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**THE RETENTION AND PERFORMANCE OF U.S.
NAVAL OFFICERS WITH FUNDED AND
SELF-FUNDED GRADUATE DEGREES**

Pitzel, Benjamin F.

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**NAVAL
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MONTEREY, CALIFORNIA

THESIS

**THE RETENTION AND PERFORMANCE OF U.S.
NAVAL OFFICERS WITH FUNDED AND SELF-FUNDED
GRADUATE DEGREES**

by

Benjamin F. Pitzel

March 2018

Thesis Advisor:
Co-Advisor:

Simona Tick
William Hatch

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**THE RETENTION AND PERFORMANCE OF U.S. NAVAL OFFICERS WITH
FUNDED AND SELF-FUNDED GRADUATE DEGREES**

Benjamin F. Pitzel
Lieutenant, United States Navy
B.S., University of North Carolina at Charlotte, 2008

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

**NAVAL POSTGRADUATE SCHOOL
March 2018**

Approved by: Simona Tick
 Thesis Advisor

William Hatch
Co-Advisor

Yu-Chu Shen
Academic Associate
Graduate School of Business and Public Policy

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ABSTRACT

The U.S. Navy offers funded graduate education to its officers in order to compete for talent and meet its current and future manpower needs. Opportunities exist both in military and civilian educational institutions to produce a well-educated and balanced group of men and women equipped to make sound decisions when facing unprecedented threats that affect the Navy's mission. This thesis uses a multivariate analysis approach to examine retention and promotion rate differences for officers with graduate degrees, considering the educational institution and whether it is civilian or military, the officer designator, and the timing of the graduate education. The analysis focuses on naval officers with degrees from Navy commissioned cohorts 1997 to 2002, followed annually until separation, or until 2017. The findings show that in the Unrestricted Line community, officers with funded graduate degrees have higher twelve- and fifteen-year retention and higher O4 and O5 promotion rates than officers with self-funded graduate degrees. In the Restricted Line and Staff community, officers with funded graduate degrees have only slightly better rates of fifteen-year retention and O4 promotion outcomes when compared with officers with self-funded graduate degrees.

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LIST OF ACRONYMS AND ABBREVIATIONS

E-6	First Class Petty Officer
E-7	Chief Petty Officer
E-8	Senior Chief Petty Officer
O-1	Ensign (Navy)
O-2	Lieutenant, Junior Grade (Navy)
O-3	Lieutenant (Navy)
O-4	Lieutenant Commander (Navy)
O-5	Commander (Navy)
O-6	Captain (Navy)
BUPERS	Bureau of Naval Personnel
CIVINS	Civilian Institutions
CNA	Chief of Naval Analyses
CWO	Chief Warrant Officer
DMDC	Defense Manpower Data Center
DOD	Department of Defense
EOD	Explosive Ordnance Disposal
FSEP	Fleet Scholar Education Program
FTS	Full Time Support
JAG	Judge Advocate General
JMILINTEL	Joint Military Intelligence University
JPME	Joint Professional Military Education
LDO	Limited Duty Officer
MECP	Medical Enlisted Commissioning Program
MILPERSMAN	<i>Naval Military Personnel Manual</i>
MPN	Military Personnel Navy
NAVADMIN	Navy Administrative Message
NDU	National Defense University
NPC	Navy Personnel Command
NPS	Naval Postgraduate School
NROTC	Naval Reserve Officer Training Corps
NWC	Naval War College

OCS	Officer Candidate School
OPINS	Officer Personnel Information System
OPNAVINST	Office of the Chief of Naval Operations Instruction
ppts	Percentage Points
RL	Restricted Line
RAND	Research and Development Company
ROI	Return on Investment
ROTC	Reserve Officer Training Corps
SEABEE	Civil Engineer
SEAL	Special Warfare Officer
SECDEF	Secretary of Defense
SELRES	Selected Reserve
STA-21	Seaman to Admiral-21 Program
SUB	Submarine Warfare Officer
SWO	Surface Warfare Officer
SWOCP	SWO Continuation Pay
URL	Unrestricted Line
USAFA	United States Air Force Academy
USNA	United States Naval Academy
USU	Uniformed Services University
VGEP	Voluntary Graduate Education Program
YOS	Years of Service

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I. INTRODUCTION

The Navy's fully funded graduate education programs represent a strategic investment in human capital. In an era of constrained resources, the Navy must ensure that this investment yields a positive return to the organization. The Department of Defense (DOD) requires officers with fully or partially funded graduate education to serve in a "pay-back" tour. OPNAV Instruction 1520.23C, *Graduate Education* dictates that upon completion of funded graduate education officers incur, typically, a three-year service obligation.

This thesis examines retention and promotion of officers with Navy-funded graduate degrees obtained from both civilian and military institutions. This thesis takes a quantitative multivariate analysis approach using individual-level data on Navy officers commissioned between 1997 and 2002, followed annually through September 2017, or until separation. The findings of this thesis provide a baseline for evaluating the retention impact of the current expansion of the civilian institutions' (CIVINS) quotas.

The research questions addressed in this thesis are as follows.

1. What are the current retention rates for officers with Navy-funded graduate degrees? How do they differ by type of educational institution (civilian versus military), designator, and timing of graduate education, among other factors?
2. What factors explain any differences in retention and job performance among naval officers with, and without, funded graduate education?

The main goal of this study is to examine the returns from funded graduate education obtained from civilian and military institution. In FY16, the quota of officers sent to elite civilian institutions (CIVINS) has increased significantly as compared with previous years. This study aims to generate a baseline for CIVINS retention expectations by examining historical data on promotion and retention of officers who obtained their Navy-funded graduate degrees at military and civilian institutions. To observe the officers over a sufficient number of years past their graduate school graduation date, this study uses data on officers who commissioned in the Navy in fiscal years 1997 to 2002, observed annually until September 2017, or until the officers left the Navy.

As discussed in previous work (Bowman & Mehay, 1999) an analysis of the effect of attaining a graduate degree on retention and promotion needs to account for the selection bias that may be present in the estimates. Selection for funded graduate education is based on established criteria, and is not the result of a random assignment process. There is potential selection bias when attempting to estimate the effects of funded graduate education on retention and promotion rates of naval officers. Officers who obtained graduate degrees may have characteristics (observed and unobserved, such as ability and motivation) that set them apart from officers without graduate degrees. This thesis does not have access to detailed data that could be used to address the selection bias and provide more accurate estimators of causal effect of funded graduate education on retention and promotion rates. Therefore, this thesis presents only summary statistics on retention and promotion rate differences among officers with and without graduate degrees, while focusing its multivariate analysis on retention and promotion outcomes among officers with graduate degrees, whether from military or civilian institutions, funded or self-funded.

The remainder of this thesis is organized into five chapters. Chapter II discusses the many aspects of returns to graduate education, presents naval officer career paths and the different opportunities for funded graduate education available for naval officers' communities. Chapter III reviews previous literature on retention and promotion of Navy officers with graduate education. Chapter IV describes the data set and presents descriptive statistics. Chapter V presents the multivariate analysis models and discusses the results. Chapter VI presents the conclusions and recommendations.

II. BACKGROUND

Under the “Design to Maintain Maritime Superiority” mission and “Sailor 2025” initiatives, the Navy is increasing its efforts to manage its talent through a diverse set of policies. These policies include the use of Navy-funded graduate education as a strategic human capital investment to recruit, promote, and retain the most talented and diverse officers. The Navy invests time and money into graduate education for service members in order to compete for talent, and meet its current and future manpower needs. Navy officers have opportunities to pursue Navy-funded graduate degrees in both military and civilian educational institutions. How can the Navy improve its investment and future returns on these investments? What policy changes have the most potential for improving the returns to funded graduate education?

The need for graduate education in the U.S. Navy comes from specific graduate-level job requirements. Officers with graduate degrees can fill positions whose duties require specific expertise and critical thinking skills acquired in graduate school. Sending officers to graduate education institutions is costly to the Navy in terms of pay and allowances, but also in terms of opportunity cost incurred. During graduate education, the officer’s service is lost to an operational billet, and the officer acquires no mission experience. When officers graduate, whether from a funded or self-funded graduate program, the return on investment is that the graduate will return to his or her service with a set of advanced skills to enhance mission accomplishment. The Department of Defense (DOD) requires officers with funded graduate degrees to serve in a “pay-back” tour, which is typically an additional three years of obligated service per OPNAV Instruction 1520.23C, *Graduate Education*.

This chapter discusses the different dimensions of the returns on investment the Navy gains from officers acquiring graduate education. The chapter also presents the timeline of milestones in a naval officer’s career to highlight the timing of opportunities for funded graduate education for different naval officer communities and the minimum service requirements for each funded graduate education program.

A. RETURN ON INVESTMENT IN FUNDED GRADUATE EDUCATION

The discussion on return on investment from graduate education presented here is divided into four sections. The first is the “Human Capital” section, which discusses technical skills and competencies acquired through graduate education as a form of investment in human capital. The second section, on “Social Capital,” discusses the social dimension, of bonding and bridging of networks gained while attending graduate education. The third section, “Impact,” considers the aspect of return on investment that may show as enhanced performance, promotion, and retention of naval officers with graduate degrees. The fourth section, “Pay Incentive,” discusses monetary or cost benefits of graduate education. The Office of the Chief of Naval Operations Instruction states that a Navy graduate education encourages professional knowledge, technical competence, and individual aspirations rewarded with distinctive sub-specialty skills, outlined in the 1991 Chief of Naval Operations Instruction (OPNAVINST) 1520.23B, *Graduate Education*.

1. Human Capital

Graduate education is more than a tool to fill billets; it is meant to increase future officers’ abilities by financing progressive incentives to produce dedicated officers with the needed skills and capacities, as detailed in a 2008 Department of Defense (DOD) Instruction 1322.10, *Policy on Graduate Education for Military Officers*. Human capital is a measure of positive or negative technical skills and positive or negative general competencies as discussed in *Evaluating Navy’s Funded Graduate Education Program a Return-On-Investment Framework* by Kamarck, Thie, Adelson, and Krull (2010).

The U.S. Navy's funded graduate education programs represent a strategic investment in human capital to help meet the Navy’s current and future manpower needs. This type of investment in human capital generates returns in the form of increased abilities of naval officers to think critically and to make quicker and more effective decisions in an increasingly dynamic global environment. Upon graduation, officers with graduate degrees are expected to have higher productivity on the job, higher retention rates and higher promotion rates as compared with officers without graduate

degrees. This is due to the selection effect (acceptance into graduate programs accounts for skills, ability and future performance potential of each officer) as well as the human capital accumulated during graduate education programs. This thesis will examine the retention and promotion rates of Navy officers with graduate degrees that are Navy funded or self-funded.

2. Social Capital

Kamarck et al. (2010) discuss another form of returns from graduate education, supported by the social capital theory. This other by-product of graduate education describes the gains in social networks and trust acquired during graduate school. These gains are intangible, and, therefore, difficult to measure. These difficult-to-measure resources gained through graduate education are the social facilitators to the Navy's collective whole. The social capital gained from a graduate education may be positive or negative, depending on the group. If the group members work well with each other, they will create a bond and continue to strengthen. If the group members do not work well, or one member of the group is an outsider, the group and bonding deteriorates. An officer attending graduate education might form bonds at school with different communities, civilians, other military branches or foreign militaries. At the same time, the officer may be losing bonds from his or her own community. Bridging uses different personnel from different communities to intermingle and connect individuals. Bridging builds from bonding. An example would be an officer meeting another officer in graduate school and then later in their career are able to assist in some way. These bridges and bonds develop throughout the educational process, and enable officers to increase their overall efficiency of knowledge. The officers gain a social return on investment and in return help the overall efficiency of the Navy and other services.

The Naval Postgraduate School (NPS) provides the largest military graduate-educated social network, with over 1,400 resident graduate students from all services, including foreign militaries and civilians, as detailed in a 2016 *NPS Fact Sheet*. No other graduate education facility incorporates as large a military social network. The Naval War College (NWC) has approximately 600 resident graduate students, noted in *NWC Fact Sheet 2017*. Those attending NPS and NWC may attain network advantages over

their peers; this could lead to positive career outcomes, such as enhanced promotion rates by networking with peers and leaders.

3. Impact

The human and social capital increases through graduate education may be predictors of career impact. The most notable and measurable factor of return on investment discussed by Kamarck et al. (2010) is the impact, a term to define how an individual officer's retention, utilization, performance, and promotion affect the military.

An expectation of Navy's return to investment (ROI) is that officers receiving funded, or partially funded graduate education, fulfill as many sub-specialties coded billets associated with their education, as their community permits, following graduate education. If they fill a sub-specialty-coded billet, they are positively affecting the military by utilizing their education and contributing to improving the Navy's overall mission. Officers who receive orders to sub-specialty-coded positions are expected to use their education and perform well in their positions, positively affecting their performance records, which lead to promotions, which may improve the Navy's overall mission.

Retention is defined as remaining in the Navy upon completion of a minimum service obligation, and beyond. Officers wishing to participate in graduate education make the decision to attend Navy-funded graduate education around the end of their first service obligation. To recoup some of the investment in graduate education, the Navy required a pay-back tour. Each graduate education curriculum has different additional service obligations, typically three-year obligation, based on the length of the program. If the officers with funded graduate degrees remain in the Navy beyond their obligated service, this can enhance the Navy's ROI. This thesis will examine this particular aspect of the returns to investment in graduate education, as measured by rates of retention and promotion among officers with graduate degrees, Navy funded or self-funded, from military or civilian institutions.

4. Incentive Pay

The last section is the cost level. What does it cost to send an officer to graduate education, and what return does the military attain? Kamarck et al. (2010) estimate the cost of graduate education at \$245,000 for an eighteen-month program. The majority of graduate education programs are twelve-month to twenty-four month programs.

When officers examine military graduate education, some may consider the future and the educational benefit, but most see graduate education as a check in the box for promotion, and promotion leads to a larger salary. For some communities, specific graduate education may open career opportunities, but for other community's milestone career paths override a specific graduate education.

A student in the civilian sector shopping for graduate education looking to increase their salary would have to examine several factors. First, do I have the funds available to attain a graduate education, will I need a loan, or will my employer pay? Second, competing work time versus education time for classes. Third, what is the cheapest education with the largest salary increase? Finally, what degree would my employer value the most?

B. TYPICAL NAVY CAREER PATH AND OPPORTUNITIES FOR NAVY-FUNDED GRADUATE EDUCATION

An officer can commission into the U.S. Navy in several different ways: The United States Naval Academy (USNA), Officer Candidate School (OCS), Naval Reserve Officer Training Corps (NROTC), and Seaman to Admiral (STA-21), Chief Warrant Officer (CWO), Limited Duty Officer (LDO), Merchant Marine Academy (MMA), Medical Enlisted Commissioning Program (MECP) and Uniformed Services University (USU). Initial service obligations follow completion of these programs. The Secretary of Defense (SECDEF) defines these minimum service obligations as either six or eight years, composing of active and reserve components.

After officer's commission into the Navy, select into different designated communities. There are six major communities: Unrestricted Line (URL), Restricted Line (RL), Staff Corps, Reserve, LDO and CWO classified in the 2017 *Naval Military*

Personnel Manual (NAVPERS) 15839I. The first factor that attempts to explain the differences in retention is the time in which graduate education is available within a community’s career path. Each community has a different career path and experiences complications in terms of offering Navy-funded graduate education.

1. Unrestricted Line

The Unrestricted Line makes up the largest community with approximately forty-five percent of the Navy’s officer corps, and is the baseline framework for a naval career progression. The Unrestricted Line includes Aviation, Submarine Warfare (SUB), Surface Warfare (SWO), Special Warfare (SEAL), and Explosive Ordnance Disposal (EOD) Officers classified in the 2017 *Naval Military Personnel Manual* (NAVPERS) 15839I. Breaking URL community down further, an aviation officer spends the first four-and-a-half-years of service at flight training and then a sea duty, split between the ranks of Ensign (O-1) and Lieutenant Junior Grade (O-2). Following that tour there is a two-and-a-half-year shore duty. This shore duty is the first opportunity to receive a Navy-funded graduate education, shown in Figure 1. If aviators do not continue to actively fly, and choose to get a graduate education, between years six and ten, it hurts their career. Submarine Warfare Officers also attend training and then a sea duty followed by a shore duty as seen in Figure 2. Figures 1–5 are adapted from BUPERS active duty officer community brief 2017.

Figure 1. Aviation Officer Career Path. Source: BUPERS (2017).

