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The Effect of Compensation on Aviator Retention

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Background

Recent reviews of the military compensation system have all stressed the need for flexible, targeted compensation tools. These tools provide the services with the discretionary authority to carry out their strategies and quickly address emerging problems and issues. The aviation community has two pays that are explicitly designed for this purpose: Aviation Career Incentive Pay (ACIP) and Aviation Career Continuation Pay (ACCP). In principle, these tools provide the services with the capability to offer additional compensation to aviators in order to meet their requirements.

The objective of this study is to examine the empirical relationship between financial incentives and retention of naval aviation officers. If the expected level of aviator retention is not aligned with the Navy's requirements for aviators, these estimates determine the extent to which the Navy could adjust pay to achieve this alignment. We also estimate the empirical relationship between civilian labor market conditions and aviator retention. In principle, changes in compensation can offset any deleterious effect of favorable employment opportunities outside the Navy. This research memorandum summarizes the results of our analysis.

Methodology

We estimate the relationship between relative military compensation and naval officer retention using the Annualized Cost of Leaving (ACOL) framework. Given the disparate job descriptions and civilian earnings opportunities of pilots and Naval Flight Officers (NFOs), we distinguish between these two groups in our analysis. The measure of retention on which we focus is the continuation rate of aviators who complete their minimum service requirement within the year.

We use three primary sources of data in our analysis. The first is the Officer Master File (OMF) data, which we use to provide information on retention decisions over the FY84 to FY05 time period and on the demographic characteristics of aviators who make these decisions. The second source of data provides information on civilian earnings opportunities at major U.S. airlines, as well as the number of annual hires within this industry. Finally, the Aviation Officer Community Manager provided us with historical data on ACIP and ACCP and with a summary of changes to these programs over time.

Findings

Our analysis suggests that increases in relative military pay do lead to increases in pilot retention. Specifically, our results indicate that a 1-percent increase in basic pay leads to a 0.55-percent increase in pilot retention. This estimate can be used to predict changes in pilot retention due to congressional adjustments to basic pay. Furthermore, a $1,000-per-year increase in ACCP is associated with an increase in the retention rate of 0.6 percentage point. This estimate can be used to adjust aviator pay in order to align pilot retention with requirements. In both cases, the data suggest that responsiveness to compensation is highest for propeller pilots and lowest for helicopter pilots.

In contrast, we do not find any statistical evidence supporting a positive relationship between relative military compensation and NFO retention. We suspect this is due to the relatively little variation in NFO retention over the time period on which we focus, rather than the actual absence of a behavioral response to financial incentives.

We also observe a relationship between civilian labor market conditions and pilot retention. Specifically, a 1,000-person increase in total additional hires by major airlines would reduce jet and propeller pilot retention by 2 to 3 percentage points. In principle, then, increases in ACCP can offset the deleterious effect of a healthy civilian airline industry on pilot retention. For NFOs, we do not find any statistical evidence supporting a relationship between civilian labor market conditions and retention.

Implications and recommendations

These estimates provide only some of the information that policy-makers need when considering an adjustment to aviator pay. Setting the appropriate level of pay, from a cost-effectiveness standpoint, depends on three factors: (1) the Navy's requirement for aviators, (2) the expected level of aviator retention, and (3) the responsiveness of aviators to changes in financial compensation. The intent of the Director, Military Personnel Plans and Policy Division (N13) is to combine our empirical results with a model of aviator retention developed jointly by SAG Corporation and The Lewin Group. This combination of modeling efforts will help the Navy assess whether aviator pay is set appropriately, as well as help determine whether the Navy has the statutory authority to offer a sufficient level of ACCP.

The lack of a statistical relationship between pay and NFO retention complicates this assessment. Policy-makers may choose to use older estimates found in the literature, or they may choose to use our pilot estimates as a proxy of the responsiveness of NFOs to changes in compensation. Further analysis is needed to assess the behavioral response of NFOs to any subsequent changes in compensation.

Finally, we note that the evolution of ACCP—from a pay targeted to communities with shortages to an across-the-board pay for all aviators—is not consistent with the Department of the Navy's guiding principles for a compensation strategy. ACCP, while still targeted to aviators, is no longer targeted to address specific manning problems within the naval aviation community. Paying any additional ACCP to communities without manning shortages generates additional costs without any measurable benefit. We recommend that the Navy revisit how it compensates aviators, to ensure that any increases in ACCP are explicitly tied to manning shortages in specific communities.

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Introduction

Recent reviews of the military compensation system have all stressed the need for flexible, targeted compensation tools [1, 2, 3]. The services must be able to quickly and effectively change compensation policies to respond to both changing market conditions and changing requirements. Flexible and targeted compensation tools provide the services with the discretionary authority to carry out their strategies and quickly address emerging problems and issues. Furthermore, it is widely acknowledged that targeted compensation can provide cost-effective solutions to address service-specific needs. In contrast, across-the-board compensation tools can usually solve the same manning challenges, but at significantly greater cost.

The aviation community has two pays that are explicitly designed to “increase the ability of the uniformed services to attract and retain officer volunteers in a military aviation career”: Aviation Career Incentive Pay (ACIP) and Aviation Career Continuation Pay (ACCP) [4]. In principle, these tools provide the services with the capability to offer additional compensation to aviators in order to meet their requirements.

The recent report of the Defense Advisory Committee on Military Compensation (DACMC), however, notes that the flexibility of these two pays is, in practice, fairly limited [3]. Furthermore, the DACMC concludes that “the budget for these pays is subject neither to continuous scrutiny nor analysis of competing staffing needs” [3]. Therefore, the issue of whether the current levels of ACIP/ACCP are appropriate for the Navy is an empirical question.

Setting the appropriate level of pay, from a cost-effectiveness standpoint, depends on three factors: (1) the Navy’s requirements for aviators, (2) the expected level of aviator retention, and (3) the responsiveness of aviators to changes in financial compensation. The expected level of aviator retention depends not only on pay but also on additional factors. Consequently, future projections of changes in the environment faced by aviators can also inform the structuring of aviator pay.

For these reasons, the Director, Military Personnel Plans and Policy Division (N13) requested that CNA examine the empirical relationship between financial incentives and retention of aviation officers. We also estimate the empirical relationship between civilian labor market conditions and aviator retention. This research memorandum summarizes the results of our analysis.

N13's intent is to combine these empirical results with a model of aviator retention developed jointly by SAG Corporation and The Lewin Group. This combination of modeling efforts will help the Navy assess whether aviator pay is set appropriately, as well as help determine whether the Navy has the statutory authority to offer a sufficient level of ACCP.

We begin with a description of the data used in our analysis, followed by a discussion of the methodology we use to develop a model of aviator retention. The section that follows contains the bulk of our empirical results; we focus on the relationship between changes in financial incentives and retention officers, and on the more general impact of changes in the economic environment faced by aviators. Next, we offer some brief thoughts on the use of these estimates to adjust aviator pay. The final section presents our general conclusions.

Data and methodology

Our data on the retention decisions of aviators, as well as the characteristics of the people who make these decisions, come from CNA's holdings of the Officer Master File (OMF) data. For each year from FY84 to FY05, we extract information for each aviator on active duty at the beginning of the fiscal year.[1]

Within this population of aviators, we distinguish between pilots and Naval Flight Officers (NFOs), given the disparate job descriptions and civilian earnings opportunities of these two groups. For similar reasons, we also disaggregate pilots further into helicopter, jet, and propeller pilots and NFOs further into jet and propeller NFOs.[2]

Our baseline measure of retention indicates whether an aviator is still on active duty and in the same community at the end of the fiscal year. The proportion of aviators who remain at the end of the fiscal year is referred to as the *continuation rate*. Note, however, that we are measuring retention within each community and not necessarily in the Navy[3]—an important distinction when interpreting the results of our analysis.

1. Our data indicate whether a person is on active duty on the last day of the previous fiscal year. We assume that all those on active duty on the last day of the previous fiscal year are still on active duty on the first day of the new fiscal year. This assumption is for convenience when describing our results and does not affect our results.
2. This distinction depends on the type of airframe on which a person was trained during flight training.
3. Clearly, people that separate from the Navy are no longer in their community at the end of the year. However, the reverse is not always true.

Methodology

For the majority of our analysis, we make use of the Annualized Cost of Leaving (ACOL) model to estimate the relationship between compensation and aviator retention.[4] In an ACOL model, "pay" is the discounted difference between expected military compensation (if a person chooses to remain in the Navy) and expected civilian compensation (if he or she chooses to separate from the Navy). This methodology assumes that a servicemember combines all elements of military compensation into a single measure of remuneration and compares it with civilian earnings opportunities when deciding whether to remain in the Navy. Thus, the model can be used to examine the effect of any policy that can be expressed in financial terms.[5]

While the theory is straightforward, several decisions are necessary to estimate an ACOL model. Reference [8] separates these decisions into four major categories: choice of sample, defining retention, modeling compensation, and the choice of independent variables. Having defined our sample above, we focus the remainder of this section on the other three categories of decisions.

Defining retention

To examine the relationship between relative compensation and voluntary retention behavior, we follow [8] and focus on the first, non-obligated decision of the aviator. Here, we briefly describe data on retention of both pilots and NFOs, with an emphasis on the point at which these aviators make their "first, non-obligated decision."

Pilots

Figure 1 shows data on retention of pilots in the time period on which our analysis focuses; for illustrative purposes, figure 1 displays data for FY85, FY95, and FY05. These data are represented as *cumulative continuation rates*, defined for each year of service as the probability that a

4. See [5] for a summary of the ACOL framework.

5. Seminal papers include [6] and [7].

person completing undergraduate flight training will remain in the Navy through that year of service [9]. These data are not continuation rates for any single accession cohort, but rather are estimates for *synthetic cohorts*. Synthetic cohorts combine data from all accession cohorts to simulate what retention behavior would be if a cohort were to behave like individuals in that fiscal year. For example, the FY05 data show that, if an accession cohort displayed the retention behavior we observe from all cohorts in FY05, 89 percent of pilots would remain through the eighth year of service; similarly, 29 percent would remain past the 20-year point.

Figure 1. Cumulative continuation rates of pilots—FY85, FY95, and FY05

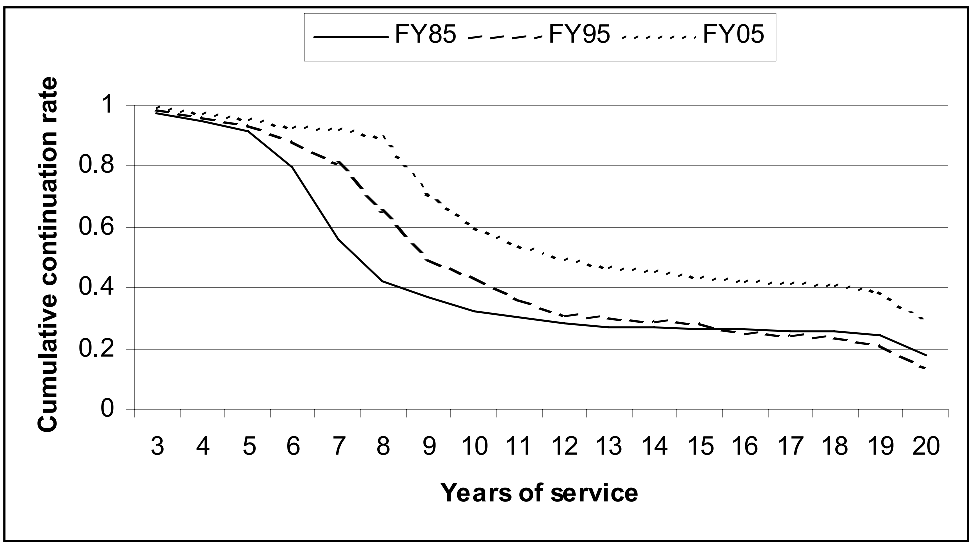


Figure 1 shows that there have been some substantive changes in pilot retention over the past 20 years. For example, in FY85 and FY95, pilots that remain through the twelfth year of service have similar retention rates throughout the remainder of their careers. However, the FY95 continuation rates show higher retention than in FY85 during the early part of one's career. For example, cumulative continuation rates through the seventh year of service are about 81 percent in FY95, in contrast with about 56 percent in FY85. In contrast, FY05 cumulative continuation rates are notably higher throughout a pilot's career than in these earlier years.

The continuation rate profiles in figure 1 describe the entire retention patterns of pilots through their first 20 years of service. From a policy perspective, however, a specific portion of these profiles is of primary interest. Those who complete undergraduate flight training incur an additional active duty obligation in exchange for additional training. This additional obligation, the *minimum service requirement* (MSR), is currently 8 years for pilots and 6 years for NFOs.

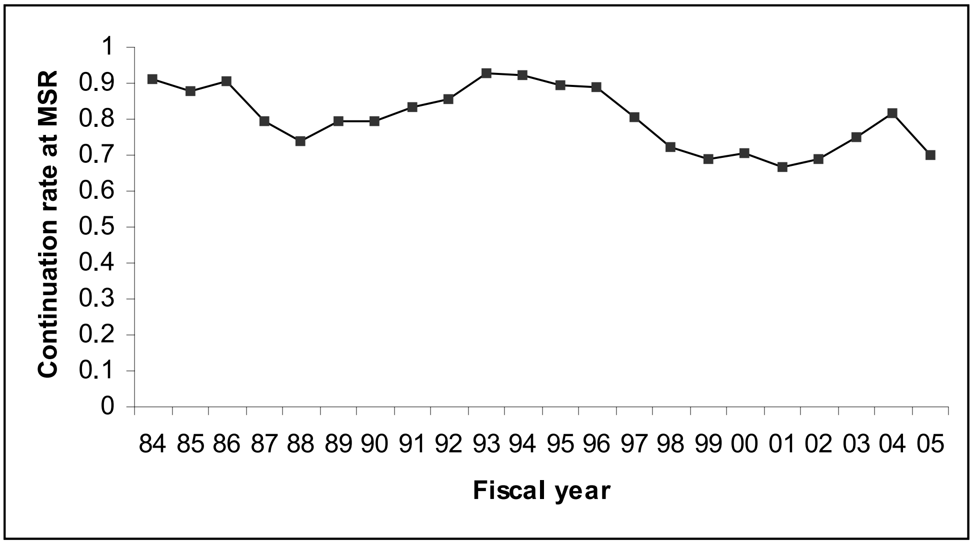
Completion of this MSR, then, represents the first opportunity for aviators to make a formal decision to remain in or separate from the Navy.[6] Given the importance of this decision, policy-makers target ACCP to aviators who have reached this point. Consequently, much of our analysis focuses on the retention decision at the completion of this MSR.

