, an understanding of the attrition issues facing the services, and ideas about the factors affecting attrition (as outlined in Chapter 2), we now turn to the empirical model. A behavioral model of pilots' decisions to stay in the services or leave them is critical to sorting out the competing effects that various factors have on attrition. A review of previous studies that take a quantitative approach to understanding pilots' decisions to leave or stay in military service can be found in Appendix B.

The Approach of This Study

Our approach is to estimate an individual-level model of pilots' decisions to leave or stay in the services. In particular, our concern is with a pilot's decision on whether to leave or stay at the end of his initial ADSO. When making this decision, pilots compare two earnings streams: (1) military earnings from ADSO until YOS 20 and civilian earnings thereafter and (2) civilian earnings from ADSO onward.

As discussed in Appendix B's literature review, attrition models have differed from one other in their determination of the relevant future military tenure over which the value of staying in the military is calculated. Our approach is to look at individuals' decisions near ADSO and assume that those who stay in the service at the ADSO decision point remain in the service until YOS 20, at which point they retire and join the civilian airlines.

Very few pilots in our sample who stay two years beyond the standard ADSO quit before YOS 20.[1] Those who leave near the ADSO are assumed to stay in the civilian airlines until mandatory retirement at age 60. Before describing the model and addressing specification issues in detail, we discuss the data that we compiled for our analysis. Specification of the model is in part constrained by the limits of our data.

[1]Service representatives have suggested that this pattern may be changing.

Military Data and File Construction

We merged three military databases to create a file for analysis: the Officer Cohort file, the Active Duty Pay file (formerly known as JUMPS), and the Perstempo file. A discussion of each follows.

The Officer Cohort file contains accession and separation information on officers. Officers who enter commissioned service in the same fiscal year constitute a cohort. The file contains information on an officer at the time of accession (including demographic characteristics and characteristics of military employment, such as the DOD occupation code). Appended to the accession data is information about the officer at the time of separation if the officer is no longer in the service, or information about the most recent year of service if the officer is still serving.

We extracted information on the cohorts from 1977 through 1989. Officers entering earlier than 1977 would have completed their initial ADSO before 1983; we do not have pay information for those earlier years. Officers who accessed in 1989 completed their ADSO in 1997, the last year for which we have cohort, pay, and perstempo data (see the next section on "The Perstempo file").

Our sample from the Officer Cohort file consists of officers who were pilots in their separation year or most recent year of service. We therefore exclude individuals who were pilots at one time but then switched to another occupation. The cohort sample also eliminates pilots who left and returned to the service, a number slightly less than 8 percent of the entire sample. The model we estimate assumes that individuals who leave the military leave permanently. This simplifying assumption, rarely violated, improves the stability of the model. Therefore, we select only pilots who either stayed or left the service, and not those who switched between the two more than once.

Our selection criteria results in an Officer Cohort file sample size of 55,191. This extract of the Officer Cohort file was merged to the Perstempo file.

The Perstempo file contains data from the last month of every quarter from December 1987 to December 1992 and monthly data thereafter. The file includes rank, demographic data, and data on Imminent Danger Pay (IDP) and Family Separation Allowance (FSA) from which we can construct measures of perstempo[2] (following Hosek and Totten, 1998). We aggregated the Perstempo file to the annual level by retaining demographic data from the last month of the

[2] *Perstempo* stands for "personnel tempo," and is a measure of the level of deployment of personnel. It is also often called "operational tempo."

year and by summing pay indicators over the year. We therefore have annual information for all years of service for all pilots who accessed during FY 1989 and for most pilots who accessed in FY 1988. We also have information on a subset of years for those who accessed earlier than FY 1988 and who separated after December 1987. We merged this Perstempo file with our third file, the Active Duty Pay file.

In terms of operational tempo, we have measures indicating hostile territory deployment based on IDP (formerly Hostile Fire Pay) and any deployment of married service members based on FSA. Data on IDP and FSA result in a limited measure of deployment activity. FSA is paid only to members with dependents and is paid only for deployments of 30 days or more. IDP, on the other hand, requires no minimum stay in the hostile area and is paid to both married and unmarried service members.

The FSA misses shorter-term deployments (less than 30 days) to non-hostile areas for all aviation officers and does not provide a measure of deployment tempo among officers without dependents. IDP provides a measure of deployment activity among officers with and without dependents, but the length of deployment is not observed (IDP is either paid within a month or not at all) and only deployments to hostile areas are measured. Our specification of the variables using IDP and FSA data followed Hosek and Totten (1998), after which alternative specifications were explored.[3]

The Active Duty Pay file is a longitudinal file containing information on pay received by each pilot. This file contains data beginning in September 1983. The data are quarterly from September 1983 through June 1991, and are monthly from August 1991 through December 1997. Ideally, we would like longitudinal pay information (from 1983 through 1997) on each pilot in the Officer Cohort file extract, but because of the large number of pay files (one for each quarter or month of each year), creation of a longitudinal pay file for a set of particular individuals is an extremely time-consuming and expensive process.

To expedite file creation, we extracted every record in which ACIP or ACP was positive. The methodology results in data that contains "holes," or years, in which a pilot has no pay data. Pilots who do not meet their gates do not receive ACIP (see Chapter 2); therefore, many of the holes occur in the records of these

[3]Service-specific measures of tempo over time would be preferable to using these variables. However, long-term information on tempo in each of the services is simply not available. In addition, we would like to have a more refined measure of deployment than the proxy provided by FSA and IDP, including some measure of non-deployment operational tempo.

pilots. Inconsistent data result in other holes. In addition, pilots who leave the service before 1983 do not have pay data.

We restricted our multivariate analyses to male officers. We made this restriction because fewer than 4 percent of pilots are female. Furthermore, we expect female pilots to follow different career paths than men.[4] Given their small sample size we are unable to address the separate analysis issues that arise for female pilots.

Limitations of the Data

One limitation of the data is that we are unable to observe the exact time a pilot reaches the end of his ADSO. We would like to know that because we want to model pilots' decisions on whether to leave or stay in the service at that time.

The information we do have about when an individual reaches ADSO is derived from several sources. First, we have information about the time when most pilots should reach the ADSO based on our knowledge of the changes in required ADSO over time.

We also can attempt to estimate the ADSO based on when a pilot underwent training. However, some pilots incur additional obligations. For instance, participation in professional military education and qualification in a new aircraft incur an additional commitment. In addition, training time can vary depending on the type of aircraft and on the attrition of prior cohorts. Training time can be extended if there is a shortage of more-experienced pilots to be qualified instructors. Therefore, the year of expected ADSO for each type of pilot for each cohort year is not a perfect indicator of when individuals actually reach the ADSO.

We have additional information about when individuals are likely reaching their ADSO from data indicating the year at which ACP was first received. The distribution of the year in which ACP is first received by members of a given cohort is a useful indicator of the end of the training period associated with the initial ADSO. However, it does not help us distinguish individuals who have incurred obligations in addition to the initial ADSO. Often, individuals are offered ACP when their training ADSO is complete, but before their additional obligations are completed.

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[4]Fullerton (1999) found that female pilots are 7 percent more likely to leave the military at ADSO than male pilots.

The year in which ACP receipt is first observed depends on whether or not the ACP program was in place at the time of the ADSO. Air Force pilots are first offered ACP well beyond their ADSO and sometime after their tenth year of service. The Air Force began offering ACP contracts in 1989.[5] The Navy, on the other hand, offered Aviation Officer Continuation Pay (AOCP) from 1981 through 1982 and from 1984 through 1988 and ACP thereafter.[6] The pattern of receipt of ACP by year of service among Naval pilots is somewhat "noisier," and is not as useful in helping to determine ADSO as are the patterns observed among Air Force pilots. The Marine Corps offered AOCP in 1981 and 1984 and then offered short-term ACP contracts from 1990 on. The year of first ACP receipt is highly variable, likely due to the small sample sizes in the Marine Corps.

Besides the ADSO rules and distribution of years of service at first ACP receipt, the distribution of voluntary losses over years of service was also used to set the ADSO window for airplane pilots. The data showed a "clumping" of voluntary losses in certain years, and these clumps were used to identify likely ADSO. We empirically verified that the median quit YOS did not occur at YOS 20 or YOS 14, but at a point that it was reasonable to assume was the end of initial ADSO.

In the vast majority of cases, the year of first ACP receipt was identified as the year in which losses were clumped. On the rare occasions on which they differed, we selected the YOS suggested by the first year of ACP receipt, with the following exception: For certain cohorts, the ACP program was not in place when they chose to stay or leave the military after their initial ADSO. Therefore, for these cohorts, we used the decision year determined by the median quit YOS of the cohort. Table 3.1 shows the service year at which pilots had to choose to stay with or depart the military.

Given the lack of precision with which we are able to estimate the end of ADSO, we allow for a five-year ADSO "window" in the specification of our dependent variable. This five-year window includes two years before the designated decision year and two years after that decision year. Therefore, the dependent variable is whether a person chooses to stay or leave in a five-year period that is determined empirically. Figure 3.1 illustrates this ADSO window for the 1981 Air Force entry cohort. Note that almost all attrition occurs in the five-year window. We will refer to voluntary attrition during this five-year window as "attrition at ADSO" or "attrition during ADSO."

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[5] In the pay file data, ACP receipt for the Air Force is first observed in 1991.

[6] Aviator continuation pay is now referred to as "ACCP" in the Navy.

Table 3.1

Decision YOS[a] for Airplane Pilots by Cohort Year

Cohort Year	Navy	Air Force	Marine Corps
1977	9	8	8
1978	9	8	8
1979	9	8	8
1980	9	8	9
1981	9	8	9
1982	9	8	9
1983	9	8	9
1984	9	8	9
1985	9	8	10
1986	9	8	10
1987	9	9	10
1988	9	9	10
1989	9	9	10

[a]Decision YOS is determined using information on the ADSO and on the empirically observed year of ACP receipt and quit in the data.

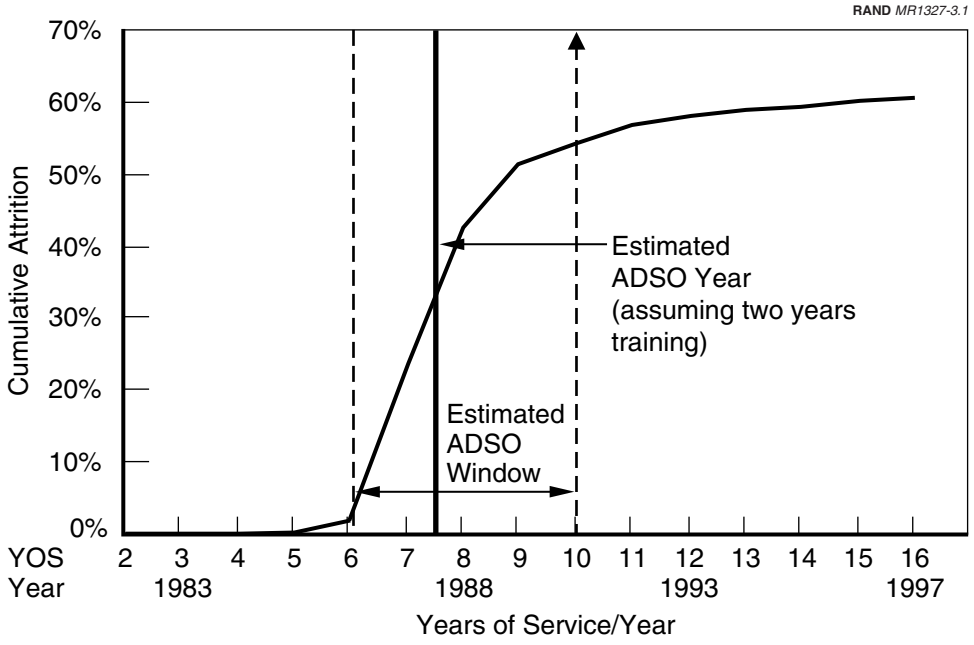

Figure 3.1—Cumulative Attrition as a Percentage of Initial Cohort Size, 1981 Air Force Entry Cohort

Levels of Attrition at ADSO

Figure 3.2 depicts voluntary attrition of airplane pilots by service during their five-year ADSO windows. For both Navy and Air Force pilots, ADSO attrition declined among the 1984 through 1987 entry cohorts. In the Navy, the 1984 cohort would have likely reached ADSO in about 1992 (with the five-year window running from 1990 through 1994), whereas in the Air Force that cohort would have reached ADSO in about 1991 (with a five-year window from 1989 through 1993). The likely ADSO year for the 1987 cohort in both services is 1995 (with a 1993 through 1997 window). Thus, the decline in ADSO attrition occurred from about 1991 to 1995. Attrition among Marine Corps airplane pilots has fluctuated over the years, reaching a high among the 1981 entry cohort, who likely would have reached ADSO in 1989. Levels of attrition at ADSO have ranged from 20 percent to more than 70 percent in the period observed.