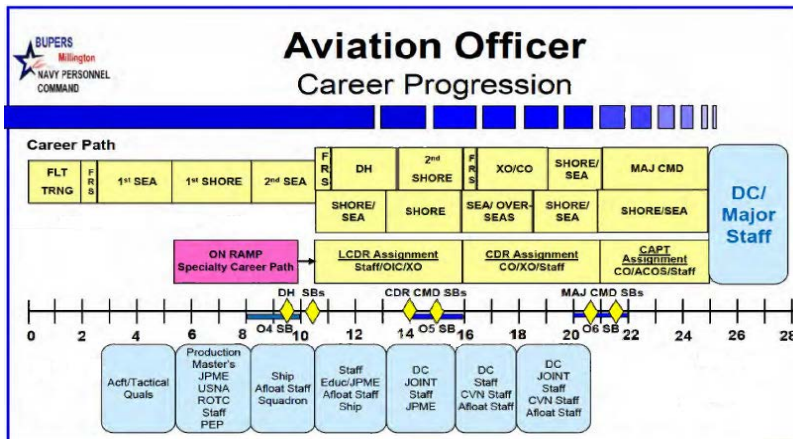
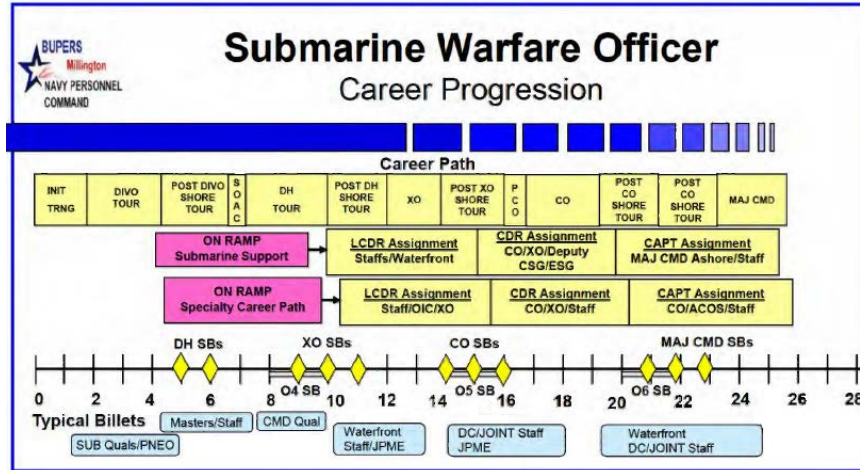


Figure 2. Submarine Warfare Officer Career Path. Source: BUPERS (2017).



A SWO spends the first four years of service (yos) on sea duty, typically split into two tours of two years (O-1 & O-2). After making Lieutenant (O-3), a SWO will go to a three-year shore duty. This shore duty is the first opportunity to receive a Navy-funded graduate education, shown in Figure 3. The SEAL path is quite similar to the SWO path depending if or when the officer lateral transfers into the special operations field, four-year period for Navy graduate education shore duty, exhibited in Figure 4. The only URL field that does not see shore duty until year six is EOD, which makes up less than two percent of the URL community and less than one percent of all officers.

Figure 3. Surface Warfare Officer Career Path. Source: BUPERS (2017).

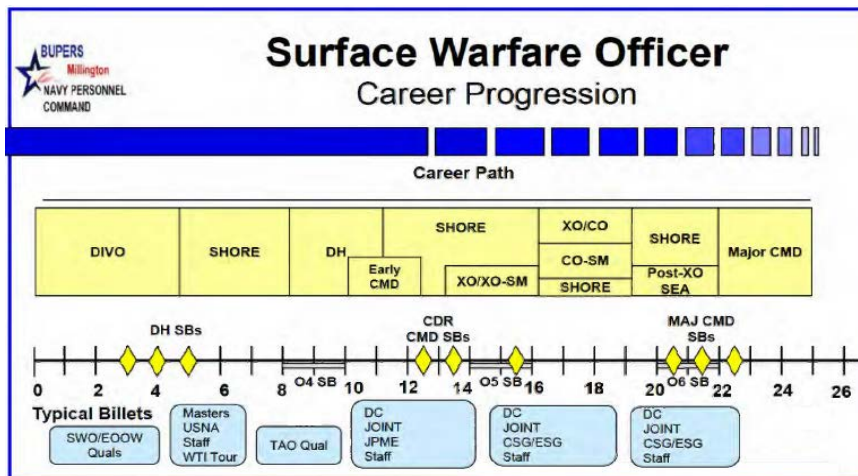
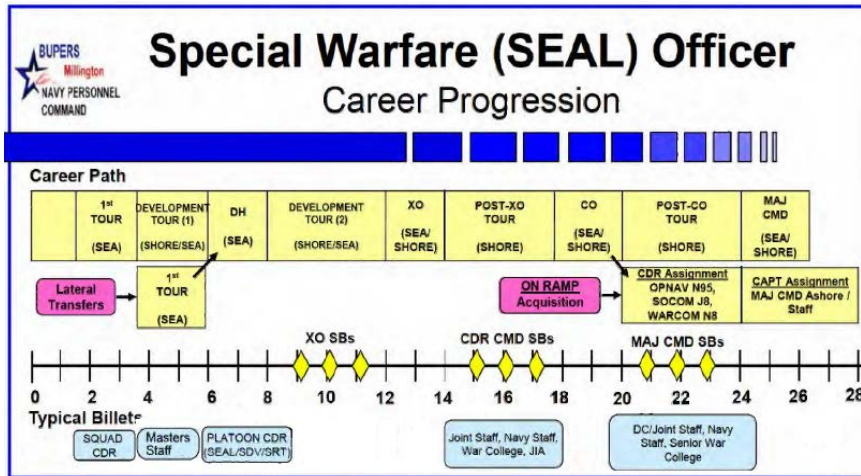


Figure 4. SEAL Officer Career Path. Source: BUPERS (2017).



Once an Unrestricted Line Officer graduates from a master’s program, the officer incurs a new service obligation based on the received education, typically three years, requiring graduates to remain through nine years of service. An officer will incur a three-year service obligation upon completion or withdrawal from a degree program or a one-year service obligation upon completion or withdrawal from a certificate program explained in a 2015 OPNAV Instruction 1520.23C, *Graduate Education*.

Traditionally, after graduate education or three years of shore duty, an Unrestricted Line Officer will proceed to three or four years as a department head at sea, during this time they will screen for the O-4 promotion. The second chance to receive Navy-funded graduate education would be at the eleven-year mark. However, at this point in a URL career, the goal is to proceed in career advancing billets, not attain a graduate education. For aviation and special warfare officers, billet and education timing overlap and causes separation. The next step in the career path is a four- or five-year shore duty where an officer will screen for O-5, and then four or five years back at sea. At twenty years, URL officers are eligible for retirement or screen for O-6. Continued careers proceed into another three-year shore tour, giving the URL officer a third chance to receive a Navy-funded graduate education. The next milestone is Major Command or a three-year sea duty. Most communities arrive at major command between the twenty-

second and twenty-fourth years of service. The URL career progression from 1997–2002 was very rigid. With the Sailor 2025 initiative, many different career paths are now open for graduate education.

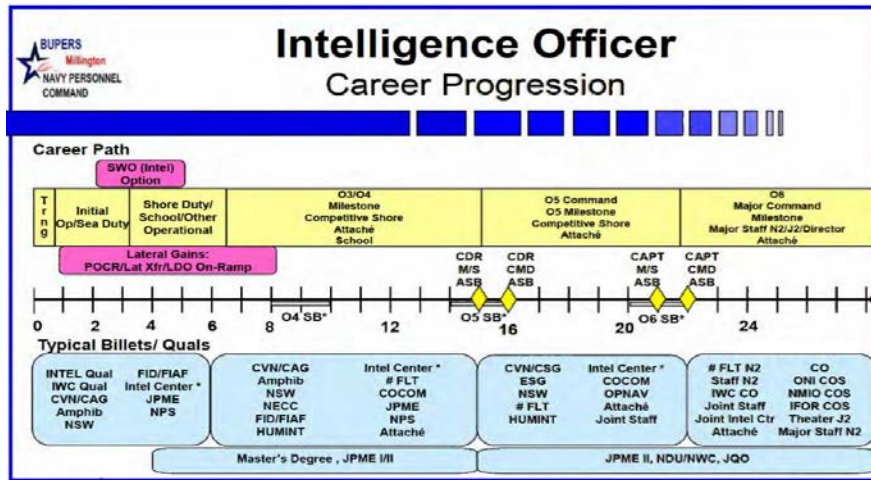
2. Staff Corps

The second-largest community of naval officers falls into the Staff Corps. The Staff Corps Officers make up twenty-nine percent of Navy officers corps, and include Medical, Dental, Nurse, Chaplain, Supply, Civil Engineer (SEABEE), and Judge Advocate Generals' (JAG), as grouped in the 2017 *Naval Military Personnel Manual* (NAVPERS) 15839I. The Staff Corps encompasses many different career paths; all have limited time available to receive a Navy-funded graduate education. The easiest facilitator of a smooth path is the Supply Corps, closely paralleling the SWO path by having two sea tours followed by a period of shore duty where Navy-funded graduate education is available. Outside of this opportunity, some Staff Officers receive graduate education prior to commissioning.

3. Restricted Line

Restricted Line Officers make up twelve percent of the naval officer corps, being the third largest community. The Restricted Line includes Intelligence, Human Resource, Engineering Duty, Nuclear Propulsion and Engineering, Permanent Military Professors, Aerospace Engineering Duty, Public Affairs, Foreign Area, Meteorology, Cryptologic, Information Warfare and Professional, and Cyber Warfare organized in the 2017 *Naval Military Personnel Manual* (NAVPERS) 15839I. The Restricted Line community is comprised mostly of lateral transfers from the URL community. A chance of Navy-funded graduate education in the RL community depends on the time of lateral transfer. Lateral transfer typically occurs after the two-year mark, which modifies the normal four-year graduate education window. This moves graduate education two years further at the six-year mark. Some RL Officers receive graduate education prior to commissioning.

Figure 5. Intelligence Officer Career Path. Source: BUPERS (2017).



4. Limited Duty Officer

In the Navy, LDOs are enlisted First Classes, promotable to Chief Petty Officer, or Chief Petty Officers. First Class Petty Officers (E-6), and current Chief Petty Officers (E-7) and Senior Chief Petty Officers (E-8) that have between eight and fourteen years of service may qualify for the LDO commissioning program. At the earliest, the first time a LDO would have the chance at Navy-funded graduate education, would be in the twelve-year mark. Graduating around year fifteen and incurring the three-year service obligation a LDO would be in their eighteen-to-twenty-four years of service mark.

5. Reserve Officer

An officer can transition to Selected Reserve (SELRES) at the completion of their four- or five-year mark depending on their initial contract. They are eligible for shore duty, but not Navy-funded graduate education at the same time. Full Time Support (FTS) is another form of reserves that officers are available to transition into at year ten. Most officers would be going to their second shore duty and this would be their second chance at Navy-funded graduate education. Reserve officers seldom get the chance to obtain a Navy-funded graduate education.

6. Chief Warrant Officer

The Navy Chief Warrant Officer community is Chief Petty Officer (E-7) through Master Chief Petty Officer (E-9) that are experts in their field and that have a minimum of fourteen-years of service to advance to commissioned officer. Similar to a LDO, the first time a CWO would have the chance at Navy-funded graduate education would be at their eighteen-year mark, they would finish around year twenty-one and incur the three-year service obligation, putting them in their twenty-four-year mark.

C. TYPES OF GRADUATE EDUCATION

In 1912, the Navy fully established graduate education. Officers would attend the Naval Academy; and then finish their graduate education at top ranked civilian institutions to include Harvard, Massachusetts Institute of Technology, Yale, Columbia, and John Hopkins.

The intent of the Sailor 25 Initiative is that sailors attend fourteen leading civilian institutions. Through the Fleet Scholar Education Program (FSEP) 30 URL or Information Warfare Officers Lieutenants per year are nominated to attend Georgetown, Southern California, Duke, Stanford, Tennessee, Johns Hopkins, North Carolina, Dartmouth, Maryland, Harvard, Columbia, San Diego, Georgia, or Boston College. These institutions are the elite civilian institutions (CIVINS). From 1997–2002, sixty-five CIVINS offered full-time curricula for officers to start graduate education.

The Navy offers officers three types of education: fully funded, partially funded, and self-funded education. Fully funded education is identified in the 2015 OPNAV Instruction 1520.23C, *Graduate Education* as a service member receiving full pay and allowances, while the U.S. government compensates for tuition and other costs. The 2015 OPNAV Instruction 1520.23C instruction states that the officers' primary duty is as students instead of military duties. These programs extend more than twenty-six weeks and receive billet based sub-specialty codes. Upon graduation, officers receive a service obligation equivalent to the length of schooling times two. Per Chief of Naval Operations Instruction 1000.16L, *Navy Total Force Manpower Policies and Procedures*, graduates are obligated to serve a sub-specialty billet directly or within two years of graduation.

The 2015 OPNAV Instruction 1520.23C, *Graduate Education* defines partially funded education as the service member receiving full pay and allowances, while the service member compensates their own tuition and other costs from their personal funds. The instruction again states that their primary duty is as a student, instead of military duties. Partially funded education service obligation is equivalent to fully funded graduate education. Self-funded graduate education means a service member receives full pay and allowances while the service member compensates their tuition and other costs from their personal funds. The instruction differentiates for these officers that the primary duty is normal military duties, while participating in educational programs during their off-duty hours. The service obligation for self-funded graduate education is two years.

The primary source of graduate education for naval officers is at the Naval Postgraduate School (NPS) located in Monterey, CA. NPS offers Navy-specific curriculum and Joint Professional Military Education (JPME), making it the number one choice for graduate education for most naval officers. The secondary source of graduate education for Navy officers is the Naval War College (NWC), which offers a more limited number of Navy-specific curriculums, and includes JPME.

The Voluntary Graduate Education Program (VGEP) described in a 2005 *Military Personnel Manual* (MILPERSMAN) 1301-900, *Subspecialty Management, Graduate Education, and Service Colleges*, is a fully funded program, allowing 20 Midshipmen from the Naval Academy to attend the Washington, DC, area universities and receive graduate education. VGEP graduates receive a seven-month service obligation. The Burke Program, implemented through the 2013 Chief of Naval Operations Instruction 1520.18J, *Junior Line Officer Advanced Educational Program (Navy Burke Program)*, allows thirty officers, half from the Naval Academy and half from NROTC, to receive scholarships to postgraduate studies. The instruction further explains that if the science or engineering curriculum is not at NPS or AFIT, students may attend a civilian institution. The Burke Program applicants include URL, and officer candidates registered for the Enlisted Commissioning Program and the nuclear option.

Officers not receiving funded graduate education are encouraged to utilize their available tuition assistance and GI Bill to pursue a self-funded graduate degree to increase their personal and profession value (DODD 1322.16, p. 2).

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III. LITERATURE REVIEW

This chapter examines the previous relevant studies that addressed Navy-funded graduate education and its return on investment. Previous studies provide support for the framework of analysis followed in this thesis.

A. CONZEN (1999)

Conzen's (1999) NPS thesis examines the relationship between graduate education and service obligation and retention of naval officers using observations from officers on active duty between 1992–1998, within the ranks of O-3 and O-6, with fewer than thirty-years of service. Using a logit-regression model approach, Conzen finds that the proportion of officers with Navy-funded graduate degrees that separate is lower than that of officers with self-funded graduate degrees. Conzen's work also shows that officers with Navy-funded graduate degrees have separation rates that are lower than officers who are not obtaining master's degrees. This last result is not surprising as it is expected that the officers who are selected to pursue graduate education on the Navy's dime are more likely to be high performers or to be a good fit for the Navy, therefore they might be more likely to stay in the Navy longer than the officers without Navy-funded graduate degrees.

Figure 6. Proportion of Officers Leaving the Navy by Education Level.
Source: Conzen (1999).

EDUCATION	1992	1993	1994	1995	1996	1997
No College	10.9	11.5	11.1	10.8	12.1	12.0
Bachelor's Degree	8.8	11.9	10.6	8.1	9.4	11.3
NPS Master's Degree	8.0	11.1	9.6	5.7	7.3	8.8
Other Funded Master's Degree	8.6	11.8	10.5	6.1	7.8	9.9
Non-funded Master's Degree	9.2	12.0	10.1	8.0	9.6	9.4
Funded Ph.D	6.1	10.2	8.4	7.7	6.9	5.2
Non-funded Ph.D	9.3	22.6	11.7	9.4	14.6	11.4

As shown in Figure 6, the results find that graduate education is associated with a smaller propensity to leave the Navy; attending NPS is associated with a lower separation percentage, compared with officers with bachelor's degrees or no college. Officers with funded doctoral degrees (PhD) have the lowest separation proportion among officers with graduate educations, followed by NPS master's degree holders; perhaps this is due to the self-selection into this category.

