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The Impact of a Quality Undergraduate Education on Marine Corps Officer Performance

March 2022

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Department of Defense Management

Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943

ACQUISITION RESEARCH PROGRAM
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NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

To meet the demands of future conflicts against increasingly capable adversaries, the Marine Corps must recruit, promote, and retain the most capable officers. Yet, every year money is spent training and educating Marine officers, and each year high performing and capable officers voluntarily separate, resulting in Marine Corps talent loss. The goal of this thesis was to determine if the type of college attended predicts performance of career-level officers. U.S. universities with Naval Reserve Officer Training Corps were grouped by selectivity. Models used ordinary least squares to predict officer retention at 5-, 7-, 10-, and 15-year career milestones and a logit model to study predictive variables for promotion to Major. Our results suggest that graduates of top-ranked public or private universities are less likely to be retained in the first 10 years of service. Graduates of top-ranked private universities who decide to stay in the Marines are more likely to retain at 15 years and promote to Major. Graduates of bottom-ranked public universities are more likely to retain at 7 years of service but are less likely to remain on active duty at 15 years or promote to Major. A Marine's accession source was not found to be a significant factor in predicting promotion or retention after controlling for gender and race. Since school type retention rates were found to be similar, results do not support any policy changes that emphasize recruitment from a particular college type.

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I must acknowledge my family for supporting me throughout my career and the long hours spent in my office over these past two years at Naval Postgraduate School. Katie, I would be hard-pressed to find a more committed wife and loving partner. Mason and Mallory, you are both amazing kids that I am so blessed to have you three in my life. Thank you, family, for your enduring patience, love, and support. Without you, I would certainly struggle to succeed. Every success in my life reflects the support I have received from family, friends, mentors, and colleagues.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACT	American College Test
CFT	Combat Fitness Test
CMC	Commandant of the Marine Corps
CSC	Command and Staff College
ECP	Enlisted Commissioning Program
EWS	Expeditionary Warfare School
FITREP	fitness report
FMF	Fleet Marine Force
GPA	grade point average
LtCol	Lieutenant Colonel
MCRC	Marine Corps Recruiting Command
MECEP	Marine Enlisted to Commissioning Education Program
MMRP	Manpower Management Records and Performance
MOS	Military Occupational Specialty
NROTC	Naval Reserve Officer Training Corps
OCC	Officer Candidate Course
OCS	Officer Candidate School
PFT	Physical Fitness Test
PLC	Platoon Leaders Class
SAT	Scholastic Aptitude Test
TBS	The Basic School
TFDW	Total Force Data Warehouse
U.S.	United States
USNA	United States Naval Academy
WTI	Weapons and Tactics Instructor
YCS	years of commissioned service
YOS	years of service

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I. INTRODUCTION

A deeply personal and often difficult choice that high school graduates face is where to go to college. However, student preference only makes up one aspect of this decision. More critical decisions often include what college or university to apply to, school location, tuition costs, and which schools an applicant was accepted. Each year a small portion of college-bound high school graduates explore the possibility of becoming a commissioned officer in the United States (U.S.) military. A smaller subset of Marine officer candidates are recruited and selected from across the country after finishing an arduous screening and evaluation process to earn a seat at officer candidate school (OCS).

Upon completion of OCS, hundreds of newly minted Marine Second Lieutenants report to The Basic School (TBS) for six months. They then attend follow-on training in their Military Occupational Specialty (MOS) schools before joining the Fleet Marine Force (FMF). Previous research on Marine officer performance and retention has examined the different accession sources at depth or analyzed performance at TBS as a predictive variable. However, few researchers go back one step further to study whether the quality of undergraduate education systematically effects performance and retention. One significant requirement common to all Marine officers is the possession of a four-year undergraduate degree, regardless of the individual's major field of study. This degree requirement and the quality of the awarding institution form the foundation of this study. This research quantitatively analyzes Marine Corps' officer data and qualitatively analyzes performance metrics compared to test scores and educational achievement to predict officer performance based on promotion and retention.

A. BACKGROUND INFORMATION

The *Commandant's Planning Guidance 2019* and *Joint Operating Environment 2035* agree that future conflicts against increasingly capable adversaries will be dynamic and complex (Berger, 2019, 2020). When General David H. Berger assumed duties as the 38th Commandant of the Marine Corps (CMC) in 2019, he published the Commandant's Planning Guidance to provide the force with his plan to change direction for the Marine

Corps (Berger, 2019). One of his five priorities was force design, which requires vital planning and actions from the manpower department (Berger, 2019). The CMC is redesigning the force to meet the warfighting challenges of the next generation. History has shown the rigors that a Marine officer must endure, and the future implies that such challenges will only continue to grow. In response, the Marine Corps has made significant changes to the future force design with emphasis on modeling, artificial intelligence, and individual PME to foster innovation. "In 2020, the Defense Department spent about 25 percent, of its $630 billion base budget on cash pay and benefits for current service members" (Harper, 2021, p. 1). Given military personnel costs are one of the most significant cost drivers, the Marine Corps must appropriately apportion the budget to target the highest quality candidates to ensure we have the best quality officers Corps eligible for promotion and retention at each career milestone. If this study can show evidence that the quality of undergraduate education can predict future officer performance it can have overarching implications to recruitment, promotion, and retention to maximize the return on investment of Marine officers.

Throughout this study, the terms "university," "college," "school," and "post-secondary education" are used interchangeably. Although college ranking systems do not commonly use the terms "quality" and "selectivity" equally, this study uses these terms interchangeably to convey the differences among colleges. The term "retained" means the Marine stayed on active duty. This requires a two-part obligation: (1) the Marine Corps invites the officer to stay, and (2) the officer decides to stay. The default is the Marine Corps invites everyone to stay unless they are twice passed for promotion based on performance or punitive problems.

B. PURPOSE OF RESEARCH

This research analyzes the quality of Marine Corps officer undergraduate education by accession sources by evaluating performance metrics of promotion and retention. Each year the Marine Corps commissions hundreds of new officers from different quality schools across the country. Each year large sums of money are spent on training and education to produce future leaders. However, all undergraduate educations are not equal

and each year high performing and capable officers voluntarily separate, resulting in a talent loss to the Marine Corps. After qualitative binning U.S. Universities and Colleges, this study compares school types to determine if graduates of one school type are more likely to be successful officers. This success is measured using performance metrics of achieving career milestones or being promoted to Major. These results are compared to determine if there is evidence that a quality undergraduate education predicts Marine officer performance. In times of budget restraint, such research can provide the Marine Corps with the framework needed to efficiently allocate recruitment and training funds towards select universities. Once identified, the Marine Corps can prioritize those select universities most likely to produce high-performing officers with the highest probability to be retained to specific career level milestones.

C. RESEARCH QUESTION

1. How Does Graduating from Private or Public Universities Offering NROTC Predict Performance as a Marine Officer?

2. Is there a Relationship between a Marine's Commissioning Source and the University's Ranking that Predicts Performance?

Results of this study suggests that top-rated public or private university students are less likely to be retained in the first 10 years of service. Graduates of top-rated public universities who decide to stay in the Marines are positively associated with retention at 15 years and promotion to Major. Graduates of public bottom universities are positively associated with the first 10 years of service but are negatively associated at 15 years and with promotion to Major. Marines commissioned through PLC or NROTC were found more likely to be retained than their OCC counterparts. However, once variables for gender, race, and MOS were included in the models, the accession source lost all significance on retention.

D. SCOPE AND LIMITATIONS

1. Scope

The initial goal of this research was to assess the quality of all undergraduate universities attended by Marine officers. However, due to data limitations and time constraints,

the study was scaled down to a representative sample of random Marine officers from universities with NROTC. The scope of this thesis incorporates U.S. undergraduate colleges and universities binned into school selectivity using Barron's (2018) 6-point selectivity index and Bowman and Mehay's (2002) public versus private institution comparison. The accession sources used by the officer who attended a college with NROTC was also accounted for. Career retention milestones of 5-years, 7-years, and 10-years are used following the precedent by Kelly and Kilber (2021) and this study adds a 15-year milestone to further examine Marine officer retention. Constructed models use multivariate linear regression to analyze performance data of an officers' career to determine predictive variables of successful performance compared to their promotion and retention. This study utilized observational data collected from total force data warehouse (TFDW) that spanned from 2000 to 2020 to conduct multivariate analysis on dependent variables for retention and promotion to Major.

2. Limitations

This study encountered several limitations with the data. First, Barron's selectivity index was hand merged into the data file, meaning there is a small possibility of human error. Second, the TFDW data file had some discrepancies in the coding of university names or missing entirely. Third, fitness report (FITREP) data was collected to be paired with this study but the merged FITREP observations to the final sample were too small to be of significance and were dropped from the study.

E. ORGANIZATION OF THE STUDY

This thesis is organized into six chapters. Chapter I introduced what college applicants face and the future needs of the Marines. Chapter II provides a brief background on accession sources and Barron's selectivity index used to bin the colleges and universities. Chapter III provides a literature review revealing this field is more extensively studied in the civilian sector by assessing the earned wages of graduates from a type of school. Chapter IV describes the data and independent variables used as well as the methodology used to conduct the study. Chapter V features the models and summary

findings of the research. Chapter VI concludes this study and provides a recommendation based on research results, to include future areas of study.

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II. BACKGROUND

Chapter II develops a reader's understanding of Barron's selectivity index and the process of how a Marine officer is recruited, their accession options to commissioning, and how their performance is evaluated through FITREPs to earn promotions and retention eligibility.

A. EDUCATION QUALITY

Quantifying the quality of a university is difficult and subjective. Numerous different ranking systems attempt to measure the quality of U.S. universities, but the most common are Barron's *Profiles of American Colleges*, *U.S. News and World Report rankings, The Princeton Review*, and basic admissions statistics. This study uses Barron's *Profiles of American Colleges* selectivity index to rank U.S. colleges into the following six categories based on the competitiveness of their admissions requirements: most competitive, highly competitive, very competitive, competitive, less competitive, and non-competitive (Barron's, 2018). Barron's uses the median test scores of accepted students to generate a rating of 1 to 6 to determine which bin a university belongs to, with 1 being the most competitive and 6 being the least, or noncompetitive. The most competitive colleges have the lowest selection rates. Whereas non-competitive colleges admit nearly every student who applies. The commonly used scores are aggregated from the scholastic aptitude test (SAT) or American college test (ACT) and high school class ranking and grade point average (GPA) then compared to the percent of applicants offered acceptance to the university (Barron's, 2018).

B. RECRUITING

Each year, Congress directs the Marine Corps end strength. Manpower and Reserve Affairs oversees the recruiting mission of Marine Corps Recruiting Command (MCRC) to ensure high caliber officer candidates are sent to OCS (United States Marine Corps Recruiting Command [MCRC], 2015a). Recruiting stations are spread throughout the nation and Marine officer selection officers are tasked to recruit and process future candidates

through several different accession sources covered below in commissioning. Figure 1 depicts the percent of officers by accession source in fiscal year 2021.

