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THESIS

DOES THE QUALITY OF UNDERGRADUATE EDUCATION PREDICT OFFICER PERFORMANCE?

by

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June 2019

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This study investigates whether various indicators of college education quality affect retention and career progression of Navy officers. The cost of tuition, how selective a school is, and the average entry test scores of an institution's student body all impact an officer's decision to stay in the military or not. These indicators are also correlated with the probability of promoting to O-4 rank. The results of this study shed light on the value that high-ranking institutions provide as opposed to lower-ranked schools. These comparisons are difficult to make in the civilian labor market, due to lack of internal firm data on turnover and career progression. The United States Navy uses the same performance evaluation for all officers, from all schools, and all years, thus allowing for a comparison of the value that post-secondary institutions bring to the Navy through officer job performance, advancement, and retention.

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DOES THE QUALITY OF UNDERGRADUATE EDUCATION PREDICT OFFICER PERFORMANCE?

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ABSTRACT

This study investigates whether various indicators of college education quality affect retention and career progression of Navy officers. The cost of tuition, how selective a school is, and the average entry test scores of an institution's student body all impact an officer's decision to stay in the military or not. These indicators are also correlated with the probability of promoting to O-4 rank. The results of this study shed light on the value that high-ranking institutions provide as opposed to lower-ranked schools. These comparisons are difficult to make in the civilian labor market, due to lack of internal firm data on turnover and career progression. The United States Navy uses the same performance evaluation for all officers, from all schools, and all years, thus allowing for a comparison of the value that post-secondary institutions bring to the Navy through officer job performance, advancement, and retention.

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LIST OF ACRONYMS AND ABBREVIATIONS

CEO	Chief Executive Officer
DMDC	Defense Manpower Data Center
FITREP	Fitness Report
FY	Fiscal Year
GPA	Grade Point Average
IPEDS	Integrated Postsecondary Education Data System
MSR	Minimum Service Requirement
NCES	National Center for Education Statistics
NROTC	Naval Reserve Officers Training Corps
OCS	Officer Candidate School
POCR	Probationary Officer Continuation and Resignation
RL	Restricted Line
SUB	Submariner Officer
SWO	Surface Warfare Officer
URL	Unrestricted Line
USNA	United States Naval Academy

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I. INTRODUCTION

The one constant that exists in every United States Military Officer is the achievement of an undergraduate degree. The curricula studied and institutions attended can be as varying as the individuals who are recruited, but all must work alongside one another in teamwork. Some complete their initial obligations with their service and move on, while others make a lasting career with their service. The United States Navy seeks to maximize the quality and retention of its recruits while minimizing the expense associated with an officer's development and training. Analyzing the effects that an educational institution's characteristics have upon that development and training is critical in planning for future defense of this nation. Are junior naval officers with bachelor degrees from higher ranked colleges and universities better officers? In a dynamic, more technologically advanced Navy, are the skills and abilities brought in by officers from different educational background allowing them to train after and better, and to make a successful, long-term career in the Navy? Or are they more likely to find lucrative career opportunities in the civilian labor market and, therefore, less likely to stay past their initial obligation.

According to the National Center for Education Statistics (NCES) in academic year 2015, postsecondary institutions in the United States received $346 billion in revenue from tuitions, fees, grants, and scholarships. Using the NCES 2015 data (US ED Data), this study shows that dollars spent above the minimum tuition cost do not significantly contribute to military personnel's promotion. Obtaining admission into a highly selective school does not increase the chances for promotion, yet it does encourage Navy personnel commissioned between the years of 1999 and 2002 to leave the service and enter the civilian labor market.

Every year, high school students compete for admittance into the top schools of their choice. Historically, schools with a history of academic excellence and low acceptance rate are the most sought after. The belief is that elite schools are worth the higher price tag and are likely to provide a superior education and better opportunities in life.

University quality or ranking is considered to be a direct reflection of the effort and hard work that high schoolers exhibit. Often, university reputation goes too far. "In one survey, respondents listed Princeton as one of the top 10 law schools in the country. The problem? Princeton doesn't have a law school" (Robbins, 2019). Students who are less privileged, weaker in performance, or simply cannot afford the exclusive schools generally attend less-desirable school. In 2018 more chief executive officers (CEO) of the top 100 Fortune 500 companies graduated from Texas A&M than Harvard (Robbins, 2019). As of 2018, 14 of the 30 colleges that produced the most Fortune 500 CEOs were public state universities (Robbins, 2019).

Well established and long standing universities claim a higher volume of success stories than state schools. However, those successes cannot be solely attributed to the perceived superior education that is promoted at elite institutions. Alumni organizations, quality of facilities, geographical location, the self-selection of the student body, brand recognition, and other factors need to be controlled for to isolate the quality of education upon success. This is extremely difficult to do because very few graduates work together at firms that can be directly compared. A student who graduates and works at Google and promotes twice in five years cannot be directly compared to a graduate from a different institution who works for Procter & Gamble and promotes three times. Organizations that recruit and pay similarly may value different employee characteristics and apply different criteria for promotions that occur at contrasting milestones.

The race to the top often crosses ethical boundaries. In 2019, the U.S. Attorney in the District of Massachusetts charged 50 people in federal court as part of a nationwide conspiracy to illicitly gain admission into top colleges (Robbins, 2019). Furthermore, the pressure to attend selective schools is causing serious concerns about young people's health. At Harvard, rates of attempted suicide are nearly twice the national rate for college students, and more high school suicides are citing pressure for academic success as a motivator (Robbins, 2019).

All Navy officers are required to have at least a bachelor's degree. The fact that these degrees are as diverse as the schools where they were earned, provides an opportunity to compare job attachment and advancement of Naval officers by college selectivity, and

to identify any patterns or variables that predict retention and promotion relevant to the quality of school attended.

In this thesis, I aim to address the following research questions:

1. Do Naval officers from more selective colleges make better Junior naval officers? Specifically, how do retention and O4 promotion rates of Naval officers differ by college selectivity?

There is a large literature attempting to quantify the effect of school selectivity on labor market outcomes. However, only few studies examine the link between college selectivity and performance outcomes for military personnel. This thesis uses a large personnel dataset to investigate the relationship between college selectivity and retention and O4 promotion for Navy officers who commissioned into the Navy between fiscal years 1999 and 2003.