The services often measure retention by "take rates," the proportion of those offered ACP who accept ACP contracts in a given year. This measure sometimes results in estimates of attrition that differ somewhat from our estimate of attrition. These differences can be traced to at least three possible sources:

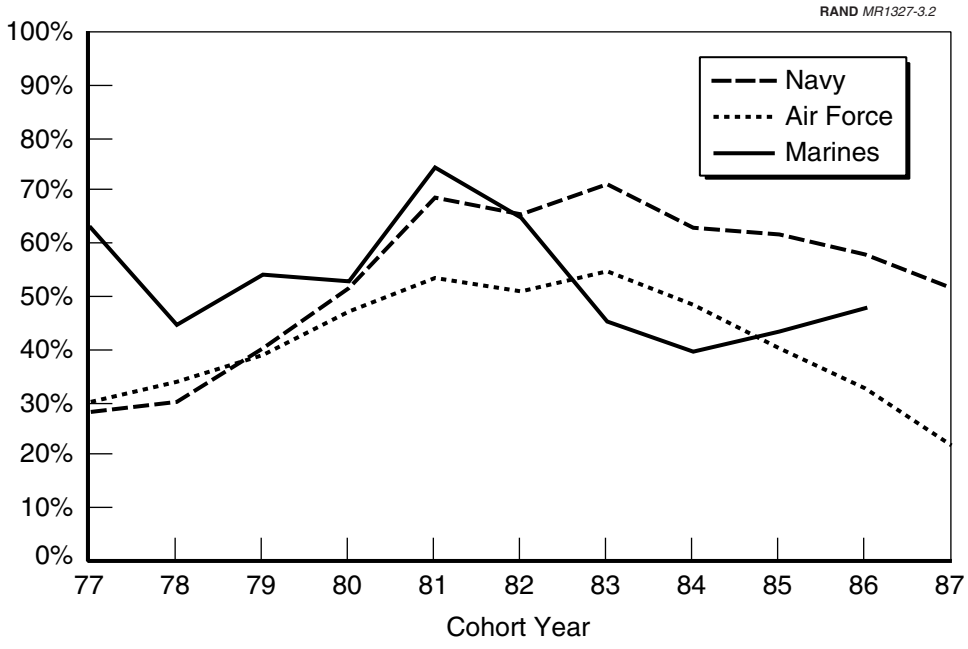

Figure 3.2—Attrition During ADSO Window by Service Entry Cohort

- First, pilots can decide to remain in the military without signing a bonus contract. These cases are accounted for in the services' attrition numerators, but not in ours. Many pilots have speculated that this option is chosen more frequently when the future of military aviation in general is uncertain and particularly when changes in ACP are anticipated. If this is so, the discrepancy between our measure and that used by the services may be especially great for recent cohorts. This would also suggest that both measures should be interpreted with greater than normal caution.
- Second, our measure looks at the behavior of one cohort at a time; the services' measure is a weighted average across several cohorts at different YOS stages.
- Third, records of ACP take rates exist for only the past few years. This makes it much more difficult to determine whether current ACP take rates are historically unusual.

Pilots who take the ACP bonus are required to stay in the service for a number of additional years (the actual number depends on the specific ACP contract). Therefore, we should not observe ADSO attrition among ACP takers. Attrition among non-takers is quite high. On average, 80 percent of Air Force pilots who do not take the bonus leave during the ADSO window, although the rate of attrition has declined slightly among recent cohorts (approximately 12 percentage points from the 1984 through 1987 entry cohorts with ADSO years from around 1991 through 1995). Figure 3.3 compares Air Force ACP offers and pilot attrition by decision year.

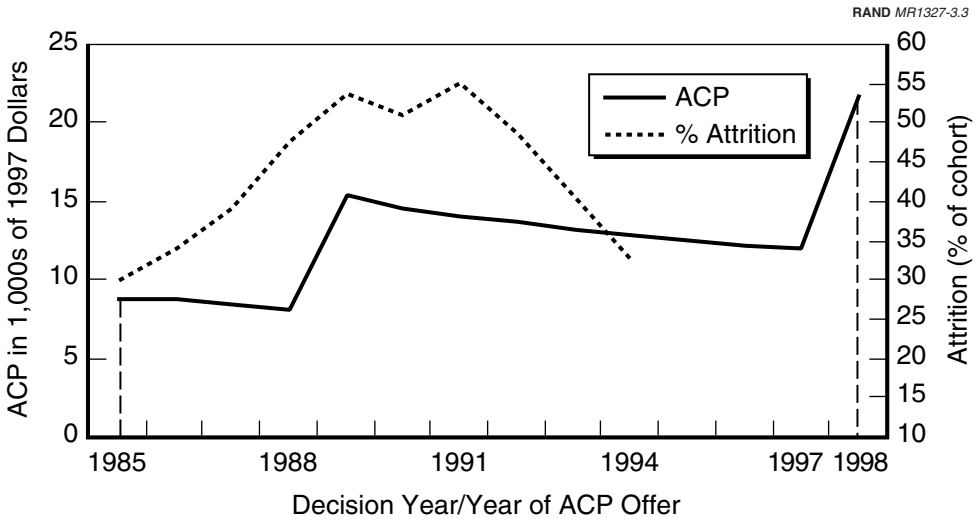

Figure 3.3—U.S. Air Force ACP Officers and Pilot Attrition During ADSO Window by Decision Year

Not all Navy pilots are necessarily eligible for ACP in years in which it was offered. Rather, eligibility can depend on community (ACP can be targeted to communities with attrition problems). Thus, non-takers consist of pilots ineligible for ACP and pilots eligible for ACP. Attrition among ineligibles is notably higher than attrition among eligible non-takers. More than 90 percent of ineligible airplane pilots in the 1981 through 1985 cohorts left at ADSO (between about 1989 and 1993), although attrition has declined among more recent cohorts. This difference exists despite the fact that *a priori* one might expect lower attrition among those ineligible for bonuses, given that bonuses were offered to communities with attrition problems. The finding is consistent with assertions by Navy service representatives that disparities in salary from ACP may actually increase overall attrition. This will have important implications for interpreting estimates of the effect of pay on attrition for Navy pilots.

It is worth noting that the separation of Navy pilots into eligibility categories is not exact. Eligibility was assigned based on the central year of the ADSO window, whereas a pilot may have reached ADSO before or after that time. Similarly, not all Marine Corps pilots are eligible for ACP in years in which it is offered. The ACP data in the Pay file for Marine Corps are missing for virtually all pilots; therefore, we are unable to separate eligible non-takers from eligible takers.

Post-ADSO attrition has declined over time. In recent cohorts, almost all attrition occurs during the ADSO window. There has been somewhat more attrition among Marine Corps pilots post-ADSO.

Civilian Data

In addition to historical data on pilots' careers in the military, we procured historical data on the civilian aviation market. Most of the data were provided by Aviation Information Resources (AIR) Inc., a company that provides data for job search and career development for potential airline pilots.

The data include the number of pilots hired by the major airlines from 1980 through 1997 and salary and retirement benefits that various airlines offered to pilots at different stages in their careers.

Unfortunately, we are not able to account for other factors that affect civilian opportunities over time, such as union strikes and airline furloughs.

Issues in Specification of the Pilot Attrition Model

In this section, we discuss the details of the development of the specific mathematical form of our pilot attrition model.

Dependent Variable

The dependent variable is the indicator of whether an individual stays or leaves during the first period in which he has the option to leave. Individuals who leave involuntarily during this period are not included in the estimation of the model. Involuntary separations are identified by a separation choice variable on the Officer Cohort File. This variable was used to exclude involuntary separations from the analysis.

As described in Chapter 2, individuals incur a commitment of 4.5 to 8 years from the time they receive training. Most individuals reach the end of their ADSO at about 8 to 10 YOS, which includes about 2 years of training time. We do not observe the actual ADSO for each individual; instead, we use the distribution of the year at first ACP receipt by cohort for pilots to approximate a five-year ADSO "window."

While the specification of a multiple-year decision window is necessary due to our inability to identify the exact year that individual pilots decide to stay in or leave the military, several issues arise from this specification. First, because our objective is to estimate the impact of future pay stream expectations on the decision to stay in the military or leave it, we construct these pay streams assuming that the individual decides to stay or leave in the third year of the five-year window. That, by definition, is the year that most individuals in the cohort leave or receive ACP; hence, the assumption that pay profiles should start in this year is accurate for this subsample. However, the constructed pay profiles will be mismeasured for individuals who decide to stay or leave at different years within the window. This induces measurement error in the explanatory variables, resulting in a possible bias toward zero on the estimates.

A second issue worth consideration is that when pilots incur an additional year or two of obligation by accepting a change of station or aircraft, they implicitly make a voluntary decision to stay in the military at that point in time.[7] However, it is beyond the scope of this study to model the decision to incur additional obligations; therefore, for individuals choosing to incur additional obligations

[7]Our communications with Air Force personnel indicate that virtually all additional obligations are incurred voluntarily.

within the window, the pay variables are mismeasured. Nevertheless, examination of the 1997 Air Force Uniform Officer Record suggests that the vast majority of actual ADSOs are within the specified window. For all entry cohorts from 1980 through 1989, the proportion of pilots with an ADSO more than two years greater than that incurred by undergraduate pilot training (UPT) alone is less than 10 percent.

In addition, the Marine Corps has offered a short-term, two-year, ACP contract. The Navy, too, has offered short-term contracts. Because our decision window spans five years, some individuals may potentially take ACP and then quit within the window. Because we construct pay measures according to the assumption that individuals taking ACP will stay until 20 YOS, our pay variables are mismeasured for individuals who take ACP and leave before YOS 20. This results in possibly biased coefficients on the pay variables in the models that include short-term contracts. Although this issue is problematic, the descriptive statistics suggest that the attrition of ACP takers in the Navy in years when short-term contracts were offered was similar to the attrition of ACP takers in years when no short-term contracts were offered.

Independent Variables

The length of time it takes to complete training may affect attrition. Although we do not observe training time, we include variables indicating attrition rates among pilots in prior cohorts. Prior attrition influences the availability of instructors, and may therefore affect the probability of promotion among later cohorts: Low rates of attrition in some years can mean fewer opportunities for promotion among those in later cohorts. Therefore, the expected effect of prior attrition on the stay-or-leave decision is ambiguous.

While it may be desirable to include controls for the exact aircraft flown, doing so involves the interpretation and grouping of service occupational codes, which is beyond the scope of this project. Besides which, we generally have only duty service occupational codes in the data; therefore, we have limited information on aircraft types for pilots assigned to desk or instructor slots. In addition, a change in a pilot's choice of aircraft is a voluntary decision that is accompanied by additional obligations in the military. This implies that a pilot's choice of aircraft and the decision to stay in the military past ADSO may be jointly determined outcomes. Therefore, it is not entirely clear that the inclusion of the choice of aircraft as an explanatory variable is appropriate. We will limit information about type of aircraft flown to a binary split between fighters/bombers and other airplanes.

Just how strong a taste for military life a pilot may have is not observable. We include a variable indicating source of commission (academy or non-academy), which may partially control for differences in pilots' attitudes toward or feelings about the military, but we are not able to otherwise control for individual feelings regarding military life or flying military aircraft.