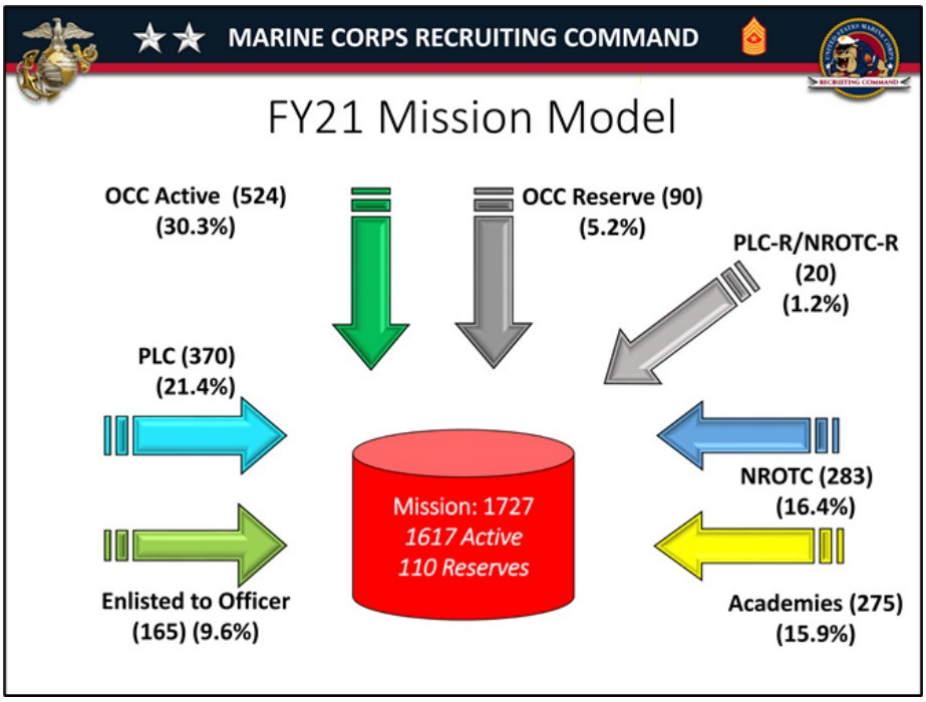

Figure 1. FY 2021 Officer Accession Mission. Source: MCRC (2021).

C. COMMISSIONING

There are six different Marine Corps accession sources to become a Marine officer: they are the Naval Reserve Officers Training Corps (NROTC), the United States Naval Academy (USNA), Platoon Leaders Class (PLC), Officer Candidate Course (OCC), Marine Enlisted Commissioning Education Program (MECEP), and Enlisted Commissioning Program (ECP). Each accession program is tailored to a different officer candidate based on their educational commitments and if they are currently an active duty enlisted Marine. Therefore, each program has different obligations to satisfy commissioning requirements. Each source of commissioning is briefly described below.

1. NROTC

The NROTC exists to train and educate college students for service as commissioned officers in the Navy and Marine Corps (Naval Education and Training Command [NETC], 2020). Students are accepted into NROTC separate from their college admissions process. Once accepted into NROTC, midshipmen are required to complete their college classes and the additional curriculum required of NROTC midshipmen regardless of their scholarship status. Those NROTC students interested in becoming a Marine must apply to the Marine Corps and may apply for a Marine-option NROTC scholarship. If accepted, they will attend a six-week OCS during the summer of their junior year and then commission upon their college graduation.

2. USNA

Selection to attend the USNA is a grueling process often requiring prospective students to receive an appointment from a member of congress and has a low acceptance rate. Those fortunate enough to be accepted receive an all-expenses-paid four-year scholarship. USNA midshipmen interested in the Marines must go through an additional screening process at the Naval Academy and then complete a four-week OCS-like training event called Leatherneck during the summer of their junior year in Quantico, Virginia (USNA, 2020). After successful completion of Leatherneck and graduating from the Naval Academy they are commissioned into the Marines with a 5-year service obligation.

3. PLC / OCC

PLC candidates attend two six-week OCS sessions. Their first session is during freshmen or sophomore summer and the second session is during their junior summer. A single 10-week OCS summer session is available after a candidate's junior year is complete for those who join on a later timeline. Both PLC and OCC will commission upon their undergraduate graduation (MCRC, 2015b).

4. MECEP / ECP

MECEP is a highly competitive commissioning program only available to active-duty enlisted Marines without an undergraduate degree. A qualified applicant must meet

requirements for rank, time in service, scholastic aptitude, admission to a NROTC school, receive a favorable command endorsement, and be selected by a Headquarters Marine Corps board. Before reporting to their NROTC unit the MECEP candidate must complete the 10-week OCS program. A MECEP candidate is commissioned after having completed both OCS and their undergraduate degree. Alternatively, ECP is a clearer path for those enlisted Marines already in possession of an undergraduate degree and at least one year of enlisted service. Once they are selected for the ECP program they report to the 10-week OCS and receive a direct commission upon successful completion of OCS (MCRC OCM, 2016).

D. OCS

A defining moment for any Marine officer is their graduation from OCS when they earn their eagle, globe, and anchor. OCS is designed to test a candidate and ensure only the highest caliber earn the right to stand before and lead enlisted Marines. OCS states its mission is "to educate and train officer candidates in a challenging environment to screen candidates for the leadership, moral, mental, and physical attributes required of a Marine Corps officer" (USMC OCS, 2020). OCS training has three distinct schedules of different lengths to accommodate NROTC, OCC, PLC, MECEP, and ECP commissioning. Those candidates who have graduated from college will direct commission and report to TBS, while the remainder of OCS graduates return to complete college before they are eligible to commission.

E. TBS

Upon commissioning, all Marine officers report to the basic school in Quantico, Virginia regardless of their future MOS for 26 weeks. The stated mission of TBS is to "Train and educate newly commissioned or appointed officers in the high standards of professional knowledge, esprit-de-corps, and leadership to prepare them for duty as company grade officers in the operating forces, with particular emphasis on the duties, responsibilities, and warfighting skills required of a rifle platoon commander" (TBS webpage, 2022). TBS is unique to the Marine Corps and no other branch of the U.S. military commits so much time and resources to train their officer corps to a single

standard. Here all Marine officers train together from all accession sources and MOSs to learn what is required of a Marine rifle platoon commander. Following graduation, the Lieutenants are sent to their MOS schools. Figure 2 represents an average TBS class size, demographics, and population by accession source.

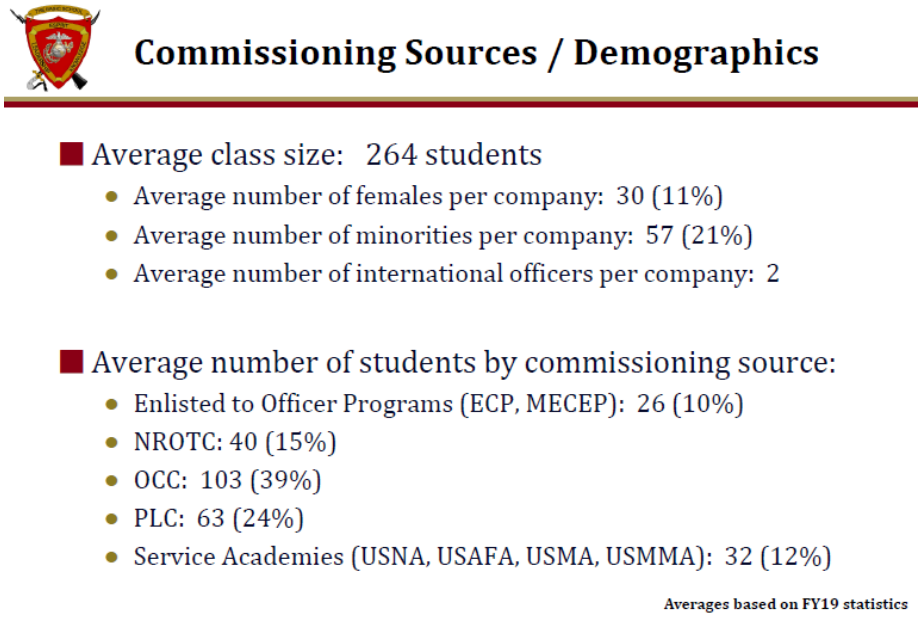

Figure 2. 2019 Average Distribution of Officer Accessions.
Source: Everly (2019, p. 39).

F. MOS

There is a diverse field of Marine officer MOSs, but they can be grouped into three common categories of Ground Combat, Combat Service Support, and Aviation with a few exceptions like lawyers. Ground Combat has MOSs like Infantry, Artillery, Tanks, and Reconnaissance. Combat Service Support is comprised of Logisticians, Engineers, Communicators, and Supply. Whereas Aviation consists of all fixed-wing pilots, rotary-wing pilots, and aviation support roles. This is just a brief outline of what type of jobs fall within these three groups.

G. PROMOTIONS

Fitness Reports are one of the primary tools used to evaluate Marines and play a critical role in promotions. These written performance reports grade a Marine on 14 individual attributes and describes the Marine reported. This allows each eligible officer to be evenly compared against fellow officers of the same rank and experience. Officer promotions are conducted by a board to ensure only the best and most competitive are selected to the next rank. The board is governed by Title 10 of the United States Code, Headquarters Marine Corps guidance called a board precept, and manpower staffing goals on a 5-year cycle (HQMC, 2006). Per the Officer Promotion Manual, eligible officers are divided into three promotion zones encompassing the most senior to the junior officer under consideration (HQMC, 2006). The three zones include the above-zone, in-zone, and below-zone. The in-zone contains the primary population of the officers being considered for promotion. While the above-zone is for those not selected while in-zone on a previous board. The above-zone provides those officers a second or third and final look for consideration. Below-zone officers are junior in date of rank to those officers in-zone and are rarely selected. On next year's board, the below-zone officers move to the in-zone.

H. SUMMARY

The background information provided in Chapter II briefly describes educational quality ratings and chronicles the pathway to become a Marine officer from recruiting, the different accession source, earning a commission, and completing the entry-level training pipeline of OCS, TBS, and MOS school. The chosen path to become a Marine officer varies by the individual based on their school choice and accession options but provides insight into an individual's ability, drive, and motivation to serve.

III. LITERATURE REVIEW

OVERVIEW. Since students self-select their colleges and are not randomly assigned it is difficult to ascertain if benefits are a result of school quality or the students attracted to the post-secondary institution make the school a self-fulfilling prophecy. Interest in academic performance, the type of college, the institutional quality relative to costs, and future economic returns are not new areas of study. The earliest studies focused on the quantity of education, meaning the number of years studied or degrees obtained. There is a growing field of study that assesses the benefit of attending a highly selective post-secondary institution. Most prior studies focus on earnings as a measure of performance when assessing the payoff of graduating from a more selective college compared to a less selective one. Many of these studies track a graduate's annual earned income in the civilian market as evidence to substantiate their claim that grads of more selective colleges are higher paid. There are however few studies that assess the impact of more selective education on military performance and retention.