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II. BACKGROUND

Technology continues to advance and amazing new discoveries awe the world but the United States Navy's greatest asset is still the same one since 1775 – people. Recruiting quality individuals, developing those individuals into exceptional personnel, and then retaining these new sailors has constantly been a major struggle. Talent and manpower management begins with clearly identifying the needs of the Navy and forecasting the future labor force requirements. The Navy needs to know what educational standards can be expected from new recruits and what type of development and training needs to be undertaken. An officer's postsecondary education is a critical element in the matrix of personnel recruitment and development.

Each Navy officer is required to have at least a bachelor's degree when he or she commissions into the U.S. Navy. The college degrees obtained by Naval officers are granted by a diverse body of colleges and universities, some more prestigious than others.

A. BECOMING AN OFFICER

There are four major ways in which to become a United States Naval Officer: NROTC, USNA, OCS, or Direct Commissioning. Below I briefly describe each commissioning source.

1. Naval Reserve Officers Training Corps

As of academic year 2019, there are over 160 schools that provide an NROTC scholarship which can include "full tuition, text book stipend, uniforms and Naval Science textbooks, and subsistence allowance." ("Naval Reserve Officers Training Corps - Scholarships," n.d.) Some schools offer further assistance such as room and board or additional scholarship funds.

An individual does not have to be an NROTC scholarship recipient to participate in a school's NROTC program. College Program Midshipmen are individuals who attach to an NROTC program, participate in all NROTC activities and standards, and seek to join the Navy upon graduation without ever receiving a scholarship. NROTC members are

expected to maintain physical fitness and take a series of Naval Science courses as an elective. (“Naval Reserve Officers Training Corps,” 2018)

2. United States Naval Academy (USNA)

The most students at the USNA are students who commonly receive a letter of recommendation from a member of congress and are eligible to apply for a full ride, four-year education at the academy. Students are held to the same standard as NROTC candidates regarding studies and physical fitness but campus lifestyle is quite different. Midshipmen at USNA are held to a high standard and expected to exemplify the image of a naval officer. Almost always in uniforms, following a plan of the day, and abiding by strict rules regarding campus life.

3. Officer Candidate School (OCS)

Individuals who have already graduated from a postsecondary institution and are seeking to join the Navy apply to OCS. Candidates apply for specific communities and begin training for that position right away. Applicants selected attend a 12-week course in which candidates are indoctrinated to military life. Living in barracks, following strict daily schedules, and taking accelerated Naval science courses. Upon course completion, the candidates are commissioned and sent to their respective communities.

4. Direct Commissioning

Direct Commissioning is usually only for restricted line officers or staff officers. These officers are typically specialized individuals with skills and knowledge that is directly relevant to their community or field of employment. Lawyers, medical workers, chaplains, and nuclear instructors are examples of individuals who, if selected, are commissioned and then sent to a five-week introduction course. The course provides instruction about their role as a newly commissioned Naval officer.

B. COMMISSIONING

Upon graduation from USNA, the NROTC program, or OCS, midshipmen commission and begin service to fulfil their commitment. Five years of active military

service is required for the Navy and four years for the Marines. Non-scholarship participants are only required to fulfill three years active duty.

NROTC and Naval Academy graduates are required to become an unrestricted line officer (URL). These communities include: Surface Warfare, Aviation Pilots and Flight Officers, Submarine Warfare, Naval Special Warfare, and Explosive Ordnance Disposal. ("RC Unrestricted Line (URL)," n.d.) OCS graduates can be restricted or unrestricted line officers.

Newly commissioned officers report for further training to prepare them for their future jobs. This training is as diverse as the communities they represent. The new officers are still required to perform at a high standard and fulfill their obligations. Officers that are not meeting standards or develop personal problems may be relocated. Medical disqualifications and sub-par performance can mean a community transfer or a complete discharge. Junior officers that are subject to review typically go to a Probationary Officer Continuation and Resignation (POCR) Board.

POCR boards require an officer to write a document that outlines an individual's desires and justification of desires. This document also states if the individual would like to continue his/her career in the Navy, and, if so, where. The officer lists up to five other communities that interest him/her and explains why they feel that that community is a good fit. It is strongly encouraged for officers to receive recommendation letters and site tours of communities they seek to join, if possible. The POCR process allows the opportunity for officers that were constrained to URL designators to now move to a Restricted Line Officer designator; such as Supply Corps or Public Affairs Officer. Individuals who are not selected for a new community are then discharged from the Navy.

With all of the effort, resources, and training that the Navy places upon recruiting and developing quality officers, it becomes vital to maximize retention and productivity of college graduates. It is, therefore, essential to investigate whether certain education institutional characteristics can affect officer retention and promotion, both for force shaping purposes, and also for future policy decisions.

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III. LITERATURE REVIEW

There is an entire market developed for assisting prospective students to find the institutions that best fit their desires and provide the greatest opportunity for success. Consequently, institutions have structured departments that focus on improving their appeal to prospective students. A school's athletics program, campus location, curriculum offered, or even party ranking, all factor into students' decision on applying.

A wide literature exists discussing the effects that a college's characteristics may have upon career success. Most of these interpret success as income earned post-graduation averaged across a graduating class. Though this is a strong indicator, there are many factors that need to be addressed with that assumption. A school that has more engineering majors graduating than high school educators will show a greater average income. Additional degrees or professional certifications earned are difficult to track and therefore often left out of a regression, yet can provide a large effect on the annual income earned. In addition, there is always the concern that high performing students tend to choose schools that are considered high performing, thus their success may simply be due to self-selection rather than school quality. For a study to be considered reliable, it needs to at least acknowledge these factors, if not control for them.

Bowman and Mehay (2002) conducted a study like this thesis using Navy officer cohorts from 1976 to 1985. To identify key success markers in the military they use retention and O-4 promotion. Moss (2018) also uses the same indicators to track Navy careers. The Navy considers these two factors extremely important because retention maximizes the return on investment for intensive Navy training. Promotions are awarded competitively, thus provide a good indicator of performance on the job. Each of these studies conducted further analysis comparing line officers to staff officers and the respective schools that those officers attended.