Figure 2 displays, for each fiscal year, the continuation rate of pilots who complete their MSRs within the year.[7] The data in figures 1 and 2 tell very different stories about retention. In general, continuation rates appear to improve in figure 1 over the time period. As figure 2 shows, continuation rates for pilots at the completion of their MSRs fluctuate significantly over time. Continuation rates declined from FY84 to FY88, and then increased through FY93, reaching their highest point over the time period (93 percent). These continuation rates began to decline through the rest of the 1990s, mostly notably from FY96 to FY97 percent (from 89 to 80 percent) and then again from FY97 to FY98 (from 80 to 72 percent). Finally, the continuation rates of pilots who complete their MSRs began to rise through the beginning of the current decade, although declines in FY05 erased most of the improvements in recent years.

6. A small number of aviators do attrite before completion of their MSRs. However, it is at the expiration of the active duty service obligation that aviators first make an "unconstrained" decision about their careers.

7. We see the same general trends over the time period when looking at helicopter, jet, and propeller pilots separately.

Figure 2. Continuation rates of pilots who complete their minimum service requirements



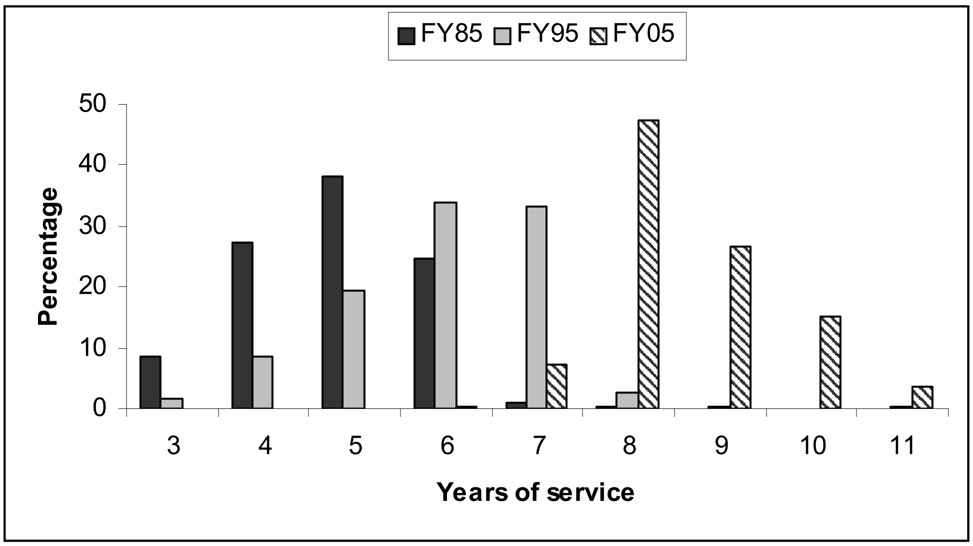
A factor that complicates this comparison is that the length of a pilot's MSR has lengthened over this same time period. Figure 3 displays data on the years of service for pilots approaching completion of their MSRs. For illustrative purposes, figure 3 again displays data for FY85, FY95, and FY05. For each fiscal year, the bars represent the percentage of pilots at each year of service who will complete their MSRs within the next 12 months. Note that these are distributions of pilots making decision within a fiscal year, *not* a representation of the length of MSR for those who access in that fiscal year.[8]

As figure 3 shows, there has been a significant increase in MSR length for pilots. In FY85, for example, 90 percent of pilots approaching completion of their MSRs had between 4 and 6 years of service; by FY95, this had shrunk to about 62 percent, with a monotonic increase

8. Because of how these data are defined, the relationship between years of service and minimum service requirement is not exact. For example, members with six years of service who will complete their MSRs in the next 12 months could have either 6 or 7 years of service at the completion of their MSRs. However, the changes in these distributions over time provide a representation of how the MSR has changed for pilots.

in the percentage of pilots at each year of service within this range. In contrast, less than 1 percent of pilots in FY05 saw their MSRs expire this early in their Navy careers; about 75 percent of pilots approaching completion of their MSRs had 8 or 9 years of service.

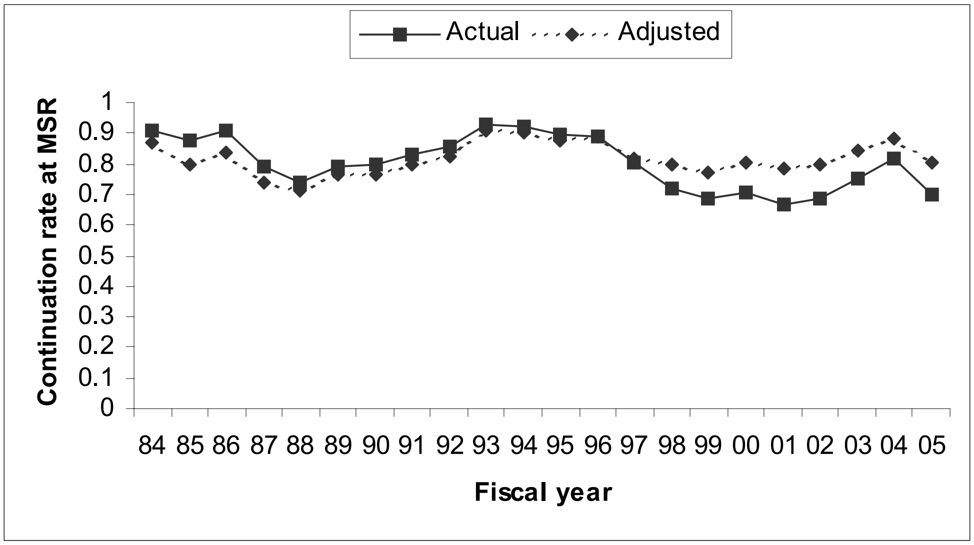
Figure 3. Years of service of pilots who will complete their minimum service requirements within the next 12 months—FY85, FY95, and FY05



Given these changes in the MSR over time, figure 4 displays adjusted continuation rates of pilots who complete their minimum service requirements. These continuation rates are "adjusted" to account for differences in the MSR over time; specifically, these estimates assume that pilots making retention decisions have the same distribution of MSR lengths in each fiscal year.[9] For comparison, figure 4 also replicates the actual continuation rates presented in figure 2.

9. We estimate predicted continuation rates using logistic regression, with dummy variables for each length of service and fiscal year. Using these estimates, we then estimate the marginal effect for each fiscal year dummy. This procedure holds the distribution of MSR lengths constant for each year during the time period.

Figure 4. Continuation rates of pilots who complete their minimum service requirements—adjusted for differences in length of MSR over time



As figure 4 shows, these adjusted continuation rates track actual continuation rates fairly closely over time. The one notable difference is that most of the decline in actual continuation rates during the 1990s can be explained by changes in the length of pilots' minimum service requirements.[10] In other words, the observed change in continuation rates is mostly due to changes in the length of the MSR, and not underlying changes in the retention behavior of pilots.

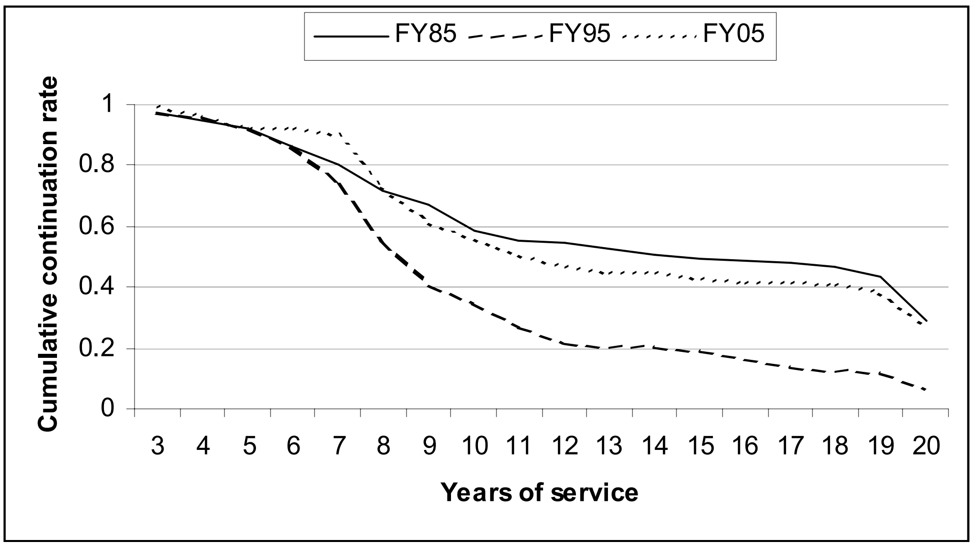
NFOs

Figure 5 presents data on the cumulative continuation rates of NFOs in the time period of our analysis; for illustrative purposes, figure 5 displays data for FY85, FY95, and FY05. As the comparable data for

10. Adjusted continuation rates are higher than actual continuation rates over this time period because of two factors. First, our logistic regression predicts a negative relationship between length of MSR and continuation rates. Second, actual MSR lengths are longer than average over this time period. We do not have a compelling explanation for the negative relationship between length of MSR and continuation rates.

pilots (figure 1) showed, figure 5 shows that there have been some substantive changes in NFO retention over the past 20 years. The changes over time for NFOs, however, are very different from those for pilots.

Figure 5. Cumulative continuation rates of NFOs—FY85, FY95, and FY05



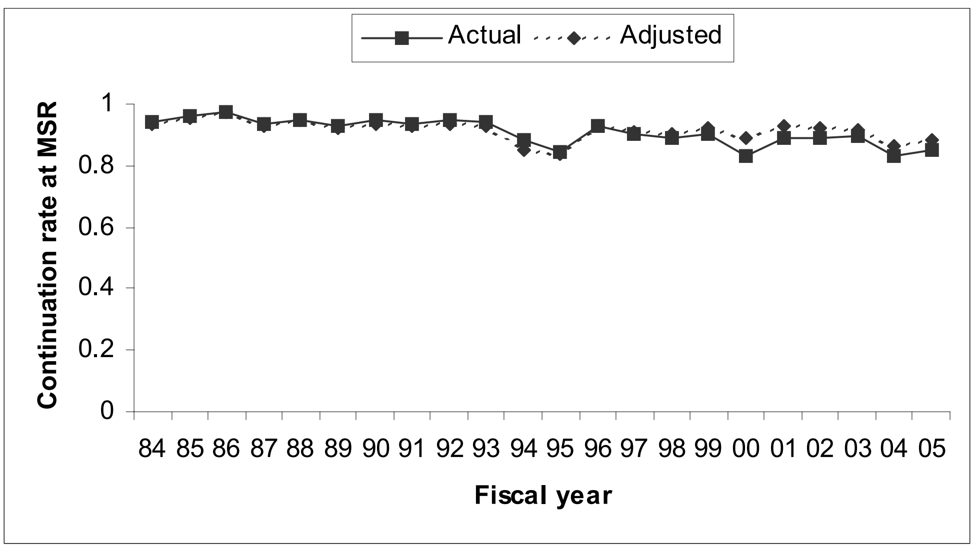
Continuation rates in FY85 and FY05 are fairly similar for NFOs, while retention in FY95 was significantly lower than at either of these two endpoints. In general, an examination of cumulative continuation rates over this 20-year period reveals a “U-shaped” pattern in retention: continuation rates fell from FY84 to FY95, and then rose from FY95 to FY05. The result was that, by FY05, retention rates had returned to similar levels as in the earliest fiscal years on which we focus.

Figure 6 displays, for each fiscal year, the continuation rate of NFOs who complete their minimum service requirements within the year.[11]

11. We see the same general trends over the time period when looking at jet and propeller NFOs separately.

Figure 6 also displays adjusted continuation rates to account for differences in the MSRs of NFOs over time.[12] As the data in figure 6 show, retention of NFOs at the completion of their MSRs is relatively unchanged over the time period on which we focus, with the exception of declines in FY94 and FY95. Furthermore, some of the declines after FY98 can be explained by changes in the length of NFOs' minimum service requirements. It is also worth noting that, in general, NFO retention is higher than that of pilots.

Figure 6. Continuation rates of NFOs who complete their minimum service requirements—adjusted for differences in length of MSR over time



Military compensation

Military compensation consists of a wide range of different components. Some of these apply to all Navy officers (e.g., basic pay), whereas others are infrequent and limited to certain types of servicemembers (e.g., family separation allowance). Most of the empirical

12. While the MSR for NFOs is shorter than for pilots, we see the same general increase in length of the MSR for both pilots and NFOs.

literature has focused on the three largest components of military pay: basic pay, allowances for subsistence and housing, and retirement pay [5]. In addition, measures of military pay used in retention models include the financial incentives associated with that decision since these are often the policy tools being examined.

Why not use actual compensation received?

Although it is tempting to use actual compensation received, it is not appropriate for two reasons. First, for aviators eligible to receive ACCP, only those who actually choose to remain in the Navy receive the bonus. For those who separate at the expiration of their MSRs, actual compensation received will not reflect any ACCP. However, ACCP was presumably a factor in the aviator's decision-making process; in fact, aviators not to stay in the Navy *despite* the availability of ACCP. This is the type of response to compensation that we wish to estimate, yet using actual compensation received precludes estimation of this effect.

Second, housing and subsistence are often provided as in-kind benefits, rather than as an allowance. As an example, servicemembers living in onbase housing do not receive a housing allowance, yet the housing they are provided has value. Again, the use of actual financial compensation received by an aviator would not reflect the true value of benefits received in kind.