A. PAST CIVILIAN RESEARCH

In civilian research, earnings became the proxy for market productivity to measure success after graduation. James et al. (1989) began looking at the college quality and its characteristics using national longitudinal surveys (NLS) of male High School class of 1972 as their data set (NLS72) (James et al., 1989). Findings stated that college selectivity and attending a private college had positive effects on future earnings, while higher per-student costs did not (James et al., 1989). This study also identified that what you do at college matters more than college experience variables of "family background, ability, and college characteristics combined" (James et al., 1989, p. 252). This is an important theme that is repeated in later research. Loury and Garman (1995) found college GPA and choice of major had a significant effect on income (Loury & Garman, 1995). Brewer et al. (1996) were able to use longitudinal data by combining the NLS 72 with High School and Beyond data to assess the "effects of college quality on wages and earnings," they found the effect of attending a better university varies across time (p. 105). This study found "a large

premium to attending an elite private institution and a smaller premium to attending a middle-rated private institution, relative to a bottom-rated public school" (Brewer, 1996, p. 119).

Dale and Krueger (1999) examined the payoff of attending a more selective college compared to a non-competitive college over two decades to assess graduation's immediate and short-term effects. They used civilian market data to study the effect of a school's quality on individual careers, first publishing their research in 1999 and released follow-up publications in 2002 and 2014. In 1999, Dale and Krueger used NLS72 and the College and Beyond data to study the effect of a school's quality on individual careers. The results indicated, "students who attend higher-quality colleges earn more on average than those who attend colleges of lesser quality" (Dale & Krueger, 2014, p. 323). The authors adjust for school selection by comparing earnings among students who applied to and were subsequently accepted or rejected by comparable colleges. This is a significant step in this field of research to compare like students for aptitude and drive. This is important to minimize possible selection bias of prospective students based on colleges they applied to. As proxies of college quality, Dale and Krueger (2014) used, college average SAT scores, Barron's index of selectivity, and net tuition. They found that a higher quality school appears to affect career earnings positively and these effects increase over time, before adjusting for the self-revelation of where a student applied (Dale & Krueger, 2014).

Since Dale and Krueger used self-reported survey data there was potential for people to inflate their true earnings. To mitigate this risk, they compared reported earnings with reported taxable income. Then studied the effects from 1976 and 1989 graduates of 34 different colleges (Dale & Krueger, 1999). One obvious concern is that "students who attend more selective colleges may have greater earning capacity regardless of where they attend school" (Dale & Krueger, 1999). A strong probability exists that college admissions look positively at the same traits that equate to success post-graduation. In a case study on Master of Business Administrations Students, Roger Martin, who was the partner in charge of recruiting at a large strategy consulting firm said, "If you give me a choice of recruiting with the admissions list or the graduating list from Harvard Business School… I'd go with the admissions list" (Coughlan et al., 2007, p. 3). Martin believed it was the traits these

elite colleges sought that set their students apart, not whether they attended or even graduated. Drive, aptitude, and commitment may be a few of these highly desirable traits.

In Dale and Krueger's (1999) study, it was "necessary for students to be accepted by a diverse set of schools and for some of those students to attend the less selective colleges" from their acceptance list while others attended more selective colleges (p. 7). Then Ordinary Least Squares (OLS) regressions were applied to "control for differences in student attributes… correlated with earnings and college quality" (Dale & Krueger, 1999, p. 1). However, since the student characteristics used by college admissions are unobserved, researchers cannot hold them constant for estimations. Therefore, there is potential for unobserved characteristics with a positive effect on wages to overstate the benefit of attending a more selective school with OLS. Regressions using unobserved student characteristics are consistent with previous research that finds elite colleges provide a greater return on investment for career earnings are therefore statistically significant.

Dale and Krueger (1999) used "SAT scores as a proxy for unobserved student characteristics" and, in doing so, found the "effects of going to an elite school were insignificant." One exception was the minority and lower-income disadvantaged students tended to have a higher positive impact of attending an elite college. The authors found that "students who attended more selective colleges do not earn more than other students who were accepted and rejected by comparable schools but attended less selective colleges" (Dale & Krueger, 2002, p. 1523). The future effect on a student's income is better predicted based on higher school tuition than SAT score (Dale & Krueger, 2002). Conversely, Seki (2014) found students with 118-point higher average SAT scores received 3% higher earnings compared to their college peers. Overall, their future findings suggest the typical student does not benefit from attending the most selective college they were admitted to, it is more about the quality fit and effort of the student that yields higher performance and earnings (Dale & Krueger, 2012).

In the 2015 book *Mastering Metrics,* authors Angrist and Pischke build on the Dale and Krueger studies to compare the monetary effect on wages of attending a private or public university, called a tale of two colleges. Standard studies that simply compare the income of private school graduates to public school show a $20,000 difference annually.

The authors identify that selection bias plays a role in the wage gap given private school graduates on average have 120-point higher SAT scores and are the product of 13% wealthier families (Angrist & Pischke, 2015). The gap can better be explained by a combination of ambition and ability based on the schools the applicants applied to (Angrist & Pischke, p. 55). The initial regression showed the private school was likely to make 14% higher wages and was highly significant (Angrist & Pischke, 2015). To achieve a ceteris paribus comparison among private and public schools they controlled for which schools' students applied to and approved for admission as previously done by Dale and Kreuger. This leveled the field for ability test scores, ambition, parental income, race, and gender as researchers now compare equally capable students. These added control variables reduced the wage gap to $0 (Angrist & Pischke, 2015).

B. MILITARY RESEARCH

While civilian research commonly compares the tradeoffs of attending a highly selective college to tuition, the military usually compares the effects of promotion and retention to obtain performance measures. Bowman and Mehay (2002) researched the employee job performance in the U.S. Navy compared to their quality of college education (Bowman & Mehay, 2002). In the Bowman and Mehay (2002) study they identified that prior study's findings are inconsistent because studies using earnings data may provide an uneven correction for selection to school type, and "results may vary due to unmeasured heterogeneity of individuals within a firm" (Bowman & Mehay, 2002). Employees are likely to leave firms and firms are not typically open about internal data complicating this field of research. Therefore, Bowman and Mehay used Navy officer cohorts' data to account for these issues. Their data showed graduates from nearly 1,000 different colleges over 10 years spanning 1976 to 1985. Their study divided the personnel into two groups: admin/support and line personnel. Line personnel consisted of aviators, submariners, and ship personnel, while admin/support comprised the remainder. To evaluate the data for their study, the authors used three measures of job performance. First, they measured performance from the first four years of service (grades O1–O2). Second, four through 10 years of service (grade O3). The third measurement was the outcome of promotion to grade O4 for those who stayed in the Navy for at least 10 years.

Retention and promotion to O4 are markers of success to the Navy to maximize their return on investment after costly investments from accessions to entry-level training that consume time, resources, and money to make an O4. Using Barron's six categories of selectivity they collapsed the quality classification to top, middle, and bottom. Barron's two highest categories of (1) "most competitive" and (2) "highly competitive" became the top-rated colleges. Barron's (3) "very-competitive and (4) "competitive" were middle-rated, while Barron's bottom-rated was (5) "less competitive" and (6) "non-competitive" (Bowman & Mehay, 2002). Then an indicator variable for a public or private college was added. The final binned colleges were top-rated private, medium-rated private, low-rated private, top-rated public, medium-rated public, and low-rated public. All comparisons were relative to the low-rated public institutions. A unique benefit of this data set not previously available to other researchers pertains to a single employer which "minimizes the effects of unmeasured firm heterogeneity" (Bowman & Mehay, 2002, p. 702).

A possible flaw is not all personnel performance and promotion assessments are evenly compared to similar 'like' individuals performing the same tasks. It can be argued that individual performance evaluations are subjective to the evaluator despite a strict system of objective standards. However, there is no other way to measure all the intangible skills that equate to higher performance. One problem is the college quality bias of students who self-select the colleges they apply to. To correct this bias, Bowman controlled for pre-college selection variables SAT score and family attributes (Bowman & Mehay, 2002). Results of the study showed the effects of graduating from a top- or middle-rated private school to have positive outcomes for those served for 10 years but are statistically insignificant at O3 (Bowman & Mehay, 2002). In their study, college "GPA is positively related to job performance and promotion," yet during the first 10 years of service "technical majors receive significantly lower" evaluation scores than other majors (Bowman & Mehay, 2002, p. 706).

The study also shows that women are more likely to be promoted to O4 than males over the first 10 years (Bowman & Mehay, 2002). Race and gender were interacted as college indicators but were found statistically insignificant among line officers. They concluded in their study that, "controlling for GPA and major," graduates of top-private

universities demonstrated the highest performance (Bowman & Mehay, 2002, p. 711). In addition, they reported that regardless of school, those with higher college GPAs typically "received higher job performance ratings" and were "more likely to be promoted" (Bowman & Mehay, 2002, p. 711). Following the completion of their initial service obligation graduates of top-private universities are likely to exit the Navy fostering the question of if the Navy recouped their initial cost of their investment for tuition (Bowman & Mehay, 2002).

On the contrary, college ranking and their selectivity have been challenged regarding what they actually measure. A Stanford study suggests that a "good fit is a college where a student is engaged" (Stanford University, 2018, p. 2). The article argues that many students are too focused on their SAT score and college selectivity without understanding how those college ratings are tabulated. In fact, colleges strive to conform with the rubric of college ranking systems like *Barron's Profile of American Colleges*, *The Princeton Review*, and *U.S. News and World Report* to attract new applicants, (Challenge Success, 2018). Job fit is about more than future income, it also includes a students' learning, well-being, and job satisfaction (Stanford University, 2018). *U.S. News and World Report* apply a ranking system, while Barron's and *The Princeton Review* focus on the selectivity of applicants admitted. In short, college rankings are problematic because they "measure a set of factors that are weighted arbitrarily, drawn from data that are most easily quantifiable and comparable, sometimes poorly documented, and not always relevant to undergraduate education" (Stanford University, 2018, p. 9).

Numerous NPS theses focus on Marine retention, promotion, and accessions. Stolzenberg (2017) studied the qualities of a Marine officer promoted to Lieutenant Colonel (LtCol) O'Brien (2002) studied prior-enlisted Marine Corps officers' performance and retention. Zamarripa and Lianez (2003) studied the effect of PME and graduate-level education on Marine performance. Several studies exist about TBS performance as a future predictor like Hurndon and Wiler (2008). Hoffman (2008) researched factors of promotion to Major, LtCol, and Colonel. Desrosiers and Bradley (2015) analyzed different predictors of male and female success. Rateike (2017) researched the commandant's career-level education board as a performance indicator of high-quality officers. Conlan (2021) studied

which accession source is most likely to be promoted and retained until O4 and O5. Druffel-Rodriguez (2021) studied the effect of graduate education programs on the LtCol command screening board. Kelly and Kilber (2021) studied the predictive power of socio-demographic variables and NROTC mentorship on retention. Eric Lehmann's (2019) NPS thesis studied the effect of undergraduate education on Naval officer performance. However, I was unable to find any studies comparing the quality of undergraduate education to the performance and retention of Marine Corps officers.