Conzen (1999) limited the sample to the ranks of O-3 to O-6 because officers at these ranks can voluntarily leave the service, unlike O-1 & O-2 ranked officers who are still within their initial commissioning service obligation. He also removed from the sample those who involuntarily leave and those who served thirty-years.

The baseline logit equation uses the binary dependent "QUIT," which measures the probability that an officer would leave the service after MSR. The base line model included paygrade, education level, community and demographics as independent variables as shown in Figure 7.

Figure 7. Logit Model 1995 Data Set. Source: Conzen (1999).

$$L_i = \beta_0 + \beta_1 \text{PAYGRADE} + \beta_2 \text{EDUCATION} + \beta_3 \text{COMMUNITY} + \beta_4 \text{MARRIED} + \beta_5 \text{DEPS} + \beta_6 \text{RACE}$$

The left out, comparison group for his model was an unmarried Lieutenant, with no college degree, in the Surface Warfare community with an unknown number of dependents and unknown race. The base line logit model estimates for each year group. By isolating the education variable, Conzen (1999) shows a 0.2 percent decrease for retention probability for "QUIT" as compared with the left out-group. Funded graduate education did not appear in Conzen's findings to be significantly associated with retention over obligated service length compared to no college. A ten-year retention model estimate found that graduate education was not associated with a higher retention past ten years compared to no college. In Conzen's promotion to O4 model, the findings included that fully funded graduate education officers promote at a higher rate than other education levels.

Conzen (1999) does not consider the timing of obtaining of graduate education and the additional service obligated when estimating the retention models. Therefore, as the author discusses, the estimated results might capture the effect of required service, especially for officers receiving Navy-funded graduate education in-between their fourth and fifth-year mark, then attending two years at a graduate education institution like NPS, followed by the three-year service obligation. When estimating retention models, the current study will carefully examine the timing of graduate degrees and the additional service obligated as a result. To this end, the longitudinal data set used in this study selected cohorts of Navy officers that can be observed annually for at least fifteen years of service. In addition, this study will account for officers who received a graduate degree prior to joining the Navy. Furthermore, this thesis will focus on retention and promotion rate differences among officers with funded and self-funded graduate degrees in order to reduce the selection bias in the estimates.

B. KAMARCK, THIE, ADELSON, AND KRULL (2010)

In 2010, the RAND National Defense Research Institute assessed the qualitative and the quantitative measures on ROI for funded graduate education on URL and RL officers in its study titled *Evaluating Navy's Funded Graduate Education Program a Return-On-Investment Framework*, by Kamarck et al.

The 2010 Kamarck et al. study assessed the DOD and Navy graduate education policy, it presented a cross-service comparison of graduate education programs, and it conducted a thorough review of human and social capital investment literature, both civilian and military.

To estimate the returns on Navy-funded graduate education, Kamarck et al. (2010) discuss a five-level evaluation, divided into reaction, learning, application, impact, and ROI. Reaction refers to the satisfaction of the officer in the program, learning is the knowledge and skills gained, application encompasses changes in behavior, impact refers to impact on retention, promotion, performance, and thesis contribution, while ROI compares the billet and education cost with utilization. While the 2010 study identified these different dimensions of the Navy returns to funded graduate education, it clearly

states that the military literature on returns from graduate education focuses on the effect of graduate education on officers' performance, promotion and retention, which are returns to graduate education outcomes examined in this thesis. One of reviewed military studies on returns to funded graduate education is the Bowman and Mehay (1999) study, which examined graduate education's impact on promotion to O-4 for URL and RL officers. The Bowman and Mehay (1999) analysis found that officers with a graduate education were more likely to be promoted to O-4 than officers without graduate education. Finding officers with full-time Navy-funded education promoted at a higher rate than officers with graduate education obtained through other modes. However, using a two-stage Heckman type estimation technique, Bowman and Mehay (1999) found that a large portion of the relationship between graduate degree attainment and promotion is due to selection bias resulted from unobserved attributes that may lead more-promotable officers to attend or be selected for graduate school.

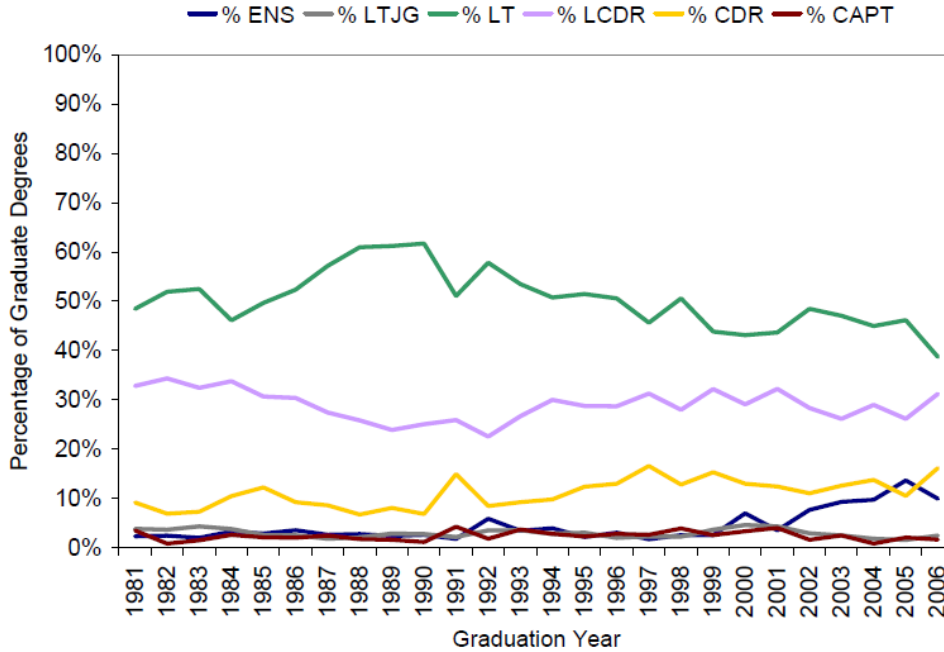
This thesis does not have access to the detailed data required to correct for the potential selection bias in the estimation of the relation between graduate education and promotion rates. Therefore, this thesis presents only summary statistics on retention and promotion rates among officers with and without graduate degrees, while focusing its multivariate analysis on retention and promotion outcomes among officers with graduate degrees, whether from military or civilian institutions, funded or self-funded. The estimates for differences in retention and promotion rates among officers with funded and self-funded graduate degrees are still likely to contain some potential selection bias; this thesis argues that this potential selection bias is smaller than the selection bias in estimates of retention and promotion rate among officers with and without graduate degrees.

C. MOSKOWITZ, RODNEY, AND LAWLER (2008)

A 2008 Chief of Naval Analyses (CNA) research paper, titled *Data Analysis for a Navy Education Strategy* by Moskowitz et al., focused its effort on analyzing and creating a feasible graduate education strategy for URL officers, and timing it most efficiently. The analysis found that more than seventy percent of URL officers obtain a

graduate degree at the Lieutenant or Lieutenant Commander Rank (4-15 YOS), shown in Figure 8.

Figure 8. Grade When Graduate Degree Is Obtained.
Source: Moskowitz et al. (2008).



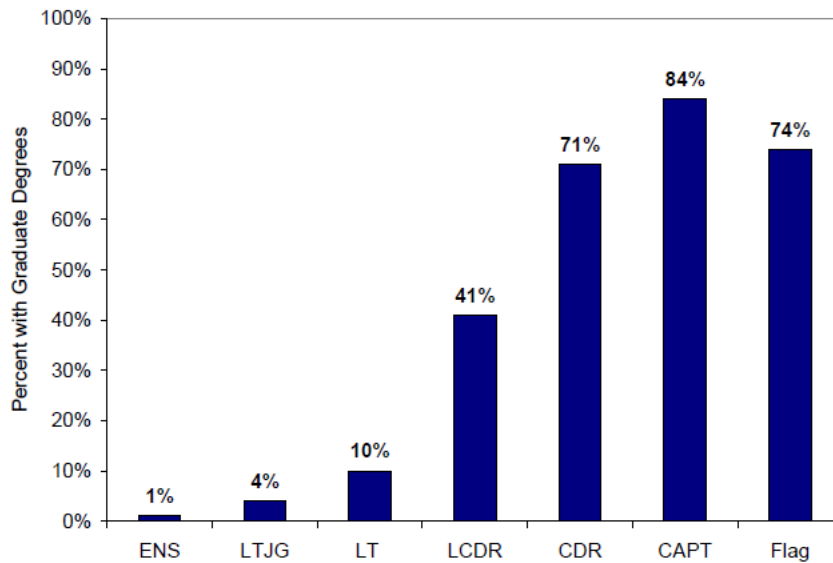
The 2008 Moskowitz et al. study shows that thirty-eight percent of URL officers receiving a graduate degree received it at the Naval Postgraduate School and eleven percent at the Naval War College (NWC). The study also shows that attendance at NPS and NWC has decreased from 1999 to 2005, although officers with graduate degrees promote more often and tend to serve longer than officers without graduate degrees.

Officers with graduate degrees are significantly more likely to promote to all ranks from O-4 to O-6, but are not more likely to promote to flag officer, controlling for other factors. (Moskowitz et al, 2008, p. 23)

A previous CNA study titled *Analysis of Aviation Officer Career Paths* by Monroe (2004) concluded the aviation career path offers little room in their early career for Navy-funded graduate education. Indeed, Moskowitz et al. (2008) found a distinct difference in the timing opportunity for aviators to attend Navy-funded graduate education

compared to SWO and SUB in the URL community. The 2008 study used SWO and SUB to discuss the typical URL career path. Figure 9 shows the percentage of officers to have graduate degrees in 2006, showing that a factor of successful promotion appears to be graduate education attainment.

Figure 9. Percentage of URL Officers with Graduate Degrees (2006).
Source: Moskowitz et al (2008).



This thesis will account for the officer communities, within URL, and in the RL/Staff communities, and it will consider the differences in timing of availability of funded graduate education opportunities in these communities. It will also carefully consider the timing of the graduate education attainment in the retention models to account for additional service obligated.

IV. DATA AND DESCRIPTIVE STATISTICS

This chapter presents the data set used in this thesis, its sources, the definition of variables used in the analysis, and the summary and descriptive statistics.

A. DATA DESCRIPTION

This thesis examines retention and retention rates for officers who obtained their graduate education, whether Navy-funded or self-funded, at military and civilian institutions. To observe the officers a sufficient number of years past their graduate school graduation date, this thesis uses data on officers who commissioned in the Navy from fiscal year 1997 to fiscal year 2002, observed annually until September 2017 or until separation.

The Officer Personnel Information System (OPINS) is the source of the data set used in this thesis. The oldest Navy entry cohort captured in OPINS is the 1997 fiscal year officer entry cohort. The data set used in this thesis contains demographic and professional information on the population of officers commissioned from 1997 to 2002, observed annually until 2017 or until separation. To be able to compare performance among officers, observations on officers commissioned at a grade other than O-1 have been removed along with entry level CWOs, LDOs and reservist officers. The remaining data set follows longitudinally 21,661 officers accessed at O-1. Among these officers, 5,498 had no education data and were removed from the sample, leaving 16,163 observations as the main data sample. The distribution of officers with no data on education appears to be randomly distributed among males and females, communities and accession sources. The main data sample includes 7,503 graduate-educated officers and, of those, 4,282 (57.1 percent) have Navy fully funded graduate degrees. Table 1 shows the number and percentage of officers with graduate degrees in each commissioning year group.

Table 1. Distribution of Officers with Graduate Degrees by Cohort Years

	1997	1998	1999	2000	2001	2002	Total
Grad_Educ	1,173	1,188	1,286	1,277	1,348	1,231	7,503
%	41.7%	42.9%	51.3%	47.0%	49.7%	46.6%	46.4%
No_Grad_Ed	1,640	1,584	1,220	1,442	1,362	1,412	8,660
%	58.3%	57.1%	48.7%	53.0%	50.3%	53.4%	53.6%
Total	2,813	2,772	2,506	2,719	2,710	2,643	16,163

Graduate education is tracked throughout an officer's career, to ascertain the time line in which each community tends to acquire funded graduate education.

The sample contains 7,212 officers who obtained graduate degrees after entering the service. Forty-five percent of all officers in the sample attain a graduate education during the first twenty years of their career. The three years with the highest frequency of graduates are years of service seven, eight and twelve. This directly informs any research stating that ten-year mark is a good point to judge retention models. Those graduating in year seven and eight would be obligated to stay until year ten and eleven, and those who attain their education in year twelve will be obligated to stay until year fifteen. Only twenty-eight percent of officers with graduate degrees obtain those degrees by year seven. Almost fifty percent of graduate degrees in the sample are obtained by year nine, as shown in Table 2. However, seventy-five percent had received a graduate degree by year twelve. Communities were separately analyzed, due to the different points in a career path when officers can attend graduate education. Graduate education opportunities are available to all communities, as presented in the Background chapter. However, there are differences in the timing of these opportunities among officer communities. For example, in the aviation, SEAL, and EOD communities, only thirty percent of officers with graduate degrees obtain those degrees by year nine. By comparison, the officers in SWO, SUB and RL communities, about sixty-five percent of graduate degrees obtained by year nine. The number of graduate degrees attained in each year of service, in each community, shown in Appendix A.

Table 2. Graduate Education Degrees Obtained by Year of Service

Variable	Percent	Cumulative Percent
Grad Yr 1	5.8	5.8
Grad Yr 2	1.8	7.6
Grad Yr 3	1.7	9.3
Grad Yr 4	1.1	10.4
Grad Yr 5	2	12.4
Grad Yr 6	4.7	17.1
Grad Yr 7	10.9	28
Grad Yr 8	12.5	40.5
Grad Yr 9	8.8	49.3
Grad Yr 10	7.3	56.6
Grad Yr 11	7.7	64.3
Grad Yr 12	10.3	74.6
Grad Yr 13	7.3	81.9
Grad Yr 14	5	86.9
Grad Yr 15	5.4	92.3
Grad Yr 16	3.9	96.2
Grad Yr 17	2.2	98.4
Grad Yr 18	1.1	99.5
Grad Yr 19	0.4	99.9
Grad Yr 20	0.1	100
Total	7,212	

The majority of officers attain a graduate degree between years seven and fifteen, as shown in Table 2. Appendix A presents more detail on when each community attains its graduate education in the sample. Half of the unqualified line officers get their graduate degrees by year four. Half of SWO and SUB officers complete a graduate degree by year eight. Most SEALs graduate by year fifteen, and EODs spread between year nine and year fifteen. Aviators receive graduate degrees between years nine and twelve. Many RL officers obtain a graduate degree prior to commissioning, or by year seven. Staff officers get a graduate education prior to commissioning, or by year twelve. Over all communities, the average time to obtaining a graduate education for half of officers with graduate degrees is by year eight, while two thirds attain graduate education by year twelve.

Twenty-seven percent of the sample or 4,282 observations attain a funded graduate degree. Table 3 shows the percent of funded graduate degrees earned during each year, from years seven through fifteen. As shown in Appendix A, half of unqualified line officer get funded graduate degrees by year four; SWOs’ funded graduate degrees are typically obtained by year eight. SUBs’ funded graduate degrees are obtained by year seven, while SEALs obtain their funded graduate degrees between year eight and twelve. EODs have a spread-out graduate degree attainment between year nine and year fifteen. Aviators receive funded graduate degrees between years nine and twelve. RL officers typically obtain funded graduate degrees by year seven, while staff officers do so by year twelve. The average time for all communities for obtaining funded graduate degrees is year eight.

Table 3. Funded Graduate Education Degrees Obtained by Year of Service

Variable	Freq.	Percent
Grad Yr 7	541	12.6
Grad Yr 8	591	13.8
Grad Yr 9	385	9.0
Grad Yr 10	335	7.8
Grad Yr 11	338	7.9
Grad Yr 12	418	9.8
Grad Yr 13	283	6.6
Grad Yr 14	198	4.6
Grad Yr 15	214	5.0
Total	3,303	

1. Dependent Variables

Two of the main outcome (dependent) variables used in this thesis are retention at twelve- and fifteen-years. If the Navy invests in its officers’ human capital by funding an officer’s graduate education, this may result in a longer service after graduation, past the obligated additional service, which can mean a higher return on this investment. The second category of dependent variables measures promotion rates to ranks O4 and O5 for qualified officers. Table 4 shows the definition of the dependent variables.