As described earlier in this chapter, the dependent variable in the model is the indicator of the decision to stay or leave during the ADSO window. Some of the independent variables included in the model are

- military and civilian opportunities over time
- measures of deployment and deployment specifically to hostile territories
- an indicator variable for fighter and bomber pilots (the omitted category is all other airplane pilots such as transport carrier pilots)
- source of commission (academy or non-academy).

Other independent variables include

- marital status
- an indicator variable for the effect of the Gulf War stop loss policy
- eligibility for separation incentive programs such as Voluntary Separation Incentives (VSI) and Special Separation Benefit Program (SSB)
- reserve versus regular commission
- the number of pilots hired by the major airlines.

Information regarding race/ethnicity was not included because the sample was almost entirely non-Hispanic white.[8] The included demographic variables and those variables indicating rate of attrition in the prior cohort and source of commission are self-explanatory; we describe the construction of the pay profiles of the two alternatives (stay in the service until YOS 20 or leave at ADSO) and the other variables in the discussions that follow.

We construct three measures of deployment broadly following the perstempo methodology developed by Hosek and Totten (1998). The first variable is an indicator for whether any deployment occurred in the 24-month period

[8]Less than 2 percent of airplane pilots in our sample are African-American. Other nonwhite ethnic groups are in even smaller numbers. Our Air Force, Navy, and Marine Corps samples contained 182, 58, and 7 African-Americans, respectively. We cannot estimate the effect of race on attrition in the Navy or Marine Corps with any precision. In the Air Force, we included an indicator for African-American race in a specification check. We found that the coefficient on this indicator is small and statistically insignificant (coefficient = 0.002, s.e. = 0.030), and the inclusion of this variable does not change coefficient estimates on other variables.

preceding an individual's decision year. The second variable is the number of months of hostile deployment in this 24-month period, calculated by summing the number of months an individual received IDP. The third variable is the total number of months of deployment, hostile and non-hostile, over the 24-month period.

We follow Hosek and Totten (1998) in measuring non-hostile deployment with FSA. Individuals with dependents who are deployed in a non-hostile area for more than 30 days receive FSA. Measuring non-hostile deployments with FSA is imprecise for two reasons: (1) We observe only non-hostile deployments that last more than 30 days and (2) we observe such deployments only for individuals with dependents.

The two perstempo variables, the indicator variable for any perstempo and the continuous variable measuring number of months of perstempo, are set to zero for single individuals.[9] This requires entering the first two measures of perstempo in the form of interactions with the "married" indicator. Thus, the coefficients on the two perstempo variables must be interpreted carefully: The measured effect is the effect of perstempo on married individuals compared with married individuals with no perstempo and single individuals.

We also considered the possibility that the effects of perstempo on attrition may increase at a less than linear rate with linear increases in perstempo. This would be the case if very high amounts of perstempo have smaller marginal effects. This consideration, along with a concern that the estimates from the linear specification may have been unduly influenced by a few high perstempo outliers, led to the decision to investigate the square root of months of perstempo, rather than untransformed months, as specifications of the second and third measures of deployment (total months and total hostile months).[10] As it turned out, this nonlinear specification had a consistently stronger bivariate relationship with probability of loss at ADSO than the linear specification and resulted in multivariate models that consistently explained a greater proportion of the variance of ADSO loss probability. This nonlinear specification was therefore chosen as the primary specification on this empirical basis.

We include a control variable for the impact of the Gulf War's stop-loss policy on pilots' decisions to leave the military. During the Gulf War (in 1990 and 1991), the

[9]We estimate the deployment coefficients from the sample of married individuals only, rather than use unit deployment averages to impute deployment for single individuals. The calculation of the unit deployment variables was based on somewhat arbitrary criteria that have been quite controversial.

[10]As was the case with the linear specification, this nonlinear version of total months was specified as an interaction with the indicator for "married."

military instituted a stop-loss policy such that pilots who had completed their ADSO were not allowed to leave the military. We should observe an effect of the stop-loss policy on attrition only if the stop-loss occurred in the last year of the five-year ADSO window. Individuals who were not subject to the stop-loss in the last year of the window would have been free to leave in the last year or years of the window. Therefore, we include a dummy variable equal to one for the cohorts in which either the last year or last two years of the window were stop-loss years. We expect the effect of the Gulf War variable will be negative, indicating less attrition during the window.

We also include a variable indicating the number of pilots hired by the major airlines. We assume that the number of pilots hired by the majors is related to the probability of a pilot being hired by a major airline. We hypothesize that the number of pilots hired by the major airlines is an indicator of some of the uncertainty in the civilian market and measures to some extent the health of the airline industry.

The number of hires also affects the level of urgency to leave the military. The rate of promotion to captain for a new entrant to the major airlines is a function of seniority and therefore inversely related to the number of pilots hired immediately before the new entrant.

The total number of pilots that will be hired in the current year is difficult to estimate mid-year, even for professional organizations such as AIR, Inc. We therefore believe it is more likely that the number of pilots hired by the majors in the previous year (the year before the central year of the ADSO window), which is knowable, is the relevant number. Note that this is consistent with peaks in military airplane pilot losses lagging behind major airline hiring peaks, as discussed in Chapter 2.

The military drawdown may affect the stay-leave decisions we observe in our data. To induce early separation, three programs were enacted by the National Defense Authorization Act (NDAA) 1992 and 1993 (and have been authorized through 1999). These programs are Voluntary Separation Incentives (VSI), the Special Separation Benefit Program (SSB), and an early retirement program. To be eligible for VSI or SSB, the individual must have between 6 and 20 YOS. For early retirement, the individual must have more than 15 YOS.

Because the early retirement program was not offered to individuals who were at their decision point, for the purpose of these analyses we focus only on VSI and SSB. Both VSI and SSB offered monetary separation incentives; therefore, eligibility for these programs clearly increases the probability that a pilot separates from the military. For pilots who were at their decision point, eligibility

for VSI and SSB was restricted to certain communities. Using the service occupation codes in the Defense Manpower Data Center (DMDC) data, we have mapped the services' reports of the eligible communities to the data set of pilots.

It is important to note that as with the construction of the variable measuring ACP eligibility, described in more detail later in this chapter, considerable noise exists in the construction of the VSI/SSB eligibility measure. This is primarily because we have access to only duty service codes, and not primary service codes, for the majority of our sample. Because eligibility for VSI/SSB is more likely to be based on primary service codes, our constructed VSI/SSB eligibility variable is likely to be mismeasured.

Another variable included in the analysis is an indicator variable for reserve commission. This variable captures whether the original commission was reserve or regular. It is possible that reserve pilots may be more likely to quit because they are less committed to a military career. It is also possible, however, that their remaining without a regular commission is an indication of their strong taste for military service.

Military and Civilian Opportunities

As noted earlier in this chapter, our estimation approach involves examining individuals' decisions at ADSO and assuming that those who stay in the service at the ADSO decision point remain in the service until YOS 20, at which point they retire and find a job in the civilian market. Those who leave at ADSO are assumed to stay in the civilian sector for the remainder of their careers.

The specification of civilian opportunities for airplane pilots assumes that those who leave become pilots for the civilian airlines, although we do not assume that pilots join major civilian airlines. As stated earlier in this chapter, airplane pilots therefore compare two earnings streams in deciding whether to stay in the services or leave: (1) military earnings from ADSO until YOS 20 and civilian earnings as an airline pilot thereafter and (2) civilian earnings as an airline pilot from ADSO onward.

Our primary specification includes the log of military pay in the model, but parameterizes civilian opportunities by including only the number of hires by major airlines. This specification has an advantage in that it does not rely on any assumptions to construct expected pay from civilian airlines. Furthermore, because much of the variation of the civilian pay profile lies in the probability of being hired, the number of civilian major airline hires should be a good proxy variable for civilian opportunities.

An alternative specification of the relative value of military and civilian earnings is a simplification of the ACOL model described in the review of the literature.[11] In a traditional ACOL model, individuals are allowed to leave at any point following the first decision point. Our alternative specification involves an empirically motivated simplification of the traditional ACOL.

Specifically, to improve the tractability of the model we assume that individuals leave voluntarily only at ADSO or YOS 20. We believe that this simplification does not deviate substantially from observed behavior in the sample. Most individuals who stay in the services accept ACP (which is offered to all pilots in the Air Force and particular communities in the Navy and Marine Corps), which obligates them to stay for a certain number of years. In the Air Force and Navy, long-term ACP contracts obligate pilots to stay until at least YOS 14. Because of the cliff-vesting of the military retirement benefit, most pilots in our sample who served as long as that ultimately continued until YOS 20.

In the Marine Corps, short-term ACP contracts of two years have been offered. Similarly, in the Navy, short-term ACP contracts of one and two years were briefly offered, but attrition from the end of the ACP commitment until YOS 20 is still not appreciable in the sample. Under these assumptions, we specify the relative earnings opportunities from the two choices (leave at ADSO or stay until YOS 20) as the difference between the log of the two expected earnings profiles.[12]

Whereas ideally we would like to separate the effect of ACP from the effect of other military pay on the stay-or-leave decision, two issues prevent us from doing so. First, there is limited variation in the ACP bonus amount over time, and second, observed ACP is somewhat problematic as an independent variable in that it is both a *cause* of low attrition and a *consequence* of high attrition. High attrition in one year may result in greater ACP bonuses in subsequent years to discourage attrition. This dual role of ACP as both a cause and a consequence of attrition (economists describe this as "endogeneity"), is an issue particularly for the Navy and Marine Corps because ACP is offered only to communities in which a pilot shortage exists.

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[11] Although we had once considered this specification as the primary one because of the ACOL-like appeal, we were ultimately uncomfortable with the strenuous assumptions that approach required and relegated it to alternate specification status. In any event, the conclusions from this alternate specification were similar to those derived from the primary specification.

[12] We also experimented with entering the expected earnings profiles of the two alternatives separately. We hypothesized that changes in the profile associated with staying in the military until YOS 20 would be viewed with more certainty than changes in the profile associated with leaving at ADSO.

Construction of Estimated Military Pay Profiles

Our approach requires that we calculate the expected military pay from the decision point at the end of the ADSO to YOS 20. Military pay consists of several components that depend on some combination of the following variables: officer rank, YOS, presence of dependents, and year.[13]

Broadly speaking, the process by which we calculate expected pay requires that we first project YOS, rank, age, and dependent status (a binary variable) from ADSO to YOS 20. The details of our approach are noted in Appendix C.

Civilian Pay Profiles

In Appendix D we describe the methodology used to estimate the earnings that military members are likely to achieve if they leave the service and work for a civilian airline. Note that the primary specification that is used omits this information and instead uses only information on numbers of hires by major airlines.

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[13]In addition, the housing components of military pay depend on location. We do not incorporate current location into the expected calculation because we have data on current location only. To predict future housing pays, we use the median housing allowance. We discuss this in further detail in Appendix C.

4. Model Results and Sensitivity Analyses

As part of this study, we estimated a probit model of attrition at ADSO. As discussed in Chapter 1, the dependent variable is an indicator variable that takes on the value of one if a pilot who is in the military at the start of a "decision window" voluntarily leaves the military during the designated decision window (see Chapter 3 for a discussion of decision windows). If the pilot stays in the military beyond the decision window, the dependent variable is zero. Several explanatory variables are included in the estimation. The independent variables included in the estimation are

- marital status[1]
- an indicator variable for academy graduates
- an indicator variable for reserve commission
- an indicator variable for fighter and bomber pilots (the omitted category is all other airplane pilots such as transport carrier pilots)
- a stop-loss indicator for cohorts that may have been influenced by the Gulf War
- an indicator for eligibility for VSI/SSB
- measures of deployment and deployment specifically to hostile territories
- hiring by major civilian airlines.

These variables are a subset of factors discussed in Chapter 1 that could potentially affect pilot attrition. These variables were selected because they were measurable in our data sources and central to our primary questions on pilot attrition.