Basic pay, housing and subsistence allowances

Historical data on basic pay are readily available from the Defense Finance and Accounting Service (DFAS), and we use these data for our measure of basic pay. Since basic pay is completely determined by paygrade and length of service (LOS), the use of the basic pay tables to estimate *current* levels for each aviator is very straightforward.

Historical data on housing and subsistence allowances are also available from DFAS. For each fiscal year, there is a single Basic Allowance for Subsistence (BAS) for all commissioned officers. In contrast, the Basic Allowance for Housing (BAH) varies by paygrade, dependency status, and geographic location. Unfortunately, historical data on the full housing allowance are only available from FY99 to the present.

Consequently, we use a combination of BAH-II and the Basic Allowance for Quarters (BAQ) as a proxy for the allowance available to aviators. These allowances do not vary by geographic location and are based on the national average of housing prices; year-to-year variation reflects the percentage growth in the national average of these prices.[13] Since the majority of officers have dependents, we use the with-dependents rates in our measure of military compensation.

Recognizing that housing and subsistence are often provided as in-kind benefits, we assign the appropriate values of BAS and BAH to each aviator in our data. Our implicit assumption, then, is that the value of in-kind benefits is equal to that of the allowances. Though this is probably not always correct, we are hard-pressed to think of a more acceptable alternative, and we follow most of the literature in this respect.

Expectations of future promotion

Since basic pay and BAH both depend on paygrade, expected future compensation depends on aviators' expectations about their future promotion possibilities.[14] To estimate expected compensation, then, it is first necessary to model the career path an aviator would expect to follow if he chose to remain in the Navy.

The Defense Officer Personnel Management Act (DOPMA) of 1980 provides a comprehensive system for career progression for the majority of officers [10]. For each officer community, promotions are governed by time-in-grade requirements (the minimum amount of time a person must spend in a paygrade before being eligible for promotion) and promotion opportunities (the percentage of a cohort that will be promoted). The time-in-grade requirements define promotion "zones," the years of service at which a cohort will be considered for promotion. While a small number of officers within a cohort

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13. The advantage of using BAH-II instead of the full BAH is that it ensures that differences in compensation are *not* due to differences in the location at which an aviator is stationed.

14. Basic pay also depends on years of service; however, future projections of years of service are trivial to calculate.

are promoted before and after these promotion points,[15] the officer promotion process is much more regimented than the rules governing promotion of enlisted personnel.[16]

Table 1 lists, by paygrade, the years of service at which most aviators in our data are promoted to that grade and the number of years that most aviators spend in that grade before promotion. For example, as table 1 shows, most aviators in the O-1 paygrade spend 2 years in that grade before promotion to O-2. During their second year of service, most aviators are promoted to O-2 and spend 2 more years as O-2s before O-3s. Aviators spend significantly longer amounts of time in the O-3, O-4, and O-5 paygrades before eventually being promoted.

Table 1. Promotion points and time spent in grade for aviators

Paygrade	Median years of service at promotion	Median time-in-grade before promotion to next grade (years)
O-1	n/a	2
O-2	2	2
O-3	4	6
O-4	10	5
O-5	15	6
O-6	21	n/a

We use the data in table 1 in constructing the expected career path of aviators in our data. In doing so, "time spent in grade" is a binding constraint that results in some variation in expected promotions. For example, if a person has spent less than 6 years as an O-3 before reaching the tenth year of service, we do *not* assume that he or she immediately promotes to O-4. Rather, we predict that this person promotes to O-4 as soon as he or she has spent 6 years as an O-3. This

15. Early promotions are for officers who have distinguished themselves from their cohort; in addition, a small number of officers that are "passed over" for promotion are eventually promoted [10].

16. Reference [11] contains an outline of the DoD directives and instructions and Navy policies that implement the Navy's approach to officer personnel management. In particular, see tables 5 through 8 of [11].

results in some variation since there are people who have actually promoted to a grade before the years of service listed in table 1.

These expected career paths do not match actual profiles in two respects. First, people who are slower (faster) to promote to a paygrade are likely to promote even slower (faster) to the next paygrade. A more accurate estimate would incorporate this information into an explicit model of promotion. We do not attempt to do this because slow (fast) promoters probably have below- (above-) average civilian earnings opportunities that we are not able to identify. Incorporating this information into estimates of military earnings, without a commensurate correction of our estimates of civilian earnings, will result in biased estimates of relative military compensation.[17]

A second, related way in which these expected career paths differ from actual profiles is in the implicit assumption that a person will promote *with certainty* to a paygrade at the promotion points identified in table 1. Selection rates for promotion at each grade are less than 100 percent; not everyone in a given paygrade will be promoted to the next grade.[18] Our implicit assumption, then, is that aviators deciding whether to remain in the Navy until a given year of service assume that, if they choose to remain until that point, they will have achieved the career milestones that allow them to remain in the Navy.

We use the basic pay tables, as well as the BAH and BAS rates, in effect at the time of the aviator's retention decision to construct estimates of future compensation. By doing so, we are assuming that servicemembers expect future changes to these components of compensation to keep pace with inflation. While actual changes to the basic pay

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17. Reference [12], for example, demonstrates that the specification of individual promotion opportunities dramatically reduces estimates of the responsiveness to compensation of enlisted personnel. However, this could be due to the correlations of promotion opportunities, individual quality, and civilian earnings opportunities.

18. As [13] shows, some people who initially fail to be selected for promotion are eventually promoted. However, many are not promoted at all, and those who are promoted do so at a slower pace than their cohort. See, in particular, table 9 of [13].

tables usually differ from the rate of inflation, our assumption is a reasonable (and more tractable) alternative to modeling aviators' expectations about how Congress will change compensation in the future.

ACIP and ACCP

ACIP

The aviation community has two pays that are specifically targeted to aviators: Aviation Career Incentive Pay (ACIP) and Aviation Career Continuation Pay (ACCP). ACIP was established by the Aviation Career Incentive Act of 1974 and was explicitly intended to serve as both a recruiting and a retention incentive.[19] ACIP rates are based on a person's length of service as an aviator.

Table 2 lists the current ACIP rates at the time of this research memorandum. The years of aviation service associated with changes in ACIP have changed over time, and Congress has adjusted the levels of ACIP over time as well. However, the general patterns in table 2 are representative of the structure of ACIP since its inception. As shown, ACIP rates follow an inverted U-shaped pattern, with the highest rates targeted to retention-critical points during an aviator's career.

Table 2. Current ACIP rates

Years of aviation service	Monthly rate ($)
2 or less	125
Over 2	156
Over 3	188
Over 4	206
Over 6	650
Over 14	840
Over 22	585
Over 23	495
Over 24	385
Over 25	250

19. For a detailed discussion of the history of ACIP, see [4].

We follow our approach with future basic pay and use the ACIP rate data at the time of the aviator's retention decision to construct our estimates of future compensation.[20] This assumption is more tenuous with ACIP than with basic pay, since changes to ACIP over time are sporadic and therefore do not keep pace with inflation (e.g., ACIP rates have not changed since FY99). It is not clear, however, how often aviators expect ACIP to change.[21]

ACCP[22]

ACIP essentially establishes a permanent differential in military compensation for aviators. It is this characteristic of ACIP that likely helps to attract people to pursue an aviation career. In contrast, ACCP is explicitly intended to be a retention incentive. The 1981 Defense Authorization Act established this continuation bonus, which is targeted to aviators who complete their minimum service requirement. Those who accept ACCP also incur an additional active duty service obligation.

Table 3 contains a detailed summary of structural changes to the ACCP program over the time period on which we focus.[23] There are three points at which there were "major" changes in the structure of the program. The first occurred in FY89, when the Navy doubled the maximum annual payment and tied actual payments (possibly zero) to the degree of aviator shortages within each community. The second occurred in FY00; ACCP was paid to all aviators, regardless of

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20. Over the FY84–FY87 time period, those who accepted ACCP were paid the ACIP amounts in effect on 30 September 1981. We were not able to incorporate this "offset" into our modeling. However, given the relatively small differential in ACIP amounts, we suspect that our results are not sensitive to this factor.

21. Adjusting ACIP rates for inflation implicitly assumes that people expect them to never change.

22. We are extremely grateful to CDR Hughes, the Aviation Officer Community Manager, for providing us with historical data on ACCP and with a summary of changes to the ACCP program over time.

23. Appendix A contains a summary of the ACCP amounts available to aviators, by community, over this time period.

community, with different amounts set for pilots and NFOs. Finally, in FY06, ACCP was changed again so that both pilots and NFOs receive the same amount of ACCP. The DACMC observation about the limited flexibility of ACCP probably reflects the evolution of ACCP from a pay targeted to communities with shortages to an across-the-board pay for all pilots and NFOs [3].[24]

Table 3. Summary of changes to ACCP program—1984 to 2006[a]

Fiscal year	Eligibility	Target population	Type of agreements	Maximum amounts	Method of payment
1984	6-11 years of active duty	All aviators	3-, 4-, or 6-years	$4,000 per year (3-year agreement) $6,000 per year (4- or 6-year agreement)[b]	Equal annual installments
1985	No change	Communities with shortfalls	No change	No change	100% lump sum payment available to some communities
1986	No change	No change	No change	No change	No change
1987	No change	No change	No change	No change[c]	No change
1988	No change	No change	No change	No change	No change
1989[d]	6-13 years of active duty	no change	Agree to remain on active duty to complete 14 years of commissioned service, or for 1 or 2 years	$12,000 per year (long-term agreement) $6,000 per year (short-term agreement)	Equal annual installments or 50% lump sum with remainder paid in annual installments
1990	No change	No change	1-year agreement eliminated[e]	No change	No change
1991	No change	No change	No change[f]	No change	No change
1992	No change	No change	No change[g]	No change	No change
1993	No change	No change	2-year agreement eliminated[h]	No change	No change
1994	No change	No change	No change[i]	No change	No change
1995	No change	No change	No change	No change	Equal annual installments option eliminated

24. ACCP is still targeted to aviators approaching completion of their minimum service requirements.

Table 3. Summary of changes to ACCP program—1984 to 2006[a] (continued)

Fiscal year	Eligibility	Target population	Type of agreements	Maximum amounts	Method of payment
1996	No change	No change	No change	No change	No change
1997	No change	No change	No change	No change	No change
1998	Year group 88 or later	No change	No change	No change	No change
1999	Year group 87 or later	No change	2-year agreements only	$12,000 per year	Equal annual installments
2000	Year group 89 or later	All aviators	2- or 5-years	$25,000 per year (pilots with 5-year agreement) $15,000 per year (NFOs with 5-year agreement) $15,000 per year (2-year agreement)	Equal annual installments or 50% lump sum with remainder paid in annual installments[j]
2001	Year group 90 or later	No change	No change[k]	No change	No change
2002	Completion of initial active-duty service obligation	No change	3-year agreement added	$25,000 per year (pilots with 3-year agreement) $15,000 per year (NFOs with 3-year agreement)	Bonuses with 3-year agreements only paid out in equal annual installments
2003	No change	No change	No change	No change	No change
2004	No change	No change	No change	No change	No change
2005	No change	No change	3-year agreement eliminated	No change	No change
2006	No change	No change	No change	$25,000 per year (NFOs with 5-year agreement)	No change

a. Source: references [4] and [14].
b. Six-year agreements for those with less than 7 years of active duty.
c. Six-year agreements for those with less than 8 years of active duty.
d. Changes occur in 2nd quarter of FY89.
e. Aviators who accepted a 1-year agreement in FY89 were eligible for an additional agreement of at least 2 years.
f. Aviators who accepted a 2-year agreement in FY89 were eligible for an additional long-term agreement.
g. Aviators who accepted a 2-year agreement in FY90 were eligible for an additional long-term agreement.
h. Aviators who accepted a 2-year agreement in FY91 were eligible for an additional long-term agreement.

i. Aviators who accepted a 2-year agreement in FY92 were eligible for an additional long-term agreement.
j. Bonuses with 2-year agreements only paid out in equal annual installments
k. Aviators who accepted a 2-year agreement in FY99 were eligible for an additional 3-year agreement at the rates offered to those who accept 5-year agreements.

We follow our approach with other components of compensation and use the ACCP rates at the time of the aviator's retention decision to construct our estimates of future compensation.[25] In addition, we assume that, if an aviator were to accept an additional active-duty service obligation, he would choose, when available, the lump-sum (with remainder paid in annual installments) payment option for ACCP. This decision is due to the fact that, all else equal, people prefer to receive compensation sooner rather than later [15].[26]

The structure of the ACCP program has a direct influence on our models of aviator retention. Starting in FY00, there is no variation in ACCP within a fiscal year for pilots or for NFOs. Consequently, the only variation in relative military compensation during this time period comes from changes over time in other components of military pay, our estimates of civilian earnings, and the erosion of the value of ACCP due to inflation. Therefore, our preferred model of aviator retention focuses on data before this structural change in ACCP. However, we do examine the sensitivity of our estimates to including these more recent data in our analysis.

25. Like ACIP, ACCP payments do not keep pace with inflation. However, future ACCP payments are known *with certainty* for people who have reached the expiration of their minimum service requirement, unlike future changes to basic pay. Therefore, aviators will place more weight on the value of ACCP in their decision-making process than a comparable amount of "expected basic pay." The extent to which this offsets the impact of inflation is unknown.

26. This preference for immediate over deferred compensation implies that aviators would prefer some amount less than $1 paid today to $1 paid a year from now. Since the ACCP payment options essentially ask an aviator to choose whether he wants $1 today or $1 paid a year from now, our decision seems reasonable. In our analysis, we assume that aviators have a real discount rate of 10 percent.

Civilian earnings

A fundamental hypothesis of most retention models is that financial considerations play a role in the decision to remain in or separate from the military. While military compensation is certainly a factor, so too are the civilian earnings opportunities available to personnel if they were to separate from the Navy. Focusing specifically on naval aviators, it is likely that pilots and NFOs face different job opportunities on completion of their active duty service. In this section, we describe the data we use as a proxy for these opportunities.