Bowman and Mehay used Barron's *Profiles of American Colleges* selectivity index to capture institutional characteristics. This index rates colleges on a six-point scale using entering freshmen's high school class rank, SAT scores, and the percentage of applicants

admitted. Tuition cost was not addressed in any of the models nor were any of the Barron's contributing factors tested independently. Bowman and Mehay then married that school data to the respective individuals from 1976 to 1985 cohorts.

This study builds upon Bowman and Mehay by using many of the factors captured in Barron's and adding tuition cost to better understand what truly affects career success. Bowman and Mehay reported that Barron's selectivity index did have a significant effect on retention and O-4 promotion but were not able to identify what aspects of the index contributed to the results.

Using civilian market data, Dale and Krueger have examined the effect of a school's characteristics on careers through a number of studies published over the past two decades. In 2002, their paper examined the payoff of attending a more selective school, and later in 2014, they used those findings in an extended study. Their 2002 paper looked at the immediate and short-term effects of graduates, whereas the 2014 study examined the effects over a longer timeframe.

Dale and Krueger look at the raw long-term effects and argue that a higher quality school appears to have a positive effect on career earnings. Using self-reported survey data and tax information from administrative earnings data, the study was able to look at the effects from 1976 and 1989 graduates of 27 colleges. Regressions using observed student characteristics reinforce other studies findings that more elite colleges provide a greater return in career earnings of statistical significance.

No variable or control will completely account for a student's characteristics and career performance but accounting for its existence is critical. When Dale and Krueger used SAT scores as a proxy for unobserved student characteristics, they discovered that the effects of going to an elite school were negligible and near zero. This finding exists from the early years right out of school and even 30 years post-graduation. Though selection-adjusted models show the effects generally indistinguishable from zero, certain subgroups maintain significant effects on earnings.

Sweden ranks among the top three Organization for Economic Co-operation and Development countries that spend the most on higher education and provide their education

free of charge. This provides the country a unique perspective to higher education compared to the United States. Even with university education being free there is still a perceived difference between the quality of education received from the 39 varying institutions. It is known that the student's characteristics influence the educational and career outcomes. To control for unobserved ability, Lindahl and Regner (2005) used siblings to account for support at home, higher initial endowments, or other pre-college background effects.

This study also uses annual earnings to determine the effects that quality of education has on careers. Swedish universities cannot choose freely among eligible students, but school choice is instead determined by national aptitude tests scores and high school performance. This is a major contrast to the United States, where college choice is dependent upon admission decisions and financial aid available. The study accounts for full and half siblings and the data addresses how long the siblings lived in the same household and which parent(s) were present. Including these controls provides for greater accuracy when accounting for the effects of student characteristics on career earnings.

Lindahl and Regner concluded "that a regression estimator of college-type effects that does not adjust properly for family characteristics will overestimate the earnings premium differential among colleges." Without proper data it is extremely difficult to adjust for a student's characteristics prior to graduation however, with an idea of the effects it will have upon a model, it can be accounted for. This study does not have household information for the subjects but will be using college-level data as well to address the main study questions. Academic grades, naval evaluations, fitness reports, and overall college performance create a trend of student type that is reflected in post commissioning success.

Dale and Krueger's data consist of graduates from two-year groups that spread across 27 colleges with different majors, causing a diverse assortment of career choices, and ultimately few constants to compare. This study seeks to control for the unknowns that Dale and Krueger could not control for. Using a greater sampling of year groups across 1100 institutions where all the graduates are employed by the same employer allows for an improved assessment of career performance and is not limited to earnings.

Using data from Navy officers allows access to many of the career details that Lindahl and Regner and Dale and Kreugar were missing. While students in these prior studies all work for different companies, personnel systems, etc., this study will be holding constant most internal labor market conditions. However, Bowman and Mehay (2002) address some of the military bias that favors certain commissioning sources over others. USNA graduates, due to the nature of the program, are exposed to Navy life long before other Naval candidates. “Graduates of the Naval Academy matriculate with 30 credits of "professional development," live in a military environment for four years, and receive on-the-job training every summer. Consequently, affective skills of USNA graduates may differ from those of officers who enter the military via other commissioning programs.” (Bowman & Mehay, n.d.)

Borgen (2014) revisited the question of elite school contribution in a study with data from Norway. The choice of Norway was due to the extensive data available from the Norwegian Universities and College Admission Service. The sample included all students who applied to an institution between the years of 1997-2004. The data included the schools applied to, aptitude testing results, household data, sibling data, and post-graduation career data. Borgen includes many of the variables that were considered crucial from Dale and Krueger and Lindahl and Regner. Furthermore, Borgen acknowledges the issue of using average SAT scores as the single proxy in determining school quality. For the purposes of this study we will be utilizing tuition costs, selectivity, and average SAT scores to proxy for the quality of the postsecondary institution.

As Borgen discussed in his study, it is difficult to truly quantify an institution’s quality. “Most researchers treat college quality as a single dimension. Colleges may, however, differ in several potentially important ways, such as the quality of their learning environments, the signaling value of the credentials they provide, or the opportunities for inclusion in useful social networks” (Borgen, 2014).

Borgen found that the quality of a school had no significant impact on entrance into a top wage occupation after all effects were controlled for. The significant returns to a higher quality school came later in career wages where students who attended elite schools earned more. Borgen concedes that these effects are greater in Norway than the United

States because of the differences in the educational systems. Norway has fewer schools with less variance in performance than the United States, which means employers likely do not place as much value in school quality signaling for new hires. The returns to education come from the graduate's performance in the labor market and the rewards they receive.

Though these findings may be difficult to generalize to the United States labor market, they illustrate the typical variables that are used to quantify school quality, and the methods used to obtain unbiased returns to schooling. All the students within our study are employed by the United States Navy, regardless of the school of choice. Graduates succeed or fail upon their own merits and are all evaluated in the same fashion. Where Borgen uses wages in late career to determine the effect of school quality, our study will utilize the graduate's career performance. Wages are not a clear indicator of success within the United States Navy because everyone must be paid at the same rate within same ranks and similar time in service. Only community bonuses and collateral pay, such as sea pay or flight pay, would cause a difference between graduates. None of these special pays reflects any difference in job performance.