In 2019, Eric Lehmann's NPS thesis investigated how the quality of undergraduate education affects Navy officers' retention and career progression. Variables used in the regressions include tuition costs, school ranking, school selectivity, demographics, commissioning source, retention, promotion to O4, and average SAT/ACT scores of the attended colleges. One research question was whether elite schools provide a perceived benefit and how their performance compares to individuals from other colleges. His research found that school ranking and selectivity had less effect on career success than other indicators like commissioning source and household demographics. Interestingly, graduates of more expensive universities are more likely to leave the Navy after completing their service contract (Lehmann, 2019). Lehmann associates this lower rate of retention to greater career opportunities in the civilian labor market.

In contrast to the Bowman and Mehay study, no correlation was found between elite institutions with higher tuition and increased performance in the Navy or its effect on promotion to O4. This study found that SAT scores were more significant than ACT scores based on the data. A possible explanation is that fewer colleges require ACT scores and that ACT and SAT reflect different attitudes among those who take it. The study shows "schools that select top SAT performers produce graduates that are more likely to separate throughout their first ten years of service" (Lehmann, 2019, p. 34). Comparisons like this are difficult to replicate in the civilian labor market since it is not single employer data. Conducting this study within the Navy means applying similar performance measures for comparable individuals in the same jobs. Whereas in the civilian market, it is challenging to obtain internal firm data on turnover and track subsequent career progression due to data

availability. The standardization provided by the Navy allows for a comparing the value of education to Navy officer job performance, promotion, and retention.

C. SUMMARY

Previous research found that students who attended universities with higher average SAT scores (Seki, 2014) or higher tuition (Dale & Krueger, 2002) "tend to have higher earnings when observed in the labor market" (p. 1). Overall, the previous literature suggests that when variables are controlled for to compare "like" students based on SAT scores, family background, and tuition costs that there is no longer a statistical significance of attending a more selective college. Military research on the Navy found top-or middle-rated private colleges have positive outcomes for those serving 10 years or more. Selectivity of college type has statistical significance in determining the probability of retention but is not significant for promotion to O4. Lehman (2019) found graduates of "highly selective schools are more likely to leave the service" when controlling for tuition costs and SAT scores (p. 34). This retention rate potentially indicates that selectivity depends on other variables than just academic performance. This study seeks to build upon this foundation of research to further explore if the quality of undergraduate education predicts Marine officer performance by modeling promotion and retention as dependent variables. Chapter IV provides summary statistics for the dependent and independent variables.

IV. DATA AND METHODOLOGY

This chapter describes the sources of data, the dependent, and independent variables used in the multivariate analysis. Basic summary statistics are described using tables to visualize the data. Lastly, the chapter reviews the methodology used to complete the research models.

A. DATA SOURCES

This research uses data collected from the TFDW. Using a unique encrypted identification number, the data is merged by matching individuals through the encrypted identification number. Then a unique identification number is created for each individual and the encrypted identification is dropped from the data.

1. TFDW

A large collection of data was provided by TFDW broken into five files to capture Marine information, awards, education, resident schools attended, and correspondence courses completed from Marine Corps Institute. The files included longitudinal data from January 2000 to December 2020 on commissioned officers with a total of 112,595 unique observations before cleaning the data. Variables included in the data are demographics for gender, race, married, children, accession source, MOS, and undergraduate education. The demographic data from TFDW is essential to compare a diverse pool officer on the same dependent variables. Predictor variables to measure officer retention at career milestones of 5-, 7-, 10-, and 15-years based on the number of years of commissioned service (YCS). To be included in a career retention milestone the YCS must be greater than or equal to the year described.

2. Data Issues

The data received from TFDW had several issues that required correction before merging the files and conducting analysis. To access the quality of undergraduate education as a predictor of performance required the college or university name to be present. There were 112,595 unique officer observations in the Marine information data. Unfortunately,

many observations were missing the university name or had erroneously recorded high schools' names and were dropped leaving 25,209 unique observations. Due to the scale of this data possessing over 1,600 different universities attended which required coding by hand, the decision was made to focus on the 78 universities that have NROTC as a representative population of all colleges. Of note, university names were not consistently labeled the same in the data and usually written 2–5 different ways to describe one distinct university. Correcting this required additional hand coding to merge the universities under a singular name before assigning their level of selectivity. All universities without NROTC were dropped from the data leaving a final sample size of 4,224 unique observations. Given the extensive use of hand-coding for university names and then binning by school type and selectivity, a small possibility of human error exists.

B. VARIABLES

Dependent variables represent the outcome variables while the independent variables are used in the models to access their predicted impact on the dependent variable. Most of the variables were converted into binary for "1" is equal to yes and "0" is equal to no. There are a few continuous variables such as commissioning age and body fat represented by a corresponding number. Figure 3 provides the number of officers commissioned by cohort year within this study.

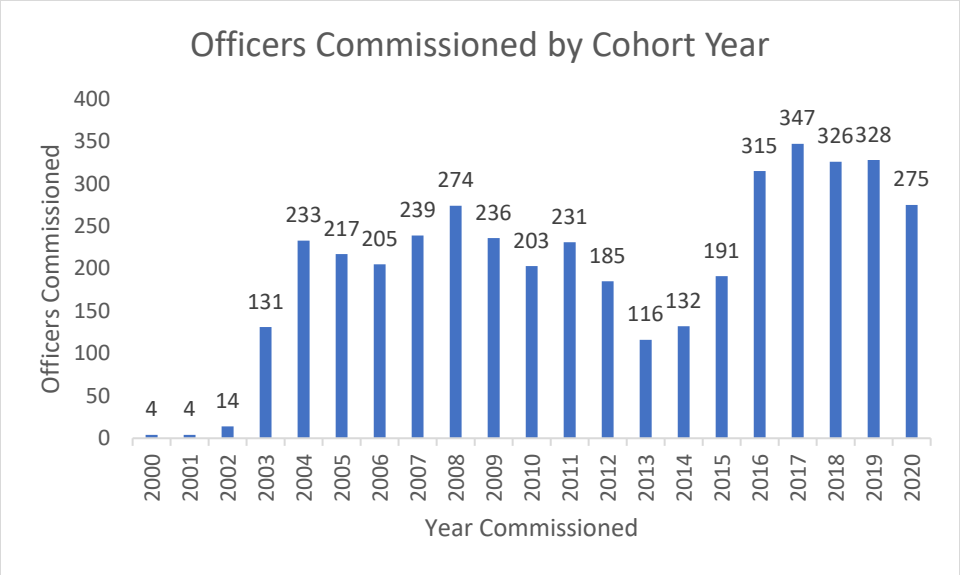

Figure 3. Officer Commissioned by Cohort Year

From 2001 to 2003, the observations are uncharacteristically low representations of the officers commissioned by universities with NROTC but is an accurate representation of the data received. These low observations do not negatively skew the data, as each observation was independently assessed on their retention and promotion.

1. Dependent Variables

Retention and promotion to Major are the two dependent variables used in this study. Retention is accessed at the 5-, 7-, 10-, and 15-year career milestones. Previous research by Kelly and Kilber (2021) used 5-, 7-, and 10-year career milestones to assess the effects of mentorship on NROTC students. The addition of a 15-year career milestone is new to this study. The 5-year retention milestone is significant because all officers have fulfilled their minimum active commitment and accepted career designation to continue service on active duty. A career designation board conducted by headquarters Marine Corps screens each officer before their 5-year retention milestone to determine eligibility to remain on active duty. If an officer is selected and accepts career designation, they incur a 2-year active-duty service obligation. Throughout this study, the selection rates for career designation fluctuated based on operational needs for commissioned officers. The 7-year

milestone signifies the completion of their second tour of duty and staying in the Marines beyond career designation's service obligation. The 10-year milestone aligns with promotion to Major and continued future service. Lastly, the 15-year milestone strongly indicates retention in the Marine Corps to earn retirement after 20 years of active service.

The second dependent variable, promoted to Major, measures performance as a significant career milestone as previously done by Lehmann (2019) studying Navy promotions to O4 and Conlan (2021) researching Marine accessions and promotion to O4. Binary variables were created from the sample with "1" is equal to yes, the Marine was retained to the career milestone or promoted to Major and "0" is equal to no. Table 1 depicts the dependent variables used in this study and Table 2 provides the associated summary statistics.

Table 1. Dependent Variables

Dependent Variable	Variable Definition
5-Year Retention	= 1 if ≥ to 5 YCS
7-Year Retention	= 1 if ≥ to 7 YCS
10-Year Retention	= 1 if ≥ to 10 YCS
15-Year Retention	= 1 if ≥ to 15 YCS
Major	=1 if promoted to Major

Table 2. Dependent Variable Summary Statistics

Dependent Variable	N	Mean	Std. Dev.	Min	Max
5-Year Retention	2,615	0.348	0.009	0	1
7-Year Retention	2,292	0.229	0.008	0	1
10-Year Retention	1,760	0.119	0.008	0	1
15-Year Retention	603	0.043	0.008	0	1
Major Promotion	1,760	0.088	0.007	0	1

2. Independent Variables

Independent variables in Table 3 are broken into variable groups to be applied to the dependent variables. The variable groups are incrementally added to the models by column to assess their explanatory power on the dependent variable.