Pilots

Our assumption is that Navy pilots making retention decisions consider a career as a civilian pilot to be their most promising civilian earnings opportunity. This assumption does *not* mean that all Navy pilots who separate become civilian pilots; rather, it means that expected earnings as a civilian pilot are their best estimate of the financial remuneration they would receive upon leaving the Navy.

Data on civilian pilot salaries are available from Future Aviation Professionals of America (FAPA) for 1984 to 1994 [16, 17, 18, 19, 20, 21, 22, and 23], and from Aviation Information Resources, Inc. (AIR), for 1997 to 2002 and 2004 to 2005 [24, 25, 26, 27, 28, and 29]. These data contain, for each airline, salaries for civilian pilots by years of service, rank (e.g., first officer, captain), and type of aircraft flown (e.g., B747, DC10). In many respects, these data reflect a salary structure that resembles the basic pay tables for military personnel.

We use the data on major U.S. airlines to construct a proxy of civilian earnings opportunities.[27] These data also include information on the "typical" career paths of pilots as they gain experience, both in terms of their rank and the type of aircraft flown. We assume that Navy pilots use these career paths in forming their estimates of civilian earnings.

27. Major airlines are those typically associated with commercial passenger travel (such as USAirways and Delta Airlines), as well as airlines that ship large volumes of commercial goods (such as FedEx and United Parcel Service).

It is important to note that major U.S. airlines are only one source of employment for Navy pilots upon separation from active duty. There are several other smaller airlines that also hire pilots. We do not have data, however, on the extent to which Navy aviators pursue careers with major airlines versus other employers, nor do we have information on the relative opportunities for helicopter, jet, and propeller pilots. Consequently, our civilian earnings estimates serve only as a *proxy* for non-Navy opportunities and are not necessarily predictors of the actual earnings that a servicemember will receive upon leaving the Navy.

While these data contain a great deal of information about civilian pilot salaries over the past 20 years, they are not complete. For 1995, 1996, and 2003, we do not have any data on civilian pilot salaries.[28] For 1984 through 1989, the only data we have are on pilots' starting salaries and salaries at their second, tenth, and thirtieth year of service. For 1990 through 1994, the only data available are on pilots' salaries from the first through tenth year of service and the thirtieth year of service. It is only for the most recent years (1997 through 2002 and 2004 through 2005) that we have complete salary data for each year of service.

To construct more complete civilian earnings profiles for Navy pilots, then, we impute expected civilian salaries for the cases where we do not have complete data. For 1984 through 1989, we use the data on pilots' salaries from the second through tenth years of service from 1990 through 1994, 1997 through 2002, and 2004 through 2005 to estimate increases by year of service in this range. Specifically, we calculate the difference in salary between the tenth and second year of service and, for each year, measure the percentage of this wage growth that occurs at each year of service in between. For each year of service, we average this percentage over all years for which we have data and then apply this estimate to the 1984 through 1989 data.[29] We

28. It appears as though FAPA was acquired by AIR in 1995, and that this acquisition is responsible for the lack of published data in 1995. At least one other researcher using these data shows a similar gap [30]. We were unable to successfully contact anyone at AIR who could provide us with data from 1996 or 2003.

use a similar procedure to impute expected civilian earnings from the eleventh through thirtieth years of service from 1984 through 1994.[30]

Once we impute earnings in the manner described above, we use these data to estimate earnings profiles by year of service for the years in which we have no data (1995, 1996, and 2003). For 1995 and 1996, we assume that earnings are equal to the average of the 1994 and 1997 earnings at each year of service. This assumption is probably reasonable. Our data show no change in earnings from 1993 to 1994 and from 1997 to 1998; consequently, our assumption of no change in earnings from 1995 to 1996 seems plausible. Similarly, for 2003, we assume that earnings are equal to the average of the 2002 and 2004 earnings at each year of service.

Figure 7 plots our estimates of civilian pilot earnings by years of service for 1985, 1995, and 2005. For ease of comparison, earnings at each year of service are divided by the average starting salary for pilots in that year. This allows us to observe the extent to which earnings rise with experience, and how this growth earnings varies over time.

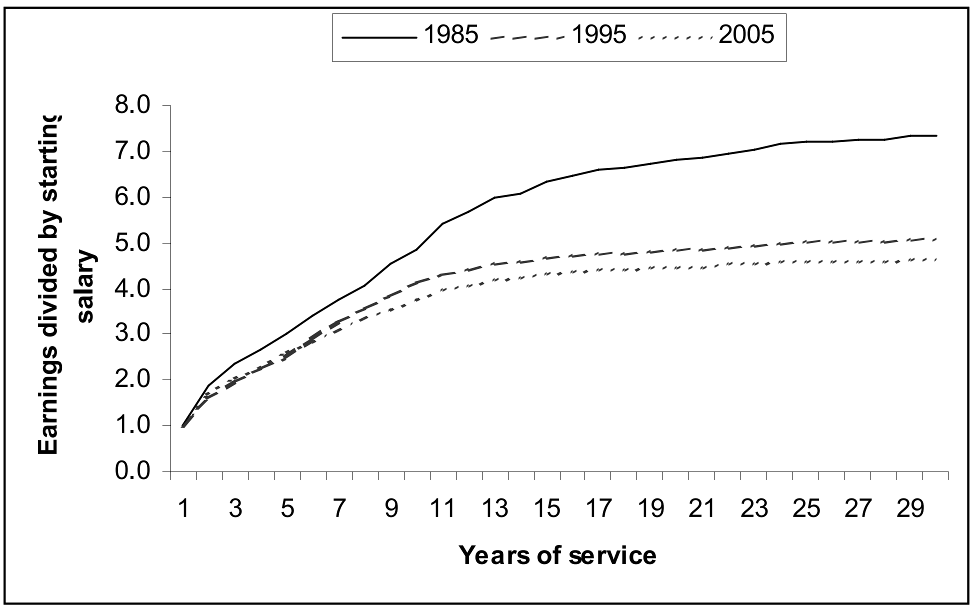
As figure 7 shows, there are significant differences in wage growth. For the first ten years of service, the rate at which earnings increase is slightly higher in 1985 (when earnings at the tenth year of service are 4.9 times as high as starting salaries) than in 2005 (when earnings at the tenth year of service are 3.8 times as high as starting salaries). From the tenth through thirtieth years of service, however, wage growth is significantly higher in the earlier years of data. For example, the average maximum salary in 1985 was almost 7.4 times as high as the average starting salary. In contrast, the average maximum salary

29. Since the percentage difference between salaries at the tenth and second year of service differs for each year between 1984 and 1989, these calculations ensure that our imputed earnings profiles in these years pass through the data points that are available to us.

30. Reference [31] uses a similar procedure in its imputation of civilian earnings, although the authors have fewer years of data on which to base their estimates. Consequently, our estimated earnings profiles are different; the extent to which this has an effect on the conclusions of our analysis is likely to be small.

in 2005 was only about 4.7 times as high as the average starting salary. In other words, expected wage growth for civilian pilots in 2005 *over their entire careers* was about the same as expected wage growth for civilian pilots in 1985 *through the first ten years of service*. These dramatic differences over time reinforce the need to consider the entire expected civilian earnings profile.

Figure 7. Growth in civilian pilot earnings by years of service—1985, 1995, and 2005



NFOs

Our estimation strategy for NFOs' civilian earnings opportunities closely follows reference [8]. We make use of the March Current Population Surveys, which contain annual data on the labor market experiences of a large cross-section of civilians. To obtain some comparability with Navy commissioned officers, we restrict our sample each year to include only full-time, full-year male workers with a minimum of a 4-year college degree.[31] Furthermore, we focus only on civilians working in engineering and technical occupations. Our assumption is that NFOs view these occupations as their best civilian alternative.[32]

Using these data, we estimate log earnings regressions separately for each year, controlling for both race and age.[33] The estimated coefficients allow us to predict civilian earnings for each NFO. This approach implicitly assumes that NFOs separating from the Navy have the same civilian earnings opportunities as comparable civilians that have been working in the private sector. The literature concludes that, in general, it is reasonable to use the earnings of civilians to approximate the earnings opportunities of Navy personnel [34].

Labor market conditions

Finally, we make use of data intended to capture the extent to which economic conditions are favorable. First, we include information on the number of civilian major airline hires for each year from 1984 to 2005.[34] Civilian airlines have a strong preference for Air Force and Navy pilots because of the training they receive while in military service [31]. Consequently, the variation in civilian major airline hires from one year to the next is a direct measure of the civilian opportunities available to Navy pilots.[35]

Figure 8 displays these data over the time period on which we focus. Airline hiring of pilots has varied widely over the past 20 years. For

31. The Current Population Surveys define "full-time" workers as those who work 35+ hours per week and "full-year" workers as those who work 50+ weeks per year.

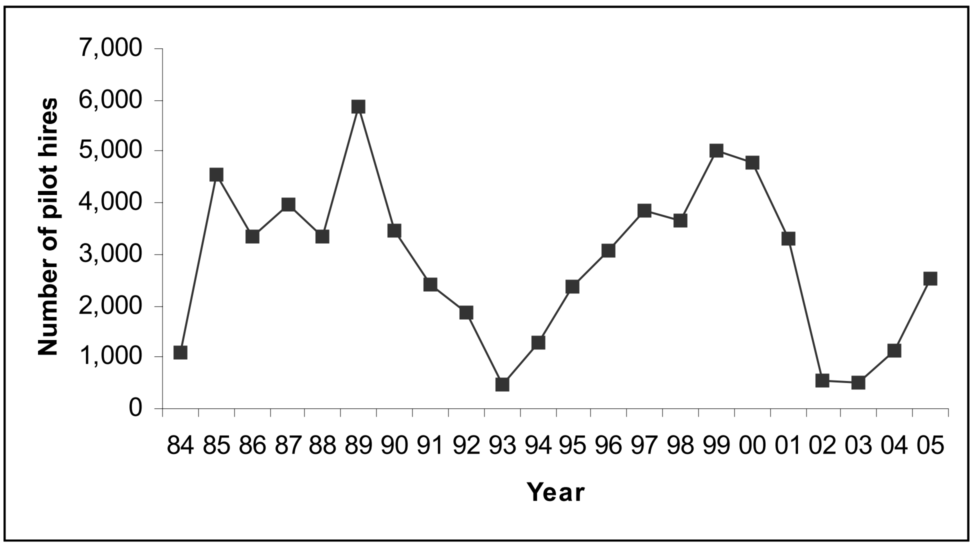
32. Reference [32] takes a similar approach, using the annual salary of engineers in the Department of Labor's National Survey of Professional, Administrative, Technical, and Clerical Pay: Private Service Industries.

33. We estimate a quadratic in age, which allows us to capture the well-known fact that earnings increase with age (experience), but at a decreasing rate [33].

34. These data come from the same sources as our data on civilian pilot earnings. Because each publication presents data for more than one year, however, we do not have any gaps in the time series of civilian major airline hires.

example, the major airlines hired almost 5,900 new pilots in 1989; by 1993, this number had shrunk to less than 500. Hiring subsequently increased through 1999, before plummeting in the years right after September 11th, 2001. In the last few years, it appears as though the airline industry is recovering, with hiring levels more than doubling from 2003 to 2004, and again from 2004 to 2005.

Figure 8. Pilot hires by major airlines—1984 to 2005



It is useful to compare the data in figure 8 with the continuation rates of pilots who complete their minimum service requirements (refer back to figure 4). Pilot retention is negatively correlated with the number of pilot hires by the major airlines; this correlation is much stronger once we adjust for differences in the length of pilots' minimum service requirements over time.[36] A closer inspection of the data (not shown) reveals that these correlations are strongest for jet and propeller pilots.

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35. Air Force pilots make up a higher percentage of the hires by civilian airlines; however, the Navy's share of total hires has remained relatively constant over time [31].

In contrast, there does not appear to be a relationship between the number of civilian pilot hires and NFO retention. This is consistent with our hypothesis that NFOs and pilots face different job opportunities upon completion of their active duty service. However, this means that we need additional metrics to serve as a proxy for the labor market conditions faced by NFOs. As an additional control for economic conditions at the time of the retention decision, then, we use annual unemployment rates from the Bureau of Labor Statistics (BLS). Our hypothesis is that the civilian unemployment rate serves as a reasonable proxy for NFOs.

Descriptive statistics

Table 4 presents descriptive statistics of the variables we use in our analysis, calculated over the FY84–FY05 time period. These statistics are calculated for aviators who will complete their minimum service requirements within 12 months from the time we observe them in the data. In addition to the data discussed in previous sections, note that we also include variables describing certain personal characteristics (e.g., age, marital status), accession source (e.g., Naval Academy, Officer Candidate School), and characteristics of military service (e.g., paygrade, length of service). Including this additional information is standard practice in the literature since retention often varies by these characteristics [8].

Table 4 presents retention rates and ACOL values separately for pilots and NFOs. The significant difference between the average ACOL for pilots and NFOs is due to the way in which we estimate civilian earnings opportunities for each type of aviator. Negative (positive) ACOL values imply that our estimate of lifetime civilian earnings is greater (less) than our estimate of lifetime military earnings.

36. The correlation between pilot continuation rates and the number of civilian hires is -0.29. Once we adjust for length of MSR, this correlation rises to -0.60. Correlations range between -1.0 and +1.0, with +1.0 (-1.0) signifying perfect positive (negative) correlation. A correlation of 0 would mean that there is no relationship between the two variables.