The primary pay specification includes only the logarithm of military pay and (lagged) civilian hires by major airlines. The civilian pay measure is excluded; the number of major hires by civilian airlines is the only civilian variable included. The reason for choosing this specification is that most of the variation in expected civilian pay is derived from the variation in the probability of being hired by a

[1]We use the actual marital status at the decision point as indicated by our data; however, to project future marital status for the purpose of calculating expected military pay, we assume that an individual is married after the median marriage age. Because marital status is projected for both those who stay at ADSO and those who leave at ADSO, the projection does not bias estimation.

major airline, rather than the variation in actual salaries. Therefore, it appears that the major civilian determinant of military pilot quits is more likely to be the number of open job slots in civilian airlines than the level of expected pay.[2] In this specification, no assumptions are made on the probability of hire in a civilian airline.

A more traditional alternative specification, used here as a check, parameterizes the pay variable as the difference between the logarithm of pay for a civilian career option and the logarithm of pay for a military career option. For the construction of this variable, we assumed a discount rate of 10 percent as suggested by Smith, Sylvester, and Villa (1991).

In Tables 4.1 and 4.2, we report the marginal effects obtained from the estimates of three probit models (Air Force, Navy, and Marine Corps). The estimates reported represent the change in the probability of quitting that corresponds to a one-unit change in a given independent variable, holding all other variables constant. In other words, the coefficient of 0.03 for variable *x* corresponds to a 3 percentage point increase in attrition in ADSO for each one-unit increase in *x.* We estimate separate models for each service to allow for the possibility of the explanatory variables having different effects on attrition in each of these groups.

The results in Table 4.1 show that for airplane pilots in all services the marginal effect of military pay on attrition at ADSO is negative, as would be expected. The effect is statistically significant for all except the Marine Corps, where the small sample size (fewer than 400 observations) results in a large standard error. The magnitude of the effect of military pay is fairly large, and is consistent across services.

It is important to note that, in practice, military pay for pilots grows primarily from increases in ACP. Therefore, one useful way to interpret these coefficients is to apply them to potential increases in ACP for pilots, as is done in Table 4.4. In the Air Force and Navy, a 50 percent increase in ACP (an increase in PDV of about $37,000 and $16,000, respectively) for those who are eligible would decrease attrition rates in a typical year by about 13 points (from average levels of 53.3 percent and 42.4 percent, respectively).

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[2]Although it may appear that the number of major civilian airline hires is an endogenous variable, reports from Air, Inc. indicate that these airlines have a fixed number of slots every year and fill all the open slots they have.

Table 4.1

Probit for Attrition of Pilots

Dependent Variable	Air Force	Navy	Marine Corps
Log (Military Pay Stream Present Discounted Value [PDV])	–2.804*	–3.363**	–2.718
	(1.340)	(0.635)	(4.430)
1,000s of Hires by Major Airlines in Year Before ADSO	0.140**	0.048**	–0.020
	(0.035)	(0.017)	(0.017)
Married[3]	–0.102**	–0.084**	–0.017
	(0.012)	(0.017)	(0.064)
Married x Any Deployment	–0.211**	0.016	0.182
	(0.041)	(0.126)	(0.169)
(Married x Months of Deployment)$^{1/2}$	0.064**	–0.063	–0.066
	(0.023)	(0.045)	(0.092)
(Months of Hostile Deployment)$^{1/2}$	–0.001	–0.037*	–0.028
	(0.012)	(0.017)	(0.024)
Academy Graduate	–0.023	0.010	–0.032
	(0.025)	(0.033)	(0.052)
Fighter or Bomber Pilot	–0.169**	–0.009	0.073
	(0.017)	(0.026)	(0.105)
Reserve Commission	0.055	–0.013	0.140*
	(0.032)	(0.030)	(0.058)
Eligible for VSI/SSB	N/A	0.023	0.176*
		(0.058)	(0.068)
Stop-Loss for Gulf War	0.308**	–0.005	0.543
	(0.103)	(0.065)	(0.256)
Number of Observations	8,247	2,794	363

NOTES: Marginal effects are reported; standard errors are shown in parentheses. Standard errors are adjusted for clustering within cohort. Dependent variable = 1 if pilot leaves during ADSO window, = 0 otherwise. See text for definitions of variables.

*Denotes significance at the 5 percent level.

**Denotes significance at the 1 percent level.

In the Navy and Marine Corps, the variation in eligibility for ACP within a cohort induces some variation in the military pay stream; in the Air Force, the variation is primarily between cohorts. Measurement error may exist in the military pay variable due to the fact that we assign ACP eligibility based on the designated "decision year" of the cohort.[4] Therefore, we expect the estimates of the effects of pay to be biased toward zero (assuming that the bias reflects classical measurement error).

[3]As discussed in the text, this variable does not estimate the simple effect of marriage.

[4]Recall that we are unable to determine the true decision year for each pilot.

Table 4.2

Means and Standard Deviations of Independent Variables in Primary Model

Variable	Air Force	Navy	Marine Corps
Log (Military Pay Stream PDV)	13.577	13.526	13.494
	(.045)	(0.052)	(0.032)
1,000s of Hires by Major Airlines in Year Before ADSO	3.250	2.414	2.475
	1.499)	(1.679)	(1.699)
Married	0.672	0.602	0.727
	(0.470)	(0.490)	(0.426)
Married x Any Deployment	0.167	0.179	0.383
	(0.373)	(0.383)	(0.487)
(Married x Months of Deployment)$^{1/2}$	0.342	0.408	0.848
	(0.812)	(0.913)	(1.148)
(Months of Hostile Deployment)$^{1/2}$	0.381	0.308	0.342
	(0.832)	(0.742)	(0.791)
Academy Graduate	0.283	0.258	0.234
	(0.451)	(0.438)	(0.424)
Fighter or Bomber Pilot	0.446	0.411	0.815
	(0.497)	(0.492)	(0.388)
Reserve Commission	0.689	0.523	0.455
	(0.463)	(0.500)	(0.499)
Eligible for VSI/SSB	N/A	0.824	0.361
	N/A	(0.381)	(0.481)
Stop-Loss for Gulf War	0.180	0.228	0.237
	(0.384)	(0.419)	(0.426)
Number of Observations	8,247	2,794	363

NOTES: Mean values are reported; standard deviations are shown in parentheses.

Table 4.3

Means and Standard Deviations of Other Variables of Interest

Variable	Air Force	Navy	Marine Corps
Military Pay Stream PDV in $1,000s	788.3	749.6	725.6
	(35.5)	(39.6)	(23.7)
ACP PDV in $1,000s	73.5	31.9	4.0
	(5.5)	(32.5)	(6.0)
Civilian Paystream PDV in $1,000s	768.0	752.9	759.0
	(25.7)	(29.8)	(24.5)
Age at ADSO	30.7	31.6	31.5
	(1.5)	(1.8)	(1.4)
Proportion with Any Deployment, Among Married Pilots	0.248	0.297	0.526
Number of Observations	8,247	2,794	363

NOTES: Mean values are reported; standard deviations are shown in parentheses.

Table 4.4

Projections: Expected Percentage Point Change in Attrition During the ADSO Window Corresponding to Changes in a Single Independent Variable

Change in Independent Variable	Air Force	Navy
(Historical average quit rate)	(42.4%)	(53.3%)
1,000 total additional hires by major airlines[a]	+14.0%	+4.8%
2,500 total additional hires by major airlines	+35.0%	+10.8%
50% increase in ACP ($37K, $16K PDV)	–12.8%	–13.2%
100% increase in ACP ($74K, $32K PDV)	–24.9%	–25.9%

[a]From all sources, military and non-military.

In addition, as noted in Chapter 2, ACP eligibility in the Navy and Marine Corps is endogenous, in the sense that pilots who are more likely to have attrition problems are offered bonuses. The endogeneity of ACP again suggests a likely downward bias on the estimate of the effect of pay on attrition. Because of measurement error in military pay and the endogeneity of ACP, the estimated effect of pay on attrition may be less than the true effect. Other estimation issues, such as the specification of the reduced-form probit model, as opposed to a dynamic programming model, may affect the direction of the estimates differently.

The variable indicating the number of pilots hired by the major airlines (divided by 1,000)[5] was designed to measure the level of uncertainty pilots have about the market for civilian pilots and to provide a direct indication of the probability of finding a civilian pilot job. In the Navy and Air Force models, a significant positive association existed between the number of pilots hired by the major airlines and the probability of quitting near ADSO. The magnitude of this effect is moderate in the Navy and very large in the Air Force.

Table 4.4 illustrates that a moderate increase in hiring by the majors (1,000 pilots) would result in a 14 point increase in attrition in the Air Force (requiring a more than 50 percent increase in ACP to offset this effect) and a 4.8 point increase in attrition among Navy airplane pilots. A sizable increase in major airline hiring, corresponding to a shift from almost trough to peak in the hiring cycle (2,500 pilots), would be offset only by a $100,000 increase in the PDV of the military paystream for Air Force pilots, a substantial dollar amount.

[5]We divide this variable by 1,000 to produce a reasonable scale for the interpretation of the coefficients.

Deployment variables have significant effects among married Air Force pilots, with lower rates of attrition at low to fairly high levels of deployment (one to 11 months out of 24) than with no deployment at all. Seventy-five percent of married pilots have no deployment, and of those married pilots with some deployment, the mean of the square root months of deployment is 2.06 months.[6] At this level (about 4.25 months per 24), attrition is 7.7 percent lower than with no deployment. Only at extremely high levels of deployment (4.5 root months = 20.25 months per 24 months) is attrition that much lower (7.7 percent) than with no deployment.

Although in some ways consistent with the results of Hosek and Totten (1998), the crossover point is at surprisingly high levels of deployment. In the Navy, the only significant result is a decrease in attrition with more hostile deployment; in the Marine Corps no deployment variables are significant. The limitations of these variables discussed previously are important to keep in mind. Table 4.4 suggests that the magnitude of the effect of deployment servicewide is likely to be small relative to the effects of military pay and major airline hiring. The magnitude of Perstempo results observed here are consistent with the findings of an unpublished RAND Corporation study of the effects of Perstempo on the retention of officers in general.

Eligibility for VSI/SSB has a strong positive effect— an increase of 18 percent— on the probability of quitting in the Marine Corps, but not in the Navy. Air Force pilots were not eligible for VSI/SSB within their decision window.

Unexpectedly, the stop loss for the Gulf War was associated with increased losses in the Air Force and Marine Corps, and significantly so in the former. Because this variable is specified simply as a subset of cohorts, we can interpret this to mean that those cohorts experienced unexpectedly high attrition compared with what would have been expected on the basis of pay, airline hiring, and other factors specified in the model.

The effect of marital status on attrition is negative and significant in both the Air Force and Navy models, and negative in the Marine Corps model (even after accounting for the effect of the interactions of marital status and the deployment variables that are evaluated at mean values). Fighter and bomber pilots are significantly less likely to quit in the Air Force. Marine Corps pilots with reserve commissions were more likely to quit.

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[6]This is calculated as: mean (Married x Months of Deployment)$^{1/2}$ / mean (Married x Any Deployment). For example, 0.342/0.167 = 2.06 for the Air Force.

Table 4.5 summarizes a series of specification checks of the three service models:

- First, we specified pay as the log of the difference between the estimated PDV of staying or leaving at ADSO for airplane pilots (see Appendix C). This specification, which does depend on assumptions about hiring probabilities, resulted in pay elasticities that were quite similar to those found in the primary specification. In the Air Force, hiring by majors maintains a significant further partial effect in this specification; in the Navy, it does not.
- Second, we added ADSO-year hiring to the lagged versions already in the primary specification. The ADSO-year civilian opportunity variable was not significant, and had little effect on other coefficients.