Navy officer retention studies often examine retention decisions at the end of the minimum obligated service (MSR), and at ten years of service mark when up-or-out decisions are made. Taking into account the timing of obtaining graduate education, as presented in Tables 2 and 3, and the additional service obligated by officers with funded graduate education, retention has to be examined at a later point in the career path of officers with graduate degrees to be able to capture the voluntary decision of staying in service or separating. Consequently, the retention decision will be examined at the twelve-year mark, and the fifteen-year mark. The binary variables *Twelve_Year_Retention* and *Fifteen_Year_Retention* indicate whether an officer completes at least twelve years, and fifteen years of service after commissioning, respectively.

Table 4. Definition of Dependent Variables

Dependent Variable	Variable Definition
Twelve_Year_Retention	=1 if Months_in_Service >=144; otherwise =0.
Fifteen_Year_Retention	=1 if Months_in_Service >=180; otherwise =0.
Promoted_O4	=1 promoted to O4 paygrade; otherwise =0.
Promoted_O5	=1 promoted to O5 paygrade; otherwise =0.

The binary variables *Promoted_O4* and *Promoted_O5* indicate whether an officer is selected to the pay grade of O4, and O5, respectively. Selection to O4 is the first promotion centered on an officer’s skill, performance and accomplishments in the first ten years of service. Selection to O5 is the next promotion centered on an officer’s skill, performance and accomplishments in the first fifteen years of service.

2. Independent Variables

The independent variables observed in this data categorize into five groups: demographics, commissioning source, community, entry cohort, and education. The first set of variables is the demographic characteristics variables, which include officers’ age at commission, race, and sex. Marital status, and number of dependents are also included as demographic variables, however, these variables tracked each year to establish at what

year they married and in what year they had any number of children. Previous literature finds marital status and dependents as strongly associated with the decision to stay or leave the service. Variables Married_6 and Dep_Child_10 identify an officer's marital status at year six, and whether the officer had dependent children at year ten. Table 5 defines the demographic variables.

Table 5. Definition of Demographic Variables

Demographics	
Variable	Definition
CommAge	= age of officer, at commissioning
Female	=1 if Female, otherwise = 0
Male	=1 if Male, otherwise = 0
Married_0	=1 if married at time of commissioning, otherwise = 0
Not Married_0	=1 is not married at time of commissioning, otherwise = 0
Dep_Child_0	=1 if dependent child/children at time of entry, otherwise = 0.
No_Dep_Child_0	=1 if no dependent child/children at time of entry, otherwise = 0.
Black_NonHispanic	=1 if Black (race) & Non-Hispanic (ethnicity), otherwise = 0
White_NonHispanic	=1 if White (race) & Non-Hispanic (ethnicity), otherwise = 0
Asian	=1 if Asian, otherwise = 0
Hispanic	=1 if Hispanic, otherwise = 0
Other_Unkn_Race	=1 if Race is other or not known, otherwise = 0

The commissioning sources categorize into several accession programs: *Naval Academy*, *ROTC*, *OCS_OTC_PLC*, *Direct Commission*, *Other Commission*, and *Prior Enl Commission*, all defined in Table 6.

Table 6. Definition of Commissioning Source Variables

Commissioning Source	
Naval Academy	=1 if commissioned from USNA, otherwise = 0
ROTC	=1 if commissioned from ROTC, otherwise = 0
OCS_OTC_PLC	=1 if commissioned from OCS, OTS, or PLC, otherwise = 0
Direct	=1 if direct commissioned, otherwise = 0
Other Commission	=1 if commissioned from other source, otherwise = 0
Prior Enl Commission	=1 if commissioned from enlisted service, otherwise = 0

Naval Officers maintain designators throughout their career. These designators divide officers into communities. The community variables used in this thesis are a *URL*, *RL* and *STAFF*. Due to the significant difference in timing of opportunities for funded graduate education, the URL breaks down further into *Unqual_Line*, *SWO*, *SUB*, *SEAL*, *EOD*, and *Aviator*, as shown in Table 7. Additionally, each officer has the chance to be re-designated or to lateral transfer into another community. Therefore, the community designators separate at Entry, MSR, 10 years, and 15 years.

Table 7. Definition of Community Variables

Community	
SWO	=1 if Unrestricted Line & Surface Warfare, otherwise = 0
SUB	=1 if Unrestricted Line & Submarine Warfare, otherwise = 0
SEAL	=1 if Unrestricted Line & SEAL, otherwise = 0
EOD	=1 if Unrestricted Line & EOD, otherwise = 0
Aviator	=1 if Unrestricted Line & Aviator, otherwise = 0
Unqual_Line	=1 if Unrestricted Line & Unqualified, otherwise = 0
URL	=1 if Unrestricted Line Community, otherwise = 0
RL	=1 if Restricted Line Community, otherwise = 0
STAFF	=1 if Staff Community, otherwise = 0

Additionally, to identify the fiscal year an officer commissioned into the Navy, the following binary variables are defined: *Cohort_1997*, *Cohort_1998*, *Cohort_1999*, *Cohort_2000*, *Cohort_2001*, and *Cohort_2002*, detailed in Table 8.

Table 8. Definition of Accession Cohorts

Cohorts	
Cohort 1997	=1 if commissioned during fiscal year 1997, otherwise = 0
Cohort 1998	=1 if commissioned during fiscal year 1998, otherwise = 0
Cohort 1999	=1 if commissioned during fiscal year 1999, otherwise = 0
Cohort 2000	=1 if commissioned during fiscal year 2000, otherwise = 0
Cohort 2001	=1 if commissioned during fiscal year 2001, otherwise = 0
Cohort 2002	=1 if commissioned during fiscal year 2002, otherwise = 0

The dataset includes variables that capture the educational background of naval officers. Specifically, the data set contains the names of the educational institutions the officer graduated from, the year of graduation, the type of degree obtained (bachelor, or graduate degree), and whether the degree was funded by the Navy.

Based on these data, variable *Grad_Educ* identifies those with graduate education. Officers with graduate education further categorize into officers with graduate degrees received prior to commissioning, captured by *Grad_Ed_prior*, and degrees received after commissioning, measured by *Grad_Ed_post*. Table 9 summarizes the definition of these education variables. Two hundred and ninety-one officers attained a graduate education prior to joining the service (about four percent of officers with graduate degrees) and of those, only thirty-eight received a prior funded graduate education.

Table 9. Definition of Graduate Education Variables by Timing of Degree

Graduate Education & Timing	
Grad_Educ	=1 if Officer has Postgraduate Education, otherwise = 0
Grad_Ed_post	=1 if Officer has Postgraduate Education after Commission, otherwise = 0
Grad_Ed_prior	=1 if Officer has Postgraduate Education prior to Commission, otherwise = 0

Using the university name, variables *muni* and *civuni* determine if an officer received their graduate education from a military or a civilian graduate institution. Table 10 presents the list of military institutions granting graduate degrees.

Table 10. Military Education Institutions

Military Education	
AF TECH	Air Force Technical Center
AM MIL U	American Military University
J MIL INTL	Joint Military Interagency International
MARCOR U	Marine Corps University
NAT DEF U	National Defense University
MONTEREY/NPS	Naval Postgraduate School
NWC	Naval War College
USUOFHS	Uniformed Services University of the Health Services
AIR UNIV	United States Air Force's Air Education and Training Command
USACGSC	United States Army Command and General Staff College
USAWCC	United States Army War College
VA CMN MED	Virginia Certificate of Medical Necessity

The last education variable, the sponsor, categorizes ten different Navy-sponsored graduate or special programs that identify education funding. Those graduate degrees with sponsorship are captured in the *Funded* variable, and those without sponsorship are measured by the *Self-funded* variable. Table 11 details the list of sponsors of graduate education for naval officers.

Table 11. Funded Graduate Education Sponsors

Education Sponsor	
A	Immediate Graduate Education Program (IGEP)
B	Junior Line Officer Advanced Education Program (BURKE)
C	College Degree Program (CDP)
E	Navy Enlisted Scientific Education Program (NESEP)
G	Advanced Education Program (AEP)
L	Law Education Program (LEP)
N	Navy-Sponsored graduate or advanced courses
S	Scholarship Program (scholarships/fellowships and grants)
V	Voluntary Graduate Education Program (VGEP)
Z	Designated CNO Scholars Program

Identifying the type of graduate institution, military or civilian, and whether the graduate education was funded or self-funded allow the following variables to capture the correct category of graduate education received by naval officers in the data used in this thesis: *Funded_Grad_Ed*, *Unfunded_Grad_Ed*, *MilFundGradEd*, *CivFundGradEd*, , and *CivUnfundGradEd*, with definitions shown in Table 12.

Table 12. Definition of Education Variables by Type of Education

Graduate Education Types	
<i>Funded_Grad_Ed</i>	=1 if Officer has Postgraduate Degree & funded, otherwise = 0
<i>Unfunded_Grad_Ed</i>	=1 if Officer has Postgraduate Degree & unfunded, otherwise = 0
<i>MilFundGrad</i>	=1 if Officer has Postgraduate Degree& military funded, otherwise = 0
<i>CivFundGrad</i>	=1 if Officer has Postgraduate Degree & civilian funded, otherwise = 0
<i>CivUnfundGrad</i>	=1 if Officer has Postgraduate Degree & civilian unfunded, otherwise = 0

B. SUMMARY STATISTICS

The summary statistics for the data set used in this thesis are presented in this subsection. These summary statistics include number of observations (n), and the mean value in the sample.

The full data set has observations on 16,163 naval officers, of which 7,503 have graduate degrees, as shown in Table 13. Of the 7,503 graduate degrees, 4,106 are obtained from military institutions (NPS graduates represent fifty-eight percent of this group, with 2,385 officers). Rounding to the nearest whole percentage, sixty percent of officers in the full sample stay until year twelve, fifty-one percent stay until year fifteen, fifty-eight percent promote to O4, and twenty-three percent promote to O5. The mean age at commissioning is 24.7 years old. The full sample is sixteen percent female and eighty-four percent male, with seventy-two percent whites, eleven percent Black, four percent Asian, five percent Hispanic, and seven percent of other or unknown race. At entry, nineteen percent of the sample was married and ten percent of the officers had dependent children. The commissioning source is broken into thirty-two percent *OCS_OTC_PLC*, twenty-seven percent from ROTC, twenty-eight percent from USNA, eight percent are directly commissioned, one percent was commissioned via other sources, and two percent was commissioned from enlisted.

The full sample is mostly URL officers at entry, at seventy-three percent. The seventy-three percent is made up of thirty-three percent aviators, twenty-six percent Surface Warfare, ten percent Submarine Warfare, two percent Special Warfare, less than one percent Explosive Ordnance, and less than one percent Unqualified Line. The Restricted Line makes up six percent and the Staff Corps makes up seventeen percent. Forty-six percent of the sample obtained a graduate education, two percent of those before commissioning and forty-four percent after. Twenty-seven percent of the sample received a funded graduate education, twenty percent of that was military funded and eight percent was civilian funded. Twenty-two percent of the sample received a self-funded graduate education; six percent of those were military self-funded and seventeen percent were civilian self-funded graduate education, shown in Table 13.

Table 13. Full Sample, Twelve-Year and Fifteen-Year Stayers Samples
Summary Statistics

Summary Statistics	Full Sample (n=16,163)	12 Year Stayers (n=9,621)	15 Year Stayers (n=8,190)
Dependent Variables			
Twelve_year_Retention	0.595	1.000	1.000
Fifteen_year_Retention	0.507	0.851	1.000
Promoted_O4	0.585	0.904	0.897
Promoted_O5	0.232	0.380	0.441
Independent Variables			
Demographics			
Comm Age	24.707	25.220	24.937
Female	0.162	0.122	0.118
Male	0.838	0.878	0.882
Black_NonHispanic	0.113	0.095	0.095
White_NonHispanic	0.724	0.737	0.735
Asian	0.041	0.047	0.047
Hispanic	0.050	0.050	0.052
Other_Unkn_Race	0.071	0.070	0.070
Dep_Child_6	0.298	0.381	0.367
Dep_Child_10	0.380	0.557	0.559
Married_6	0.524	0.628	0.631
Married_10	0.488	0.714	0.728
Commissioning Details			
Naval_Academy	0.281	0.231	0.247
ROTC	0.272	0.224	0.235
OCS_OTs_PLc	0.323	0.386	0.370
Direct	0.083	0.104	0.101
Other_Commission	0.015	0.020	0.019
Prior_Enl_Comm	0.025	0.033	0.025
Education			
Grad_Educ	0.464	0.679	0.707
Grad_Ed_post	0.450	0.663	0.692
Grad_Ed_prior	0.018	0.021	0.020
Funded_Grad_Ed	0.265	0.396	0.419
Unfunded_Grad_Ed	0.221	0.317	0.326
MilFundGrad_Ed	0.199	0.301	0.321
CivFundGrad_Ed	0.078	0.115	0.121
CivUnfundGrad_Ed	0.174	0.241	0.241
Navy Community			
URL_ENTRY	0.727	0.698	0.715
URL_MSR	0.553	0.610	0.626
URL_10YOS	0.360	0.527	0.551
URL_15YOS	0.221	0.364	0.420
Unqual_Line_ENTRY	0.004	0.002	0.002
Unqual_Line_MSR	0.002	0.001	0.001
SWO_ENTRY	0.265	0.212	0.215
SWO_MSR	0.173	0.164	0.165

Summary Statistics	Full Sample (n=16,163)	12 Year Stayers (n=9,621)	15 Year Stayers (n=8,190)
SWO_10YOS	0.097	0.140	0.144
SWO_15YOS	0.063	0.102	0.117
SUB_ENTRY	0.103	0.081	0.079
SUB_MSR	0.081	0.070	0.068
SUB_10YOS	0.038	0.055	0.055
SUB_15YOS	0.023	0.038	0.044
SEAL_ENTRY	0.015	0.015	0.015
SEAL_MSR	0.014	0.016	0.016
SEAL_10YOS	0.011	0.016	0.016
SEAL_15YOS	0.006	0.010	0.012
EOD_ENTRY	0.009	0.008	0.008
EOD_MSR	0.009	0.009	0.010
EOD_10YOS	0.006	0.009	0.009
EOD_15YOS	0.004	0.006	0.007
Aviator_ENTRY	0.330	0.380	0.396
Aviator_MSR	0.274	0.349	0.366
Aviator_10~S	0.208	0.307	0.327
Aviator_15~S	0.125	0.207	0.239
RL_ENTRY	0.060	0.065	0.062
RL_MSR	0.110	0.134	0.133
RL_10YOS	0.110	0.154	0.157
RL_15YOS	0.082	0.135	0.157
STAFF_ENTRY	0.174	0.189	0.182
STAFF_MSR	0.162	0.192	0.180
STAFF_10YOS	0.136	0.192	0.179
STAFF_15YOS	0.083	0.136	0.156

In the full sample, 9,621 officers retained past the twelve-year mark. Table 13 presents the summary statistics for officers who stayed until twelve years of service, and for those who continued service to year fifteen. The mean commissioning age remained constant at twenty-five years of age. The twelve-year retained sample is twelve percent female and eighty-eight percent male, showing that more females depart during or by their twelfth year of service. Seventy-three percent of officers are married by year twelve, and sixty-two percent of officers have dependent children by year twelve. The percentage of officers with graduate degrees increased to sixty-eight percent of the sample of twelve years stayers, with funded graduate degrees up, to forty percent, and self-funded graduate

degrees up ten percent, to represent thirty-two percent of the sample of twelve-year stayers. Commissioning source variables show a decrease of five percent representation among Naval Academy, and five percent for ROTC graduates from the full sample to the twelve years stayers. OCS_OTTS_PLC graduates increased to thirty-nine percent of the twelve-year stayers sample when compared with their proportions in the full sample. The demographic race variables remained constant.

The sample size for the sample of fifteen-year stayers is 8,190 officers. Table 13 presents summary statistics for this sample. The mean commissioning age remained constant at twenty-five years of age. The fifteen-year retained sample is twelve percent female and eighty-eight percent male, showing that after year twelve males and females leave the service proportionately. Twenty-one percent of the sample was married at entry. Married status percentage at year fifteen increased greatly to sixty-seven percent. The representation of officers with graduate degrees by year fifteen increased to seventy-one percent of the fifteen-year stayers sample. Funded and self-funded graduate education percentages have also increased in representation in the sample, with funded graduate degrees up, to forty-two and self-funded graduate degrees, up, to thirty-three percent. The race, commissioning source and community variable means remained constant between the twelve- and fifteen-year stayers samples.