Table 4. Descriptive statistics

Variable	Mean	Variable	Mean
Pilots[a]	0.66	**NFOs**[a]	0.34
Retention rate[b]	0.82	Retention rate[c]	0.92
ACOL ($1,000)[b]	-44.4	ACOL ($1,000)[c]	6.9
Helicopter[d]	0.33	Jet[e]	0.52
Jet[d]	0.32	Propeller[e]	0.48
Propeller[d]	0.34	**Personal characteristics**	
Fiscal year		Married[a]	0.68
FY84[a]	0.05	With children[a]	0.34
FY85[a]	0.07	Female[a]	0.03
FY86[a]	0.05	Male[a]	0.97
FY87[a]	0.05	Age	30.2
FY88[a]	0.05	White[a]	0.92
FY89[a]	0.05	Black[a]	0.02
FY90[a]	0.06	Hispanic[a]	0.03
FY91[a]	0.07	Other ethnicity[a]	0.03
FY92[a]	0.06	**Accession source**	
FY93[a]	0.06	Naval Academy[a]	0.25
FY94[a]	0.05	OCS[a]	0.24
FY95[a]	0.04	NROTC[a]	0.30
FY96[a]	0.04	Other accession source[a]	0.21
FY97[a]	0.02	Prior enlisted[a]	0.17
FY98[a]	0.04	**Characteristics of military service**	
FY99[a]	0.03	O-2[a]	0.03
FY00[a]	0.03	O-3[a]	0.95
FY01[a]	0.03	O-4[a]	0.02
FY02[a]	0.03	Length of service (years)	6.2
FY03[a]	0.04	**Labor market conditions**	
FY04[a]	0.04	Civilian major airline hires	2,811
FY05[a]	0.04	Unemployment rate	5.4

a. Proportion with this characteristic is presented.
b. Mean of this characteristic for pilots is presented.
c. Mean of this characteristic for NFOs is presented.
d. Proportion of pilots with this characteristic is presented.
e. Proportion of NFOs with this characteristic is presented.

Results

In this section, we concentrate on our estimates of the relationship between compensation and retention, as well as of the relationship between labor market conditions and retention. Note, however, that we also include additional factors, listed in table 4, that potentially affect retention.

We estimate each model using standard logistic regression. Other, more sophisticated models have been used in previous studies. However, logistic regression is a commonly used econometric framework that allows for a straightforward interpretation of the results. A complete listing of the coefficients for all variables include in the models on which we focus can be found in appendix B; a discussion of the relationship between these variables and aviator retention can be found in appendix C.

Pilots

Pay effects

Table 5 presents our estimates of two key statistics that are of central interest. The first is the *pay elasticity of pilot retention*, which measures the percentage change in retention associated with a 1-percent, across-the-board increase in basic pay.[37] This statistic is typically used to predict changes in retention due to congressional adjustments to basic pay. The second is the *effect of ACCP on pilot retention*, which measures the percentage-point change in retention associated with a $1,000-per-year increase in ACCP. This estimate is typically used to adjust ACCP in order to change the level of pilot retention. These two statistics are both different representations of the relationship

37. For perspective, a 1-percent increase in contemporaneous basic pay for an O-3 with 10 years of service is $585.

between changes in compensation and changes in retention; they are based on the same estimated relationship in our model.

The coefficient on relative military compensation is positive and statistically significant, suggesting that increases in military pay do lead to increases in pilot retention. Specifically, our results indicate that a 1-percent increase in basic pay leads to a 0.55-percent increase in pilot retention.[38] Furthermore, a $1,000-per-year increase in ACCP is associated with an increase in the retention rate of 0.6 percentage point.

Table 5. Pay effects—pilot retention model

Effect	Estimate
Pay elasticity	0.55 percent[a]
Effect of $1,000-per-year increase in ACCP	0.6 percentage point[a]

a. Zero lies outside the 99-percent confidence interval for this estimate.

As a check of the way in which we specified our model, we examined an alternate specification that *separates* military pay from civilian pay and enters them as separate explanatory variables.[39] The theoretical foundation of ACOL implies that this should make no difference in estimates of the effect of pay [35]. If the model is properly specified,

38. Throughout this memorandum, we calculate the pay elasticity of retention using the approach suggested in [5]. First, we use the predicted coefficients to estimate the average predicted probability of retention. Second, we increase basic pay by 1 percent and find the new maximum ACOL value for each person. Third, we use this new value to estimate a new, average predicted probability of retention using the original coefficients from the regression. Finally, we compare this new prediction to the original prediction to establish the percentage change in retention.

39. The maximum ACOL value is still calculated in the same way; the only difference is that, once this value is found, the military and civilian components of this ACOL value are entered separately in the regression.

the coefficient on ACOL should equal the coefficient on military pay, which should be equal (in absolute value) to the coefficient on civilian pay.[40] When we estimate this alternate specification, we find that the coefficient on military pay is statistically indistinguishable (in absolute value) from the coefficient on civilian pay. This lends credence to the reliability of our estimates of the effect of pay.

Comparisons with previous literature

It is useful to compare these estimates with those found in the previous literature. Reference [36] estimates the pay elasticity of Air Force pilot retention using 1970s data, and finds that a 1-percent increase in *all* elements of pay (basic allowances for quarters and subsistence, after-tax basic pay, and after-tax flight pay) leads to a 0.72-percent increase in retention of Air Force pilots who are at the expiration of their minimum service requirements.[41] Since [36] measures the effects of an increase in more elements of compensation than just basic pay, we conclude that our estimate of the pay elasticity is comparable to this estimate for Air Force pilots.

In both cases, the responsiveness of pilot retention to changes in pay is significantly less elastic than estimates for enlisted personnel over the same time period. For example, [35] reports a pay elasticity of 1.5 for Navy enlisted personnel and concludes that there was little variation in this responsiveness over time.

These differences, however, are not nearly as large as they appear. As noted in [5] , estimates of the pay elasticity are "extremely sensitive to the point of evaluation (i.e., the sample average retention rate)." If we use the same point of evaluation as [35], our estimate of the pay

40. This is due to the assumption that one dollar of military pay has the same value to individuals as one dollar of civilian pay.

41. See table 13 of [36]. Reference [37] reports the estimated elasticity of [36] as 0.8. The authors of [36] never explicitly state their estimated elasticity; however, they note in their summary that "in response to the 5 percent pay increase. . . the percentage of pilots retained increased by less than 4 percent." We suspect that this quote is the basis for the estimate of 0.8 reported in [37].

elasticity of pilot retention rises to 1.44.[42] Therefore, we conclude that our estimates are similar to those for enlisted personnel.

In contrast, our estimates of the effect of ACCP on pilot retention are significantly lower than those in the literature. For example, reference [32] estimates the predicted effect of a $1,000 increase in the *present value* of the bonus.[43] Adjusting these results for inflation, our comparable estimates are less than half as large. The author of [32], however, acknowledges that the changes in compensation on which he focuses are "substantial" and that the reported estimates "are only a rough approximation for a large change in pay." This is not the case for the time period on which we focus, and we have greater confidence in our results.

Differences by pilot community

The impact of pay on retention reported in table 5 is calculated for all pilots who will satisfy their minimum service requirement within 12 months. We also examine whether there are differences in the responsiveness to pay of helicopter, jet, and propeller pilots. We re-estimate our pilot retention model, including all the explanatory variables in our previous specification, but estimating separate effects of pay, airline hires, and fiscal year for each type of pilot.[44]

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42. Reference [35] reports an average reenlistment rate of 32 percent over the FY87-FY99 time period. In contrast, we observe an average pilot retention rate of 84 percent over the FY84-FY99 time period. Since the pay elasticity measures the percentage change in retention, the same *percentage-point* change in retention becomes a larger *percentage* change in retention (which results in a larger pay elasticity) as the point of evaluation is lowered.

43. See table 6 of [32].

44. There is not enough variation to estimate three separate models of pilot retention. Intuitively, estimating each model separately would allow us to estimate separate effects of each explanatory variable. As a compromise, we estimate separate effects for the explanatory variables that we suspect, a priori, could have significant different effects on retention. A complete listing of the coefficients for all variables included in the model can be found in appendix B.

Table 6 presents our estimates of the pay effects on retention for each category of pilot. Each of these estimates is statistically different from zero; in addition, these estimates are statistically different from one another. As table 6 shows, propeller pilots are the most responsive to changes in compensation, with an elasticity of 0.86; helicopter pilots are significantly less responsive to pay, with an elasticity of only 0.26. Jet pilots appear more similar to helicopter pilots than to propeller pilots, with an elasticity of 0.37.[45] Based on the results in table 6, then, we conclude that different types of pilots have measurably different behavioral responses to changes in compensation.

Table 6. Pay effects—helicopter, jet, and propeller pilots

Type of pilot	Pay elasticity	Effect of $1,000-per-year increase in ACCP
Helicopter	0.26 percent[a]	0.2 percentage point[a]
Jet	0.37 percent[b]	0.4 percentage point[b]
Propeller	0.86 percent[b]	0.9 percentage point[b]

a. Zero lies outside the 90-percent confidence interval for this estimate.
b. Zero lies outside the 99-percent confidence interval for this estimate.

Sensitivity analysis

As we have discussed, the ACCP program was significantly changed in FY00, when all pilots became eligible for the same bonus levels, regardless of community or manning shortfall. Consequently, we chose to model aviator retention using the FY84–FY99 time period since there is variation in compensation within each fiscal year.

To assess the sensitivity of our estimates to this choice, we explored the addition of more recent data to our estimation sample. Table 7 summarizes these results. Each row of table 7 lists our estimate of the pay elasticity as we add an additional fiscal year of data. For example, the first row reproduces our estimate from the FY84–FY99 time

45. These differences are not driven by the “point of evaluation.” If we assume the same baseline retention rate for each type of pilot, our estimates of the pay elasticities are virtually unchanged.

period, an elasticity of 0.55. The second row displays our estimate of the pay elasticity when we add an additional year of data (FY00); including these additional data reduces our estimate of the pay elasticity to 0.49. In general, adding additional years of data reduces our estimate of the pay elasticity, so that, when we focus on the entire period for which we have data (FY84 to FY05), our estimated pay elasticity drops to 0.37.

Table 7. Pay elasticity of retention, by time period of estimation sample

Time period	Estimate
FY84 through FY99 (preferred specification)	0.55 percent[a]
FY84 t throughFY00	0.49 percent[a]
FY84 through FY01	0.47 percent[a]
FY84 through FY02	0.39 percent[a]
FY84 through FY03	0.38 percent[a]
FY84 through FY04	0.36 percent[a]
FY84 through FY05	0.37 percent[a]

a. Zero lies outside the 99-percent confidence interval for this estimate.

As table 7 shows, our estimate of the pay elasticity is extremely sensitive to adding these more recent data. It would be surprising if there was such a dramatic shift in the behavioral responsiveness to changes in compensation, especially in the span of a few fiscal years. In fact, the previous literature tends to find evidence *against* this result [8]. Consequently, we suspect that these lower elasticities result from a lack of variation in relative military compensation within these fiscal years.

Finally, we explore the sensitivity of our estimates to our assumptions about expected civilian earnings. As we have discussed, the assumption that Navy pilots focus only on earnings at major airlines in the United States is fairly strong. As an alternative, then, we reestimate our model using expected earnings from working in engineering and technical occupations.[46] Our estimate of the pay elasticity of pilot retention falls to 0.44 but is still significantly different from zero.

Labor market conditions

In our discussion of the correlation between pilot continuation rates and civilian major airline hires, we noted that this relationship appeared strongest for jet and propeller pilots. Our model of pilot retention confirms this. We estimate a negative, statistically significant relationship between the lagged number of major airline hires and retention of jet and propeller pilots.[47] In other words, as civilian opportunities for pilots improve, more jet and propeller pilots choose to leave the Navy. In contrast, we do not observe any empirical relationship between the number of civilian airline hires and retention of helicopter pilots.

Figure 9 displays the predicted relationship between major airline hires and retention of jet and propeller pilots. For purposes of illustration, four different combinations are presented for each community. First, actual FY05 retention levels (68.6 percent for jet pilots, 57.4 percent for propeller pilots) are displayed in conjunction with actual 2004 civilian major airline hires (1,139 pilots). We use our estimates to predict jet and propeller pilot continuation rates, holding all else constant, for three different levels of civilian hires: the minimum over the 1983–2004 time period (312 pilots in 1983), the actual number of hires in 2005 (2,510 pilots), and the maximum over the 1983–2004 time period (5,868 pilots in 1989).

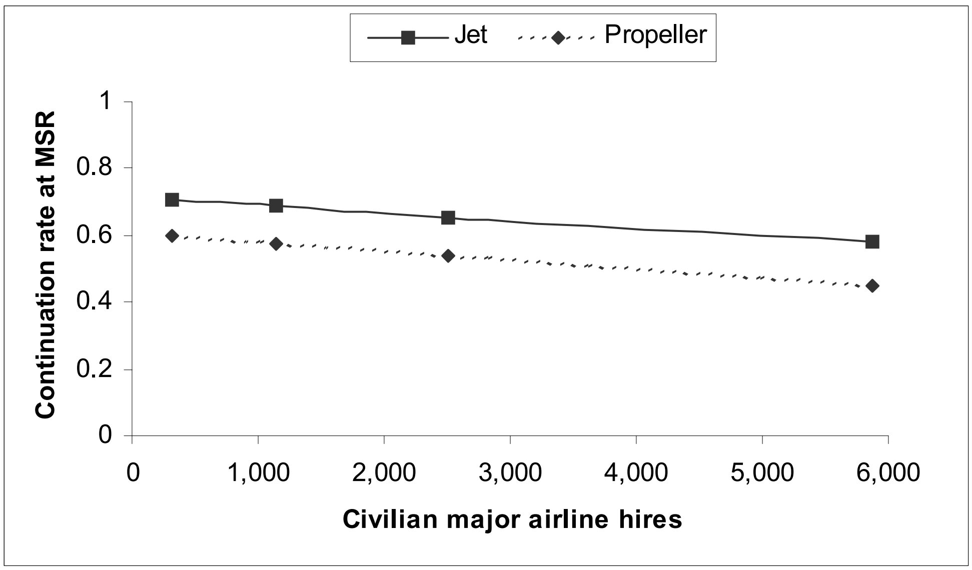
As figure 9 shows, our model predicts that, holding all else constant, pilot retention from FY05 to FY06 would fall, given the significant

46. This is the approach we use when measuring expected civilian earnings of NFOs.

47. We use the lagged number of civilian major airline hires since there is an endogenous relationship between the number of pilots that leave the Navy and the contemporaneous number of pilots hired by civilian airlines. Consequently, using the lagged number is more preferred on theoretical grounds. However, using the contemporaneous number of airline hires results in extremely similar estimates.

increase in civilian hires from 2004 to 2005. For jet pilots, we would predict a decline in retention of about 3 percentage points; the predicted decline for propeller pilots is slightly larger (3.5 percentage points).