Table 4.5

Specification Checks and Their Results

Specification Check	Air Force	Navy	Marines Corps
Log difference of stay at ADSO or leave at ADSO paystreams, rather than solely stay at ADSO paystream	Almost the same coefficient for pay (2.59), which is also significant; no effects of note on other coefficients	Slightly smaller coefficient for pay (2.85), but significant; effect of hires no longer significant	Large shift in the coefficient for pay, but still not significant; no effects of note on other coefficients
Add current (decision year) major hires, in addition to lagged hires	Not significant; no effects of note on other coefficients	Not significant; no effects of note on other coefficients	Not significant, no effects of note on other coefficients
Use level, rather than square rooted, measures of lengths of Perstempo	Similar to other specification; significant, but with smaller z-stats; no effects of note on other coefficients	Similar to other specification; significant, but with smaller z-stats; no effects of note on other coefficients	Not significant; no effects of note on other coefficients
Add the quit rate of each of the two previous cohorts	Significant positive autocorrelation with behavior of previous cohort (+0.6); no effects of note on other coefficients	Significant negative autocorrelation with behavior of previous cohort (–0.6); no effects of note on other coefficients	Mild, but significant negative autocorrelation with behavior of cohort for two years previous (–0.2); no effects of note on other coefficients

- Third, we added the quit rates of the two previous cohorts to the five primary models in order to examine autocorrelation. Although these variables often had statistically significant effects that varied from model to model, their inclusion did not alter other coefficients in any important way.
- Finally, we used the standard-level measures of length of Perstempo rather than the square-rooted versions. This manipulation made little difference, although the square-rooted versions were generally more precisely estimated.

In other specification checks, we examined the sensitivity of the estimates to discount rates. We varied discount rates from 10 percent to 15 percent and found this had little effect on the estimates. Although clear reasons exist to consider including age as one of the demographic variables in an attrition equation, in this case age is correlated with the rising ADSO over time. This correlation would have been likely to bias coefficients on age and on other correlated variables in the model, therefore age was not included.

A final specification check added a simple time trend that attempted to account for gradual, but unmeasured, relaxation in age-related hiring restrictions by major airlines. This term was not significant and did not alter other coefficients substantially.

5. Discussion and Conclusion

In this report, our goal was to explore the extent and determinants of the pilot attrition[1] problem and its responsiveness to changes in military compensation.

Our interviews with service representatives responsible for aviator management and compensation informed our modeling. The service representatives believe that whereas civilian airlines do provide an incentive for military pilots to quit the military, disillusionment with the military due to excessive deployments and lack of faith in higher military leadership were equally important factors that contributed to pilot attrition. Some service representatives also expressed the belief that increases in bonuses were unlikely to fully counteract the attrition problems.

The formal quantitative analysis in this report estimates the impact on attrition from factors such as compensation, civilian airline hires, deployment, and voluntary separation programs. We have several noteworthy findings as a result of our study:[2]

- Increases in major airline hiring are very strongly associated with increases in military pilot attrition, especially for airplane pilots in the Air Force. This finding is particularly interesting in the face of projected long-term increases in major airline hiring.
- Although attrition was found to be quite responsive to bonus pay, the magnitude of the effect of major airline hiring could make counteracting a significant increase in hiring quite costly for the services.
- The strong influence of civilian major airline hiring on military attrition necessitates a military hiring plan that is capable of responding to strong exogenous influences. It also underlines the importance of incorporating reliable forecasts of major civilian airline hiring into this planning.

It is difficult to disentangle the effects of the pecuniary and nonpecuniary aspects of the civilian major airline profession on military pilot attrition. Both the pay

[1]The term "attrition" as used in this report refers to a pilot's voluntary departure from military service.

[2]These results are generally consistent with results derived from a recent study of Air Force pilots (Fullerton, 1999).

profile and lifestyle available with major airlines contrast sharply with their military counterparts. While present research establishes a strong association between the availability of major civilian airline jobs and military pilot attrition, this research cannot disentangle the contributions of major airline pay and major airline lifestyle to this association. To the extent that particular aspects of the major civilian airline lifestyle are valued, the military may be able to decrease both pilot attrition and the responsiveness of attrition to major airline hiring by incorporating some valued aspects of that lifestyle.

Future research might integrate surveys of military pilots nearing ADSO and the pay and hiring information used in the present study. Combining these information sources in a single quantitative model could provide the means to formally assess whether changes in nonpecuniary aspects of the military would be likely to moderate the sensitivity of attrition to major airline hiring.

A. Officer Promotion Paths

An officer's career typically develops in three stages: basic training and entrance into an occupation or career field, early assignments through Grade O4, and progression to more senior ranks. Over the course of their careers, officers have the chance of progressing from the lowest grades (O1, Ensign in the Navy and Second Lieutenant in the other services; O2, Lt. Junior Grade/First Lieutenant; O3, Lieutenant/Captain), through the middle grades (O4, Lt. Commander/Major; O5, Commander/Lt. Col.), to the highest grades (O6, Captain/Colonel; O7 through O10, Admiral/General).

Promotion Rates and Timetables

Nearly all qualified officers are promoted from O1 to O2 to O3 within the first four years of service. The step to O4 takes longer than the first two grade progressions and is competitive, rather than essentially automatic. Promotion to Lt. Commander or Major (O4) occurs five to seven years after promotion to O3, and the targeted rate of promotion is 80 percent of officers who have reached O3. Promotion to higher grades is increasingly competitive and typically takes place at 15 to 17 YOS for O5 and at 21 to 23 YOS for O6 (Rostker et al., 1993).

The military system is commonly characterized by the phrase "up or out." The Defense Officer Personnel Management Act of 1980 (DOPMA) sets standards for promotion to each grade. Failure to reach specific grades in a specified number of years results in the forced departure of an officer. The maximum number of years that an officer is allowed to reach a specific grade is known as the high year of tenure (HYOT). The HYOT is 13 for Grade O3, 20 for O4, 28 for O5, and 30 for O6. Pilots, like other officers, abide by the DOPMA rules governing their promotion opportunities.

Responsibilities over a Career

The concept of the "total officer" who embodies leadership as well as technical expertise applies to pilots and other officers alike. With the exception of the

Army,[1] the career of a pilot initially begins with approximately two years of training, then focuses after that on technical expertise for a number of years, and then broadens to include nonflying positions.

Formal boards meet regularly to evaluate each officer's performance relative to his or her peers and to consider the needs of the service to decide on the officer's professional military educational opportunities, promotions, and unit command assignments. For this reason, career progress is affected by the decisions a pilot makes regarding which positions to accept. The career paths of pilots differ somewhat by service.

[1]Army aviation officers combine technical expertise and leadership experience from the beginning of their careers.

B. Previous Approaches to Estimating Models of Aviator Attrition

This appendix reviews previous studies of the attrition of military officers in general and the attrition of military pilots in particular. This review focuses on methodological issues in each of the studies and summarizes the findings of those studies that deal with pilot attrition.

Models Using Aggregate Data and/or Military/Civilian Pay Ratios

Estimation of attrition models has a long history in the literature, starting with the work done for the Gates Commission in the early 1970s. These studies primarily looked at first-term attrition, largely using aggregate data, and it was assumed that military members compared their earnings in a single period, or in some cases over a few periods, to the earnings of civilians over the same limited time horizon. Some more recent studies of aviator attrition also have relied on aggregate data and/or military/civilian pay ratios that reflect only one or a few periods of time.

Bookheimer (1996) used aggregate data on attrition rates between 1978 and 1990 for each aviation community. His dependent variables are aggregate attrition at five through eight years of service and nine through 12 years of service by community; the independent factors include two measures of national economic performance: (1) the number of pilots hired by major civilian airlines and the change in hires between the current and last period and (2) a point-in-time ratio of military to civilian pay. The variables measuring civilian hiring and the military/civilian pay ratio have statistically insignificant estimates. Nevertheless, the estimates are likely to be confounded by the use of aggregate data (and a limited number of observations), the lack of lagged and predicted future measures of civilian opportunities, and the lack of controls for expected military/civilian pay differences over a longer horizon.

Stone, Wiggins, Turner, and Looper (1997) estimated the impact of the military-civilian pay ratio on Air Force pilot attrition from 1980 to 1991. They used civilian pay data obtained from the Federal Aviation Pilot Association (FAPA). Other explanatory variables used in their model are demographic variables, such as

sex, marital status and number of dependents, type of pilot (bomber, instructor, tanker, strategic airlift, or tactical airlift), and the ratio of the number of major airline hires to the number of eligible Air Force pilots. This is a potentially problematic variable because the pool of potential hires also includes many individuals other than current members of the Air Force.

The results of Stone et al. show that a high ratio of pilots hired by the major airlines to eligible Air Force pilots is strongly associated with high attrition. A high military-to-civilian pay ratio was associated with low attrition, although the responsiveness to pay was estimated to be quite small, with an estimated elasticity of approximately 0.5 for this model specification.

Fullerton (1999) used logistic regression on panel data to estimate the effects of pay (lifetime military/civilian pay differences and the magnitude of the initial pay cut upon transition to civilian airlines), civilian conditions (airline hiring and civilian unemployment), duty (CONUS [Continental United States] versus overseas assignment and amount of Perstempo), and demographic factors (age, gender, race, marital status, dependents, special medical requirements, source of commission, type of aircraft, and drawdown incentives) for Air Force pilots. The analysis separately considers those pilots first eligible for separation (with six to ten years of service) and other pilots eligible for separation.

The conclusions of Fullerton's research were similar to those reached in this report. The decomposition of pay differences into lifetime earnings and initial pay cut is an alternative to incorporating discount rates into the paystreams directly. Fullerton concluded that pilots respond to both the undiscounted value and the shape of the paystreams. This is consistent with our finding that the impact of ACP can be relatively strong for a given amount of money because its "up front" timing does not result in much erosion in value through discounting. The author also found a large impact on attrition from airline hiring, even when controlling for lifetime differences in earnings. Demographic factors acted much as they did in the present research.

A few other studies of aviator attrition (Coughlin, 1996; Turner, 1995; Kleinman and Zuhoski, 1980) that relied on aggregated data, limited pay measures, or both are not discussed here.

Cost of Leaving Models

In other work, individual data and a more sophisticated measure of military/civilian pay known as the Annualized Cost of Leaving (ACOL) have been used. The ACOL is the annualized measure of the difference in the net

present value of staying in the military compared with leaving the military service for civilian employment at the current decision time. It takes into consideration discounted future civilian earnings if the individual leaves and discounted military earnings if the service member stays, up to a single optimal future date when the service member leaves the military (which could be five years later, at retirement, or at any time after the initial decision point).

The ACOL formulation of the military/civilian pay difference improved on the earlier specification of the pay difference (the pay ratio in a single period or over only a few periods) by incorporating future differences in the pay ratio that are likely to affect an individual's current attrition decisions. The ACOL model has the advantage of being easier to compute than a dynamic programming model (see the next section of this appendix) because the optimal departure date is calculated separately from the estimation of the effect of pay on attrition. However, the trade-off is some loss of theoretical consistency between the determination of the optimal departure date and the subsequent estimation. This theoretical problem is most consequential when making multiple-period estimates.

Riebel (1996) used an ACOL model to estimate the impact of ACIP and ACP on naval aviator attrition. To compute the ACOL variable, expected future military earnings were calculated using expected promotion opportunities and expected pay including ACIP and ACP.[1] The calculation of the civilian earnings stream is not ideal because it is not specific to aviators. Other explanatory variables—marital status, dependents, and minority status[2]—are included in the model because they may have a direct impact on attrition. Riebel found that an increase in monthly ACIP from $650 to $700 increases aviator retention by 0.2 percent. Furthermore, doubling the yearly contract payment amounts of the ACP is estimated to increase retention by 0.6 percent.[3]

A Center for Naval Analysis (CNA) study (Cymrot, 1989) examines the effects of military/civilian pay differences as measured by an ACOL variable, civilian airline hiring demand, and overall unemployment on naval aviator attrition. The sample was restricted to aviators who were not under minimum service contracts

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[1]Expected civilian earnings were obtained from a sample of military veterans in the 1990 Census Public Use Microdata Sample.

[2]Some have argued that civilian employers may be less likely than the military to provide equal opportunities for racial and ethnic minorities and that for this reason racial minorities may be less likely to leave the military. This constitutes one argument for the inclusion of minority status in a model of military retention.