This study seeks to replicate the basic model of Bowman and Mehay (2002) while incorporating the findings of later studies. From Dale and Krueger (2014) this analysis borrows the idea of looking for short-term and long-term effects. This study will use institutional characteristics similar to Borgen to investigate returns to elite education.

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IV. DATA AND SUMMARY STATISTICS

A. DATA DESCRIPTION

Our data was drawn from the Defense Manpower Data Center (DMDC). Its personnel files contain basic demographic information, promotion rates, dates of service, and educational institutions attended.

The National Center for Education Statistics (NCES) publicly available Integrated Postsecondary Education Data System (IPEDS) provided data on the characteristics of institutions referenced in the DMDC data set. NCES is a Department of Education entity that collects and analyzes data related to education throughout the US. Institutions submit IPEDS data annually via surveys. Missing survey data is estimated by NCES's statistical imputation techniques.

For this study, I merged IPEDS data to DMDC personnel files. Thus, I created a dataset that includes educational institution characteristics and demographic/career outcomes of military members that attended the institution. This allows for an investigation of the effect of school characteristics on an individual's performance and achievements. Ultimately with this link, any patterns of influence that the institutions' attributes have upon an officer's performance will be made evident.

Retention and O4 promotion are two main outcomes important to the Navy and, therefore, were the key outcomes analyzed. The military continues to struggle with retention of skilled personnel and development of quality people and certain schools' characteristics may contribute to the issue. The largest exodus from Naval Service is upon the expiration of the Minimum Service Requirement (MSR) and around ten years of service. Identifying educational institutions' characteristics that may influence the decision of continued service would allow the Navy to adapt and capitalize on those characteristics.

Promotion to the rank of O-4 is the first promotion requiring an officer's record to be evaluated. Achieving this rank requires a selection board to review officers' records and be rewarded based on job performance. This is a critical metric due to the fact that it provides a clear indicator of job performance and success. Ideally, this study would identify

which attributes of educational institutions are more likely to help officers attain such a career goal.

Table 1. below summarizes the three variables of interest that will be used as dependent variables in the multivariate models.

Table 1. Dependent Variable Definitions

Dependent Variable	Variable Definition
MSR Retention	= 1 if retained in the Navy past the Minimum Service Requirement; else = 0
O-4 Promotion	= 1 if promoted to O-4; else = 0
Ten Year Retention	= 1 if retained in the Navy for at least 10 years; else = 0

The DMDC data contains information on officers who commissioned between 1999-2001. I obtained institutional characteristics data from IPEDS for the period of 1995-2001. It is possible that someone commissioning in 1999 could have started college prior to 1995. Without information on years of college attendance, I made the assumption that most individuals commissioned right after college. For variables relative to the institution itself and unlikely to change year to year, I used the most recent (2001) values. An example of such a value would be the classification of school as public or private. The key variables chosen to identify an institution's quality are: cost, selectivity, and student body composition. I briefly describe why these variables were chosen.

One of the clearest ways to determine how the public values a product or service is to examine the dollar vote in which is cast. Every time an individual makes a purchase, that purchase acts as a vote to indicate approval and growth of that product or service. The cost of tuition is used as that signal in this analysis to determine how people value the service of an institution. A school that is able to charge a higher tuition and remains competitive is perceived as being worth that cost and therefore can continue to utilize those funds appropriately. Investigating the relationship between career success and college cost answers questions on the return on investment.

Out of state annual tuition is the most expensive tuition option and what the largest demographic of possible applicants would be expected to pay. Averaging the annual tuition

between the years of 95-01 creates an expected cost for the largest pool of applicants. In regressions, I include the natural logarithm of this value to smooth the distribution of college tuition data.

Prospective students apply to a school and may face a rejection letter. The amount of rejections sent to applicants each year is perceived as an indicator of quality. Analyzing the volume of applicants indicates the demand by prospective students and how many of those are rejected, indicates how selective an institution is. A highly selective school reflects high demand and the institution's ability to only accept those students that add value to the establishment. In theory, highly-selective institutions will choose to educate students already inclined to academic success, while institutions with a lower selectivity will educate students that need greater service. Assessing the institutions' graduate's performance in their careers will provide a metric with which to value the services rendered by those institutions.

Dividing the number of students enrolled for the year by the number of applications received for that school year, creates a ratio for how selective the school is based on the demand it has. This variable for selectivity is defined as "Percent Admitted." Selectivity can be a flawed metric because it only uses students that actually apply to the school instead of students interested but that do not apply, either because they cannot afford it, or because they believe they will not get accepted.

Standardized testing, in the form of the ACT and the SAT, are an assessment of a prospective student's level of preparedness for higher learning. Dale and Krueger (2014) use SAT scores and students' acceptance rates as controls for a student's natural predisposition for success. This study uses a school's student population top 25^{th} percentile test scores, as an independent variable to control for the incoming student quality. High test scores imply the school is composed mostly of adept students already predisposed for success.

The SAT score includes two parts, math and verbal, with a minimum score of 200 and maximum of 800 for each. All observations lower than 200 or greater than 800 were dropped and then math and verbal scores were combined to create the total SAT score. The

ACT has a minimum score of one and a maximum of 36 therefore any observations outside of that range were dropped. In regressions, I include ACT or SAT test scores divided by their respective standard deviations for more comparable partial effects.

Table 2. below summarizes the IPEDS variables selected to proxy for institution quality.

Table 2. Educational Institutions' Variables

Independent Variable	Variable Definition
Average Tuition	Average annual out of state tuition cost over years 95-01
Percent Admitted	Percent of applicants that are enrolled for the school year
SAT	Institution's top 25-percentile scores of first-year students
ACT	Institution's top 25-percentile scores of first-year students

Using the DMDC data, I create variables accounting for demographics, commissioning sources, and cohort years. Table 3 provides the definitions of the demographic variables created.