Table 3. Independent Variables

Independent Variable	Variable Definition
Demographics	
Married	= 1 if married, =0 otherwise
Military Spouse	= 1 if spouse is military, =0 otherwise
Female	= 1 if female, =0 otherwise
Parent	= 1 if has one or more children, =0 otherwise
Number of Dependents	0 to 7
Caucasian	= 1 if Caucasian, =0 otherwise
African American	= 1 if African American, =0 otherwise
Asian	= 1 if Asian, =0 otherwise
Native American	= 1 if American Indian/Alaskan Native, =0 otherwise
Hawaiian	= 1 if Hawaiian/pacific islander, =0 otherwise
Hispanic	= 1 if Hispanic, =0 otherwise
Other	= 1 if other, race not specified, =0 otherwise
Prior Enlisted	= 1 if prior enlisted, =0 otherwise
YOS	1 to 30
YCS	1 to 20
Fitness	
1st Class PFT	= 1 if ≥ to 225, =0 otherwise
2nd or 3rd Class PFT	= 1 if < to 225, =0 otherwise
1st Class CFT	= 1 if ≥ to 235, =0 otherwise
2nd or 3rd Class CFT	= 1 if < to 235, =0 otherwise
Accession Source	
PLC	= 1 if completed PLC, =0 otherwise
OCC	= 1 if completed OCC, =0 otherwise
NROTC	= 1 if completed NROTC, =0 otherwise
ECP	= 1 if completed ECP, =0 otherwise
MECEP	= 1 if completed MECEP, =0 otherwise
MOS Grouping	
Combat Arms	= 1 if MOS is combat arms, =0 otherwise
Combat Service Support	= 1 if MOS is combat service support, =0 otherwise
Aviation	= 1 if MOS is aviation, =0 otherwise
Aviation Support	= 1 if MOS is aviation support, =0 otherwise
Special MOS	= 1 if MOS is special MOS, =0 otherwise
University Selectivity & Type	
Barron's Selectivity	1 to 6
Top Private University	= 1 if ranked 1 or 2 by Barron's and Private, =0 otherwise
Middle Private University	= 1 if ranked 3 or 4 by Barron's and Private, =0 otherwise

Independent Variable	Variable Definition
Bottom Private University	= 1 if ranked 5 or 6 by Barron's and Private, =0 otherwise
Top Public University	= 1 if ranked 1 or 2 by Barron's and Public, =0 otherwise
Middle Public University	= 1 if ranked 3 or 4 by Barron's and Public, =0 otherwise
Bottom Public University	= 1 if ranked 5 or 6 by Barron's and Public, =0 otherwise
Private	= 1 if private university, =0 otherwise
Public	= 1 if public university, =0 otherwise
Resident School PME	
EWS Complete	= 1 if Expeditionary Warfare School resident or non-resident PME complete, =0 otherwise
CSC Complete	= 1 if Command and Staff College resident or non-resident PME complete, =0 otherwise
EWS Resident PME	= 1 if Expeditionary Warfare School resident PME complete, =0 otherwise
EWS Non-Resident PME	= 1 if Expeditionary Warfare School non-resident PME complete, =0 otherwise
WTI PME	= 1 if Weapons and Tactics Instructor PME complete, =0 otherwise
FELLOWSHIP PME	= 1 if Congressional Fellowship PME complete, =0 otherwise
FOREIGN PME	= 1 if Foreign Service PME complete, =0 otherwise
Top Level School PME	= 1 if top level school PME complete, =0 otherwise
Advanced PME	= 1 if SAW, MAWS, or SAMS PME complete, =0 otherwise
Awards	
Personal Award	= 1 if received a personal award, =0 otherwise
Combat Award	= 1 if received a combat award, =0 otherwise
No Award	= 1 if no personal award, =0 otherwise

a. Demographics

There are 16 demographic variables used in this study. Most are binary variables with a "1" equal to yes, indicating the demographic variable applies to an officer, while "0" does not apply. The five continuous variables in the data are the number of dependents, Barron's selectivity, commissioning year, YOS, and YCS variables. An observation below 4,224 indicates the variable was missing in the data but small enough not to impact the research. Table 4 lists the summary statistics for demographic variables.

Table 4. Demographics Variables Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
Married	4,205	0.390	0.488	0	1
Military Spouse	4,223	0.028	0.165	0	1
Female	4,224	0.078	0.268	0	1
Parent	4,223	0.262	0.440	0	1
Number of Dependents	4,223	1.011	1.279	1	7
Native American	4,224	0.013	0.113	0	1
Asian	4,224	0.049	0.216	0	1
African American	4,224	0.040	0.196	0	1
Hawaiian	4,224	0.006	0.078	0	1
Hispanic	4,224	0.081	0.272	0	1
Caucasian	4,224	0.746	0.435	0	1
Race Unknown	4,224	0.028	0.165	0	1
Prior Enlisted	4,224	0.022	0.146	0	1
YOS	4,224	6.762	4.140	1	31
YCS	4,224	6.762	4.140	1	20

Trends in the summary statistics for demographics show Caucasian males are the majority representative. Caucasians make up 74.6% of observed Marines officers by race. As for gender, females are only 7.8% of the sample. 39% of the observed Marines are married but only 26.2% are a parent. Due to the high density of Caucasian males, minorities and females are more likely to be found significant in the models.

b. Accession Source

There are six different accession sources as discussed in Chapter I, but USNA was not included in this study since the research focused on schools with NROTC. All variables are binary, and Table 5 demonstrates the sample population.

Table 5. Accession Source Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
PLC	4,224	0.246	0.431	0	1
OCC	4,224	0.432	0.495	0	1
NROTC	4,224	0.227	0.419	0	1
ECP	4,224	0.034	0.180	0	1
MECEP	4,224	0.009	0.093	0	1

OCC produces the largest number of commissioned officers from that data with 43.2% or 1,826 observations. Interestingly, PLC produces approximately two percentage points more commissioned graduates than NROTC. NROTC is more costly in comparison to PLC and OCC due to scholarship opportunities. It does generate the question of whether there is an exposure effect on NROTC campuses that attracts equally qualified candidates to the Marines.

c. MOS

Occupation fields were formed into five binary MOS groups to determine if performance or retention deviated among the groups as done by Conlan (2021). Table 6 outlines the sample distribution by MOS group.

Table 6. MOS Group Variable Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
Combat Arms	4,224	0.160	0.366	0	1
Combat Service Support	4,224	0.241	0.428	0	1
Aviation	4,224	0.089	0.284	0	1
Aviation Support	4,224	0.025	0.156	0	1
Special MOS	4,224	0.038	0.191	0	1

Combat service support comprises 24.1% of the population followed by combat arms with 16%. For a complete list of the MOSs by group see Appendix A.

d. Physical Fitness

Fitness is a measure of performance used to compare Marine officers by two different standards. The physical fitness test (PFT) consists of a 3-mile run, pull-ups or flexed arm hang, and crunches for 2 minutes. The combat fitness test (CFT) is more combat-oriented and conducted in the camouflage utility uniform. The CFT consists of an 880-yard maneuver-to-contact, 2-min ammo can lift, and maneuver under fire event. Both tests have a maximum score of 300 but divide scores into first-, second-, or third-class performance with first being the highest. The data shows 97.6% of officers score a first-class on their PFT and 97.8% on the CFT. Since most officers score a first-class PFT and CFT, second- and third-class PFT and CFT are grouped together in Table 7.

Table 7. Physical Fitness Variables Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
1st Class PFT	4,224	0.976	0.153	0	1
2nd or 3rd Class PFT	4,224	0.024	0.153	0	1
1st Class CFT	4,224	0.978	0.148	0	1
2nd or 3rd Class CFT	4,224	0.022	0.148	0	1

e. Barron's Selectivity

Each of the 78 universities ranked 1–6 for selectivity according to Barron's (2018). Then divided into binary public or private variables and then grouped into binary variables by school type and recoded to reflect the following numbers in Table 8.

Table 8. Barron's Selectivity Variable Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
Barron's Selectivity	4,224	2.699	1.122	1	6
Top Private University	4,224	0.099	0.299	0	1
Middle Private University	4,224	0.090	0.286	0	1
Bottom Private University	0	0.000	0.000	0	0
Top Public University	4,224	0.294	0.456	0	1
Middle Public University	4,224	0.492	0.500	0	1
Bottom Public University	4,224	0.022	0.147	0	1
Private	4,224	0.189	0.392	0	1
Public	4,224	0.808	0.394	0	1

Public universities comprise 80.8% of commission officers from this sample and 49.2% of the officer sample attended a middle public university. Only 9.9% percent attended a top private university while 29.4% attended a top public university. Middle private seems low at 9% but may suggest that students chose top public over middle private universities. Appendix B provides a complete distribution by university name, selectivity, and quantity attended. Public middle universities are the largest representative for school type at 49.2%, while public bottom is 2.2%. There are no private bottom universities that have NROTC. Table 9 provides the quantity of observations and percentage of the sample by school type.

Table 9. Analysis of School Type by Quantity and Percent

4,224 Observations	Top University		Middle University		Bottom University	
	Quantity	Percent	Quantity	Percent	Quantity	Percent
Private	420	9.94%	380	9.00%	0	0%
Public	1,242	29.40%	2,078	49.20%	93	2.20%

f. PME

Completion of resident or non-resident PME schools are required for promotions. Completion of expeditionary warfare school (EWS) is required to be promoted to Major

and completion of command and staff college (CSC) is necessary to promote to LtCol. This is not an all-inclusive list of PME schools, but 11 different PME schools were turned into binary variables to indicate completion. Since the Marines cannot send all officers to resident PME, those officers who attend resident PME are selected by a board. Therefore, EWS and CSC are depicted in three different ways to reflect if the Marine completed resident, non-resident, or the combined variable EWS or CSC complete, regardless of type, per Table 10.

Table 10. PME Variables Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
EWS Complete	4,224	0.023	0.203	0	1
CSC Complete	4,224	0.006	0.084	0	1
EWS Resident PME	4,224	0.004	0.075	0	1
EWS Non-Resident PME	4,224	0.019	0.179	0	1
CSC Resident PME	4,224	0.002	0.043	0	1
CSC Non-Resident PME	4,224	0.004	0.065	0	1
WTI PME	4,224	0.003	0.003	0	1

EWS has a higher completion percentage based on the year groups in the data set that reflects the need to complete EWS for promotion to Major, whereas CSC is necessary for promotion to LtCol. Weapons and Tactics Instructor (WTI) is not a formal promotion requirement, but is a highly desired level of PME in the aviation community.

g. Awards

Personal awards are another measure of performance used and were further sub-divided to isolate combat awards. Combat awards included the Combat Action Ribbon, Purple Heart, Bronze Star, Silver Star, Distinguished Flying Cross, Silver Cross, and any personal awards with the valor device. All variables are binary and no unit awards were counted. From the sample, 6% of officers received personal awards while only 0.4% received a combat award in Table 11.

Table 11. Awards Variable Summary Statistics

Independent Variable	N	Mean	Std. Dev.	Min	Max
Personal Award	4,224	0.060	0.237	0	1
Combat Award	4,224	0.004	0.061	0	1
No Award	4,224	0.935	0.864	0	1

C. METHODOLOGY

The methodology is both quantitative and qualitative to assess predictive variables of Marine officer performance. The dependent variable of focus is career retention milestones using linear multivariate analysis models to determine if a specific bin of colleges is more likely to produce and retain high-performing officers. A 2021 NPS thesis by Kelly and Kilber studied the effects that NROTC mentors had on Marine Corps officer retention. Their thesis used historical retention milestones of 5-, 7-, and 10-years, and this study replicates those career milestones as individual decision points (Kelly & Kilber, 2021). The 5-year retention milestone is significant because all officers have fulfilled their minimum active commitment and accepted career designation to continue service on active duty. Headquarters Marine Corps conducts a career designation board to screen each officer before their 5-year retention milestone to determine eligibility to remain on active duty. Throughout this study, the selection rates fluctuated based on operational needs for commissioned officers. The 7-year milestone signifies the completion of their second tour of duty and the decision to stay in the Marines. The 10-year milestone aligns with promotion to Major and becoming a careerist, while the 15-year milestone is a strong indicator of intention to retire from the Marine Corps.