[3]Because Riebel performs these calculations by manipulating the ACOL variable in the model, but does not report the level of the ACOL variable before and after the simulation, it is not possible to calculate the elasticity from these estimates.

or prior ACP contracts and therefore were able to make voluntary mobility decisions. The difference in relative pay as measured by the ACOL variable was not a significant predictor of attrition in the jet and propeller communities, but was a factor in the helicopter[4] community. Civilian airline hiring affected attrition in all communities, with the largest effects for propeller pilots and the smallest for helicopter pilots.

Dynamic Retention Models

Dynamic retention models were developed to incorporate the uncertainty individuals face about future earnings and future decisions to remain in the military if they initially decide to stay. The dynamic models allow for an individual's assessment of the optimal departure time, provided he or she stays in the initial period, to change over time as information about civilian opportunities, promotions, and the like change. Thus, the military/civilian pay variable is a weighted average of the net returns to staying in the military averaged over all possible points at which a member may leave the service, as opposed to being a measure of net lifetime military/civilian pay differences based on the optimal point of leaving calculated at the initial decision time (Hogan and Black, 1991). Despite their theoretical advantage, dynamic retention models are far more computationally complex than ACOL models.

Gotz and McCall (1984) estimated a dynamic retention model for Air Force officers for FY 1973 through FY 1977. The model was estimated separately for pilots, navigators, and nonrated officers. The predictions from this model suggest that the attrition decisions of pilots are less responsive to pay changes than those of nonrated officers. Specifically, in response to a 5 percent pay increase in the first two years after completing the active-duty service obligation, the percentage of pilots retained increases by less than 4 percent, whereas the percentage of nonrated officers retained increases by more than 7 percent. The authors also found that the responsiveness of attrition to pay decreases as years of service increase.

Gotz and McCall also simulated the impact of the introduction of a bonus of $10,000 in 1974 and subsequent years for pilots who complete nine years of service. They estimated that the bonus would increase retention by less than 4 percent. However, because of the computational complexities associated with dynamic model estimations, the model was estimated in a restrictive form

[4]The services use the term "rotary-wing" to denote helicopters.

without exogenous covariates such as race and family size. In addition, standard errors could not be computed (Daula and Moffitt, 1995).

Ausink (1991) estimated several models of the impact of compensation on the decision of a pilot to leave the Air Force. Three models of attrition behavior are estimated: an ACOL model, a dynamic programming model similar to the work of Daula and Moffitt (1995) and Gotz and McCall (1984), and an "option value" model, which models the probability of leaving as a function of the largest value of the gain from remaining in the Air Force. These models are estimated using civilian data from the Current Population Survey and the Air Line Pilots Association to predict expected civilian earnings.

Longitudinal data for Air Force pilots from 1974 to 1991 were also obtained. The primary variable of interest is the expected utility from delaying departure until the year that provides the maximum benefit from staying in the Air Force. No demographic- or occupation-related explanatory variables were included in the models. Ausink also re-simulated the impact of the reform proposals examined in a study conducted by the Congressional Budget Office (see the next section of this appendix) and found large differences in the predictions of the different models, suggesting that the simulations may be sensitive to the particular model chosen.

Daula and Moffitt (1995) estimated a dynamic model of reenlistment for the infantry. Although Daula and Moffitt did not study aviators, the Daula and Moffitt model is reviewed here because of its methodological contribution to the dynamic retention literature. In this dynamic model, the decision to stay or leave the military is modeled as a function of future streams of civilian and military pay, weighted by the probability of receiving those pay streams.

In addition, several exogenous variables such as the number of dependents, race, aptitude scores, and initial enlistment length are included as other variables that may explain the decision to stay or leave. An ACOL model and a Total Cost of Leaving (TCOL) model (where re-enlistment is a function of the difference between the maximum value of staying and the value of leaving the military) are estimated as comparisons to the dynamic retention estimates. No model has a distinct advantage in fitting the observed attrition date, although Daula and Moffitt argue that the dynamic model provides more plausible results for simulated changes in compensation schedules.

Other Models of Attrition

A 1989 Congressional Budget Office (CBO) study examined the impact of compensation on attrition of Air Force pilots. The CBO estimated pay elasticities for naval aviators that reflect how responsive attrition is to changes in ACP and ACIP. These elasticities were then applied to predict attrition for Air Force aviators in response to the five proposed changes in pay.

The CBO found that a 10 percent increase in pay increased retention by 3.1 percent among jet pilots, 2.9 percent among propeller pilots, and 1.5 percent among helicopter pilots. Variables such as relative civilian pay to military pay, civilian opportunities, and the unemployment rate are used to predict attrition. Details regarding the estimation of the model and definitions of the variables used to estimate attrition are not reported in the CBO paper, therefore the reliability of the CBO study's results is difficult to assess. Furthermore, the assumption that pay elasticities in the Navy and Air Force are equal may be problematic.

Lawry (1993) primarily focused on the effect of flight hours (available in Naval Safety Center data) on attrition at the end of the initial ADSO, but his attrition model controls for some family and demographic characteristics (race, marital status, and number of children), starting airline salary (but not salary over time), and number of pilots hired by major civilian airlines.

Lawry hypothesized that increasing flight time would lead to higher attrition but he found that, in fact, more flight hours led to lower attrition in the jet and propeller communities. (Flight hours did not appear to significantly affect helicopter pilot attrition.) The results may indicate that pilots prefer flying time to nonflying duties. More flight hours do not necessarily mean more deployments (they could reflect increased training time), so the effects of time away from home on attrition were not estimated. The results may also be biased because of omitted variables, such as relative military/civilian pay over time.

North et al. (1995) examined voluntary separations occurring during the seventh through eleventh YOS for Marine Corps officers who reached seven years of commissioned service in 1992 to 1993. The authors used a logit model to look at the influence of race, gender, commissioning source, occupation (including dummy variables for helicopter and airplane pilots and naval flight officers), marital status, physical fitness, ability (as measured by the General Classification test score and leadership, academic, and military skills class rank), prior military service, and college major.

Holding demographic, ability, and other such factors constant, North et al. predicted higher rates of attrition among helicopter pilots (30 percent) and airplane pilots (50 percent) than for other occupations in general (20 percent). The authors found inhibitive influences from being married and being commissioned by the Officer Candidate School (OCS) on attrition. The study does not attempt to explain the higher attrition rates among pilots.

C. Construction of Expected Military Pay Profiles

The process by which we calculate expected pay is to first project YOS, rank, age, and dependent status (a binary variable) from ADSO to YOS 20. To project dependent status, we assume that a service member older than the median marriage age[1] has dependents. To project rank, we calculate the average YOS at which a pilot is promoted from Grade O3 to O4 and from O4 to O5. Because we have these promotion points available only after 1986 in the Perstempo data, we rely on an alternative data set that contains annual data on the cohorts of 1967, 1970, 1977, 1980, 1983, 1987, 1991, and 1994.[2]

Using these data, we calculate average promotion YOS for each service. To calculate these promotion times, we restrict the sample to those cohorts for which we observe the full potential promotion time. Note that because promotion for officers is determined by the DOPMA up-or-out rules, these average promotion times are likely to be a good approximation for expected promotion times. However, a limitation exists on this imputation process: We are unable to incorporate the probability of not being promoted, and therefore, being forced to leave the military. This scenario is contrary to our assumption that individuals who stay past ADSO will stay until YOS 20. Because all pilots are O3's at ADSO, we assign the promotion YOS to O4 and O5 on the basis of these service averages.

We assume that service members expect the increase in future pay associated with a certain position to match the inflation rate; therefore, we use the pay table in effect in the decision year, in conjunction with projected rank, YOS, and dependent status, to determine all future pay streams. The exceptions to this rule are ACP, ACIP, and retirement benefits for some cohorts that explicitly do not adjust completely for inflation every year. Therefore, as discussed in more detail later in this appendix, we allow these pays to erode with projected inflation.

We take into account several components of pay: basic pay, BAQ, BAS, VHA, ACIP, ACP, tax advantage, and retirement benefits.

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[1]The median marriage age, obtained from the Vital Statistics, is 26.

[2]The data set for ongoing research on Officer Pipeline issues was created by Rebecca Kilburn, RAND Corporation.

Basic pay constitutes a large component of a pilot's monthly cash compensation. Service members receive basic pay as a function of YOS, rank, and year.

The military also provides in-kind transfers or services (or a cash equivalent) to service members. We follow the approach of assigning the cash equivalent of these benefits to all service members because it is difficult to project whether a service member will use the cash transfer or the in-kind benefit in the future.

Military compensation for housing is one such in-kind benefit. BAQ—which is a function of dependent status, pay grade, and year—is paid to those who are not furnished government housing. We attribute this figure to everyone because we do not know who will get government housing.

Depending on their assignment location, individuals may also receive VHA, which is designed to supplement BAQ for individuals living in areas with expensive housing. Because the VHA depends on an officer's housing location in the future, we calculate the median VHA received by pilots by year of receipt and assign this amount as expected VHA.[3] We believe that including VHA in our measure of military compensation is appropriate, even though VHA is intended as a cost-of-living adjustment because it is, on average, a positive cash transfer. Ignoring this transfer, especially in light of the fact that civilian airlines do not provide cost-of-living adjustments, may be problematic. According to an unpublished RAND study of enlisted compensation, even the sum of BAQ and VHA is likely to underestimate the value of government housing.

Another component of military compensation that may be allocated by cash payment or in-kind benefit is board, or BAS. BAS is granted when in-kind rations are not available to the service members—for example, when they live off base. BAS is a function of rank and year. As with BAQ, we assign BAS to all service members assuming that the value of in-kind rations is equivalent to BAS.

Because BAQ, BAS, and VHA are not taxed, an implicit part of military compensation is the tax advantage. We calculate the additional before-tax amount an individual would have to be given to be indifferent between the benefit being taxable and non-taxable. This calculation allows for the possibility

[3]For the Air Force, the median VHA received by aviators is likely to be lower than the median VHA received by all officers because aviation bases tend to be in areas with less expensive housing. For this and other related reasons, the median VHA received by aviators is likely to be the best predictor of the VHA received by an aviator. Therefore, it is important to use a sample of aviators to calculate expected VHA. VHA varies by rank; however, our sample medians of VHA by rank were somewhat unreasonable, possibly due to our not having a large sample. Therefore, we use median VHA, averaged over officer ranks Grades O3 to O5 within the service of the service member. Because the difference between the VHA for O3 and O5 is not large in most locations, the fact that we use median VHA over officer rank is unlikely to be problematic.

that the additional before-tax payment might move the individual into a higher tax bracket. The tax advantage is a function of marital status, total pay, taxable pay, and year. We use tax tables from 1983 to 1996 to check the tax bracket, personal exemption, and deduction based on the total pay, and thereby calculate the tax advantage.

We make several assumptions about the expectations of ACIP. Unlike most other components of pay that are adjusted every year, ACIP rates are nominally fixed over time, and are periodically reset to account for increases in the cost of living that have accumulated since the last adjustment.

ACIP rates were increased in 1974, 1981, 1990, and 1998. In each case, it appears as though the adjustment resets the real value of ACIP. Therefore, we assume that a continuation of this fairly regular restoration of the real value of ACIP is what individuals expect. We assume that individuals expect ACIP values to be reset after a fixed length of time, where that length of time is the average of the prior adjustment periods. Therefore, cohorts after 1981 were postulated to have expected an adjustment in 1988. We further assume that individuals are informed of an impending adjustment the year prior to the adjustment;[4] therefore, in 1987 for example, expectations were revised so that individuals would expect ACIP to adjust in 1989.

One concern is that pilots will stop receiving ACIP before YOS 20, possibly because they no longer meet their gates.[5] However, using our pay data, we have confirmed that the vast majority of pilots continue receiving ACIP through YOS 20.

The calculation of expected ACP is more straightforward. Because pilots enter contracts for specific nominal yearly amounts, we assume that these installments erode with expected inflation over time. Therefore, a $12,000 ACP installment in YOS 14 is worth less than a $12,000 ACP installment in YOS 10. After 1991, the Air Force allowed pilots to receive 50 percent of their total ACP contract up front in a lump sum. The Navy also has similar provisions. The remaining ACP payments are then paid out annually until YOS 14. Because the value of this lump-sum provision is always greater than equal annual installments, we calculate the ACP payments assuming that an individual will avail himself of the lump-sum option if it is offered.