Table 3. Variable Definition of Demographic

Independent Variable	Variable Definition
Female	= 1 if female; else = 0
Married	= 1 if married at time of commissioning; else = 0
Married Year 2	= 1 if married by year 2; else = 0
Married Year 6	= 1 if married by year 6; else = 0
Dependent Children Year 2	= 1 if has dependent child/children by year 2; else = 0
Dependent Children Year 6	= 1 if has dependent child/children by year 6; else = 0
White Non-Hispanic	= 1 if White (race) & Non-Hispanic (ethnicity); else = 0
Black Non-Hispanic	= 1 if Black (race) & Non-Hispanic (ethnicity); else = 0
Asian	= 1 if Asian; else = 0
Hispanic	= 1 if Hispanic; else = 0
Other Unknown Race	= 1 if race is other/unknown; else = 0

Source: Moss (2018)

Line officers are only commissioned at three sources. The Naval Academy is the Navy's own 4-year educational institution. Naval Reserve Officers Training Corps (NROTC) commissions students after completing four years of naval training while

attending one of the 168 partnered educational institutions. Individuals who receive a degree, completely separate from the Navy, but then wish to join as an officer after graduating, may commission through Officer Candidate School. Other commissioning sources that produce staff officers or direct commissions represent a very small portion of commissioned officers and therefore are grouped under one variable.

Table 4. Variable Definition of Commissioning Sources

Independent Variable	Variable Definition
Naval Academy	= 1 if commissioning source was the Naval Academy; else = 0
NROTC	= 1 if commissioning source was NROTC; else = 0
OCS	= 1 if commissioning source was OCS; else = 0
Direct/Other Commissioning	= 1 if commissioning source was Direct, Other, or Unknown; else = 0

Adapted from Moss (2018)

Officers in the United States Navy are attached to a community. These communities represent the overall job and career path for commissioning individuals. Table 5 outlines the communities represented and how they have been broken out. Pilots and Naval Flight Officers (NFO) have been combined and represented as Aviators.

Table 5. Variable Definitions of Communities

Independent Variable	Variable Definition
SWO	= 1 if SWO designator at time of entry; else = 0
SUB	= 1 if SUB designator at time of entry; else = 0
Pilot	= 1 if Pilot designator at time of entry; else = 0
NFO	= 1 if NFO designator at time of entry; else = 0
Aviator	=1 if NFO or Pilot =1; else =0
Special Warfare	= 1 if Special Warfare designator at time of entry; else = 0
Restricted Line	= 1 if Restricted Line designator at time of entry; else = 0
Staff	= 1 if Staff designator at time of entry; else = 0
Unknown Designator	= 1 if unknown designator at time of entry; else = 0
SWO Year t	= 1 if SWO designator at time t, where t = 1, 2…10; else = 0
SUB Year t	= 1 if SUB designator at time t, where t = 1, 2…10; else = 0
Pilot Year t	= 1 if Pilot designator at time t, where t = 1, 2…10; else = 0
NFO Year t	= 1 if NFO designator at time t, where t = 1, 2…10; else = 0
Aviator Year t	=1 if NFO or Pilot =1; else =0
Special Warfare Year t	= 1 if Special Warfare designator at time t, where t = 1, 2…10; else = 0

Independent Variable	Variable Definition
Restricted Line Year t	= 1 if Restricted Line designator at time t, where t = 1, 2…10; else = 0
Staff Year t	= 1 if Staff designator at time t, where t = 1, 2…10; else = 0
Unknown Designator Year t	= 1 if unknown designator at time t, where t = 1, 2…10; else = 0

Adapted from Moss (2018)

The year in which an individual commission is recorded by the variable cohort year. They will remain attached to that cohort for their entire career and it will affect aspects of their career accordingly. For example, economic conditions at the time of commissioning or at key retention points are likely to vary with cohort year. Table 6 defines the variables for the cohort years that are used in the DMDC data.

Table 6. Variable Definition of Cohort Year

Independent Variable	Variable Definition
Cohort FY99	= 1 if officer commissioned in FY99; else = 0
Cohort FY00	= 1 if officer commissioned in FY00; else = 0
Cohort FY01	= 1 if officer commissioned in FY01; else = 0
Cohort FY02	= 1 if officer commissioned in FY02; else= 0
Cohort FY03	= 1 if officer commissioned in FY03; else = 0

Source: Moss (2018)

B. SUMMARY STATISTICS

Summary statistics for the variables used in the statistical analyses are presented in the tables below. This data tracks officers longitudinally until they are reviewed for O-4 promotion or leave the Navy. Education variables are from the data available from IPEDS which is collected by surveys and, therefore, some observations will not have all of the variables available causing different amounts of observations. As par to most military data sets, white males make up the biggest demographic group. Pilots, NFO, and SWO communities are the largest representation for the analysis and will reflect the community trends already known there. The average out of state tuition cost is about $12,850 and schools accept an average of 30% of applicants.

Table 7. Summary Statistics of Variables in DMDC File

Variable	Obs.	Mean	Std. Dev.
Dependent Variables			
MSR Retention	16,075	0.74	0.44
Ten Year Retention	16,075	0.44	0.50
O-4 Promotion	16,075	0.34	0.47
Demographic Variables			
Female	16,075	0.18	0.39
Male	16,075	0.82	0.39
Married Year 2	16,075	0.34	0.47
Not Married Year 2	16,075	0.66	0.47
Married Year 6	16,075	0.45	0.50
Not Married Year 6	16,075	0.55	0.50
Dependent Children Year 2	16,075	0.24	0.47
No Dependent Children Year 2	16,075	0.76	0.43
Dependent Children Year 6	16,075	0.26	0.44
No Dependent Children Year 6	16,075	0.73	0.44
White Non-Hispanic	16,075	0.75	0.43
Black Non-Hispanic	16,075	0.07	0.26
Asian	16,075	0.05	0.22
Hispanic	16,075	0.09	0.29
Other Unknown Race	16,075	0.03	0.17
Commissioning Source Variables			
Naval Academy	16,075	0.24	0.43
NROTC	16,075	0.27	0.44
OCS/ODS	16,075	0.32	0.47
Direct/Other Commissioning	16,075	0.11	0.31
Community Variables			
SWO	16,075	0.23	0.42
SUB	16,075	0.10	0.30
Aviators	16,075	0.29	0.45
Special Warfare	16,075	0.02	0.13
Restricted Line/Staff	16,075	0.24	0.43
Cohort Year			
Cohort FY99	16,075	0.18	0.39
Cohort FY00	16,075	0.21	0.41
Cohort FY01	16,075	0.21	0.41
Cohort FY02	16,075	0.21	0.40
Cohort FY03	16,075	0.19	0.39
Education Variables			
ACT_STD	4,345	9.05	1.00
SAT_STD	8,387	12.33	1.00
AVG Tuition	7,045	12,862.25	5,534.38
Percent Admitted	9,258	29.9	14.7