Figure 9. Predicted relationship between civilian major airline hires and retention of jet and propeller pilots



These estimates are smaller than those found in the recent literature. Reference [31] predicts a 4.8-percentage-point increase in Navy attrition due to a 1,000-person increase in total additional hires by major airlines. In contrast, our estimates imply a 2.3- to 2.7-percentage-point reduction in retention rates for jet and propeller pilots, respectively.

Our model implies that increases in ACCP can offset the deleterious effect of a healthy civilian airline industry on jet and propeller pilot retention. Combining our community-specific estimates of the ACCP effect (table 6) with our estimates of the effect of civilian airline hires, we estimate that the Navy could counteract a 1,000-person increase in airline hires with a $5,800-per-year increase in ACCP for jet pilots. For propeller pilots, a $3,000-per-year increase in ACCP would offset the same increase in hires. Even though the predicted decline in retention is higher for propeller pilots than for jet pilots, the higher estimated pay elasticity for propeller pilots results in a smaller necessary increase in ACCP.

We do not find a statistically significant relationship between the civilian unemployment rate and pilot retention. In other words, the level of civilian major airline hires appears to be a sufficient proxy for the labor market conditions faced by jet and propeller pilots. For helicopter pilots, we are unable to find any evidence that labor market conditions, above and beyond the effect of expected civilian earnings, affect retention.

NFOs

Our empirical results for NFOs stand in stark contrast to our results for pilots. We do not find any statistical evidence of a positive relationship between relative military compensation and NFO retention. We examined a number of different specifications of our model of NFO retention, including each of the alternative approaches described in our discussion of pilot retention. In every case, the coefficient on relative military compensation is not statistically different from zero.

There are three possible explanations for this finding. The first is an absence of a behavioral response to financial incentives. While technically possible, this would be extremely surprising. Previous literature has been able to estimate a behavioral response for most NFOs [32],[48] and there is a large theoretical and empirical literature supporting the existence of a behavioral relationship. More simply, the absence of a behavioral response does not make sense. We suspect that few readers would expect no change in NFO retention if, for example, ACCP was reduced from $25,000 per year to $0.

48. There are some subcommunities of NFOs for which the author of [32] is unable to estimate a statistically significant relationship between compensation and retention, but, for the most part, the author does find a relationship. See, in particular, table 6 of [32].

Second, it is possible that we have misspecified our model of NFO retention. This could be due to missing explanatory variables that are correlated with relative military compensation, or it could be due to the fact that NFOs respond differently to incentives than the Annualized Cost of Leaving model suggests. This possibility seems less likely given our robust empirical results for pilots. We do model pilot and NFO retention separately—a choice based on our belief that the two groups have disparate job descriptions and civilian earnings opportunities. However, we are not able to identify any factors beyond those we have discussed that affect NFO, but not pilot, retention.

The third, and, in our opinion, the most likely, explanation is that there is relatively little variation in NFO retention over the time period on which we focus. A comparison of figures 4 and 6 makes it clear that there is significantly more variation in pilot retention than in NFO retention. The only substantive changes in NFO retention over the time period occur in FY94 and FY95, when the Navy was actively drawing down the size of its active duty forces. While the level of ACCP offered to NFOs did change over the time period, this lack of variation in retention makes it difficult to estimate a precise statistical relationship between the two variables of interest.

Similarly, we do not find any statistical relationship between changes in labor market conditions and NFO retention. It is not surprising that changes in civilian hiring of pilots have no effect; our approach in modeling NFO retention was based on the premise that factors other than the civilian airline industry affect the decisions of NFOs. However, the lack of a relationship between changes in the civilian unemployment rate and NFO retention runs contrary to our expectations. Again, we suspect that this is due to a lack of variation in NFO retention over the time period on which we focus.

Using these estimates to adjust aviator pay

As we have noted, these estimates constitute only some of the information that policy-makers need when considering an adjustment to aviator pay. Setting the appropriate level of aviator pay, from a cost-effectiveness standpoint, depends on three factors: (1) the Navy's requirements for aviators, (2) the expected level of aviator retention, and (3) the responsiveness of aviators to changes in financial compensation. Our estimates of the relationship between changes in compensation and retention inform this third factor. In addition, our estimates of the relationship between changes in labor market conditions and retention inform the second factor since expectations about civilian earnings opportunities will affect the expected level of aviator retention.

N13's intent is to combine our empirical results with a model of aviator retention developed jointly by SAG Corporation and The Lewin Group. Although this modeling is not complete at the time of this research memorandum, here we briefly describe how our estimates can be used.[49] Suppose, for example, that this modeling were to conclude that the expected level of aviator retention is insufficient to meet the Navy's requirements for aviators. Our empirical results demonstrate that, for pilots, increases in pay will raise retention. Furthermore, our measured responsiveness of pilots to changes in financial compensation determines the extent to which the Navy should raise pilot pay to alleviate this shortage.

As our results show, the expected level of aviator retention depends on factors other than pay. In principle, future projections of changes in the environment faced by aviators can also inform the structuring of aviator pay. For example, we estimate a negative relationship

49. The previous literature also contains examples of this approach to setting aviator pay. For example, see reference [38].

between the level of civilian airline hiring and pilot retention. If projected trends in the civilian airline industry are significantly positive, our analysis suggests that increases in pilot pay offset the deleterious effect on retention.

Two additional observations are worth noting here. The first concerns the implications of the lack of a statistical relationship between pay and NFO retention. This probably does *not* mean that no relationship exists. However, the lack of a reliable estimate makes it difficult to recommend changes in compensation if NFO retention is found to be lower than needed. Policy-makers may choose to use older estimates found in the literature; alternatively, they may choose to use our pilot estimates as a proxy of the responsiveness of NFOs to changes in pay. Further analysis is needed to assess the behavioral response of NFOs to any subsequent changes in compensation.

Second, we note that the evolution of Aviation Career Continuation Pay—from a pay targeted to communities with shortages to an across-the-board pay for all aviators—is not consistent with the Department of the Navy's guiding principles for a compensation strategy [2]. One of these principles is that compensation provide *strategic best value*, maximizing mission contribution while minimizing cost. ACCP is more targeted than, for example, basic pay, since it is paid only to aviators who have the appropriate qualifications. However, it is not as targeted as it could be, or even as targeted as it used to be, since it is not tied to communities with shortages. Paying any additional ACCP to communities without manning shortages generates additional costs, without any measurable benefit.

The consequences of this evolution can be seen by revisiting our estimates of the factors affecting pilot retention. We estimate different behavioral responses to compensation of helicopter, jet, and propeller pilots, and find an effect of civilian airline hiring on only jet and propeller pilot retention. Consequently, our analysis demonstrated that different changes to ACCP would be necessary to offset changes in the civilian earnings opportunities affecting pilots. Paying the same level of additional ACCP to all pilots would be more expensive than paying the community-specific levels that would offset these changes.

Conclusions

Our analysis suggests that increases in relative military pay do lead to increases in pilot retention. Specifically, our results indicate that a 1-percent increase in basic pay leads to a 0.55-percent increase in retention. This estimate can be used to predict changes in pilot retention due to congressional adjustments in basic pay. Furthermore, a $1,000-per-year increase in ACCP is associated with an increase in the retention rate of 0.6 percentage point. This estimate can be used to adjust aviator pay in order to align pilot retention with requirements. In both cases, the data suggest that responsiveness to compensation is highest for propeller pilots and lowest for helicopter pilots.

In contrast, we do not find any statistical evidence supporting a positive relationship between relative military compensation and NFO retention. We suspect this is due to the relatively little variation in NFO retention over the time period on which we focus, rather than the actual absence of a behavioral response to financial incentives.

We also observe a relationship between civilian labor market conditions and pilot retention. Specifically, a 1,000-person increase in total additional hires by major airlines would reduce jet and propeller pilot retention by 2 to 3 percentage points. In principle, then, increases in ACCP can offset the deleterious effect of a healthy civilian airline industry on pilot retention. For NFOs, we do not find any statistical evidence supporting a relationship between civilian labor market conditions and retention.

These estimates provide only some of the information that policymakers need when considering an adjustment to aviator pay. Setting the appropriate level of pay, from a cost-effectiveness standpoint, depends on (1) the Navy's requirement for aviators, (2) the expected level of aviator retention, and (3) the responsiveness of aviators to changes in financial compensation. N13's intent is to combine our empirical results with a model of aviator retention developed jointly by SAG Corporation and The Lewin Group. This combination of modeling efforts will help the Navy assess whether aviator pay is set appropriately, as well as help determine whether the Navy has the statutory authority to offer a sufficient level of ACCP.

The lack of a statistical relationship between pay and NFO retention complicates this assessment. Policy-makers may choose to use older estimates found in the literature; alternatively, they may choose to use our pilot estimates as a proxy of the responsiveness of NFOs to changes in compensation. Further analysis is needed to assess the behavioral response of NFOs to any subsequent changes in compensation.

Finally, we note that the evolution of ACCP, from a pay targeted to communities with shortages to an across-the-board pay for all aviators, is not consistent with the Department of the Navy's guiding principles for a compensation strategy. ACCP is still targeted to aviators, but it is no longer targeted to address specific manning problems within the naval aviation community. Paying any additional ACCP to communities without manning shortages generates additional costs with no measurable benefit. We recommend that the Navy revisit how it compensates aviators to ensure that any increases in ACCP are explicitly tied to manning shortages in specific communities.

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Appendix A: Summary of ACCP amounts

Table 8 contains a summary of the Aviation Career Continuation Pay amounts available to aviators, by community, over the FY84–FY06 time period. We are extremely grateful to CDR Hughes, the Aviation Officer Community Manager, for providing us with these data. See table 3 for a detailed summary of structural changes to the ACCP program over this time period.

Table 8. ACCP amounts—FY84 to FY06

			ACCP amount per year	
Fiscal year	Pilot/ NFO	Community	Long-term agreements	Short-term agreements
1984		All Aviators	$6,000	$4,000 / $6,000
1985		**AQDs**: DA4, DA9, DA2, DA7, DB2, DB4, DB6, DC4, DF2, DL2, DL3, DD1, DD2, DD3, DD4, DS1, DS2, DP8, All DV & All DW[a]	$6,000	$4,000 / $6,000
1986		**AQDs**: DA4, DA9, DA2, DA7, DB2, DB4, DB6, DC4, DF2, DL2, DL3, DD1, DD2, DD3, DD4, DS1, DS2, DP8, All DV & All DW	$6,000	$4,000 / $6,000
1987		**AQDs**: DA4, DA9, DA2, DA7, DB2, DB4, DB6, DC4, DF2, DL2, DL3, DD1, DD2, DD3, DD4, DS1, DS2, DP8, All DV & All DW	$6,000	$4,000 / $6,000
1988		VF, VA, VAM, VAQ, VAW, VS, VQ, VRC, All Helos[b]	$6,000	$4,000 / $6,000
1989	Pilot	HC, HSL	$7,000	$3,500 / $4,500

Table 8. ACCP amounts—FY84 to FY06 (continued)

Fiscal year	Pilot/ NFO	Community	ACCP amount per year: Long-term agreements	ACCP amount per year: Short-term agreements
		HM, HS	$6,000	$3,000 / $4,000
		VAL/VFA	$10,000	$5,000 / $6,000
		VAM	$12,000	$6,000
		VAQ	$12,000	$6,000
		VAW	$11,000	$5,500 / $6,000
		VF	$10,000	$5,000 / $6,000
		VP	$8,000	$4,000 / $5,000
		VQ (Jet)	$10,000	$5,000 / $6,000
		VQ (Prop)	$8,000	$4,000 / $5,000
		VS	$10,000	$5,000 / $6,000
	NFO	VAL/VFA	$10,000	$5,000 / $6,000
		VAQ	$4,000	$2,000 / $3,000
		VAW	$4,000	$2,000 / $3,000
		VF	$4,000	$2,000 / $3,000
		VQ (Prop)	$4,000	$2,000 / $3,000
1990	Pilot	HC, HSL	$9,000	$4,500
		HM, HS	$6,000	$3,000
		VAL/VFA	$12,000	$6,000
		VF	$12,000	$6,000
		VAM	$12,000	$6,000
		VAQ	$12,000	$6,000
		VAW	$12,000	$6,000
		VP	$10,000	$5,000
		VQ (EW Jet)	$12,000	$6,000
		VQ (TACAMO/EP-3)	$10,000	$5,000
		VS	$12,000	$6,000
	NFO	VAL/VFA	$12,000	$6,000
		VAQ	$6,000	$3,000
		VAW	$6,000	$3,000
		VF	$6,000	$3,000
		VQ (TACAMO/EP-3)	$6,000	$3,000
1991	Pilot	HC, HSL	$9,000	$4,500
		HM, HS	$6,000	$3,000
		VF	$12,000	$6,000
		VAL/VFA	$12,000	$6,000
		VAM	$12,000	$6,000
		VAQ	$12,000	$6,000

Table 8. ACCP amounts—FY84 to FY06 (continued)

			ACCP amount per year	
Fiscal year	Pilot/ NFO	Community	Long-term agreements	Short-term agreements
		VAW	$12,000	$6,000
		VP	$10,000	$5,000
		VQ (EW Jet)	$12,000	$6,000
		VQ (TACAMO/EP-3)	$10,000	$5,000
		VS	$12,000	$6,000
	NFO	VAL/VFA	$12,000	$6,000
		VAQ	$6,000	$3,000
		VAW	$6,000	$3,000
		VF	$6,000	$3,000
		VQ (TACAMO/EP-3)	$6,000	$3,000
1992	Pilot	HC	$9,000	$4,500
		HS, HSL, HM	$6,000	$3,000
		VAL/VFA	$12,000	$6,000
		VAM	$12,000	$6,000
		VAQ	$12,000	$6,000
		VAW	$12,000	$6,000
		VF	$12,000	$6,000
		VP	$10,000	$5,000
		VQ (EW Jet)	$12,000	$6,000
		VQ (TACAMO/EP-3)	$10,000	$5,000
		VS	$12,000	$6,000
	NFO	VAL/VFA	$12,000	$6,000
		VAQ (NFO)	$3,000	$1,500
		VAW (NFO)	$3,000	$1,500
		VF (NFO)	$6,000	$3,000
		VQ (TACAMO/EP-3 NFO)	$3,000	$1,500
1993	Pilot	VA	$9,000[c]	n/a
		VAQ	$12,000	n/a
		VAW	$12,000	n/a
		VF	$12,000	n/a
		VFA	$12,000	n/a
		VQ (EW Jet)	$12,000	n/a
		VQ (TACAMO/EP-3)	$12,000	n/a
		VS	$9,000	n/a
1994	Pilot	HM	$9,000	n/a
		VF	$6,000	n/a