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[4]This assumption is consistent with the legislative lags that typically accompany pay increases.

[5]The term "meet their gates" refers to pilots satisfying the requirements to maintain their ACIP.

All Air Force airplane pilots are eligible for ACP; however, the Navy and Marine Corps have changed the communities that are eligible for ACP several times over the years. The Navy and Marine Corps have also occasionally changed the available ACP contract length and, as a result, the annual ACP dollar installment associated with the contracts has changed.

To determine which pilots are eligible for ACP in the Navy and Marine Corps, we matched the service occupation codes on the Perstempo file to the list of eligible pilots and their ACP entitlements that were obtained from the services. Note that we must use service occupation codes because the DoD occupation codes do not provide enough detail to allow us to match eligibility to aircraft type. One problem with this assignment process is that we do not know the exact year that a pilot makes his decision to stay or leave; therefore, we attribute the ACP eligibility criteria in effect in the decision year to each pilot. However, if the pilot were to make his decision a year later or earlier, different rules would apply. As a result, there is considerable noise in the ACP assignment process.

Another issue in the assignment of ACP and AOCP is that for several years the Navy offered contracts of multiple lengths. We used our pay data to empirically verify that, in fact, most pilots chose a contract of a particular length and we then assigned the value of this "most popular" contract to all pilots making a decision to stay in the military.

The calculation of retirement benefits is quite complex given that the rules and regulations regarding these benefits have changed several times in the 1980s. For cohorts earlier than September 8, 1980, monthly retirement benefits are calculated based on final monthly basic pay and YOS.[6] For cohorts between September 8, 1980, and July 31, 1986, monthly retirement benefits are calculated based on the average of the highest 36 months of basic pay and YOS. For cohorts between 1986 and 1989, retirement benefits are equal to the average of the highest 36 months of basic pay x (2.5 percent x YOS - 10) up to the age of 62. After 62, the penalty for retiring earlier than YOS 30 ceases, and the monthly benefits equal the average of the highest 36 months of basic pay x (2.5 percent x YOS).[7]

In addition, the benefit's value is eroded 1 percent every period after retirement, with a one-time catch up at age 62.[8] Depending on the cohort of the military member, we calculate the appropriate monthly retirement benefit. The stream of

[6]The actual formula used is: final monthly basic pay x 2.5% x YOS.

[7]We assume that all service members retire at YOS 20 and we calculate retirement benefits on the basis of that assumption.

[8]For further details, see U.S. Department of Defense (1996), page 529.

retirement benefits is then multiplied by the probability of survival.[9] To summarize, retirement benefits are a function of basic pay (either final basic pay or the average of the highest 36 months of basic pay), cohort year, age, and survival probabilities.

Note that medical benefits are not included in this calculation. We assume that the medical benefits provided by the military are equal in value to those provided by the civilian airlines. Other benefits that we do not include in this study are, for example, paid vacations and life insurance plans. We assume that civilian jobs provide similar benefits.

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[9]Death rates are obtained from the actuarial tables published by the Department of Defense (U.S. Department of Defense, September 30, 1993).

D. Construction of Alternative Specification Civilian Pay Profiles

Data from 1985 through 1998 on salaries and retirement benefits offered by civilian airlines, and hiring rates by major airlines, were provided by Air, Inc., an organization that offers assistance to individuals who are interested in obtaining a position as a civilian airline pilot.

Earnings Data

The commercial airline salary data provided to us by Air, Inc. vary over the years. For some years, we have information on both the "probable" position a pilot will hold at different stages of his or her career and the payment rate associated with the probable position. In other years, we have only salary rates for some positions. In yet other years, we have information on the full range of position and aircraft possibilities by year of service, and information on the pilots' usual progression through position and aircraft by year.

In addition, for certain years we have information on payment rates and probable aircraft and position for the first through tenth years. For other years, we have information on only the first, second, and tenth years. Another issue with the data is that payment rates for the eleventh through thirtieth years of civilian service are available only for the two most recent years (1997 and 1998).

The varying levels of detailed information over the years created the need for a number of empirical adjustments and assumptions:

- First, we use information on the probable position and aircraft type from preceding and succeeding years to approximate the probable position and aircraft type in years for which the data are incomplete.
- Second, we use information on the pattern of payment changes over the first through tenth years from the years when such data are available to predict the likely payment rates in the third through ninth years when payment data are available only for the first, second, and tenth years. Specifically, we let the difference between the second-year payment rate and the tenth-year payment rate equal 100 percent, and then calculate the percentage change in all intervening years using the data with the complete ten-year profile. We

apply the percentage changes estimated using the complete profile to the payment difference between the second and tenth year of the incomplete data.

- Third, we use the 1997 profile of salaries from Years 10 through 30 to estimate the same profiles for earlier cohort years.

Our model of individuals' behavior assumes that pilots reach the end of their ADSO and decide to stay in the military until YOS 20, at which point they retire and join the civilian airlines, or they leave the military and join the civilian airlines immediately. We assume that pilots who leave at ADSO are 32 years old. (We calculated the average age at which pilots reached ADSO for each service across all cohorts. For the Marines and Navy, the ages were 31.7 and 32.2 respectively, and for the Air Force, 30.8). We assume that the pilots who leave at 20 years of service are 42 years old. Therefore, we assume pilots who leave the military at ADSO work for the civilian airlines for 28 years, until retiring at age 60, and that pilots who leave at YOS 20 work for another 18 years as civilian pilots, and then also retire at age 60.

Differences in Earnings Among Types of Carriers

Earnings vary substantially by type of carrier (major, national, or regional). By far, the major airlines offer the greatest earnings growth over time. Regional and national airlines sometimes offer slightly higher earnings in the first year or two compared with the majors, but the earnings profile (the growth in earnings over time) is relatively flat. In addition, retirement benefits in the majors are far superior to those in the national and regional airlines.

Although pilots generally prefer to work for the major airlines, jobs are not always available. Pilots not hired by the majors in any particular year may join a national or regional airline with the hopes of transferring to a major airline in a later year.[1]

Our estimates of military pilots' civilian earnings expectations take into account these possibilities. Individuals consider the probability that they will be hired by a major airline immediately and the level of salary and retirement benefits they would receive, the probability of being hired by a regional airline and the

[1]Corporate piloting is another possibility. Relatively few pilots choose this alternative, and the earnings and probability of a job as a corporate pilot are not factored into the model. In addition, we do not consider national airlines separately from regional airlines. The earnings profiles are similar, with the national airlines offering slightly more on average than regional airlines.

earnings the regional airline would offer, and the probability of switching from a regional to a major airline in a later year and the salaries offered by each.

To estimate earnings expectations, we need to know the (a) probability that an individual will be hired by a major airline, (b) if the individual is not hired by a major airline, the probability of switching to a major from a regional airline, and (c) the likely time at which the switch takes place. (We assume that a pilot not hired by a major is certain to be hired by a regional airline). We derive *(a)* based on the number of pilots hired by the majors over the period from 1983 through 1997. In terms of *(b)* and *(c)*, we assume that 75 percent of those who are hired by a regional switch to a position at a major after five years at a regional airline, and 25 percent of those hired by a regional airline stay at the airline for the remaining length of their career.

The probability of being hired by a major differs depending on whether the pilot leaves at the end of the ADSO or after YOS 20. Pilots who stay on in the service for 20 years are typically switched out of flying jobs and into non-flying jobs that develop their leadership skills for some period of time. Thus, at retirement, many pilots are not considered "current" in their skills by the major airlines. If the supply of pilots is relatively low given the demand for them, a major airline may hire a pilot whose skills are not current. But by and large, pilots who are not current begin their career at a regional airline in the hope of later switching to a major.

For pilots leaving at ADSO, this alternative specification assumes that the probability of being hired in the year when the fewest number of pilots were hired by the majors (312 in 1983) was 20 percent. It also assumes that the probability of being hired by a major in the year when hiring was the greatest (5,868 in 1989) was 85 percent.[2] We linearly interpolate probabilities for the intervening years based on the number of pilots hired in those years. For pilots leaving at YOS 20, we assume that the probability of being hired by a major airline was 5 percent in the year of the most-limited hiring and 30 percent in the best year for hiring (also linearly interpolating, based on the number of hires by majors).[3]

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[2]Because we do not have data on the total number of military pilots seeking civilian jobs, we cannot compute these probabilities, and therefore postulate them.

[3]Future work should include sensitivity analyses with different assumptions about the range of probabilities of being hired by a major, and experimentation with changes to the methodology for determining the probability. For example, one may want to make the probability of hiring above the observed range of hiring increase less than linearly.

Major/Regional Data

The data used to project earnings opportunities at major and regional airlines in our alternative specification were derived from one representative airline of each type. Because earnings do not vary substantially from carrier to carrier within these types, this simplification is unlikely to have significantly affected the results of the alternative specification. Nevertheless, future research might base these projections on an average of the earnings profiles of several airlines of each type.

Specifics on Earnings Profiles in the Majors

As already mentioned, we use the 1997 profile of salaries between Years 10 and 30 to predict the profiles for earlier cohorts. In 1997, salaries reach their maximum for each aircraft at 12 years of service. Between the tenth and twelfth year of service, pay increases only slightly--a total of 1.5 percent. Beyond the twelfth year of service, salary changes only if the aircraft a pilot flies changes.

We assume that salaries stay at the same level from Years 12 through 19, and that an aircraft change occurs at 20 years of service, when the pilot is likely to have seniority status and the opportunity to choose a higher-paying aircraft. The change in aircraft increases the monthly salary by 7 percent (which reflects the average of changes to higher-paying aircraft). The salaries of less-experienced pilots in the majors have remained relatively stable over time, while more-experienced pilots saw their salaries rise from around 1989 to 1993, and then taper slightly from 1993 to 1998.

The retirement benefits offered by the major airline vary over the years. From 1985 to 1987, the retirement benefit was an annual payment of between 30 and 60 percent of the pilot's final salary, which is considered a defined benefit or "A" fund plan. In 1988, the airline instituted a different A fund and began a defined contribution benefit, or "B" fund. In terms of the former, the benefit that pilots receive annually is 1.25 percent of the average of the final five years' salary (FAE, final average earnings) multiplied by the number of years of service. In terms of the B fund, the airline contributes 11 percent of pilots' annual earnings into a fund that accrues interest. The fund is payable as a lump sum upon retirement, which is the option most pilots take and one we assume that all pilots take. We assume that the accrual rate is about 8 percent per year.

Specifics on Earnings Profiles in the Regionals

In the regional airlines in earlier years, the maximum pay for any particular aircraft occurs at ten years of service. In later years, pay increases slightly from Year 10 to Year 15, at which point the maximum is reached. As with the major airlines, we assume that at 20 years of service pilots have enough seniority to switch aircraft and earn more money. However, the pay differences among aircraft are less variable in the regionals than in the majors: The average monthly salary increase is only 3 percent, compared with a 7 percent rise in the majors. The salaries of less-experienced pilots at the regional airlines remained fairly constant, although there was a continual slight rise in the salaries of pilots at their sixth year. Again, for more-experienced pilots (ten-plus years of service), salaries rose from 1990 to 1993 and leveled off thereafter.

Regional airlines do not typically have A or B retirement funds; some have no retirement benefits whatsoever. The regional airline that we used did not offer retirement benefits until 1987. In 1987, the airline instituted a 401(k) plan, but without employer matching. In 1991, the airline began matching 25 percent of employee contributions, up to a maximum contribution by the employee of 6 percent. We assume that employees contribute the full 6 percent, and that the 401(k) fund grew about 8 percent per year.

In our model, at ADSO a military pilot compares the expected income stream from staying in the military, retiring at YOS 20, and working for the civilian airlines for 18 years until retirement at age 60 to the expected income stream from leaving the military at ADSO and working in the civilian airlines for 28 years until retirement at age 60.