Table 14. O4 & O5 Promotion Samples Summary Statistics

Summary Statistics	Full Sample (n=16,163)	Promoted O4 (n=9,452)	Promoted O5 (n=3,749)
Dependent Variables			
Twelve_year_Retention	0.595	0.920	0.975
Fifteen_year_Retention	0.507	0.777	0.963
Promoted_O4	0.585	1.000	0.986
Promoted_O5	0.232	0.391	1.000
Independent Variables			
Demographics			
Comm Age	24.707	25.259	24.567
Female	0.162	0.115	0.107
Male	0.838	0.885	0.893
Black_NonHispanic	0.113	0.073	0.066
White_NonHispanic	0.724	0.763	0.789
Asian	0.041	0.045	0.040
Hispanic	0.050	0.052	0.046
Other_Unkn_Race	0.071	0.065	0.059
Dep_Child_6	0.298	0.396	0.360
Dep_Child_10	0.380	0.593	0.600
Married_6	0.524	0.648	0.658
Married_10	0.488	0.765	0.801
Commissioning Details			
Naval_Academy	0.281	0.236	0.270
ROTC	0.272	0.223	0.245
OCS_OTC_PLC	0.323	0.407	0.365
Direct	0.083	0.079	0.079
Other_Commission	0.015	0.019	0.016
Prior_Enl_Comm	0.025	0.034	0.021
Education			
Grad_Educ	0.464	0.708	0.822
Grad_Ed_post	0.450	0.694	0.809
Grad_Ed_prior	0.018	0.019	0.019
Funded_Grad_Ed	0.265	0.413	0.505
Unfunded_Grad_Ed	0.221	0.331	0.367
MilFundGrad_Ed	0.199	0.313	0.383
CivFundGrad_Ed	0.078	0.120	0.154
CivUnfundGrad_Ed	0.174	0.253	0.267
Navy Community			
URL_ENTRY	0.727	0.717	0.757
URL_MSR	0.553	0.625	0.654
URL_10YOS	0.360	0.563	0.601
URL_15YOS	0.221	0.377	0.566
Unqual_Line_ENTRY	0.004	0.002	0.002
Unqual_Line_MSR	0.002	0.002	0.002
SWO_ENTRY	0.265	0.217	0.235
SWO_MSR	0.173	0.169	0.178
SWO_10YOS	0.097	0.150	0.163

Summary Statistics	Full Sample (n=16,163)	Promoted O4 (n=9,452)	Promoted O5 (n=3,749)
SWO_15YOS	0.063	0.107	0.159
SUB_ENTRY	0.103	0.082	0.087
SUB_MSR	0.081	0.071	0.074
SUB_10YOS	0.038	0.059	0.066
SUB_15YOS	0.023	0.039	0.062
SEAL_ENTRY	0.015	0.016	0.021
SEAL_MSR	0.014	0.018	0.022
SEAL_10YOS	0.011	0.017	0.021
SEAL_15YOS	0.006	0.011	0.021
EOD_ENTRY	0.009	0.009	0.009
EOD_MSR	0.009	0.010	0.010
EOD_10YOS	0.006	0.010	0.010
EOD_15YOS	0.004	0.007	0.010
Aviator_ENTRY	0.330	0.391	0.403
Aviator_MSR	0.274	0.355	0.367
Aviator_10~S	0.208	0.325	0.341
Aviator_15~S	0.125	0.213	0.314
RL_ENTRY	0.060	0.067	0.055
RL_MSR	0.110	0.144	0.145
RL_10YOS	0.110	0.171	0.175
RL_15YOS	0.082	0.139	0.207
STAFF_ENTRY	0.174	0.167	0.143
STAFF_MSR	0.162	0.197	0.177
STAFF_10YOS	0.136	0.204	0.182
STAFF_15YOS	0.083	0.141	0.183

A total of 9,452 officers were promoted to O4. Table 14 presents the summary statistics of the sample of O4 promoted. Among the officers promoted to O4, ninety-two percent retained to their twelfth-year, and to seventy-eight percent stay in the Navy to year fifteen years of service. The O4 promotion sample is twelve percent female and eighty-eight percent male, showing again that more females depart during or by their O4 promotion. Twenty-three percent of the O4 promotion sample was married at entry. The proportion of married officers at year ten is seventy-five percent for the O4 promoted sample, larger than the forty-eight percent of officers married by year ten, in the full sample. Officers with dependent children at ten years represent fifty-nine percent of the O4 promoted officers sample.

Seventy-one percent of the O4 promoted officers have a graduate education, showing that promotion boards reward those with graduate degrees. Funded and self-funded graduate degree percentages have increased representation among the O4 promoted officers sample. Officers with funded graduate degrees are up fifteen percent to forty-one percent of the sample, when compared with their representation in the full sample. Officers with self-funded graduate degrees are up eleven percent to thirty-three percent of the O4 promoted sample. Commissioning variables illustrate OCS_OTC_PLC graduates increased representation from thirty-two percent to forty-one percent of the sample. Black, non-Hispanic officers decreased their representation in the sample, to seven percent from eleven percent.

The sample of officers promoted to the rank of O5 has 3,749 officers. Table 14 shows the summary statistics of this sample. Promotion to O5 usually takes place around the fifteenth years of service, as shown by the large percentage of fifteen-year retention (ninety-six percent) in this sample. The O5 promoted sample is eleven percent female and eighty-nine percent male, to show that proportionally more females depart during or by their O5 promotion. Eighty-two percent of the O5 promoted officers sample have graduate degrees. Officers with funded graduate degrees is up fifteen percent to forty-one percent of the sample, and officers with self-funded graduate degrees is up eleven percent to thirty-three percent of the sample. Officers with funded graduate degree represent fifty percent of the O5 promoted sample, while self-funded graduate degrees represent thirty-seven percent of the O5 sample. Commissioning variables illustrate OCS_OTC_PLC graduates decreased representation to thirty-six percent of the O 5 sample. The race and community variable means remained constant between O4 promotion and O5 promotion samples.

From the full sample of 16,163 naval officers, 7,503 have graduate degrees. Of the 7,503 officers with graduate degree attainment, 4,106 obtained their graduate degrees from a military institution like NPS.

C. DESCRIPTIVE STATISTICS

This section presents t-tests for differences in the sample means for the retention and promotion outcome variables used in this thesis.

Table 15 shows the t-tests for the difference in mean retention and promotion rates among officers with graduate degrees from military versus civilian (civins) institutions. Retention and promotion rates are higher for the officers with graduate degrees from a military institution, when compared with the mean retention and promotion rates for officers with graduate degrees from civilian institutions. Officers with graduate degrees from military institutions, like NPS, have an average ninety-one percent twelve-year retention rate, which is statistically higher than the eighty-one percent retention rate for officers with graduate degrees from civilian institutions. All t-tests are significant at the one-percent level. These mean differences in retention rates are raw, unexplained differences. In the next chapter, the multivariate analysis will attempt to explain these differences in mean retention rates by controlling for demographic characteristics, community, cohort year, among other factors.

Similarly, officers with military graduate degrees show retention at fifteen years, promotion to O4, and promotion to O5 rates that are significantly higher than the rates of retention and promotion for officers with graduate degrees from civilian institutions.

Table 15. T-Test of Differences in Retention and Promotion Rates between Officers with Military versus Civins Degrees

Variable	Military Graduate Education (n=4,106)	Civins Graduate Education (n=3,397)	t-Test Statistic
Retention at 12 YOS	0.914	0.818	12.44***
Retention at 15 YOS	0.837	0.692	15.19***
Promotion to O4 among ten-year stayers	0.969	0.911	10.47***
Promotion to O5 among fifteen-year stayers	0.542	0.485	4.28***

*** Significant at p=.01 percent level.

Table 16 focuses the difference in mean retention and promotion rates among officers with funded graduate education, whether from military or civilian institutions. While promotion to O4 and O5 rates appear to be no different among the two groups, twelve-year and fifteen-year retention rates are statistically higher for officers with funded graduate degrees from military institutions when compared with retention rates of officers with funded graduate degrees from civilian institutions.

Table 16. T-Test of Differences in Retention and Promotion Rates between Officers with Funded Military versus Self-funded Civins Degrees

Variable	Funded Military Graduate Education (n=3,217)	Funded Civins Graduate Education (n=1,078)	t-Test Statistic
Retention at 12 YOS	0.901	0.862	3.53***
Retention at 15 YOS	0.820	0.759	4.40***
Promotion to O4 for ten-year stayers	0.964	0.952	1.54
Promotion to O5 for fifteen years stayers	0.538	0.561	1.14

*** Significant at p=.01 percent level.

Table 17. T-Test of Differences in Retention and Promotion Rates between Officers with Funded versus Self-funded Civins Graduate Education

Variable	Funded Civins Graduate Education (n=1,078)	Unfunded Civins Graduate Education (n=2,319)	t-Test Statistic
Retention at 12 YOS	0.862	0.797	4.54***
Retention at 15 YOS	0.759	0.661	5.82***
Promotion to O4 among ten-year stayers	0.953	0.892	5.53***
Promotion to O5 for fifteen years stayers	0.561	0.444	5.43***

*** Significant at p=.01 percent level.

Retention and promotion rates are statistically higher for officers with funded civilian graduate degrees when compared with the rates of officers with self-funded graduate degrees from civilian institutions, as presented in Table 17.

The next chapter uses multivariate regression analysis to attempt to explain these differences among mean retention and promotion rates by controlling for demographic characteristics, naval community, and cohort year, among others.

V. MULTIVARIATE MODELS FOR RETENTION

This chapter presents the methodology and the multivariate regression models used to analyze the relation between graduate education attainment, whether from military versus civilian institutions, funded or self-funded, and retention and promotion rates of Navy officers. The previous chapter offered a broad picture of the data set as well as comparisons of raw mean rates of retention and promotion. This chapter will take into account institutional details, such as differences in timing of graduate opportunities in officer communities, to try to explain some of these differences using multivariate regression models. To establish the career outcome effects for those with and without funded graduate degrees, from military or civilian institutions, multivariate regression models were used. To estimate the relation between the key independent variables (funded/ self-funded graduate degrees, from military versus civilian institutions) and the outcome variable (retention, or promotion rates) for groups of officers with similar demographic and professional characteristics. This chapter presents the different multivariate models and discusses the results.

A. METHODOLOGY

To examine the relation between the key independent variables and each outcome variable, this thesis uses multivariate statistical regression analysis. Since the outcome variables are binary variables, taking values of 1 or 0, the multivariate regression models are probit models. Probit models estimate the probability of the outcome (dependent) variable, given the independent variables. The dependent variables used in this thesis are twelve-year retention, fifteen-year retention, promotion to O4, and promotion to O5, taking the value of 1, if the officer retains or promotes, and 0 otherwise. Completion of a graduate degree, funded or self-funded, from military or civilian institutions, are the key explanatory variables.

Wooldridge (2015) defines probit models as models where the probability of the cumulative distribution function (cdf) is assumed a linear function of the explanatory variables. Probit models provide marginal probability estimates that indicate a sign or

direction for the partial effect of a variable on the probability of the outcome variable, and its statistical significance. All probit models are estimated using the STATA 13 statistical software.

B. MULTIVARIATE MODELS

For each model estimated, there is a reference group. The reference or comparison group is determined as the most representative groups in the sample. The comparison group follows the majority as white males, with no dependent children, not married, commissioned from OCS_OTC_PLC. In the URL community the majority is SWOs; therefore, SWO is the comparison group in the URL models. In the Staff and RL models, Staff is the majority, and therefore the control group. Additionally, the cohort year of 1997 is chosen as the comparison group.

1. Retention Models

a. Twelve-Year Retention Models for URL Officers

This thesis estimates a twelve-year retention model first. As shown in Table 2, thirty-three percent of officers with graduate education in our sample graduate by their ninth year from commissioning. The service obligation after graduate education is typically three years; therefore, the twelfth year of service is the first opportunity most graduate-level educated officers have to decide whether to leave the service.

The sample used for estimating the twelve-year retention models include all officers with graduate degrees who graduated before or on the ninth year. *Funded_Grad_Ed* is the key explanatory variable, which denotes any officer gaining a funded graduate degree on, or prior to, their ninth years of service. Those earning a funded graduate degree after the ninth years of service would be obligated past the twelve-year mark; thus, they are not included in the sample for this model.

The first set of twelve-year retention models includes only the officers in the URL community at year six. It uses a probit technique to estimate the marginal effects of funded graduate education, self-funded graduate education, demographics at year six and

commissioning source on the probability of retaining as an URL officer past their twelfth year of service.

The first probit twelve-year model estimates the marginal effects of *Funded_Grad_Ed*, compared to officers attaining an self-funded graduate degree by year nine. The second probit twelve-year model separates the marginal effects of *MilFundGradEd* and *CivFundGradEd*. The hypothesis is that the twelve-year retention model associates a positive and significant effect on funded graduate education for URL officers, compared to URL officers with self-funded graduate education.

$$(1) \text{ Probit (Twelve_year_Retention} = 1|X) = \beta_0 + \beta_1 \textit{Funded_Grad_Ed} + \beta_2 \textit{Demographics_6} + \beta_3 \textit{Commissioning} + \beta_4 \textit{Cohorts} + \beta_5 \textit{Community_6} + \mu$$

$$(2) \text{ Probit (Twelve_year_Retention} = 1|X) = \beta_0 + \beta_1 \textit{MilFundGradEd} + \beta_2 \textit{CivFundGradEd} + \beta_3 \textit{Demographics_6} + \beta_4 \textit{Commissioning} + \beta_5 \textit{Cohorts} + \beta_6 \textit{Community_6} + \mu$$

Funded graduate degree opportunities, at military or civilian institutions, might vary by commissioning source, officer community, cohort year, and demographic characteristics (like marital status). Therefore, the retention models will control for these factors.

Table 18 shows the estimates for the URL twelve-year retention models. The sample size of these two models includes 1,953 officers in a URL designation at MSR and attained a graduate education by the ninth year of service.

Each reviewed estimate is statistically significant at the one percent significance level. Estimates are rounded to the nearest percentage point.

(1) Everything else held constant, for URL officers with graduate degrees the mean probability to retain at twelve years is eighty-three percent. Officers with funded graduate degrees have a seven-percentage point (or eight percent) higher retention rate at

twelve years when compared to URL officers with self-funded graduate degrees. URL officers married by year six are six percentage points (eight percent) more likely to retain at twelve years, compared to those not married by year six. The Naval Academy graduates are ten percentage points (twelve percent) less likely to retain at twelve years, compared to OCS_OTIS_PLC. The SUB officers with graduate degrees are ten percentage points (twelve percent) less likely to stay to twelve years, compared to SWO officers.

(2) Compared to URL officers attaining an self-funded graduate degree, officers with military funded graduate degrees have about ten percentage points (eleven percent) higher twelve-year retention rates, while officers with funded civilian graduate degrees have retention rates that are not statistically significantly different from the retention rates of officers with self-funded graduate degrees. When comparing the estimates in panels (1) and (2) in Table 18, the Funded_Grad_Ed estimate appear to be driven mostly by the military funded graduate degree component. These estimates are obtained by controlling for the factors that might explain differences in retention rates among officers with funded and self-funded education, such as commissioning source, community, cohort year. These estimates are not causal, in the sense that they cannot be interpreted as an effect of funded education on retention. There might be other factors, observed or unobserved, such as ability or motivation, that might be responsible for the differences in retention rates, among officers with funded and self-funded graduate education. If we cannot control for such selection, we might have potential selection bias in our estimates. A more detailed data set that includes measures for officers' ability might allow for a more robust analysis.