Table 8. ACCP amounts—FY84 to FY06 (continued)

Fiscal year	Pilot/ NFO	Community	ACCP amount per year: Long-term agreements	ACCP amount per year: Short-term agreements
		VFA	$12,000	n/a
		VAQ	$12,000	n/a
		VQ (EW Jet)	$12,000	n/a
		VQ (TACAMO/EP-3)	$12,000	n/a
		VS	$12,000	n/a
1995	Pilot	VAQ	$12,000	n/a
		VAW	$4,000	n/a
		VFA	$12,000	n/a
		VQ (EW Jet)	$9,000	n/a
		VQ (TACAMO)	$12,000	n/a
		VS	$9,000	n/a
1996	Pilot	VAQ (EA-6)	$12,000	n/a
		VAW (E-2/C-2)	$8,000	n/a
		VF (F-14)	$12,000	n/a
		VFA (F/A-18)	$12,000	n/a
		VQ (ES-3)	$12,000	n/a
		VQ (E-6A)	$12,000	n/a
		VS (S-3)	$12,000	n/a
1997	Pilot	HS: SH-60F/SH-3H	$10,000	n/a
		VAW: EA-6	$12,000	n/a
		VF: F-14	$12,000	n/a
		VFA: F/A-18	$12,000	n/a
		VQ: EP-3	$9,000	n/a
		VQ: E-6A	$12,000	n/a
		VS: S-3	$12,000	n/a
	NFO	VAW: EA-6	$12,000	n/a
		VFA: F/A-18	$12,000	n/a
		VQ: EP-3	$12,000	n/a
1998	Pilot	VAQ	$19,000	n/a
		VAW	$10,000	n/a
		VF	$17,000	n/a
		VFA	$17,000	n/a
		VP	$10,000	n/a
		VS	$19,000	n/a
	NFO	VAQ	$10,000	n/a
1999		All Aviators	n/a	$12,000
2000	Pilot	All Pilots	$25,000	$15,000

Table 8. ACCP amounts—FY84 to FY06 (continued)

Fiscal year	Pilot/ NFO	Community	ACCP amount per year: Long-term agreements	ACCP amount per year: Short-term agreements
2000	NFO	All NFOs	$15,000	$15,000
2001	Pilot	All Pilots	$25,000	$15,000
2001	NFO	All NFOs	$15,000	$15,000
2002	Pilot	All Pilots	$25,000	$15,000 / $25,000
2002	NFO	All NFOs	$15,000	$15,000
2003	Pilot	All Pilots	$25,000	$15,000 / $25,000
2003	NFO	All NFOs	$15,000	$15,000
2004	Pilot	All Pilots	$25,000	$15,000 / $25,000
2004	NFO	All NFOs	$15,000	$15,000
2005	Pilot	All Pilots	$25,000	$15,000
2005	NFO	All NFOs	$15,000	$15,000
2006		All Aviators	$25,000	$15,000

a. For the years 1985-1987, the eligible communities were listed by primary AQD—the Additional Qualification Designation. It specifies which platforms the aviators are qualified to fly.

b. Eligibility for VF and VS NFOs expired on March 31, 1988.

c. The eligibilty of VA pilots expired on May 15, 1993.

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Appendix B: Regressions

Table 9 lists the coefficients and standard errors for each variable in our baseline pilot retention model, estimated using a standard logistic regression. The fourth column presents the probability that the sample coefficient is equal to zero, and is used to determine the statistical significance of each estimate. For example, a probability less than 0.01 means that zero lies outside the 99-percent confidence interval for this estimate. The coefficient on the ACOL variable is used to generate our estimates of the pay effects listed in table 5.

Table 9. Logit results—baseline pilot retention model

Independent variable	Coefficient	Standard error	Probability coefficient equals zero
ACOL	0.060	0.010	0.000
Civilian major airline hires	0.000	0.000	0.000
Propeller	-0.363	0.075	0.000
Helicopter	0.877	0.089	0.000
VA platform	0.520	0.147	0.000
VQ-PROP platform	-0.392	0.224	0.081
VQ-TAC platform (jet)	-1.145	0.285	0.000
VQ-TAC platform (prop)	-0.672	0.170	0.000
3 years of service	5.439	1.030	0.000
4 years of service	6.642	0.892	0.000
5 years of service	4.891	0.856	0.000
6 years of service	4.052	0.842	0.000
7 years of service	3.670	0.835	0.000
8 years of service	3.248	0.819	0.000
9 years of service	3.241	0.822	0.000
10 years of service	2.591	0.748	0.001
11 years of service	2.465	0.752	0.001
12 years of service	1.647	0.764	0.031
13 years of service	1.427	0.789	0.071
O-2	0.157	0.745	0.833
O-3	-0.719	0.486	0.139

Table 9. Logit results—baseline pilot retention model (continued)

Independent variable	Coefficient	Standard error	Probability coefficient equals zero
Female	-0.267	0.183	0.144
Married	0.134	0.067	0.044
With Children	0.186	0.069	0.007
Age	-1.247	0.375	0.001
Age Squared	0.020	0.006	0.001
Black	-0.260	0.197	0.188
Hispanic	0.060	0.188	0.751
Other ethnicity	0.061	0.213	0.775
Prior Enlisted	-0.129	0.090	0.148
Naval Academy	0.635	0.119	0.000
OCS	-0.248	0.096	0.010
NROTC	0.366	0.110	0.001
Unemployment rate	0.029	0.075	0.700
FY85	-0.594	0.170	0.000
FY86	0.473	0.191	0.013
FY87	-0.593	0.138	0.000
FY88	-0.580	0.122	0.000
FY89	-0.811	0.197	0.000
FY91	-0.834	0.170	0.000
FY92	-0.105	0.140	0.452
FY93	0.610	0.182	0.001
FY94	-0.040	0.235	0.866
FY95	0.039	0.236	0.867
FY96	0.300	0.216	0.166
FY97	-0.213	0.233	0.359
FY98	-0.431	0.166	0.009
Constant	20.715	5.747	0.000
Sample size	10,719		

Table 10 lists the coefficients and standard errors for each variable in our pilot retention model with separate effects for helicopter, jet, and propeller pilots, estimated using a standard logistic regression. The fourth column presents the probability that the sample coefficient is equal to zero and is used to determine the statistical significance of each estimate. For example, a probability less than 0.01 means that zero lies outside the 99-percent confidence interval for this estimate.

The coefficients on the ACOL variables are used to generate our estimates of the pay effects listed in table 6.

Table 10. Logit results—pilot retention model with separate effects for helicopter, jet, and propeller pilots

Independent variable	Coefficient	Standard Error	Probability coefficient equals zero
ACOL (Jet)	0.036	0.014	0.008
ACOL (Propeller)	0.071	0.014	0.000
ACOL (Helicopter)	0.052	0.029	0.069
Civilian major airline hires (Jet)	0.000	0.000	0.109
Civilian major airline hires (Propeller)	0.000	0.000	0.236
Civilian major airline hires (Helicopter)	0.000	0.000	0.939
VA Platform	0.449	0.153	0.003
VQ-PROP Platfom	-0.393	0.229	0.087
VQ-TAC Platform (Jet)	-1.583	0.295	0.000
VQ-TAC Platform (Propeller)	-0.728	0.174	0.000
3 years of service	5.046	1.063	0.000
4 years of service	6.211	0.928	0.000
5 years of service	4.421	0.894	0.000
6 years of service	3.650	0.879	0.000
7 years of service	3.271	0.870	0.000
8 years of service	2.807	0.855	0.001
9 years of service	2.758	0.851	0.001
10 years of service	2.269	0.778	0.004
11 years of service	2.181	0.775	0.005
12 years of service	1.252	0.792	0.114
13 years of service	1.155	0.801	0.150
O-3	-0.809	0.565	0.152
O-4	-0.071	0.748	0.925
Female	-0.278	0.184	0.130
Married	0.134	0.067	0.046
With Children	0.184	0.069	0.008
Age	-1.158	0.377	0.002
Age Squared	0.019	0.006	0.002
Black	-0.256	0.199	0.198
Hispanic	0.055	0.189	0.771

Table 10. Logit results—pilot retention model with separate effects for helicopter, jet, and propeller pilots (continued)

Independent variable	Coefficient	Standard Error	Probability coefficient equals zero
Other ethnicity	0.076	0.215	0.722
Prior Enlisted	-0.102	0.091	0.263
Naval Academy	0.628	0.120	0.000
OCS	-0.260	0.097	0.007
NROTC	0.356	0.110	0.001
Unemployment rate (Jet)	-0.027	0.249	0.912
Unemployment rate (Propeller)	0.213	0.247	0.387
Unemployment rate (Helicopter)	0.145	0.129	0.261
FY85 (Jet)	-0.708	0.424	0.095
FY85 (Propeller)	-0.272	0.426	0.523
FY85 (Helicopter)	0.044	0.396	0.911
FY86 (Jet)	0.693	0.288	0.016
FY86 (Propeller)	0.166	0.304	0.587
FY86 (Helicopter)	0.392	0.613	0.522
FY87 (Jet)	-0.371	0.229	0.105
FY87 (Propeller)	-0.837	0.203	0.000
FY87 (Helicopter)	-0.226	0.352	0.520
FY88 (Jet)	-0.373	0.255	0.142
FY88 (Propeller)	-0.615	0.247	0.013
FY88 (Helicopter)	-0.494	0.321	0.124
FY89 (Jet)	-0.630	0.425	0.138
FY89 (Propeller)	-0.780	0.422	0.064
FY89 (Helicopter)	-0.063	0.482	0.896
FY91 (Jet)	-0.300	0.294	0.307
FY91 (Propeller)	-1.099	0.285	0.000
FY91 (Helicopter)	-0.507	0.420	0.227
FY92 (Jet)	-0.037	0.232	0.873
FY92 (Propeller)	-0.044	0.224	0.845
FY92 (Helicopter)	-0.036	0.317	0.911
FY93 (Jet)	0.716	0.294	0.015
FY93 (Propeller)	0.754	0.275	0.006
FY93 (Helicopter)	0.580	0.390	0.137
FY94 (Jet)	0.314	0.553	0.570
FY94 (Propeller)	0.529	0.538	0.326

Table 10. Logit results—pilot retention model with separate effects for helicopter, jet, and propeller pilots (continued)

Independent variable	Coefficient	Standard Error	Probability coefficient equals zero
FY94 (Helicopter)	-0.118	0.441	0.789
FY95 (Jet)	0.696	0.666	0.296
FY95 (Propeller)	0.142	0.642	0.825
FY95 (Helicopter)	0.315	0.428	0.461
FY96 (Jet)	0.651	0.614	0.289
FY96 (Propeller)	0.505	0.571	0.376
FY96 (Helicopter)	0.587	0.409	0.151
FY97 (Jet)	0.512	0.654	0.433
FY97 (Propeller)	-0.319	0.576	0.579
FY97 (Helicopter)	0.185	0.415	0.656
FY98 (Jet)	0.606	0.486	0.212
FY98 (Propeller)	-0.530	0.466	0.255
FY98 (Helicopter)	-0.644	0.309	0.037
FY99 (Jet)	0.418	0.585	0.476
FY99 (Propeller)	0.099	0.583	0.865
Constant	18.708	6.088	0.002
Sample size	10,719		

Finally, table 11 lists the coefficients and standard errors for each variable in our baseline NFO retention model, estimated using a standard logistic regression. The fourth column presents the probability that the sample coefficient is equal to zero, and is used to determine the statistical significance of each estimate. For example, a probability less than 0.01 means that zero lies outside the 99-percent confidence interval for this estimate. Since the coefficient on the ACOL variable is not statistically different from zero, we do not estimate a pay elasticity of NFO retention.

Table 11. Logit results—baseline NFO retention model

Independent variable	Coefficient	Standard Error	Probability coefficient equals zero
ACOL	-0.013	0.027	0.625
Jet	0.345	0.601	0.566
VA Platform	0.154	0.597	0.796
VAQ Platform	0.394	0.603	0.514
VAW Platform	0.435	0.413	0.292
VF Platform	0.169	0.593	0.775
VP Platform	0.466	0.382	0.222
VS Platform	0.222	0.592	0.707
VQ-JET Platform	0.425	0.679	0.532
VQ-PROP Platform	0.301	0.453	0.507
VQ-TAC Platform	1.173	0.506	0.020
4 years of service	-2.955	0.738	0.000
5 years of service	-3.194	0.747	0.000
6 years of service	-3.250	0.767	0.000
7 years of service	-3.817	0.813	0.000
8 years of service	-3.083	0.972	0.002
9 years of service	-3.039	1.157	0.009
10 years of service	-3.761	1.709	0.028
O-2	-2.576	1.516	0.089
O-3	-0.085	1.435	0.953
Female	-0.910	0.350	0.009
Married	0.202	0.128	0.115
With Children	-0.184	0.137	0.178
Age	-1.851	0.814	0.023
Age Squared	0.032	0.013	0.015
Black	0.549	0.469	0.242
Hispanic	0.125	0.302	0.678
Other ethnicity	0.271	0.329	0.409
Prior Enlisted	0.031	0.197	0.876
Naval Academy	-0.255	0.274	0.352
NFO Candidate	-0.585	0.259	0.024
NROTC	0.038	0.271	0.887
Unemployment rate	0.052	0.107	0.629
FY85	0.480	0.336	0.153
FY86	0.974	0.385	0.012
FY87	0.073	0.291	0.801
FY88	0.341	0.344	0.320

Table 11. Logit results—baseline NFO retention model (continued)

Independent variable	Coefficient	Standard Error	Probability coefficient equals zero
FY89	-0.001	0.339	0.997
FY90	0.313	0.353	0.375
FY91	0.073	0.298	0.806
FY92	0.256	0.312	0.411
FY93	0.020	0.321	0.949
FY94	-0.791	0.281	0.005
FY95	-0.904	0.299	0.002
FY96	0.002	0.325	0.994
FY97	-0.210	0.363	0.562
FY98	-0.313	0.336	0.352
Constant	31.949	12.425	0.010
Sample size	5,550		

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Appendix C: Results of the baseline models

We present the marginal effects from our baseline models for pilots and NFOs separately (appendix B). The independent variables are divided into three categories: characteristics of military service, demographic characteristics, and fiscal year effects.