Adapted from Moss (2018)

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V. ANALYSIS

A. METHODOLOGY

Three main regression models were used to determine the effects that an institution's characteristics have on a graduate's career using military service performance as the key outcome. Military performance is evaluated with two separate key points of retention and the ability to promote to paygrade O-4. MSR Retention, Ten Year retention, and O-4 Promotion are all binary variables. The regression parameters are estimated via probit and measure the expected change in probability that each variable has upon the outcome, when all other variables are held constant. The probit estimates are presented in the appendix. Because probit coefficients do not have easy interpretations, below we present partial effects obtained from the probit regressions.

B. MODEL SPECIFICATION

1. Minimum Service Requirement Retention Model (MSR)

MSR retention is a binary variable indicating that an officer has completed their contracted requirements and has decided to continue their service. MSR Retention equals one when the individual was retained and zero when they have decided to leave the service. Key variables that are included in all models are individuals' demographics, community, commissioning source, and cohort year. The comparison group is Male, No Dependent Children, White, Not Married, Cohort FY99, SWO, and Naval Academy. Aviators were left out of regressions because they have a longer MSR. Other/Direct Commissioning has too few observations in some models causing this variable to drop out.

The first postsecondary variable introduced into the model is the tuition cost of an educational institution. This variable is entered as the log of the average annual out of state tuition, over the eight years that the Navy cohorts were most likely to have attended college. Estimates on Table 8 indicate that the cost of tuition seems to be negatively correlated with the chance of retention after initial service requirements are met. This variable is statistically significant and practically large in magnitude – a one percent increase in tuition costs, is associated with a 9.2 percentage points increase in the probability of leaving

service. The more individuals pay for their education the less likely they are to remain in the service.

An institution's selectivity is often directly linked to its reputation. Dividing the number of enrolled students by the volume of applications received yields an indicator of selectivity for the institutions. It could very well be the case that a school may be in higher demand than what the amount of applications indicates because of students not submitting an application due to self-elimination. The model indicates that as an institution becomes more selective, its graduates are 0.00283 more likely to continue their service. This effect can become quite significant when looking at a standard deviation of change in the amount of rejections a school may have.

Educational institutions use SAT and ACT scores as a metric with which to evaluate applicants. Applicants selected to attend the institution affect the school's student body composition by raising or lowering the average campus test scores. Using the top 25^{th} percentile of an institution's test scores proxies for the quality composition of the student body. Both ACT and SAT scores are used in the same way by institutions but not every institution accepts both test scores therefore two separate regressions were used for each test. The tests are weighted differently and are not scored on the same scale. To account for this, the observations were divided by the standard deviation of the respective score. Each test score variable indicated that as an institution's student body test scores rise, graduates become less likely to continue service beyond initial requirements. One standard deviation increase in the SAT score is associated with 0.316 reduction in probability of retention. When a model is comprised that includes all the variables, graduates associated with higher test results expect a 0.428 reduction and SAT scores remain the only variable that is statistically significant.

The final regression uses all introduced variables except ACT scores. Including both SAT and ACT scores in the same regression is redundant and both are highly correlated. Because SAT scores had a greater number of observations, I chose to include this variable in the model with all institutional characteristics. In this full regression each variable has the same sign as before, except for the percent of admitted students. Before it was positively correlated and in the new regression is negatively correlated. In the last

model, however, inclusion of other institutional characteristics changes the interpretation of this variable. The selectivity model suggests that officers graduating from institutions with a higher acceptance rate are more likely to stay. The last model, however, shows that, when holding constant tuition costs and SAT scores, a higher acceptance rate is associated with lower retention. In the last model, given the many controls for an institution's quality, the acceptance rate is likely to pick up institutions that emphasize applicant characteristics other than academics – such as sports and other extracurricular activities.

In the last model, the price of tuition becomes insignificant, suggesting that, when controlling for SAT scores and admission rates, the pricier institutions do not contribute to better retention.

Table 8. MSR Retention Model

VARIABLES	MSR Retention (1)	Tuition Cost (2)	Selectivity (3)	SAT Test Scores (4)	ACT Test Scores (5)	Full Model (6)
Female	-0.170***	-0.138***	-0.157***	-0.157***	-0.120***	-0.130***
	(0.0188)	(0.0261)	(0.0239)	(0.0250)	(0.0347)	(0.0282)
Married at 2 Years of Service	0.127***	0.115***	0.117***	0.116***	0.136***	0.127***
	(0.0134)	(0.0200)	(0.0185)	(0.0197)	(0.0273)	(0.0218)
Child/ren at 2 Years of Service	0.0884***	0.0544***	0.0642***	0.0680***	0.0396	0.0564**
	(0.0150)	(0.0204)	(0.0214)	(0.0228)	(0.0286)	(0.0222)
Black Non-Hispanic	0.0870***	0.0614**	0.0558*	0.0268	0.0676*	0.0314
	(0.0203)	(0.0302)	(0.0290)	(0.0329)	(0.0411)	(0.0366)
Asian	-0.00675	-0.0409	-0.0243	-0.0170	-0.0682	-0.0286
	(0.0290)	(0.0448)	(0.0399)	(0.0417)	(0.0611)	(0.0477)
Hispanic	-0.0135	0.0248	-0.000982	-0.00682	-0.0300	0.0141
	(0.0237)	(0.0343)	(0.0308)	(0.0323)	(0.0506)	(0.0374)
Other/Unknown Race	0.285***	0.0246	0.0315	0.0387	-0.0118	0.0318
	(0.0539)	(0.0517)	(0.0461)	(0.0486)	(0.0764)	(0.0560)
ROTC	-0.103***	-0.346***	-0.105***	-0.0768***	-0.418***	-0.358***
	(0.0172)	(0.0331)	(0.0216)	(0.0212)	(0.0518)	(0.0346)
OCS/OTS/PLC	-0.00768	-0.174***	0.143***	0.156***	-0.252***	-0.193***
	(0.0181)	(0.0516)	(0.0258)	(0.0256)	(0.0879)	(0.0568)
Other/Direct Commissioning	-0.532**					
	(0.213)					
Cohort FY00	-0.0304	-0.0578*	-0.0731**	-0.0541	-0.0527	-0.0517
	(0.0235)	(0.0327)	(0.0336)	(0.0349)	(0.0422)	(0.0350)