Table 18. Twelve-Year Retention Model Results for URL Officers

Variables	(1) Twelve-Year Retention	(2) Twelve-Year Retention
Funded_Grad_Ed	0.0704*** (0.0190)	- -
MilFundGradEd	- -	0.0951*** (0.0180)
CivFundGradEd	- -	0.0289 (0.0193)
CommAge	-0.0046 (0.0043)	-0.0044 (0.0042)
Female	-0.0717** (0.0343)	-0.0666** (0.0339)
Married_6	0.0648*** (0.0220)	0.0648*** (0.0219)
Dep_Child_6	0.0105 (0.0216)	0.0109 (0.0216)
Black_NonHisp	0.0055 (0.0308)	0.0038 (0.0310)
Asian	0.0609 (0.0385)	0.0585 (0.0387)
Hispanic	0.0254 (0.0365)	0.0214 (0.0368)
Other_Unkn_Race	0.0044 (0.0332)	0.0023 (0.0332)
ROTC	0.0078 (0.0252)	0.0066 (0.0252)
Naval_Academy	-0.101*** (0.0289)	-0.0972*** (0.0288)
Direct	-0.0669 (0.1460)	-0.0540 (0.1410)
Other_Commission	0.0852 (0.0734)	0.0807 (0.0759)
Cohort_1998	0.0460* (0.0267)	0.0432 (0.0268)
Cohort_1999	0.0207 (0.0276)	0.0148 (0.0279)
Cohort_2000	0.0088 (0.0281)	0.0047 (0.0283)
Cohort_2001	0.0674*** (0.0239)	0.0623*** (0.0242)
Cohort_2002	0.0460* (0.0250)	0.0402 (0.0254)
Unqual_Line_MSR	-0.0347 (0.1170)	-0.0344 (0.1170)
SUB_MSR	-0.101***	-0.0855***

Variables	(1) Twelve-Year Retention	(2) Twelve-Year Retention
	(0.0266)	(0.0264)
SEAL_MSR	0.0807 (0.0578)	0.0814 (0.0572)
Aviator_MSR	0.0326* (0.0196)	0.0388** (0.0193)
obs. mean	0.8310	0.8310
pred. mean	0.8449	0.8467
Observations	1,953	1,953
R ²	0.0569	0.0636
Correctly classified	83.15%	83.15%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

b. Twelve-Year Retention Model for RL and STAFF

The third set of twelve-year retention model includes RL and Staff officers. *Funded_Grad*, *MilFundGradEd* and *CivFundGradEd* are the key explanatory variables. The hypothesis is that the twelve-year retention model associates a positive and significant effect for funded graduate education for RL and Staff officers, compared to RL and Staff officers with self-funded graduate education by year nine.

$$(1) \text{ Probit (Twelve_year_Retention} = 1|X) = \beta_0 + \beta_1 \text{Funded_Grad_Ed} + \beta_2 \text{Demographics_6} + \beta_3 \text{Commissioning} + \beta_4 \text{Cohorts} + \beta_5 \text{Community_6} + \mu$$

$$(2) \text{ Probit (Twelve_year_Retention} = 1|X) = \beta_0 + \beta_1 \text{MilFundGradEd} + \beta_2 \text{CivFundGradEd} + \beta_3 \text{Demographics_6} + \beta_4 \text{Commissioning} + \beta_5 \text{Cohorts} + \beta_6 \text{Community_6} + \mu$$

Table 19 presents the estimates for the twelve-year retention model for RL and Staff officers. The sample includes 1,460 RL and Staff officers at MSR, who attained a graduate degree by year nine. This sample has thirty-five percent of officers with a funded graduate degree from a military institution, and thirteen percent of the sample has attained a graduate degree from a civilian institution. Fifty two percent of RL and Staff officers in this sample hold self-funded graduate degrees.

All results discussed are statistically significant at the one percent significance level. Estimates rounded to the nearest percentage point.

(1) The mean twelve-year retention probability for RL and Staff officers retaining to twelve years is seventy-six percent. Each additional year for the commissioning age is associated with a decrease of one percentage point (one percent) in the twelve-year retention rate. Officers from the Naval Academy are fifteen percentage points (nineteen percent) less likely to retain at twelve years when compared to OC_OTIS_PLC commissioned officers.

(2) RL and Staff officers with graduate degrees, whether funded or self-funded, from military or civilian institutions, have no different twelve-year retention rates, as the marginal effect coefficients for these explanatory variables are not statistically significant.

Table 19. Twelve-Year Retention Model Results for RL and Staff Officers

Variables	(1) Twelve-Year_Retention	(2) Twelve-Year_Retention
Funded_Grad_Ed	0.0334 (0.0253)	- -
MilFundGradEd	- -	0.0319 (0.0274)
CivFundGradEd	- -	0.0268 (0.0356)
CommAge	-0.0104*** (0.0037)	-0.0105*** (0.0037)
Female	-0.0756** (0.0312)	-0.0758** (0.0312)
Married_6	0.0150 (0.0290)	0.0151 (0.0291)
Dep_Child_6	0.0359 (0.0284)	0.0359 (0.0284)
Black_NonHispanic	0.0388 (0.0321)	0.0386 (0.0321)
Asian	0.0248 (0.0449)	0.0245 (0.0449)
Hispanic	-0.0093 (0.0490)	-0.0093 (0.0490)

Variables	(1) Twelve-Year_Retention	(2) Twelve-Year_Retention
Other_Unkn_Race	-0.0507 (0.0513)	-0.0518 (0.0513)
ROTC	-0.0247 (0.0402)	-0.0249 (0.0404)
Naval_Academy	-0.1477*** (0.0497)	-0.1468*** (0.0497)
Direct	0.0031 (0.0383)	0.0034 (0.0383)
Prior_Enl_Commission	0.0129 (0.0398)	0.0120 (0.0402)
Other_Commission	0.1286** (0.0513)	0.1281** (0.0514)
Cohort_1998	0.0055 (0.0404)	0.0051 (0.0404)
Cohort_1999	0.0288 (0.0374)	0.0286 (0.0374)
Cohort_2000	0.0706* (0.0360)	0.0702* (0.0361)
Cohort_2001	0.0156 (0.0372)	0.0154 (0.0372)
Cohort_2002	0.0674* (0.0365)	0.0672* (0.0365)
RL_MSR	-0.0491* (0.0272)	-0.0499* (0.0293)
obs. mean	0.7610	0.7610
pred. mean	0.7672	0.7672
Observations	1,460	1,460
R ²	0.1189	0.0264
Correctly classified	70.15%	76.03%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

c. Fifteen-Year Retention Model for URL

The sample used for estimating the fifteen-year retention model includes all officers who attained graduate degrees before, or on, the twelfth-year. As shown in Table 3, at twelve years of service there is a second point in the career path of URL officers with a high frequency of funded graduate degrees. Adding the service obligation after graduation, the fifteen-year mark is the second opportunity most graduate-level educated

officers have to make a leave or stay decision. *Funded_Grad_Ed* is the key explanatory variable, which denotes any officer gaining a graduate degree prior to their twelfth year of service. Officers earning a funded graduate degree after the twelfth year of service would be obligated past the fifteen-year retention model; therefore, they are not included in the sample for this model.

The first probit fifteen-year retention model estimates the marginal effects on retention for URL officers with *Funded_Grad_Ed*, compared to URL officers attaining an unfunded graduate degree by year twelve. The second probit fifteen-year model separates the marginal effects of *MilFundGradEd* and *CivFundGradEd*. The hypothesis that the fifteen-year retention model associates a positive and significant effect for funded graduate education for URL officers, compared to URL officers with self-funded graduate education.

$$(1) \text{ Probit (Fifteen_year_Retention} = 1|X) = \beta_0 + \beta_1 \text{Funded_Grad_Ed} + \beta_2 \text{Demographics_10} + \beta_3 \text{Commissioning} + \beta_4 \text{Cohorts} + \beta_5 \text{Community_10} + \mu$$

$$(2) \text{ Probit (Fifteen_year_Retention} = 1|X) = \beta_0 + \beta_1 \text{MilFundGradEd} + \beta_2 \text{CivFundGradEd} + \beta_3 \text{Demographics_10} + \beta_4 \text{Commissioning} + \beta_5 \text{Cohorts} + \beta_6 \text{Community_10} + \mu$$

Table 20 presents the estimates for the fifteen-year retention models. The sample size of the probit model is 2,604 URL officers with a graduate degree by year twelve. Each discussed estimate is statistically significant at the one percent significance level. Estimates rounded to the nearest percentage point.

(1) The mean fifteen-year retention probability for URL with graduate degree is eighty-two percent. Officers with funded graduate degrees, regardless of the type of institution that granted the degree (military or civilian), are two point seventy-seven percentage points (three percent) more likely to retain at fifteen years than officers with self-funded graduate degrees. This result is mainly driven by the retention of officers with funded graduate degrees from military institutions. Each additional year above the sample average age at the commissioning is associated with a one point seven percentage point (two percent) decrease in the fifteen-year retention rate. ROTC graduates are five

percentage points (six percent) more likely to stay to fifteen years, while Direct commissioned graduates are associated with a fifty-eight percentage points (seventy percent) decrease in likelihood of staying to fifteen years, compared with the OCS_OTC_PLC commissioned officers. Those designated as Aviators at their ten-years of service mark are six-percentage points (seven percent) more likely to stay to fifteen years, compared to SWO officers.

(2) Funded military graduate degree attainment is associated with a four-percentage points (five percent) higher fifteen-year retention probability, compared to URL officers attaining a self-funded graduate degree.

Table 20. Fifteen-Year Retention Model Results for URL Officers

Variables	(1) Fifteen-Year Retention	(2) Fifteen-Year Retention
Funded_Grad_Ed	0.0277* (0.0155)	- -
MilFundGradEd	- -	0.0402*** (0.0156)
CivFundGradEd	- -	0.0085 (0.0190)
CommAge	-0.0179*** (0.0034)	-0.0178*** (0.0034)
Female	-0.0792** (0.0341)	-0.0766** (0.0340)
Married_10	0.0149 (0.0225)	0.0140 (0.0224)
Dep_Child_10	0.0429** (0.0193)	0.0434** (0.0193)
Black_NonHisp	-0.0335 (0.0300)	-0.0347 (0.0301)
Asian	0.0617* (0.0337)	0.0616* (0.0337)
Hispanic	0.0226 (0.0320)	0.0218 (0.0321)
Other_Unkn_Race	0.0173 (0.0280)	0.0175 (0.0280)
ROTC	0.0530*** (0.0191)	0.0522*** (0.0191)
Naval_Academy	0.0141 (0.0220)	0.0145 (0.0220)
Direct	-0.5810*** (0.217)	-0.5790*** (0.220)

Variables	(1) Fifteen-Year Retention	(2) Fifteen-Year Retention
Prior_Enl_Commission	-0.0971 (0.1060)	-0.1000 (0.1060)
Other_Commission	0.0657 (0.0649)	0.0652 (0.0652)
Cohort_1998	-0.0047 (0.0276)	-0.0055 (0.0277)
Cohort_1999	-0.0061 (0.0270)	-0.0077 (0.0272)
Cohort_2000	0.0364 (0.0245)	0.0355 (0.0246)
Cohort_2001	0.0003 (0.0263)	-0.001 (0.0264)
Cohort_2002	-0.0996*** (0.0300)	-0.1010*** (0.0301)
SUB_10YOS	-0.0418* (0.0248)	-0.0376 (0.0247)
SEAL_10YOS	0.00941 (0.0527)	0.00688 (0.0532)
EOD_10YOS	0.0145 (0.0730)	0.0115 (0.0737)
Aviator_10YOS	0.0583*** (0.0167)	0.0589*** (0.0167)
obs. mean	0.8268	0.8268
pred. mean	0.8438	0.8442
Observations	2,604	2,604
R ²	0.0761	0.0636
Correctly classified	82.72%	82.83%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

d. Fifteen-Year Retention Model for RL and Staff Officers

The third set of fifteen-year retention models include RL and Staff officers with graduate degrees.

Table 21 presents the estimates for the fifteen-year retention model for 2,335 RL and Staff officers who obtained a graduate degree by year twelve. This sample is larger than the sample used in the twelve-year retention model due to the larger number of officers with graduate degrees by year twelve.

(1) The mean probability of a RL or Staff officer with graduate degree attainment to remain in service at fifteen years is seventy-three percent. RL and Staff officers with funded graduate degrees have a four-point-four percentage point (six percent) higher fifteen-year retention probability, compared to RL and Staff officers with self-funded graduate degrees by year twelve. As shown in panel (2) of Table 21, this result is mainly driven by the higher probability of retention of RL and Staff officers with funded graduate degrees from military institutions when compared to the retention probabilities of RL and Staff officers with self-funded graduate degrees.

(2) Each additional year increase in commissioning age is associated with about two-percentage points (three percent) smaller probability of retention at fifteen years. ROTC commissioned officers are about fourteen percentage points (nineteen percent) more likely to retain compared OC_OTC_PLC commissioned officers. Prior enlisted RL and Staff officers in this sample are about twelve percentage points (sixteen percent) less likely to retain to fifteen years compared with OC_OTC_PLC commissioned officers. The 2000 entry-cohort is thirteen percentage points (fourteen percent) more likely to retain to fifteen years, compared to the 1997 entry-cohort. The RL officers have about seven-percentage points (ten percent) smaller probability of retention at fifteen years, compared to Staff officers in this sample.

Table 21. Fifteen-Year Retention Model Results for RL and Staff Officers

Variables	(1) Fifteen-Year Retention	(2) Fifteen-Year Retention
Funded_Grad_Ed	0.0442** (0.0207)	- -
MilFundGradEd	- -	0.0517** (0.0215)
CivFundGradEd	- -	0.0305 (0.0275)
CommAge	-0.0220*** (0.0029)	-0.0221*** (0.0029)
Female	0.0053 (0.0259)	0.0056 (0.0259)
Married_10	0.0664** (0.0290)	0.0677** (0.0291)
Dep_Child_10	0.0103 (0.0237)	0.0101 (0.0237)

Variables	(1) Fifteen-Year Retention	(2) Fifteen-Year Retention
Black_NonHisp	-0.0012 (0.0291)	-0.0006 (0.0291)
Asian	0.0337 (0.0344)	0.0331 (0.0344)
Hispanic	0.0131 (0.0391)	0.0134 (0.0391)
Other_Unkn_Race	-0.0422 (0.0394)	-0.0425 (0.0395)
ROTC	0.1369*** (0.0253)	0.1363*** (0.0254)
Naval_Academy	0.0765** (0.0317)	0.0769** (0.0317)
Direct	0.0239 (0.0298)	0.0255 (0.0297)
Prior_Enl_Commission	-0.1162*** (0.0394)	-0.1184*** (0.0397)
Other_Commission	0.0984** (0.0443)	0.0986** (0.0443)
Cohort_1998	0.0315 (0.0330)	0.0311 (0.0330)
Cohort_1999	0.0460 (0.0307)	0.0455 (0.0308)
Cohort_2000	0.0983*** (0.0291)	0.0982*** (0.0291)
Cohort_2001	0.0492 (0.0303)	0.0488 (0.0303)
Cohort_2002	-0.0662* (0.0351)	-0.0657* (0.0351)
RL_10YOS	-0.0718*** (0.0211)	-0.0773*** (0.0223)
obs. mean	0.7272	0.7272
pred. mean	0.7484	0.7484
Observations	2,335	2,335
R ²	0.0955	0.0959
Correctly classified	73.22%	73.22%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

2. Promotion Models

a. O4 Promotion for URL Officers

This thesis examines job performance of officers with graduate education attainment by estimating O4 and O5 promotion models. After assessing the retention statistics, the O4 promotion model's hypothesis is that officers with graduate education by ten years of service are more likely to promote to O4.

The sample used for estimating the O4 promotion models include all officers with graduate degrees obtained before, or on, the tenth year, and still in the Navy by ten years of service in order to be eligible for O4 promotion consideration. *Funded_Grad_Ed* is the key explanatory variable, which indicates any officer gaining a graduate degree on, or prior to, their tenth years of service.

The first set of O4 promotion models examines the URL officers' O4 promotion rates. It uses a probit technique to estimate the marginal effects of graduate education (funded, or self-funded, from military or civilian institutions), demographics at year six, and commissioning source on the probability of promoting an URL officer to O4.

The first probit O4 promotion model estimates the marginal effects of *Funded_Grad_Ed*, compared to URL officers attaining an self-funded graduate degree by year nine. The second probit O4 promotion model estimates separately the marginal effects of *MilFundGradEd* and *CivFundGradEd*.

$$(1) \text{ Probit (Promoted_O4 = 1|X)} = \beta_0 + \beta_1 \text{Funded_Grad_Ed} + \beta_2 \text{Demographics_6} \\ + \beta_3 \text{Commissioning} + \beta_4 \text{Cohorts} + \beta_5 \text{Community_6} + \mu$$

$$(2) \text{ Probit (Promoted_O4 = 1|X)} = \beta_0 + \beta_1 \text{MilFundGradEd} + \beta_2 \text{CivFundGradEd} \\ + \beta_3 \text{Demographics_6} + \beta_4 \text{Commissioning} + \beta_5 \text{Cohorts} + \beta_6 \text{Community_6} + \mu$$

Table 22 exhibits the estimates for the O4 promotion model. The sample size of the first set of probit estimates is 2,048 URL officers who attained a graduate degree by year ten and are ten-year stayers. Each reviewed estimate is statistically significant at the one percent significance level. Estimates rounded to the nearest percentage point.