There are 78 undergraduate universities across the country that offer NROTC. These universities were binned into school types using Barron's six-point selectivity index of a "1" for the most competitive to "6" for non-competitive. Then each university was divided into public or private. Following the work by Bowman and Mehay (2002), a college comparison index was created by combining school selectivity with private or public to create six distinct school types. A private university with a selectivity rating of "1" or "2" was labeled top-private. Additional private universities ranked "3" or "4" were

labeled as middle-private, while bottom-private ranked "5" or "6." This pattern repeated for public universities binned into top-public, middle-public, and bottom public.

Career retention milestones of 5-years, 7-years, 10-years, and 15-years examine Marine officers' performance based on their previous undergraduate educational accomplishments. Constructed models use multivariate linear regression of ordinary least squares to analyze performance data on an officers' career to determine predictive variables of successful performance compared to their retention. The goal of this thesis is to determine if one type of undergraduate school type produces better performing or more successful career-level officers compared to other types of schools. By identifying if top-public universities are more cost-effective than top-private universities at producing career-level officers by career retention milestones the Marines can generate a greater return on investment by targeting select school types.

Multivariate analysis results from previous retention studies showed that military officers who attend top- and middle-private universities are less likely to be retained (Lehmann, 2019). The Marine Corps' promotion and retention system must retain a pool of talented Marine officers from Lieutenants to Generals. As a result, there is a cost and benefit tradeoff between spending money on recruiting candidates with higher attrition rates versus spending money on retention. However, since the Marine Corps rarely provides retention bonuses for officers, to affect retention, the model tested for lower officer retention among graduates from top-private schools and top-public schools when compared against the largest sample of middle-public universities.

D. SUMMARY

Chapter IV described the data from TFDW used in this research and the associated issues cleaning the dataset. This sample contains 4,224 officers who graduated from universities with NROTC between 2000 and 2020. The 5-year retention model's sample population has 2,615 observations whereas the 7-, 10-, and 15-year retention models had 2,292; 1,760; and 603 observations, respectively. A total of 50 variables were tested in the models and only the most explanatory variables were used in the final models to test for significance in Chapter V.

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V. ANALYSIS AND RESULTS

A. MODELS

The retention models assess the predictive value of the independent variables at the 5-, 7-, 10- and 15-year career milestones. According to Woolridge (2016), regression analysis assesses how the dependent variables change relative to changes in the independent variables. Table 12 explains the retention model with the independent variables relative to their respective control variables.

Table 12. Retention Model, Adapted from Kelly and Kilber (2021).

Retention Milestone = *f* (School Type, Demographics, Race, Accession Source, MOS Group)
Comparison Group: School Type: Middle Public University Demographics: Gender: Male Married: Single Parent: No children Race: Caucasian Accession Source: OCC MOS Group: Combat Service Support

Each comparison group in the retention model comprises the highest population density of each sub-group in the sample. The reader can assume the control subject is a single white male that graduated from a middle ranked public university who commissions through OCC and is in a combat service support MOS. While the 10-year mark is a common career milestone used in previous research (Ergun, 2003; Lehman, 2019), this study uses the career milestones from Kelly and Kilber (2021). Table 13 provides a multivariate regression of school type by career milestones without any additional independent variables for control.

Table 13. Officer Retention by School Type and Career Milestone

	(1) 5 Year Retention	(2) 7 Year Retention	(3) 10 Year Retention	(4) 15 Year Retention
Private Top University	-0.055	-0.063*	-0.025	0.020
	(0.031)	(0.028)	(0.025)	(0.032)
Private Middle University	0.093*	0.033	0.016	0.008
	(0.037)	(0.035)	(0.031)	(0.030)
Public Top University	-0.011	-0.021	-0.028	-0.001
	(0.021)	(0.020)	(0.017)	(0.018)
Public Bottom University	0.074	0.217**	0.086	-0.041***
	(0.070)	(0.078)	(0.079)	(0.012)
R-squared	0.005	0.008	0.004	0.002
N	2615	2292	1760	603
Outcome mean	0.35	0.23	0.12	0.04

Observational data from Total Force Data Warehouse (TFDW)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Private top universities are negatively associated with retention until reaching the 15-year milestone when compared to public middle. At 7-years private top is 6.3 percentage points less likely to be retained than someone from public middle and is statistically significant at 5% level. Private middle is significant at the 5% level for 5-year retention compared to the control. Public top is not found to be significant among any of retention milestones. In comparison, private top is 200% more likely to exit the Marines before 7-years of service compared to public top. Private middle are 9.3 percentage points or 25.7% more likely to be retained than public middle. Interestingly, public bottom is positively associated with retention at 7-years and negatively associated at 15-years, yet both are found to be statistically significant.

From this initial model without additional controls, private middle, public middle, and public bottom are positively associated with retention and graduates from these types of schools are most likely to be retained across the career milestones. This suggests that officers from private or public top universities are more likely to exit the Marines. The sign

of the coefficient inverts for private top and public bottom at 15-years. One possible reason is that graduates of private top who stay in the service beyond 10-years choose this lifestyle as a career choice compared to those of public middle universities. Whereas public bottom becomes negatively associated at 15-years, presumably indicating a shift in either performance or personal preference. Public bottom is the smallest of the observed school types with only 94 observations. Table 14 measures retention of private universities compared to public and each accession source to OCC by career milestone.

Table 14. Retention by Accession Source by Career Milestone

	(1) Retention at 5 Years	(2) Retention at 7 Years	(3) Retention at 10 Years	(4) Retention at 15 Years
Private University	0.011	-0.022	0.001	0.015
	(0.024)	(0.022)	(0.020)	(0.023)
PLC	0.080**	-0.002	0.009	-0.040*
	(0.026)	(0.023)	(0.021)	(0.018)
NROTC	0.079***	0.032	0.036	-0.010
	(0.022)	(0.021)	(0.019)	(0.022)
ECP	0.194***	0.153**	0.088	0.014
	(0.054)	(0.054)	(0.047)	(0.069)
MECEP	-0.096			
	(0.172)			
R-squared	0.010	0.006	0.004	0.007
N	2615	2292	1760	603
Outcome mean	0.35	0.23	0.12	0.04

Observational data from Total Force Data Warehouse (TFDW).

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

At 5-years retention, Marines commissioned through PLC, NROTC, and ECP are statistically significant compared to OCC. PLC and NROTC are 27% more likely to be retained than their OCC counterparts. ECP is 15.6% and 7.7% more likely to be retained at 5- and 7-years, respectively, compared to the OCC control group. Only PLC is found

significant at 15-year retention and is negatively correlated by 4 percentage points relative to OCC.

The MECEP and ECP Marines have prior service time, which impacts their YCS differently than other officers. ECP retention drops after 10-years and can likely be attributed to meeting retirement eligibility after 20 years of service. NROTC graduates are 19.8% more likely to be retained at 7 years and 8.4% more likely to be retained at 10 years than are OCC graduates. NROTC students often receive a 2-, 3-, or 4-year scholarship while attending college. NROTC students are also required to participate in more military activities during their college experience, possibly suggesting a higher level of dedication and commitment to service throughout their first 10-years.

The next model compares the final column of the 5-, 7-, 10-, and 15-year models, depicting the most explanatory variables on retention in Table 15. Variables for marital status, dependents, and MOS validate the significance of findings of previous NPS theses by O'Brian (2002) and Conlan (2021). Multivariate analysis was conducted at each career milestone using the most predictive independent variables. Full models by year are available in Appendix C-F.

Table 15. Full Retention Comparison by Career Milestones

	(1) 5-Year Retention	(2) 7-Year Retention	(3) 10-Year Retention	(4) 15-Year Retention
Private Top University	-0.025 (0.026)	-0.035 (0.026)	0.001 (0.024)	0.031 (0.036)
Private Middle University	0.031 (0.032)	-0.034 (0.032)	-0.014 (0.030)	0.001 (0.033)
Public Top University	-0.002 (0.018)	-0.017 (0.017)	-0.021 (0.016)	-0.004 (0.019)
Public Bottom University	0.003 (0.061)	0.130 (0.067)	0.033 (0.072)	-0.060* (0.024)
Female	0.098** (0.034)	0.082* (0.033)	0.024 (0.029)	0.055 (0.047)

	(1) 5-Year Retention	(2) 7-Year Retention	(3) 10-Year Retention	(4) 15-Year Retention
Married	0.188***	0.162***	0.067***	0.018
	(0.019)	(0.018)	(0.016)	(0.018)
Parent	0.105***	0.108***	0.106***	0.038
	(0.020)	(0.020)	(0.018)	(0.021)
Asian	0.111**	0.143***	0.070	0.008
	(0.040)	(0.041)	(0.043)	(0.041)
African American	0.043	0.034	0.023	0.002
	(0.044)	(0.045)	(0.046)	(0.051)
Hispanic	-0.052	-0.024	-0.026	0.020
	(0.030)	(0.030)	(0.029)	(0.043)
PLC	0.014	-0.019	-0.008	-0.039
	(0.023)	(0.021)	(0.020)	(0.021)
NROTC	0.031	-0.009	0.009	-0.015
	(0.018)	(0.018)	(0.018)	(0.021)
ECP	0.094	0.052	0.010	-0.009
	(0.049)	(0.054)	(0.048)	(0.083)
Combat Arms MOS	0.158***	0.067***	0.035	-0.014
	(0.022)	(0.019)	(0.018)	(0.016)
Aviation MOS	0.567***	0.430***	0.154***	0.008
	(0.024)	(0.029)	(0.028)	(0.024)
Aviation Support MOS	0.244***	0.233***	0.193**	0.150
	(0.053)	(0.057)	(0.062)	(0.115)
Special MOS	0.417***	0.159***	0.080	-0.020
	(0.045)	(0.043)	(0.041)	(0.032)
R-squared	0.308	0.257	0.116	0.043
N	2605	2283	1753	600
Outcome mean	0.35	0.23	0.12	0.04

Observational data from Total Force Data Warehouse (TFDW).

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Once all variables were controlled for, graduates of public bottom universities were statistically significant at the 5% level as less likely to be retained compared to public middle at 15-years. Retention of top ranked private university graduates remained negatively associated when compared to public middle at 5- and 7-years, while top public university graduates were negatively associated at all milestones compared to the control group. Females were 14.8% more likely to be retained than males at 7-years of service, but the female variable lost its significance after 10 years of retention. Asian was the most significantly affected race and was more likely to be retained than Caucasians at 5- and 7-years. MOS was found statistically significant but became less significant at each subsequent milestone compared to combat service support MOSs.