VARIABLES	MSR Retention (1)	Tuition Cost (2)	Selectivity (3)	SAT Test Scores (4)	ACT Test Scores (5)	Full Model (6)
Cohort FY01	-0.0621***	-0.0133	-0.0174	-0.00692	-0.000814	-0.00930
	(0.0231)	(0.0331)	(0.0322)	(0.0335)	(0.0434)	(0.0355)
Cohort FY02	-0.122***	-0.0759**	-0.0995***	-0.0958***	-0.0841*	-0.0809**
	(0.0231)	(0.0334)	(0.0315)	(0.0330)	(0.0441)	(0.0363)
Cohort FY03	-0.155***	-0.104***	-0.130***	-0.130***	-0.103**	-0.113***
	(0.0235)	(0.0339)	(0.0316)	(0.0328)	(0.0448)	(0.0363)
Subs	0.0656***	0.133***	0.123***	0.136***	0.124***	0.150***
	(0.0147)	(0.0209)	(0.0190)	(0.0198)	(0.0293)	(0.0224)
Special Forces	0.128***	0.0807**	0.152***	0.159***	0.136***	0.0803**
	(0.0249)	(0.0364)	(0.0292)	(0.0306)	(0.0444)	(0.0394)
The logarithm of Average Annual Out-of-State Tuition (per $1000)		-0.0919***				-0.0540
		(0.0227)				(0.0425)
Percent Admitted			0.00283***			-0.00345**
			(0.000792)			(0.00140)
SAT				-0.0316***		-0.0428***
				(0.00926)		(0.0127)
ACT					-0.0257*	
					(0.0133)	
Observations	5,586	2,569	3,335	3,088	1,524	2,263
Pseudo R2	0.0766	0.155	0.113	0.110	0.141	0.162
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1					

2. Ten Year Retention

Just as Dale and Kruger (2014) examined effects by salary and wage late in career progression of graduates, this analysis uses Ten Year Retention rates as a metric for long-term success. The Ten-Year Retention outcome is measured using months of service to create a binary variable. If the officer reaches 120 months of service, then Ten Year Retention equals one, but if the officer does not, then the variable Ten Year Retention equals zero. The sample for this retention outcome is the same as MSR Retention, though a new group - Aviator - is now added. Pilots and Naval Flight Officers (NFO) have completed their community's MSR at this point and are eligible for voluntary separation. Due to ACT having fewer observations reported than other variables, Other/Direct

Commissioning has an omitted coefficient. This analysis seeks to isolate the distinction between those baselines when introduced to educational institution variables.

After ten years of service the effect that an educational institution has upon the decision to continue military service becomes less significant. The correlations have the same style of effects at ten years as the MSR retention but with a lesser impact. This makes sense as a graduate's success becomes more dependent upon their ability to learn and adapt with the job than starting education. Besides SAT test scores, all the variables have a lower level of statistical significance and smaller coefficients when examined independently. When the educational variables are combined together in the same model, their level of statistical significance increases. The cost of tuition still has a substantial effect on the decision to stay in or not with a coefficient of almost -8 percentage points in the probability of leaving service per percent increase in tuition cost. An increase in SAT scores of one standard deviation is impactful with a 0.0298 increase in the probability to leave the service. This demonstrates that even after ten years of service, educational choices still impact career decisions.

Table 9. Ten Year Retention Model

VARIABLES	Ten Year Retention (1)	Tuition Cost (2)	Selectivity (3)	SAT Test Scores (4)	ACT Test Scores (5)	All Variables (6)
Female	-0.0952***	-0.0888***	-0.0956***	-0.107***	-0.0978***	-0.117***
	(0.0190)	(0.0268)	(0.0249)	(0.0263)	(0.0352)	(0.0295)
Married at 6 Years of Service	0.117***	0.113***	0.111***	0.110***	0.0881***	0.112***
	(0.0122)	(0.0181)	(0.0166)	(0.0175)	(0.0236)	(0.0194)
Child/ren at 6 Years of Service	0.135***	0.129***	0.131***	0.129***	0.138***	0.128***
	(0.0122)	(0.0178)	(0.0175)	(0.0188)	(0.0234)	(0.0195)
Black Non-Hispanic	0.0838***	0.112***	0.122***	0.0889***	0.139***	0.0878***
	(0.0198)	(0.0273)	(0.0269)	(0.0320)	(0.0337)	(0.0336)
Asian	0.0460*	0.0967***	0.0537	0.0626	0.0900*	0.112***
	(0.0254)	(0.0364)	(0.0366)	(0.0382)	(0.0510)	(0.0380)
Hispanic	0.0129	-0.0162	0.00681	-0.00695	0.00381	-0.0441
	(0.0208)	(0.0332)	(0.0296)	(0.0316)	(0.0441)	(0.0369)
Other/Unknown Race	0.118	0.346***	0.392***	0.401***	0.134***	0.353***
	(0.202)	(0.00899)	(0.00811)	(0.00857)	(0.0512)	(0.00981)
ROTC	-0.0146	-0.211***	-0.0405**	-0.0135	-0.240***	-0.190***