(1) The mean probability of promotion to O4 for URL officers with graduate degrees obtained by the tenth year of service is ninety-two percent. Those with funded graduate degrees have a four-percentage point (four percent) promotion to O4 probability, when compared to URL officers with self-funded graduate degrees by year nine. The 2002 entry-cohort is about seven percentage points (eight percent) less likely to promote to fifteen years, compared to the 1997 entry-cohort.

(2) Compared to URL officers with funded graduate degrees, URL officers with funded graduate degrees from a military institution have about four percentage points (four percent) higher probability of O4 promotion, while civilian institutions have about a three percentage points (three percent) higher probability of O4 promotion.

Table 22. O4 Promotion Model Results for URL Officers

Variables	(1) Promoted_O4	(2) Promoted_O4
Funded_Grad_Ed	0.0409*** (0.0130)	- -
MilFundGradEd	- -	0.0402*** (0.0117)
CivFundGradEd	- -	0.0308*** (0.0119)
CommAge	-0.0045 (0.0028)	-0.0044 (0.0028)
Female	0.0112 (0.0177)	0.0119 (0.0177)
Married_6	0.0342** (0.0152)	0.0343** (0.0152)
Dep_Child_6	-0.0026 (0.0143)	-0.0024 (0.0143)
Black_NonHisp	-0.0256 (0.0233)	-0.0256 (0.0233)
Asian	0.0178 (0.0260)	0.0178 (0.0260)
Hispanic	-0.0024 (0.0255)	-0.0029 (0.0255)
Other_Unkn_Race	0.0151 (0.0196)	0.0152 (0.0196)
ROTC	0.0063 (0.0158)	0.0061 (0.0158)
Naval_Academy	-4.9305 (0.0175)	-0.0004 (0.0175)

Variables	(1) Promoted_O4	(2) Promoted_O4
Other_Commission	0.0300 (0.0431)	0.0297 (0.0431)
Cohort_1998	-0.0037 (0.0223)	-0.0043 (0.0223)
Cohort_1999	0.0241 (0.0182)	0.0235 (0.0182)
Cohort_2000	0.0051 (0.0204)	0.0047 (0.0204)
Cohort_2001	-0.0002 (0.0207)	-0.0010 (0.0207)
Cohort_2002	-0.0752*** (0.0271)	-0.0755*** (0.0271)
Unqual_Line_MSR	0.0105 (0.0701)	0.0108 (0.0701)
SUB_MSR	0.0261* (0.0136)	0.0265* (0.0136)
EOD_MSR	0.0238 (0.0445)	0.0244 (0.0445)
Aviator_MSR	0.0107 (0.0123)	0.0114 (0.0123)
obs. mean	0.9229	0.9229
pred. mean	0.9336	0.9339
Observations	2,048	2,048
R ²	0.0528	0.0639
Correctly classified	92.29%	92.29%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

b. O4 Promotion for RL and Staff Officers

The third set of O4 promotion model includes RL and Staff officers. The third set of probit promotion models uses equations from the first set, applying to the RL and Staff communities. *Funded_Grad*, *MilFundGradEd* and *CivFundGradEd* are the key explanatory variables.

$$(1) \text{ Probit (Promoted_O4 = 1|X)} = \beta_0 + \beta_1 \text{Funded_Grad_Ed} + \beta_2 \text{Demographics_6} + \beta_3 \text{Commissioning} + \beta_4 \text{Cohorts} + \beta_5 \text{Community_6} + \mu$$

$$(2) \text{ Probit (Promoted_O4 = 1|X)} = \beta_0 + \beta_1 \text{MilFundGradEd} + \beta_2 \text{CivFundGradEd} + \beta_3 \text{Demographics_6} + \beta_4 \text{Commissioning} + \beta_5 \text{Cohorts} + \beta_6 \text{Community_6} + \mu$$

Table 23 presents the estimates for the O4 promotion model. The sample size of the first set of probit estimates is 1,657 RL and Staff officers who attained a graduate degree by year ten and are ten-year stayers. All results statistically significant at the one-percent significance level. Estimates rounded to the nearest percentage point.

(1) RL and Staff officers' mean probability is about eighty percent, funded graduate degree increases four percentage points (five percent), on O4 promotion probability, compared to RL and Staff officers attaining a self-funded graduate degree, at the ten percent significance level.

(2) Compared to RL and Staff officers attaining a self-funded graduate degree, military-funded graduate education increases O4 promotion about six percentage points (seven percent), and funded civilian graduate degree attainment does not associate a significant percent change, on O4 promotion probability. Prior Enlisted commissioned officer RL and Staff officers decrease O4 promotion probability by fifteen percentage points (sixteen percent), compared to OC_OTs_PLC commissioned officers.

Table 23. O4 Promotion Model Results for RL and Staff Officers

Variables	(1) Promoted_O4	(2) Promoted_O4
Funded_Grad_Ed	0.0431* (0.0195)	- -
MilFundGradEd	- -	0.0577*** (0.0195)
CivFundGradEd	- -	-0.00813 (0.0294)
CommAge	-0.0054* (0.0029)	-0.0058** (0.0029)
Female	-0.0223 (0.0232)	-0.0229 (0.0233)
Married_6	0.0169 (0.0228)	0.021 (0.0231)

Variables	(1) Promoted_O4	(2) Promoted_O4
Dep_Child_6	0.0364 (0.0220)	0.0347 (0.0220)
Black_NonHisp	-0.0232 (0.0275)	-0.0235 (0.0274)
Asian	-0.0392 (0.0385)	-0.0437 (0.0389)
Hispanic	0.0004 (0.0388)	0.0004 (0.0387)
Other_Unkn_Race	-0.0410 (0.0405)	-0.043 (0.0407)
ROTC	-0.0366 (0.0322)	-0.0408 (0.0326)
Naval_Academy	-0.0328 (0.0364)	-0.0311 (0.0362)
Direct	-0.0464 (0.0354)	-0.0441 (0.0351)
Prior_Enl_Commission	-0.1368*** (0.0438)	-0.152*** (0.0454)
Other_Commission	0.02431 (0.0466)	0.0406 (0.0474)
Cohort_1998	0.0029 (0.0321)	0.00238 (0.0321)
Cohort_1999	0.0192 (0.0291)	0.0167 (0.0293)
Cohort_2000	0.0467 (0.0273)	0.0459* (0.0274)
Cohort_2001	-0.0097 (0.0315)	-0.012 (0.0302)
Cohort_2002	-0.0067 (0.0315)	-0.00531 (0.0313)
RL_MSR	-0.1288*** (0.0213)	-0.145*** (0.0225)
obs. mean	0.8467	0.8467
pred. mean	0.8589	0.8597
Observations	1,657	1,657
R ²	0.0457	0.0488
Correctly classified	84.67%	84.67%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

c. O5 Promotion for URL Officers

Next, the thesis analyzes the O5 promotion models for officers who are fifteen-year stayers to be eligible for O5 promotion consideration. The entry cohorts 2001 and 2002 are dropped from the O5 estimating sample, as these cohorts are too young to be eligible for O5 promotion by 2017.

The sample used for estimating the O5 promotion models include all officers with no graduate education and the officers who graduate before or on the fifteenth year. *Funded_Grad_Ed* is the key explanatory variable, which denotes any officer gaining a graduate degree on, or prior to, their fifteenth year.

The first set of three: O5 promotion models, includes URL officers. It uses a probit technique to estimate the marginal effects of funded graduate degree, self-funded graduate degree, demographics at year ten, and commissioning source on the probability of promoting an URL officer to O5.

The first probit O5 promotion model estimates the marginal effects of *Funded_Grad_Ed*, compared to URL officers attaining a self-funded graduate degree by year twelve. The second probit O5 promotion model separates the marginal effects of *MilFundGradEd* and *CivFundGradEd*.

$$(1) \text{ Probit (Promoted_O5} = 1 | X) = \beta_0 + \beta_1 \text{Funded_Grad_Ed} + \beta_2 \text{Demographics_10} \\ + \beta_3 \text{Commissioning} + \beta_4 \text{Cohorts} + \beta_5 \text{Community_10} + \mu$$

$$(2) \text{ Probit (Promoted_O5} = 1 | X) = \beta_0 + \beta_1 \text{MilFundGradEd} + \beta_2 \text{CivFundGradEd} \\ + \beta_3 \text{Demographics_10} + \beta_4 \text{Commissioning} + \beta_5 \text{Cohorts} + \beta_6 \text{Community_10} + \mu$$

Table 24 exhibits the estimates for the O5 promotion model. The sample size of the first set of probit estimates is 1,928 URL officers who attain a graduate degree by year fifteen and are fifteen-year stayers. Each reviewed estimate is statistically significant at the one percent significance level. Estimates rounded to the nearest percentage point.

(1) *Ceteris paribus*, on O5 promotion probability, URL officers mean probability is seventy-three percent. Funded graduate education associates a significant change at the ten percent significance level of about four percentage points (six percent) on O5

promotion probability, compared to URL officers attaining a self-funded graduate education. Commissioning age associates with a two-percentage point (three percent) decrease on O5 promotion rate. Naval Academy commissioned officers are about seven percentage points (ten percent) more likely to promote to O5, compared OC_OTC_PLC commissioned officers.

(2) Compared to URL officers attaining a self-funded graduate degree, funded military and funded civilian graduate degrees are not associated with a significant change on O5 promotion probability.

Table 24. O5 Promotion Model Results for URL Officers

Variables	(1) Promoted_O5	(2) Promoted_O5
Funded_Grad_Ed	0.0452** (0.0209)	- -
MilFundGradEd	- -	0.0354* (0.0208)
CivFundGradEd	- -	0.0531** (0.0258)
CommAge	-0.0235*** (0.00499)	-0.0235*** (0.00499)
Female	0.0162 (0.0455)	0.0136 (0.0457)
Married_10	0.0630* (0.0344)	0.0630* (0.0343)
Dep_Child_10	0.00745 (0.0252)	0.00734 (0.0252)
Black_NonHisp	-0.112** (0.0478)	-0.110** (0.0478)
Asian	-0.0729 (0.0644)	-0.0756 (0.0648)
Hispanic	-0.0695 (0.0481)	-0.0686 (0.0481)
Other_Unkn_Race	-0.0544 (0.0439)	-0.0540 (0.0439)
ROTC	0.0267 (0.0278)	0.0264 (0.0278)
Naval_Academy	0.0748*** (0.0285)	0.0748*** (0.0285)
Direct	0.0273 (0.230)	0.0304 (0.228)

Variables	(1) Promoted_O5	(2) Promoted_O5
Prior_Enl_Commission	0.134** (0.0585)	0.135** (0.0581)
Other_Commission	-0.0520 (0.103)	-0.0503 (0.103)
Cohort_1998	0.0109 (0.0294)	0.0109 (0.0294)
Cohort_1999	-0.00434 (0.0297)	-0.00292 (0.0297)
Cohort_2000	-0.0309 (0.0294)	-0.0291 (0.0294)
SUB_10YOS	-0.0191 (0.0368)	-0.0207 (0.0370)
SEAL_10YOS	0.0465 (0.0693)	0.0470 (0.0692)
EOD_10YOS	-0.0406 (0.0869)	-0.0373 (0.0864)
Aviator_10YOS	-0.0546** (0.0237)	-0.0527** (0.0237)
obs. mean	0.7386	0.7386
pred. mean	0.7479	0.7480
Observations	1,928	1,928
R ²	0.0447	0.0450
Correctly classified	73.34%	73.60%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

d. O5 Promotion for RL and Staff Officers

The third set of O5 promotion model includes RL and Staff officers. The third set of probit promotion models uses equations from the first set, applying to the RL and Staff communities. *Funded_Grad*, *MilFundGradEd* and *CivFundGradEd* are the key explanatory variables. The hypothesis is that the O5 promotion model associates a positive and significant effect of funded graduate education for RL and Staff officers, compared to RL and Staff officers with self-funded graduate education.

Table 25 presents the estimates for the O5 promotion model. The sample size of the probit estimates is 1,582 RL and Staff officers that attained a graduate degree by year fifteen and are stayers at year fifteen to be eligible for O5 promotion. All results statistically significant at the one percent significance level. Estimates rounded to the nearest percentage point.

(1) On O5 promotion probability, the mean probability to promote to O5 for a RL or Staff officers is about sixty percent. Funded graduate education does not associate with a significant difference in O5 promotion probability, compared to RL and Staff officers attaining a self-funded graduate education. Commissioning age decreases probability three percentage points (five percent) each year older, to promote to O5. ROTC graduates are twelve percentage points (twenty-one percent) more likely to promote to O5, compared to RL and Staff OCS_OTS_PLC graduates.

(2) Compared to RL and Staff officers attaining a self-funded graduate degree, funded military and funded civilian graduate degrees do not associate a significant percent change in O5 promotion probability.

Table 25. O5 Promotion Model Results for RL and Staff Officers

Variables	(1) Promoted_O5	(2) Promoted_O5
Funded_Grad_Ed	0.0085 (0.0279)	- -
MilFundGradEd	- -	-0.0125 (0.0295)
CivFundGradEd	- -	0.0543* (0.0373)
CommAge	-0.0325*** (0.0042)	-0.0323*** (0.0042)
Female	0.0428 (0.0352)	0.0435 (0.0352)
Married_10	0.0821** (0.0381)	0.0798** (0.0381)
Dep_Child_10	0.0108 (0.0319)	0.0095 (0.0320)
Black_NonHispanic	-0.0581 (0.0431)	-0.0573 (0.0452)
Asian	-0.0643 (0.0525)	-0.0629 (0.0525)

Variables	(1) Promoted_O5	(2) Promoted_O5
Hispanic	-0.142** (0.0603)	-0.142** (0.0603)
Other_Unkn_Race	-0.0105** (0.0518)	-0.0103** (0.0519)
ROTC	0.121*** (0.0369)	0.122*** (0.0368)
Naval_Academy	0.0889** (0.0414)	0.0855* (0.0416)
Direct	0.0383 (0.0420)	0.0291 (0.0428)
Prior_Enl_Commission	0.0136 (0.0613)	0.0202 (0.0611)
Other_Commission	0.126* (0.0674)	0.126* (0.0674)
Cohort_1998	-0.0279 (0.0387)	-0.0270 (0.0388)
Cohort_1999	-0.0240 (0.0366)	-0.0270 (0.0366)
Cohort_2000	-0.134*** (0.0378)	-0.135*** (0.0377)
RL_10YOS	-0.147*** (0.0279)	-0.134*** (0.0291)
obs. mean	0.6030	0.6030
pred. mean	0.6125	0.6131
Observations	1,582	1,582
R ²	0.0973	0.0985
Correctly classified	68.71%	68.71%
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

C. SUMMARY

This chapter presented the estimates on the probabilities of retention and promotion for officers with funded and self-funded graduate education, from military or civilian institutions. Twelve-year and fifteen-year retention, as well as O4 and O5 promotion probit models estimated marginal effects on these retention and promotion probabilities associated with types of graduate education obtained by officers, while

controlling for demographic characteristics, commission source, cohort year, and officer communities.

The findings show that, in the URL community, officers with funded graduate degrees have statistically higher twelve- and fifteen-year retention rates, and higher O4 and O5 promotion rates when compared with self-funded graduate degrees. In the RL and Staff community, officers with funded graduate degrees have better rates of fifteen-year retention, and O4 promotion outcomes when compared with officers with self-funded graduate degrees.

When accounting for the type of institution that granted the funded graduate degree, URL officers with funded graduate degrees from military institutions have statistically higher twelve-, and fifteen-year retention rates compared with officers with a self-funded graduate degree. URL officers with funded graduate degrees from civilian institutions have no different twelve-, and higher fifteen-year retention rates, compared to URL officers with self-funded graduate degrees.

The RL/Staff officers with funded graduate degrees, whether from military or civilian institutions, retain at the same rate at twelve year as the RL and Staff officers with self-funded graduate degrees. RL and Staff officers with funded graduate degrees are more likely to retain at fifteen years, when compared with RL and Staff officers with self-funded graduate degrees.

In the probit promotion models, O4 and O5 promotion rates for URL officers are higher than those of URL officers with unfunded graduate degrees regardless of whether they were from a military or civilian institution.

Military funded graduate education is associated with a higher RL and Staff officers O4 promotion probability, while RL and Staff officers with civilian funded graduate education have no different O4 promotion probability, when compared with RL and Staff officers with self-funded graduate education. RL and Staff officers whether with funded military- or funded civilian graduate education promote to O5 at the same rate as RL and Staff officers with self-funded graduate education.