The interpretation of the marginal effects depends on whether the variable can assume a range of values or is an indicator variable, which can either be zero or one. The marginal effects on variables that can have a range of values, such as age, indicate the percentage-point change in retention given a one-unit change in the variable, holding all other independent variables constant. The marginal effects for indicator variables, such as accession source, measure the percentage-point change in retention for people with that characteristic relative to a comparison group, again holding all other independent variables constant.

Pilots

Characteristics of military service

Table 12 presents the estimates for the effects of military characteristics on aviator retention. The predicted probability for each variable represents the retention rate if all pilots in the model had that characteristic; therefore, the 0.92 predicted probability for helicopter pilots means that, if all pilots were helicopter pilots, retention would be 92 percent. The marginal effects represent the percentage-point differences in retention between a characteristic and a reference group. For example, the marginal effect of -0.14 on propeller pilots means that the probability of a pilot staying is 14 percentage points lower for a propeller pilot than for an helicopter pilot, all else equal. The percentage change column displays the change in retention as a percentage. The 14-percentage-point difference between helicopter and propeller pilots implies that propeller pilots have retention that is 15 percent below that of helicopter pilots.

Table 12. Marginal effects of significant military variables—Pilot model

Independent variable	Predicted probability	Marginal effect	Percentage change
Platform/community			
Helicopter	0.92		
Propeller	0.78	-0.14	-15
VQPROP subcommunity	0.71	-0.07	-7
VQTAC (prop) subcommunity	0.66	-0.12	-13
Jet	0.83	-0.09	-10
VA subcommunity	0.89	0.06	6
VQTAC (jet) subcommunity	0.64	-0.19	-21
Years of service			
4 years of service	0.98		
5 years of service	0.89	-0.09	-9
6 years of service	0.80	-0.18	-18
7 years of service	0.74	-0.24	-25
8 years of service	0.66	-0.32	-32
Accession source			
Other Accession Source	0.82		
Naval Academy	0.89	0.07	8
Officer Candidate School	0.79	-0.03	-4
NROTC	0.87	0.05	5

Platform/community

The marginal effects show that helicopter pilots have retention that is 14 percentage points higher than propeller pilots and 9 percentage points higher than jet pilots. One hypothesis consistent with this result is that we did not perfectly specify civilian earnings opportunities for these different types of pilots. We implicitly assumed that all pilots, regardless of platform, faced the same probability of being hired as a pilot by a major airline. If helicopter pilots are less likely to be hired for these positions, our estimates of civilian earnings overstate the earnings opportunities for helicopter pilots. However, this hypothesis also implies that we would observe higher retention of propeller pilots than of jet pilots. In fact, our estimates show the opposite, with propeller pilot retention 5 percentage points *lower* than jet pilot retention.

For both jet pilots and propeller pilots, we also observe significant differences in retention for a few different types of pilots. Jet pilots in the VA subcommunity are 6 percent more likely to stay than all other jet pilots; those in the VQ-TAC subcommunity are 21 percent less likely to stay. Similarly, propeller pilots in the VQ-PROP (VQ-TAC) subcommunity are 7 (13) percent less likely to stay than all other propeller pilots.

Years of service

Table 13 shows the distribution of years of service within the sample population of pilots. As table 13 shows, there are relatively few observations outside the 4- to 8-year range. While we include all observations in our model of pilot retention, the small sample sizes in this table lead us to present only marginal effects for people with 4 to 8 years of service.

Table 13. Years of service distribution—pilots

Years of service	Frequency	Percentage
3	304	2.8
4	856	8.0
5	3,578	33.4
6	3,825	35.7
7	1,066	9.9
8	734	6.8
9	178	1.7
10	70	0.7
11	42	0.4
12	28	0.3
13	24	0.2
14	14	0.1

The marginal effects of years of service show a negative relationship between retention and the amount of time that a person has spent in the Navy. Since we measure retention for personnel approaching completion of their minimum service requirements, this result implies a negative relationship between retention and length of MSR. For example, all else equal, a pilot reaching MSR in the 8th year of service is 32 percent less likely to stay than a servicemember reaching MSR in the 4th year of service.

Accession source

The marginal effects for our accession source variables indicate that officers who attended the Naval Academy or participated in a NROTC program are significantly more likely to stay in the Navy than officers who accessed through Officer Candidate School. These results are consistent with well-known differences in retention by accession source. While we find significant differences by accession source, note that we find no significant differences in retention between pilots who were and were not prior enlisted personnel.

Paygrade

We do not find significant differences in retention by paygrade. There are two probable explanations for this finding. First, as table 14 shows, virtually all pilots are O-3s at the completion of their minimum service requirements. This lack of variation in the data makes it less likely that we would find significant differences in retention. Second, our estimates of relative military compensation incorporate information about a person's paygrade. A reasonable interpretation, then, is that there are no differences in retention by paygrade, above and beyond the effect of paygrade on expected military earnings.

Table 14. Paygrade distribution - pilots

Paygrade	Frequency	Percentage
O-2	350	3.3
O-3	10,211	95.3
O-4	158	1.5

Demographic characteristics

Marginal effects for the statistically significant demographic characteristics can be found in table 15.

Table 15. Marginal effects of significant demographic variables—pilot model

Independent variable	Predicted probability	Marginal effect	Percentage change
Marital status			
Married	0.84		
Single	0.83	-0.01	-2
Dependent status			
With Children	0.85		
No Children	0.83	-0.02	-3
Other characteristics			
Age	0.84	-0.01	

Dependency status

Married pilots are more likely to stay in the Navy than single pilots, all else equal. These differences, while statistically significant, are relatively small; predicted retention of single pilots is only 2 percent lower than that of married pilots. We observe a similar difference between retention of pilots with and without dependents. Therefore, our model predicts relatively high retention for married pilots with children, and relatively low retention for single pilots without children. However, we note that these retention differences are significantly smaller than differences by platform or by years of service.

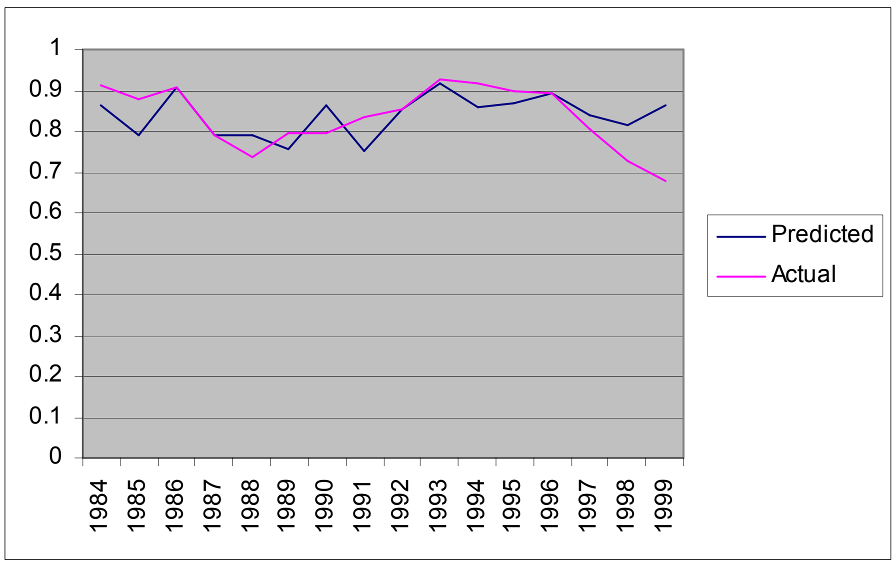
Other characteristics

We find a modest relationship between a pilot's age and the probability of retention; the marginal effect shows that, all else equal, pilot retention decreases by about 1 percentage point per year as pilots get older. In contrast, we do not find significant differences in retention by gender or by race / ethnicity. However, there are very few non-white pilots, and the percentage of female pilots is even lower.

Fiscal year effects

Figure 10 shows the comparison of actual and predicted retention rates, using the marginal effects of fiscal year to calculate the predicted values. The differences between the predicted and actual values stem from independent variables that were not controlled for in the regression.

Figure 10. Actual and predicted pilot retention, by fiscal year



NFOs

Characteristics of military service

Table 16 presents the estimates for the effects of military characteristics on NFO retention. The predicted probability for each variable represents the retention rate if all NFOs in the model had that characteristic.

Platform/community

There was no significant difference between retention of jet NFOs versus propeller NFOs, all else equal. Within the subcommunities, only those NFOs in the VQ-TAC subcommunity displayed different retention patterns, as the VQ-TAC NFOs were 7 percent more likely to stay in the Navy.

Table 16. Marginal effects of significant military variables—NFO model

Independent variable	Predicted probability	Marginal effect	Percentage change
Platform/community			
All other communities	0.91		
VQTAC	0.97	0.06	7
Years of service			
4 years of service	0.94		
5 years of service	0.93	-0.01	-1
6 years of service	0.92	-0.02	-2
7 years of service	0.88	-0.06	-7
Paygrade			
All other paygrades	0.94		
O-2	0.58	-0.36	-39
Accession source			
All other accession sources	0.95		
NFO Candidate School	0.91	-0.04	-4

Years of service

Table 17 shows the distribution of years of service within the sample population of NFOs. As the table shows, there are relatively few observations outside the 4- to 7-year range. While we include all observations in our model of NFO retention, the small sample sizes in table 17 lead us to present only marginal effects for personnel with between 4 and 7 years of service.

As in the pilot regression, there is a negative relationship between retention and years of service, indicating a negative effect of longer service requirements. The effects are less severe in the NFO model, as an NFO who reaches the decision point at 7 years of service is 7 percent less likely to stay than an otherwise identical NFO who reaches the decision point at 4 years of service.

Table 17. Years of service distribution - NFOs

Years of Service	Frequency	Percent
3	133	2.39
4	671	12.04
5	2,309	41.44
6	1,692	30.37
7	618	11.09
8	75	1.35
9	44	0.79
10	15	0.27
11	7	0.13
12	4	0.07
13	3	0.05
14	1	0.02

Paygrade

The paygrade distribution for NFOs is similar to that of pilots, with 96.6 percent of our sample population having the grade of O-3. However, there is a significant effect in our regression of being an O-2, with those NFOs 39 percent less likely to stay, all else equal. This is quite a large effect, especially when noting that only 2.8 percent of the sample population are O-2s at the decision point.

Accession source

The only significant variable in the NFO regression related to accession source was the NFO Candidate School indicator. The marginal effect implies that officers entering through the NFO Candidate School are 4 percent less likely to stay in the Navy than NFOs who entered through other sources. There was no significant difference between those who were and were not prior enlisted personnel.

Demographic characteristics

Marginal effects for the statistically significant demographic characteristics can be found in table 18.

Table 18. Marginal effects for significant demographic variables—NFO model

Independent variable	Predicted probability	Marginal effect	Percentage change
Gender			
Male	0.93		
Female	0.85	-0.08	-9
Other characteristics			
Age	0.93	0.00	

Gender

Unlike the pilot regression, the gender variable was significant in the NFO regression, with women having significantly lower retention than men, all else held constant. Female NFOs were 9 percent less likely to stay in the Navy than male NFOs.

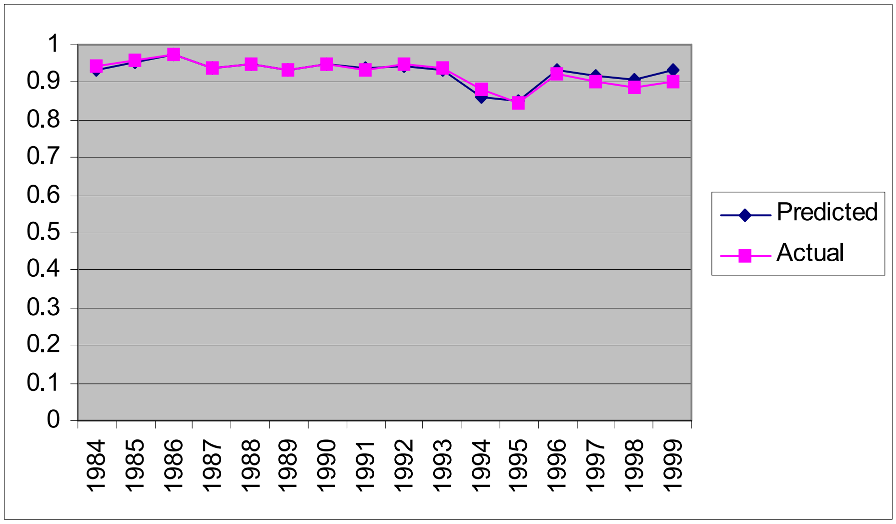
Other characteristics

The marginal effect of age on NFO retention is positive, but very slight. An additional year of age increases NFO retention by 0.3 percentage point. We do not, however, find any significant effects of race/ethnicity, marital status, or dependency status.

Fiscal year effects

Figure 11 shows the comparison of actual and predicted NFO retention rates, using the marginal effects of fiscal year to calculate the predicted values. The differences between the predicted and actual values stem from independent variables that were not controlled for in the regression. As one can see from figure 11, the predicted and the actual retention rates track very well, which implies that our included independent variables do not explain much of the variation from year to year.

Figure 11. Actual and predicted NFO retention, by fiscal year



List of figures

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