Interestingly, officers of public bottom universities are negatively associated with retention at 15-years and are 6 percentage points less likely to be retained compared to public middle. When public bottom is compared to private top, graduates of public bottom are 94% less likely to be retained at 15-years. This is the first time the data suggests that attending lower quality and less selective universities may negatively affect retention at 15-years.

Female officers comprised 7.8% of the dataset compared to male officers but are more likely to be retained at 5- and 7-years. This may indicate the high caliber of female officers recruited and their level of dedication to service compared to a male officer. However, at 10- and 15-years females are no longer statistically significant. Based on prior experiences talking with female officers, several have voiced frustrations with trying to time when they have children to balance their career and remain competitive. A hypothesis for why female significance drops may be that some female officers choose to exit the service and raise a family. The desire to raise a family under more stable conditions may be a plausible explanation given the variables for married and parent are both statistically significant at the 0.1% at 5-, 7-, and 10-years compared to those unmarried and without children. The data suggests that Marine officers place a premium on raising their family and variables for female, married, and parent loses significance as years of service increase.

Table 16 explains the logit model for promotion to Major with the independent variables relative to their respective control variables and Table 17 is the logit model.

Table 16. Promotion to Major Model, Adapted from Kelly and Kilber (2021).

Major Promotion = *f* (School Type, Demographics & Race, Accession Source, MOS Group & Fitness, Awards & PME)
Comparison Group: School Type: Middle Public University Demographics: Gender: Male Married: Single Parent: No children Race: Caucasian Accession Source: OCC MOS Group: Combat Service Support Fitness: 1st Class PFT & CFT Awards: Personal Award PME: EWS Non-Resident

Table 17. Logit Model for Promotion to Major in Odds-Ratio

	(1) School Types	(2) Demographics & Race	(3) Accessions	(4) MOS & Fitness	(5) PME
Private Top University	0.939 (0.279)	1.203 (0.399)	1.266 (0.428)	1.170 (0.421)	1.096 (0.409)
Private Middle University	1.019 (0.304)	0.975 (0.311)	0.999 (0.338)	0.937 (0.342)	0.940 (0.343)
Public Top University	0.812 (0.165)	0.992 (0.206)	1.025 (0.214)	0.971 (0.206)	0.962 (0.210)
Public Bottom University	1.962 (1.111)	0.961 (0.546)	1.003 (0.579)	0.998 (0.563)	0.917 (0.589)
Female		0.884 (0.472)	0.962 (0.513)	1.178 (0.675)	1.101 (0.689)
Married		4.098*** (1.103)	4.077*** (1.097)	3.316*** (0.927)	3.007*** (0.845)
Parent		4.507*** (1.051)	4.445*** (1.036)	3.900*** (0.932)	3.718*** (0.894)

	(1) School Types	(2) Demographics & Race	(3) Accessions	(4) MOS & Fitness	(5) PME
Military Spouse		2.554*	2.457*	2.346	2.290
		(1.142)	(1.101)	(1.111)	(1.102)
Asian		1.558	1.552	1.842	1.699
		(0.668)	(0.685)	(0.879)	(0.857)
African American		0.937	0.964	1.043	1.049
		(0.407)	(0.425)	(0.473)	(0.505)
Hispanic		0.407	0.396	0.409	0.452
		(0.212)	(0.210)	(0.228)	(0.255)
PLC			1.445	1.143	1.208
			(0.367)	(0.340)	(0.369)
NROTC			1.415	1.334	1.502
			(0.292)	(0.282)	(0.331)
ECP			1.245	1.532	1.552
			(0.497)	(0.671)	(0.707)
Combat Arms MOS				2.452***	2.369**
				(0.646)	(0.661)
Aviation MOS				4.116***	4.472***
				(0.989)	(1.115)
Aviation Support MOS				3.975***	3.776**
				(1.654)	(1.708)
Special MOS				3.786***	4.476***
				(1.437)	(1.731)
Resident EWS					37.062*
					(52.990)
WTI PME					27.076*
					(45.354)
Personal Award					1.496
					(0.363)

	(1) School Types	(2) Demographics & Race	(3) Accessions	(4) MOS & Fitness	(5) PME
R-squared	0.002	0.160	0.164	0.206	0.244
N	1753	1753	1753	1753	1753
Outcome mean	0.10	0.09	0.09	0.09	0.09

Observational data from Total Force Data Warehouse (TFDW).

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

School type and accession source do not have a significant impact on promotion to Major. Private top universities are positively associated with promotion to Major compared to public middle when all variables are applied but is not statistically significant. Variables for marriage and parents remain statistically significant at the 0.1% level. A married Marine officer is substantially more likely to be promoted to Major than a single officer. While parents are also substantially more likely to be promoted compared to childless officers.

Aviation and special MOS remained statistically significant at the 0.1% level compared to combat service support while combat arms and aviation support MOSs had 1% significance with all variables included in the model. Graduates of resident EWS are more likely to be promoted to Major than those who do not attend. Completion of EWS PME is a requirement for promotion to Major. Since Marines who attend resident PME are selected by a board it is not surprising these graduated have higher odds of being retained. However, this more likely represents the Marines continued desire to serve after the Marine Corps invested more in their abilities and careers. WTI graduates are also more likely to be promoted to Major than those who did not complete WTI. Similarly, completion of EWS or WTI was a strong predictor of promotion to Major and statistically significant at the 5% level.

B. SUMMARY

Chapter 5 conducted analysis on four models to assess how the quality of undergraduate education impacted retention at career milestones and promotion to Major. Model 1 found private top universities are negatively associated with retention until the 15-year milestone while public bottom changes from positively associated with retention to negatively associated at 15-years at the 0.1% level of statistical significance. In model 2

PLC and NROTC had higher retention rates compared to OCC, but only PLC was statistically significant at 15-years. A series of explanatory variables were added to model 3 to assess retention at the 5-, 7-, 10-, and 15-year milestones. Being married or a parent was found to be a significant indicator of retention to 10-years. Public bottom was the only school type of significance and was negatively associated with retention at 15-years. Model 4 was a logit model in odds-ratio to measure predictive variables for promotion to Major. Again, marriage and parenthood proved significant, but completing EWS resident PME or WTI were found to be highly significant predictors of promotion to Major. Chapter VI provides a conclusion to this study and further recommendations.

VI. CONCLUSIONS AND RECOMMENDATIONS

This final chapter provides interpretation of the models in the previous chapter relative to the initial research questions and concludes with policy recommendations and topics for follow-on research.

A. CONCLUSIONS

This study was designed to assess whether the quality of undergraduate education predicts differences in retention and promotion outcomes. Retention outcomes are assessed at career milestones of 5-, 7-, 10-, and 15-years of service. Retention is considered a measure of performance as officers must earn the right to stay in the Marines by remaining competitive and earning promotions. Promotion to Major indicates successful performance at the career-level and implies the Marine is ready to assume more responsibility and challenges as they transition to intermediate-level.

1. How Does Graduating from a Private or Public University Offering NROTC Predict Marine Officer Performance?

The first research question assessed whether graduates of different school types retain at different rates at the 5-, 7-, 10-, and 15-year career milestones. Simple models found that graduation from private top universities predicts a smaller likelihood of retention until reaching the 15-year milestone, compared to graduates of public middle universities. Holding a degree from a private middle-ranked university is associated with a larger rate of retention at 5-years. Previous research on Navy officer retention by Lehmann (2019) also found officers graduates from top-private university to have smaller likelihood of retention beyond their initial service obligation. Graduating from a public top university predicts a smaller probability of retention at all career milestones compared to public middle. However, private top is 200% more likely to exit the Marines before 7-years of service compared to public top.

Public bottom may yield the most telling research results. Initially, public bottom is positively associated with retention, but at 15-years public bottom becomes less likely to be retained. This may suggest that there is a difference in officers based on the quality

of undergraduate education. Angrist and Pischke (2015) demonstrated that students self-select the colleges to which they apply and that the colleges to which a student applies reflects a combination of their ambition and ability. One plausible explanation for public bottom changing from positive retention early in their career and negative at 15-years is their ambition and ability is not equal to graduates from middle or top universities. Each promotion becomes more competitive the longer a Marine continues to serve. The promotion model makes all officers *ceterus parabus* by accounting for demographic variables. Private top colleges have the highest probability of being promoted to Major if retained among the school types. This research suggests that public bottom officers are more likely to be screened out of the Marines based on performance.

Without additional controls, the model suggests that private middle and public middle are most likely to be retained, while officers from private or public top universities are more likely to exit the Marines. The lower level of retention of graduates from top-rated universities may indicate the vast opportunities available to them in the civilian market based on their ability, ambition, and alumni network. As independent variables were added to the model, an officers' race, and MOS impact retention at the 0.1% significance level. Those officers who were married or a parent, were found to be significant, compared to single and childless officers for retention at 5-, 7-, and 10-years. Females were positively associated with retention at 5- and 7-years, potentially indicating some type of family paradigm shift at 10- and 15-years. The impact that family variables have on Marine retention echoes previous research by O'Brien (2002), Ergun (2003), Conlan (2021), and Kelly and Kilber (2021). The impact of family variables lose significance at 15-year retention likely because the Marines retained have been married or become a parent at this stage in their life.

2. Is there a Relationship between a Marine's Commissioning Source and the University's Ranking that Predicts Performance?

The second research question analyzed the impact of accession sources on retention dependent on the quality of undergraduate education. The first model measured the retention of graduates from different accession sources across career milestones. Marines commissioned through PLC or NROTC were found more likely to be retained than their

OCC counterparts. However, once variables for gender, race, and MOS were included in the models, the accession source lost all significance on retention. This aligns with research on accession by Conlan (2021).

An interesting finding in this study was the number of officers commissioning in the Marines using OCC and PLC that attended a university with NROTC. The data that informs Figure 1 conveys officer accession for 2021 as 30.3% OCC, 21.4% PLC, and 16.4% NROTC. It is reasonable to assume these numbers fluctuate over the years, but surprising to see the variation in this data set compared to Table 7: 43.2% OCC, 24.6% PLC, and 22.7% NROTC. The elevation across these three accession sources suggests there may be an unquantified NROTC exposure variable based on the number of students commissioned from universities with NROTC through OCC and PLC. The exposure attracts students of comparable ability and ambition who see their college peers in NROTC, thereby generating interest and serving as a passive recruitment tool. The Marine Corps benefits by attracting qualified applicants without paying scholarship fees for OCC and PLC candidates. A benefit to OCC and PLC candidates is participation does not require the same commitment of time in college compared to NROTC.

The last model focused on promotion to Major as the key measure of performance. Overall, school type and accession source do not have a significant impact on promotion to Major. Private top universities are positively associated with promotion to Major, suggesting if graduates of private top are retained, they are most likely promoted to Major. Adding family variables, for being married or a parent remains significant and positively correlated with promotion. MOS was significant at 0.1% for combat arms and aviation support MOSs compared to combat service support. Given the requirement to attend PME, there was no surprise that resident EWS was highly significant in predicting promotion to Major. Since WTI is not required PME, it was interesting to see that graduating WTI was also highly significant for promotion to Major.