Conzen (1999) found that officers with graduate education promoted at a higher rate and had no different retention past ten years of service. However, there are significant differences in the samples used in Conzen (1999) and the sample used in this thesis. Conzen (1999) compares retention and promotion of officers with graduate degrees to those of officers without college degrees. In order to minimize the selection bias from officers self-selecting into pursuing graduate education, this thesis used a sample of Naval officers with graduate degrees, whether Navy-funded, or self-funded. There might still be selection bias from the Navy selecting the officers into funded graduate programs. However, due to data availability constraints, this thesis cannot address such selection.

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VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

The Navy's fully funded graduate education programs represent a strategic investment in human capital that can allow the Navy to compete for talent and to meet its future manpower needs. Opportunities exist both in military and civilian educational institutions to ensure a well-educated force that is equipped to make sound decisions in a continually changing, dynamic global environment that affect the Navy's mission. What is the return Navy receives from this investment in human capital? One approach to measuring returns from funded graduate education is to examine retention and promotion outcomes for Navy officers with graduate degrees, from military or civilian institutions. This thesis used a multivariate analysis approach to examine retention and promotion rates differences for officers with graduate degrees, by type of educational institution (civilian versus military), by designator, and timing of graduate education. The analysis used a longitudinal data set, comprised of naval officers from entry cohorts 1997 to 2002, tracked annually until 2017, or separation.

B. CONCLUSIONS AND RECOMMENDATIONS

The research questions were developed to examine an officer's retention and promotion behavior as it applied to funded graduate education, and to examine whether their retention and promotion outcomes might differ from officers educated by other means.

1. What are the current retention rates for officers with Navy-funded graduate education? How do they differ by type of educational institution (civilian versus military), designator, and timing of graduate education, among other factors?
2. What factors explain any differences in retention and job performance among naval officers with, and without, funded graduate education?

a. Conclusions

The decision to enter a graduate education program largely coincides with when an officer has the opportunity to leave the service. This creates a decision point of whether to attend funded graduate education or to get a graduate education at their own expense. If an officer chooses to attend funded graduate education, he or she makes the decision to stay (retain) in the service for at least three additional years, plus the length of the graduate education program. The graduate education decision directly affects the retention probability. On average, graduate education is at minimum a four-year commitment, and most graduate after seven years of service. Once their service obligation is complete, officers will have completed half a career or more, and are likely to retain to twenty years of service.

Commissioning source, community, cohort year, sex, age, race, marital status, and dependent children can attribute to an officer's retention and promotion probability; therefore, they are accounted for in the models.

The findings of this thesis show that female officers with graduate degrees have lower retention, and similar promotion probabilities, when compared with their male counterparts.

The findings also show that the USNA-commissioned graduate-level educated officers are more likely to leave the service by twelve years of service compared with the OCS commissioned officers, both, in UR and RL/ Staff communities. However, in the RL and Staff community, USNA graduates with graduate education are more likely to retain at fifteen years than OCS_OTS_PLC commissioned officers. Regarding promotion outcomes, USNA commissioned graduate-level educated officers have similar O4, and higher O5 promotion probabilities than OCS_OTS_PLC commissioned officers with graduate education.

When comparing types of graduate education, the findings in this thesis show that retention and promotion outcomes vary by officer community. Holding a funded graduate degree is associated with a higher twelve-, and fifteen-year retention among URL officers, compared with retention rates of URL officers with self-funded graduate

degrees. In particular, URL officers with a funded graduate degree from a military institution retain at higher rates than URL officers with self-funded graduate degree. URL officers with funded graduate degrees from a civilian institution retain at no different rate compared with URL officers with self-funded graduate degrees. In the RL and Staff community, officers with funded graduate degrees, whether from a military or civilian institution, have no different twelve-year retention rates than RL and Staff officers with self-funded graduate degrees, and only slightly larger fifteen-year retention rates if the funded graduate degree is from a military institution.

The O4 and O5 promotion probabilities are higher for URL officers with funded graduate degrees when compared with the promotion probabilities of their counterparts with self-funded graduate degrees. However, in the RL and Staff community, O4 promotion rates are higher only for officers with military funded graduate degree attainment, while O5 promotion rates are no different for officers with funded graduate degrees from civilian institutions.

b. Recommendations

The Navy's Graduate Education Department office, OPNAV code N127, should continue to offer graduate education to all designators, from civilian institutions and military education programs. Funded graduate education can be used as a retention incentive; the findings in this thesis find larger twelve- and fifteen-year retention rates for URL officers with funded graduate degrees, especially if obtained from a military institution. In the RL and Staff community, officers with funded graduate degrees from military institutions have slightly larger fifteen-year retention than officers with self-funded graduate degree attainment. N127 should establish programs to provide all designators the opportunity to attain a graduate education prior to nine years of service. The data shows this opportunity would not hinder their ability to promote. The goal should be to offer graduate education earlier in an officer's career, thus optimizing the largest returns on the Navy's graduate education investment. Recent education policies are modifying funded education timing, which in turn supports retention and promotion. The earlier an officer receives a graduate education, the sooner the benefits of the

acquired knowledge will benefit the Navy. N127 should assign officers to fully funded graduate education programs prior to nine years of service.

N127 should establish incentives to persuade officers to attend funded graduate education programs, especially among female officers. N127 should continue to monitor variables that lead to retention and promotion. A seminar or lecture on graduate education at the USNA, ROTC units and at OCS would likely increase propensity for officers to request graduate education, when their career paths make it available. Community specific statistics show that URL officers should obtain graduate education before year nine, and RL/Staff have time to wait. Staff and RL officers may be best suited to fill funded graduate education and civilian quotas, between nine and twelve years of service.

The findings shows that funded graduate education can be positively associated with retention and promotion, but the question remains, “Why is a graduate degree not required for promotion?” If officers have the opportunity to obtain a graduate education by twelve years of service, then what is the role of graduate degree at the selection boards? Most officers make O4 by ten years of service, and a large percentage do not have time before then to obtain a graduate education. Therefore, identifying officers with graduate subspecialty P codes suffixes at the O4 promotion boards may be too soon. After earning a graduate degree, officers receive a subspecialty code, or P code. After fulfilling a P coded subspecialty billet, an officer’s P code becomes a Q code. The O5 selection board generally convenes for officers with fifteen years of service, which provides officers with greater opportunity to attend a graduate education program. The research could not identify a policy that requires officers to possess a graduate education or P subspecialty code for O4 selection or Q subspecialty code for O5 selection. Funded graduate education that leads to a subspecialty should be beneficial to the work of the Navy and benefits officers at the promotion selection board.

Promotion boards should validate P or Q, subspecialty codes for O4 or O5 promotion selection, as this might ensure higher returns to investment and utilization. The change to policy would be to prioritize officers with graduate education, or officers who attain a P or Q subspecialty code for promotion selection boards. Prioritizing officers would increase retention and utilization, which would benefit the Navy.

Another recommendation is for the Navy to ensure its personnel files are fully populated to include important officer characteristics that may signal differences in traits, ability, and motivation, such as ACT/SAT scores and college GPA. Better records can allow for more robust analyses and findings in support of Navy leadership, personnel management decisions.

C. FURTHER RESEARCH

Further research can follow these cohorts at twenty years of service, to refine and confirm retention and promotion probabilities. This will allow the last two cohort years included in this analysis to reach the O5 milestone, or separation. A follow-on study should examine if these officers separated voluntarily or involuntarily. Each generation has new and exciting education curricula to attain, or ever-changing demands for specific knowledge. The most recent graduate education initiatives have provided opportunities for officers from all communities to participate in funded graduate education prior to operational experience (i.e., before four years of service). With the advent of these initiatives, the Navy should see higher returns on investment (monetarily or non-monetarily), by means for greater retention and promotion of officers with funded graduate degree attainment.

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APPENDIX A. GRADUATE EDUCATION ATTAINMENT YEAR BY COMMUNITY

Graduate Education										
Grad Ed YOS	Unqualified Line	SWO	SUB	SEAL	EOD	Aviator	RL	STAFF	Other	Total
0	2.4	1.2	3.4	1.0	7.3	2.9	15.0	8.8	6.6	4.7
1	2.4	0.7	0.9	1.0	1.8	0.8	2.3	1.5	1.2	1.1
2	4.8	2.9	3.6	3.1	1.8	0.9	0.3	1.5	1.4	1.8
3	23.8	0.8	3.4	2.1	0.0	1.0	4.1	1.3	2.0	1.7
4	26.2	0.2	0.3	0.0	0.0	0.2	3.6	2.5	1.7	1.1
5	4.8	1.5	1.6	0.0	0.0	0.3	3.3	5.3	3.4	2.0
6	2.4	6.8	6.5	4.1	0.0	0.7	10.6	5.6	6.3	4.7
7	0.0	22.6	19.4	5.2	3.6	2.8	9.1	7.0	12.9	10.9
8	7.1	21.3	20.7	8.3	9.1	7.2	8.8	7.9	14.6	12.5
9	9.5	6.8	5.2	5.2	10.9	12.8	6.2	7.7	7.5	8.8
10	2.4	4.0	4.4	10.3	12.7	9.9	4.9	9.2	7.7	7.3
11	2.4	4.0	4.3	4.1	1.8	10.1	6.2	12.3	4.9	7.7
12	4.8	6.5	7.2	8.3	3.6	14.8	6.2	12.3	6.6	10.3
13	4.8	8.6	7.7	7.2	12.7	6.7	6.5	6.6	6.3	7.3
14	0.0	4.6	3.8	6.2	9.1	6.2	4.9	3.8	5.4	5.0
15	0.0	3.2	1.9	12.4	14.6	9.6	2.9	2.8	6.0	5.4
16	2.4	2.2	2.7	12.4	9.1	6.5	2.4	1.9	3.4	3.9
17	0.0	1.1	1.6	6.2	1.8	4.1	1.5	1.2	0.3	2.2
18	0.0	0.6	1.0	3.1	0.0	1.8	1.0	0.5	0.9	1.1
19	0.0	0.4	0.4	0.0	0.0	0.5	0.3	0.2	0.6	0.4
20	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.1

Funded Graduate Education										
Grad Ed YOS	Unqualified Line	SWO	SUB	SEAL	EOD	Aviator	RL	STAFF	Other	Total
0	0.0	0.4	1.2	0.0	7.5	2.5	1.6	0.9	0.8	1.4
1	2.9	0.4	0.5	0.0	2.5	0.8	0.6	0.0	0.0	0.5
2	5.7	4.1	4.6	4.4	2.5	1.4	0.3	0.0	0.8	2.3
3	28.6	1.1	4.1	1.5	0.0	1.4	6.3	0.4	0.8	2.0
4	28.6	0.1	0.5	0.0	0.0	0.1	3.8	2.0	0.0	0.9
5	2.9	1.1	0.7	0.0	0.0	0.2	3.4	3.9	4.8	1.4
6	0.0	6.9	5.1	4.4	0.0	0.8	13.8	5.5	7.3	4.8
7	0.0	25.5	21.2	7.4	2.5	2.8	11.6	5.0	19.4	12.6
8	8.6	23.0	20.9	11.8	10.0	7.6	8.8	6.4	21.0	13.8
9	5.7	7.1	5.8	7.4	12.5	13.4	7.2	6.2	4.8	9.0
10	2.9	3.7	6.2	10.3	12.5	10.4	7.5	12.1	4.8	7.8
11	2.9	4.1	3.9	5.9	2.5	9.1	7.2	17.7	6.5	7.9
12	5.7	4.5	6.7	10.3	2.5	12.4	7.5	19.2	8.1	9.8
13	2.9	6.8	6.9	7.4	10.0	6.1	6.6	8.0	4.0	6.6
14	0.0	3.3	4.1	2.9	12.5	5.7	5.6	4.6	4.0	4.6
15	0.0	2.5	1.6	7.4	10.0	9.5	2.2	2.1	7.3	5.0
16	2.9	2.7	2.5	8.8	10.0	7.5	2.8	2.5	4.0	4.5
17	0.0	1.5	1.6	5.9	2.5	5.3	1.6	2.1	0.0	2.9
18	0.0	0.7	1.4	4.4	0.0	2.2	1.6	1.1	0.8	1.5
19	0.0	0.5	0.7	0.0	0.0	0.6	0.3	0.5	0.8	0.5
20	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2

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**APPENDIX B. RETENTION BY YEAR AND BY COMMUNITY
AMONG OFFICERS WITH GRADUATE EDUCATION**

Graduate Education Retention Year by Community										
Retention Year	Unqual Line	SWO	SUB	SEAL	EOD	Aviator	RL	STAFF	Other	Total
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.1	0.2	0.0	0.0	0.4	0.3	0.0	0.3	0.2
3	0.0	0.5	0.0	1.0	3.6	0.2	0.2	0.1	0.3	0.3
4	0.0	0.8	0.0	0.0	0.0	0.3	1.5	0.9	0.6	0.6
5	45.2	1.2	1.2	0.0	0.0	0.2	6.5	0.8	0.9	1.4
6	2.4	1.6	3.4	1.0	0.0	0.3	1.8	1.0	0.6	1.2
7	2.4	1.1	3.0	2.1	1.8	0.3	1.0	0.5	0.9	0.9
8	2.4	1.1	2.7	1.0	0.0	0.7	1.1	1.8	0.6	1.2
9	2.4	1.2	1.3	0.0	0.0	1.2	1.0	1.0	0.9	1.2
10	2.4	3.2	3.3	1.0	3.6	2.0	4.1	4.2	4.0	3.0
11	4.8	3.6	3.0	1.0	0.0	2.2	5.2	2.9	3.4	3.0
12	2.4	3.3	2.8	2.1	1.8	1.4	4.6	4.0	9.7	3.1
13	0.0	2.2	2.4	5.2	1.8	1.8	3.3	3.4	6.3	2.6
14	2.4	3.5	5.2	5.2	0.0	2.8	3.9	7.5	5.4	4.2
15	7.1	15.7	16.7	10.3	14.6	15.6	16.1	15.8	7.5	15.3
16	7.1	15.5	14.9	13.4	18.2	14.7	12.7	15.8	17.8	15.1
17	14.3	13.5	12.0	13.4	27.3	15.7	13.0	13.8	17.5	14.4
18	0.0	12.1	11.4	15.5	10.9	14.6	9.1	9.9	11.2	12.2
19	2.4	11.7	8.7	16.5	7.3	14.8	8.5	8.8	6.9	11.5
20	2.4	8.2	8.1	11.3	9.1	10.9	6.2	7.9	5.4	8.8

Funded Graduate Education Retention Year by Community										
Retention Year	Unqual Line	SWO	SUB	SEAL	EOD	Aviator	RL	STAFF	Other	Total
2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1
3	0.0	0.5	0.0	0.0	2.5	0.1	0.3	0.0	0.0	0.2
4	0.0	0.6	0.0	0.0	0.0	0.1	0.3	0.2	0.0	0.3
5	54.3	1.1	0.9	0.0	0.0	0.2	7.5	0.7	1.6	1.6
6	2.9	1.5	1.2	0.0	0.0	0.3	0.6	0.9	0.0	0.8
7	2.9	1.1	3.0	2.9	2.5	0.1	1.3	0.4	0.8	0.9
8	2.9	1.3	2.3	1.5	0.0	0.5	1.3	1.2	0.0	1.1
9	2.9	1.1	0.7	0.0	0.0	1.2	1.3	0.5	0.8	1.0
10	2.9	2.8	3.5	0.0	5.0	1.7	4.4	1.8	5.7	2.5
11	2.9	3.3	3.2	1.5	0.0	1.6	4.4	0.9	3.2	2.4
12	2.9	3.4	3.9	2.9	2.5	1.3	4.7	3.4	9.7	3.0
13	0.0	2.3	2.1	4.4	2.5	1.4	1.9	2.5	6.5	2.1
14	0.0	3.1	4.4	5.9	0.0	2.3	3.1	8.5	3.2	3.7
15	5.7	15.4	19.3	13.2	17.5	15.4	18.4	17.6	5.7	15.9
16	5.7	15.1	14.9	14.7	22.5	13.6	13.4	17.4	19.4	14.9
17	14.3	12.5	11.3	14.7	20.0	16.2	13.8	15.6	20.2	14.5
18	0.0	13.0	11.3	16.2	15.0	16.3	9.7	10.1	11.3	13.2
19	0.0	12.8	8.3	13.2	0.0	15.5	8.1	9.8	7.3	12.1
20	0.0	9.0	9.9	8.8	10.0	11.9	5.6	8.7	4.8	9.6

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