In the military option, military pay exceeds civilian pay for the first eight years past ADSO. ACP contributes to some of that difference, although, even without ACP, military pay would still far surpass initial civilian earnings.

A pilot usually begins his civilian airline career as a flight engineer, making less than $30,000 annually. However, earnings growth is rapid in the succeeding years, as pilots are promoted to first officer and then captain positions. In this example, civilian pay overtakes military pay at about nine years after ADSO, and rises steadily from there. Pay in the military option drops dramatically at 13 years post-ADSO, when the pilot moves from the military into a civilian job. The initial earnings of a pilot joining the civilian airlines at YOS 20 are lower than the initial earnings of a pilot joining the civilian airlines at ADSO. This is because military retirees are less likely to be current in their flying experience and more likely to have to work at a regional before joining a major airline.

Those leaving at 20 YOS have a valuable military pension, whereas those who leave at ADSO have no military pension at all because of the cliff-vesting feature of military retirement. Nevertheless, those who leave at ADSO have higher civilian retirement benefits than those who leave at YOS 20—"A" fund benefits are higher because final salary is higher and years of civilian service are greater, and "B" fund contributions have had more years over which to accrue interest, especially if those who leave at YOS 20 have spent a substantial portion of time in the regionals.

Despite the large difference in the net earnings over a pilot's career in the military versus the civilian option (without discounting), it is important to note that the expected value depicted does not reflect all of the uncertainty that individuals face about a civilian career path. Pilots face uncertainty about both their immediate probability of being hired by a major airline and the probability of transitioning to a major (and at what point in their career) if a major does not immediately hire them. The expected civilian pay profile assumes that the individual has some probability (which was relatively high in 1997) of being hired by a major airline, and that if not immediately hired the individual has a 75 percent chance of being hired by a major airline after five years at a regional.

The civilian earnings stream is also uncertain because strikes and furloughs can interrupt pay, and promotion paths may not progress as quickly as assumed. Promotions are affected by the stock of aircraft, retirement and attrition rates of earlier cohorts, and changes in technology and the like, and the pilot cannot be sure that the earnings of a captain will be achievable in nine or ten years. Unlike military promotions, which occur within narrowly defined windows (and which are specified in terms of years of service), promotion within major airlines is not tied to a specified length of service and can be strongly affected by economic conditions. For example, a rapidly expanding airline may promote pilots to captain in five years under ideal circumstances, whereas an economic downturn may strand pilots below the rank of captain for much longer than ten years.

Bibliography

AIR, Inc., *Airline Information and Address Directory,* 1st ed., Atlanta, 1998.

_____, *Airline Pilot Job Monthly,* February 10, 1998, p. 5.

Arguden, Yilmaz, *Personnel Management in the Military: Effects of Retirement Policies on the Retention of Personnel,* Santa Monica, Calif.: RAND Corporation, R-3342-AF, 1986.

Asch, Beth J., and John T. Warner, *A Policy Analysis of Alternative Military Retirement Systems,* Santa Monica, Calif.: RAND Corporation, MR-465-OSD, 1994.

_____, *A Theory of Military Compensation and Personnel Policy,* Santa Monica, Calif.: RAND Corporation, MR-439-OSD, 1994.

Ausink, Major John A., *The Effect of Changes in Compensation on a Pilot's Decision to Leave the Air Force,* Doctoral Thesis, Harvard University, May 1991, Ft. Belvoir, Va.: Defense Technical Information Center, AFIT/CI/CIA-91-009D.

Bookheimer, William R., *Predicting Naval Aviator Attrition Using Economic Data,* Monterey, Calif.: Naval Postgraduate School, March 1996.

Brauner, Marygail, and Daniel Relles, *The Robust Separation Projection Method for Predicting Monthly Losses of Air Force Enlisted Personnel,* Santa Monica, Calif.: RAND Corporation, N-3169-AF, 1991.

Brauner, Marygail, Kevin Lawson, William Mickelson, Joseph Adams, and Jan Chaiken, *Time Series Models for Predicting Monthly Losses of Air Force Enlisted Personnel,* Santa Monica, Calif.: RAND Corporation, N-3167-AF, 1991.

Buddin, Richard, Daniel Levy, Janet Hanley, and Donald Waldman, *Promotion Tempo and Enlisted Retention,* Santa Monica, Calif.: RAND Corporation, R-4135-FMP, 1992.

Coughlin, Matthew F., *Development of a Forecasting Model of Naval Aviator Retention Rates,* Monterey, Calif., Naval Postgraduate School, March 1996.

Cymrot, Donald, *Implementation of Aviation Continuation Pay Program,* Alexandria, Va.: Center for Naval Analyses, 1989.

Darby, Kit, *Airline Pilot Career Decisions,* 4th ed., AIR, Inc., Atlanta, 1998a, p. 73.

_____, president, Air, Inc., personal communication, 1998b.

Darby, Kit, and Dan Gradwohl, *Airline Fleet and Sim Directory,* 4th ed., Atlanta: AIR, Inc., 1997, p. ii.

Daula, Thomas, and Robert Moffitt, "Estimating Dynamic Models of Quit Behavior: The Case of Military Reenlistment," *Journal of Labor Economics,* Vol. 13, No. 3, 1995, pp. 499–523.

Fossen, T., L. M. Hanser, J. Stillion, M. N. Elliott, and S. C. Moore, *What Helps and What Hurts: How Ten Activities Affect Readiness and QOL at Three 8AF Wings,* Santa Monica, Calif.: RAND Corporation, DB-223-AF, 1997.

Fullerton, Lt. Col. Richard L., "An Empirical Assessment of United States Air Force Pilot Retention," The Mershon Center, Ohio State University, Columbus, Ohio, 1999.

Goldberg, Matthew, comment on Thomas Daula and Robert Moffitt, "Estimating a Dynamic Programming Model of Army Reenlistment Behavior," in David K. Horn, Curtis L. Gilroy, and D. Alton Smith, eds., *Military Compensation and Personnel Retention: Models and Evidence,* Alexandria, Va.: U.S. Army Research Institute for the Behavioral and Social Sciences, 1991.

Gotz, Glenn A., and John J. McCall, *A Dynamic Retention Model for Air Force Officers: Theory and Estimates,* Santa Monica, Calif.: RAND Corporation, R-3028-AF, 1984.

Heinen, William J. *USAF Pilot Retention: An Analysis of Air Force Initiatives to Improve Pilot Retention,* Master's Thesis, U.S. Army Command and General Staff College, Fort Leavenworth, Kan., 1990.

Hogan, Paul F., and Matthew Black, "Reenlistment Models: A Methodological Review" in David K. Horn, Curtis L. Gilroy, and D. Alton Smith, eds., *Military Compensation and Personnel Retention: Models and Evidence,* Alexandria, Va.: U.S. Army Research Institute for the Behavioral and Social Sciences, 1991.

Horn, David K., Curtis L. Gilroy, and D. Alton Smith, eds., *Military Compensation and Personnel Retention: Models and Evidence,* Alexandria, Va.: U.S. Army Research Institute for the Behavioral and Social Sciences, 1991.

Hosek, J., and M. Totten, *Does Perstempo Hurt Reenlistment? The Effect of Long or Hostile Perstempo on Reenlistment*, Santa Monica, Calif.: RAND Corporation, MR-990-OSD, 1998.

Hosek, James R., and Christine E. Peterson, *Reenlistment Bonuses and Retention Behavior,* Santa Monica, Calif.: RAND Corporation, R-3199-MIL, 1985.

Hughes, Harley A., "Bailing Out," *Armed Forces Journal International,* Vol. 136, No. 2, September 1, 1998, pp. 42–46.

Jordan, Bryant, "Exodus Continues Despite Bonuses," *Air Force Times,* March 3, 1998.

Kleinman, Samuel D., and Cdr. Charles Zuhoski, *Navy Pilot Attrition: Determinants and Economic Remedies,* Alexandria, Va.: Center for Naval Analyses, CNS 1133, 1980.

Lawry, Gordon, *A Statistical Analysis of the Effects of Flight Time on Naval Aviator Retention,* thesis, Monterey, Calif.: Naval Postgraduate School, 1993.

Levy, Claire M., *The Civilian Airline Industry's Role in Military Pilot Retention: Beggarman or Thief?,* Santa Monica, Calif.: RAND Corporation, DB-118-OSD, 1995.

Maze, Rick, "Ready or Not?," *Army Times,* March 9, 1998, p. A3.

Middlebrook, Capt. R., U.S. Marine Corp, personal communication, 1998.

North, James H., Dan D. Goldhaber, Kletus S. Lawler, and Jeremy N. Suess, *Successful Officer Careers: Analysis of Augmentation, Promotion, and Voluntary Continuation,* Alexandria, Va.: Center for Naval Analyses, CRM 95-55, 1995.

Office of Aviation Policy and Plans, Federal Aviation Administration, *FAA Aviation Forecasts, Fiscal Years 1998-2009,* Washington, D.C., FAA-APO-98-1, 1998.

Riebel, Daniel, Jr., *An Analysis of the Effects of Increases in Aviation Bonuses on the Retention of Naval Aviators Using An Annualized Cost of Leaving (ACOL) Approach,* Monterey, Calif.: Naval Postgraduate School, March 1996.

Roeder, Maj. Joseph, U.S. Air Force, personal communication, 1998.

Rostker, Bernard, Harry Thie, James Lacy, Jennifer Kawata, and Susanna Purnell, *The Defense Officer Personnel Management Act of 1980: A Retrospective Assessment,* Santa Monica, Calif.: RAND Corporation, R-4246-FMP, 1993.

Rydell, Peter, and Kevin Lawson, *Short-Term Aggregate Model for Projecting Air Force Enlisted Personnel (SAM),* Santa Monica, Calif.: RAND Corporation, N-3166-AF, 1991.

Smith, Alton, Stephen Sylvester, and Christine Villa, "Army Reenlistment Models," in David K. Horn, Curtis L. Gilroy, and D. Alton Smith, eds., *Military Compensation and Personnel Retention: Models and Evidence,* Alexandria, Va.: U.S. Army Research Institute for the Behavioral and Social Sciences, 1991.

Stone, Brice, Vince Wiggins, Kathryn Turner, and Larry Looper, *Air Force Pilot Retention: Evaluating the Results of Alternative Models,* Human Resources Directorate, Manpower and Personnel Division, Armstrong Laboratory, Brooks AFB, Tex., May 29, 1997.

Thie, Harry J., William W. Taylor, and Claire M. Levy, et al., *A Critical Assessment of Total Force Pilot Requirements, Management, and Training,* Santa Monica, Calif.: RAND Corporation, DB-121-OSD, 1994.

_____, *Total Force Pilot Requirements and Management,* Santa Monica, Calif.: RAND Corporation, MR-646-OSD, 1995.

Tice, Jim, "Apache Pilots Leaving in Droves," *Army Times,* February 2, 1998, p. A3.

Turner, Russell S., *The Impact of the Military Drawdown on USN Aviator Retention Rates,* Monterey, Calif.: Naval Postgraduate School, March 1995.

U.S. Congressional Budget Office, *Alternative Compensation Plans for Improving Retention of Air Force Pilots,* Washington, D.C., 1989.

U. S. Department of Defense, Office of the Secretary of Defense, *Military Compensation Background Papers: Compensation Elements and Related Manpower Cost Items, Their Purposes and Legislative Backgrounds,* Washington, D.C.: U.S. Government Printing Office, 1996.

U.S. Department of Defense, Office of the Secretary of Defense, Office of the Actuary, *Valuation of the Military Retirement System,* Arlington, Va., September 30, 1993.

U.S. General Accounting Office, *DOD Aviator Positions: Training Requirements and Incentive Pay Could Be Reduced,* Washington, D.C., GAO/NSIAD-97-60, 1997.

Wardynski, E. Casey, *Military Compensation in the Age of Two-Income Households: Adding Spouses' Earnings to the Compensation Policy Mix,* doctoral dissertation, Santa Monica, Calif.: RAND Graduate School, 2000.