B. RECOMMENDATIONS

After analyzing and interpreting the data, there is limited evidence that the quality of undergraduate education obtained may impact career retention or promotion in the

Marines. The data loses significance on most school types after including independent variables. This study corroborates other research findings that family variables for marriage and children are significant factors in a Marine's career. Gender and race were slightly significant factors at 5- and 7-years retention but lose significance the longer a Marine remains on active duty. Based on the results of this study, no current policy changes are recommended but further study is encouraged

For areas of future study, NPS student should further explore the effect of education using the entire population of Marine officers to capture every university in the dataset. The incorporation of college majors in future research may yield interesting results as a predictive variable for Marine officer promotion and retention. Another topic for research includes officer recruitment to explore the exposure effect NROTC has on a college campus by comparing the quantity of OCC and PLC applicants from universities without NROTC. The best recruitment tool to attract high-caliber officer candidates may be the select placement of an additional NROTC unit.

APPENDIX A. MOS GROUPS

Variable	Military Occupational Specialties
Combat Arms	0302, 0370, 0802, 1802, 1803, 7204
Combat Service Support	0102, 0180, 0202, 0204, 0207, 0402, 0602, 1302, 3002, 3404, 4302, 4502, 5507, 5803
Aviation	7509, 7518, 7523, 7526, 7532, 7543, 7556, 7557, 7562, 7563, 7564, 7565, 7566, 7588
Aviation Support	7315, 7318, 7202, 6602, 6002
Special MOS	8059, 8061, 4402

Adapted from Conlan (2021)

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APPENDIX B. NROTC SCHOOL RANKINGS

SCHOOL TYPES (BINNED)	BARRON'S SELECTIVITY	# OF OBSERVATIONS	% PERCENTAGES
Private Top University			
Boston University	1	32	0.76
Carnegie Mellon University	1	6	0.14
College of The Holy Cross	1	18	0.43
Cornell University	1	26	0.62
Duke University	1	13	0.31
George Washington University	2	56	1.33
Illinois Institute of Technology	2	8	0.19
Massachusetts Inst of Technology	1	6	0.14
Northwestern University	1	18	0.43
Rensselaer Polytechnic Institute	1	6	0.14
Rice University	1	9	0.21
Tulane University	1	17	0.40
University of Notre Dame	1	47	1.11
University of Pennsylvania	1	25	0.59
University of Rochester	1	5	0.12
University of San Diego	1	39	0.92
University of Southern California	1	22	0.52
Vanderbilt University	1	16	0.38
Villanova University	1	24	0.57
Yale University	1	27	0.64
Private Middle University			
Embry-Riddle Aeronautical University	4	181	4.29
Hampton University	4	5	0.12
Jacksonville University	4	11	0.26
Marquette University	3	20	0.47
Morehouse College	4	5	0.12
Norwich University	4	95	2.25
Rutgers University	3	62	1.47
Tuskegee University	4	1	0.02
Private Bottom University			
None	0	0	0.00
Public Top University			
Georgia Institute of Technology	1	36	0.85
Miami University	1	67	1.59
North Carolina State University	2	92	2.18
Ohio State University	2	103	2.44
Purdue University	2	105	2.49

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APPENDIX C. 5-YEAR RETENTION MODEL

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Private Top University	-0.055	0.003	-0.002	0.005	-0.025
	(0.031)	(0.028)	(0.028)	(0.029)	(0.026)
Private Middle University	0.093*	0.069*	0.068	0.071*	0.031
	(0.037)	(0.035)	(0.035)	(0.036)	(0.032)
Public Top University	-0.011	0.014	0.011	0.014	-0.002
	(0.021)	(0.020)	(0.020)	(0.020)	(0.018)
Public Bottom University	0.074	0.001	0.008	0.015	0.003
	(0.070)	(0.063)	(0.064)	(0.064)	(0.061)
Female		0.035	0.040	0.048	0.098**
		(0.036)	(0.036)	(0.036)	(0.034)
Married		0.265***	0.264***	0.261***	0.188***
		(0.021)	(0.021)	(0.021)	(0.019)
Parent		0.132***	0.133***	0.133***	0.105***
		(0.022)	(0.022)	(0.022)	(0.020)
Asian			0.083	0.083	0.111**
			(0.045)	(0.045)	(0.040)
African American			-0.025	-0.022	0.043
			(0.047)	(0.047)	(0.044)
Hispanic			-0.063	-0.064	-0.052
			(0.035)	(0.035)	(0.030)
PLC				0.062*	0.014
				(0.024)	(0.023)
NROTC				0.042*	0.031
				(0.020)	(0.018)
ECP				0.030	0.094
				(0.053)	(0.049)

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Combat Arms MOS					0.158***
					(0.022)
Aviation MOS					0.567***
					(0.024)
Aviation Support MOS					0.244***
					(0.053)
Special MOS					0.417***
					(0.045)
R-squared	0.005	0.137	0.139	0.142	0.308
N	2615	2605	2605	2605	2605
Outcome mean	0.35	0.35	0.35	0.35	0.35

Observational data from Total Force Data Warehouse (TFDW)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX D. 7-YEAR RETENTION MODEL

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Private Top University	-0.063*	-0.017	-0.023	-0.023	-0.035
	(0.028)	(0.026)	(0.026)	(0.027)	(0.026)
Private Middle University	0.033	0.015	0.012	0.009	-0.034
	(0.035)	(0.033)	(0.033)	(0.033)	(0.032)
Public Top University	-0.021	0.000	-0.002	-0.002	-0.017
	(0.020)	(0.019)	(0.019)	(0.019)	(0.017)
Public Bottom University	0.217**	0.140*	0.146*	0.146*	0.130
	(0.078)	(0.071)	(0.072)	(0.072)	(0.067)
Female		0.046	0.051	0.051	0.082*
		(0.034)	(0.034)	(0.034)	(0.033)
Married		0.217***	0.218***	0.217***	0.162***
		(0.019)	(0.019)	(0.019)	(0.018)
Parent		0.129***	0.130***	0.129***	0.108***
		(0.021)	(0.021)	(0.021)	(0.020)
Asian			0.125**	0.124**	0.143***
			(0.046)	(0.046)	(0.041)
African American			-0.013	-0.014	0.034
			(0.046)	(0.046)	(0.045)
Hispanic			-0.046	-0.047	-0.024
			(0.033)	(0.033)	(0.030)
PLC				-0.007	-0.019
				(0.022)	(0.021)
NROTC				0.002	-0.009
				(0.019)	(0.018)
ECP				0.019	0.052
				(0.055)	(0.054)

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Combat Arms MOS					0.067***
					(0.019)
Aviation MOS					0.430***
					(0.029)
Aviation Support MOS					0.233***
					(0.057)
Special MOS					0.159***
					(0.043)
R-squared	0.008	0.137	0.141	0.141	0.257
N	2292	2283	2283	2283	2283
Outcome mean	0.23	0.23	0.23	0.23	0.23

Observational data from Total Force Data Warehouse (TFDW)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX E. 10-YEAR RETENTION MODEL

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Private Top University	-0.025	0.005	0.001	0.003	0.001
	(0.025)	(0.024)	(0.024)	(0.025)	(0.024)
Private Middle University	0.016	0.006	0.004	0.004	-0.014
	(0.031)	(0.030)	(0.030)	(0.030)	(0.030)
Public Top University	-0.028	-0.013	-0.015	-0.014	-0.021
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)
Public Bottom University	0.086	0.041	0.041	0.040	0.033
	(0.079)	(0.077)	(0.077)	(0.077)	(0.072)
Female		0.007	0.013	0.014	0.024
		(0.029)	(0.029)	(0.029)	(0.029)
Married		0.089***	0.089***	0.089***	0.067***
		(0.016)	(0.016)	(0.016)	(0.016)
Parent		0.120***	0.120***	0.119***	0.106***
		(0.019)	(0.019)	(0.019)	(0.018)
Asian			0.061	0.061	0.070
			(0.044)	(0.044)	(0.043)
African American			0.011	0.011	0.023
			(0.045)	(0.046)	(0.046)
Hispanic			-0.032	-0.034	-0.026
			(0.029)	(0.029)	(0.029)
PLC				-0.000	-0.008
				(0.020)	(0.020)
NROTC				0.014	0.009
				(0.018)	(0.018)
ECP				0.006	0.010
				(0.048)	(0.048)

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Combat Arms MOS					0.035 (0.018)
Aviation MOS					0.154*** (0.028)
Aviation Support MOS					0.193** (0.062)
Special MOS					0.080 (0.041)
R-squared	0.004	0.082	0.084	0.084	0.116
N	1760	1753	1753	1753	1753
Outcome mean	0.12	0.12	0.12	0.12	0.12

Observational data from Total Force Data Warehouse (TFDW)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

APPENDIX F. 15-YEAR RETENTION MODEL

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Private Top University	0.020	0.030	0.029	0.032	0.031
	(0.032)	(0.033)	(0.034)	(0.035)	(0.036)
Private Middle University	0.008	0.012	0.013	0.007	0.001
	(0.030)	(0.030)	(0.030)	(0.032)	(0.033)
Public Top University	-0.001	0.002	0.002	0.001	-0.004
	(0.018)	(0.019)	(0.019)	(0.020)	(0.019)
Public Bottom University	-0.041***	-0.049**	-0.052*	-0.061**	-0.060*
	(0.012)	(0.017)	(0.021)	(0.023)	(0.024)
Female		0.062	0.061	0.059	0.055
		(0.048)	(0.047)	(0.046)	(0.047)
Married		0.017	0.018	0.021	0.018
		(0.018)	(0.018)	(0.017)	(0.018)
Parent		0.043*	0.043*	0.044*	0.038
		(0.021)	(0.021)	(0.021)	(0.021)
Asian			0.007	0.012	0.008
			(0.040)	(0.039)	(0.041)
African American			0.006	0.003	0.002
			(0.046)	(0.050)	(0.051)
Hispanic			0.021	0.022	0.020
			(0.042)	(0.042)	(0.043)
PLC				-0.047*	-0.039
				(0.018)	(0.021)
NROTC				-0.018	-0.015
				(0.021)	(0.021)
ECP				0.009	-0.009
				(0.077)	(0.083)

	(1) School Types	(2) Demographics	(3) Race	(4) Accessions	(5) MOS
Combat Arms MOS					-0.014 (0.016)
Aviation MOS					0.008 (0.024)
Aviation Support MOS					0.150 (0.115)
Special MOS					-0.020 (0.032)
R-squared	0.002	0.021	0.021	0.029	0.043
N	603	600	600	600	600
Outcome mean	0.04	0.04	0.04	0.04	0.04

Observational data from Total Force Data Warehouse (TFDW)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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