	(0.0137)	(0.0230)	(0.0186)	(0.0187)	(0.0312)	(0.0249)
OCS/OTS/PLC	0.0683***	-0.0225	0.159***	0.176***	-0.0457	-0.00920
	(0.0133)	(0.0254)	(0.0194)	(0.0196)	(0.0357)	(0.0280)
Other/Direct Commissioning	-0.0558	-0.779***	-0.735***	-0.725***		-0.774***
	(0.292)	(0.00717)	(0.00686)	(0.00732)		(0.00786)
Cohort FY00	-0.0149	-0.0249	-0.0144	-0.00635	-0.0456	-0.0131
	(0.0186)	(0.0267)	(0.0278)	(0.0299)	(0.0351)	(0.0290)
Cohort FY01	0.0299*	0.0864***	0.0580**	0.0536**	0.114***	0.0863***
	(0.0171)	(0.0238)	(0.0252)	(0.0273)	(0.0305)	(0.0262)
Cohort FY02	0.101***	0.142***	0.150***	0.155***	0.157***	0.151***
	(0.0157)	(0.0219)	(0.0228)	(0.0247)	(0.0285)	(0.0239)
Cohort FY03	0.118***	0.143***	0.161***	0.169***	0.140***	0.153***
	(0.0156)	(0.0220)	(0.0227)	(0.0245)	(0.0293)	(0.0240)
Subs	-0.203***	-0.145***	-0.146***	-0.128***	-0.171***	-0.121***
	(0.0185)	(0.0276)	(0.0246)	(0.0256)	(0.0388)	(0.0293)
Special Forces	0.0686**	0.112***	0.132***	0.139***	0.181***	0.106**
	(0.0295)	(0.0385)	(0.0336)	(0.0350)	(0.0405)	(0.0425)
Aviator	0.0853***	0.0881***	0.175***	0.199***	0.0930***	0.113***
	(0.0126)	(0.0188)	(0.0175)	(0.0184)	(0.0249)	(0.0205)
The logarithm of Average Annual Out-of-State Tuition (per $1000)		-0.0475**				-0.0793**
		(0.0193)				(0.0346)
Percent Admitted			0.00153**			-0.00364***
			(0.000648)			(0.00117)
SAT				-0.0288***		-0.0298***
				(0.00837)		(0.0105)
ACT					-0.0186	
					(0.0118)	
Observations	7,597	3,580	4,441	4,014	2,171	3,061
Pseudo R2	0.101	0.148	0.139	0.144	0.155	0.157

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

3. O-4 Promotion Model

Promotion to O-4 is a major career accomplishment for naval officers and must be earned by merit and superior performance. This model is the primary model that reflects an individuals' job-based performance relative to educational institution's characteristics effects. The outcome variable is binary where O-4 Promotion equals one if the officer has reached the paygrade of O-4 and zero otherwise. Reaching the rank of O-4 prior to ten years of service is unusual and rare. Therefore, the comparison group and variables will be the same as the Ten-Year Retention Model: Male, No Dependent Children at 6 Years of Service, White, Not Married at 6 Years of Service, Cohort FY99, SWO, and Naval Academy. Cohort variables will reflect the effect that year of commissioning has upon O-4 selection and communities for commands particular to those communities.

This regression model is designed to examine the effects that the characteristics of postsecondary institutions have upon reaching a career milestone compared to already known variables. Again, due to lack of available information on select schools from IPEDS data and small samples, Other/Direct Commissioning and Other/Unknown Race variables drop out of some of the regressions.

The O-4 Promotion Model is the only model that represents direct job performance and career advancement. Previous models analyze the possible non-voluntary separation an officer may have or the voluntary decision an officer makes to leave the service. The regression estimates of college quality have lost their statistical significance and have the smallest coefficients out of all the models. Even when all the variables are regressed together, the p-values exceed 0.1. Separately, out of state tuition is slightly significant and indicates an increase in the probability to promote by 4 percentage points per each percent increase. These results suggest that college tuition, selectivity, and quality of the student body have little to no effect on O-4 promotions in the Navy.

Table 10. O-4 Promotion Model

VARIABLES	Promoted to O-4 (1)	Tuition Cost (2)	Selectivity (3)	SAT Test Scores (4)	ACT Test Scores (5)	All Variables (6)
Female	-0.0287	-0.0480	-0.0498	-0.0619*	-0.0379	-0.0584
	(0.0230)	(0.0355)	(0.0334)	(0.0360)	(0.0467)	(0.0395)
Married at 6 Years of Service	0.129***	0.115***	0.124***	0.130***	0.111***	0.115***
	(0.0154)	(0.0233)	(0.0215)	(0.0227)	(0.0303)	(0.0250)
Child/ren at 6 Years of Service	0.0160	0.00874	0.0251	0.0304	0.0150	0.0149
	(0.0147)	(0.0220)	(0.0216)	(0.0232)	(0.0292)	(0.0240)
Black Non-Hispanic	-0.0308	-0.0290	-0.0509	-0.0447	-0.00816	-0.0193
	(0.0257)	(0.0371)	(0.0373)	(0.0426)	(0.0457)	(0.0435)
Asian	0.00913	-0.0155	0.00425	0.0186	-0.0119	-0.00450
	(0.0318)	(0.0514)	(0.0493)	(0.0505)	(0.0710)	(0.0530)
Hispanic	-0.0116	-0.00560	0.0178	0.0198	0.00197	-0.00770
	(0.0263)	(0.0436)	(0.0392)	(0.0418)	(0.0561)	(0.0481)
Other/Unknown Race	-0.799***	-0.0455	-0.0482	-0.0578	-0.0219	
	(0.00560)	(0.0575)	(0.0534)	(0.0580)	(0.0796)	
ROTC	-0.00899	-0.0985***	-0.0216	-0.0275	-0.0833**	-0.103***
	(0.0160)	(0.0263)	(0.0231)	(0.0238)	(0.0349)	(0.0288)
OCS/OTS/PLC	-0.00865	-0.0594**	0.00819	-0.00790	-0.0522	-0.0813***
	(0.0158)	(0.0266)	(0.0245)	(0.0259)	(0.0363)	(0.0298)
Other/Direct Commissioning	0.294***					-0.0596
	(0.00699)					(0.0651)
Cohort FY00	0.0192	-0.00704	-0.0101	-0.00424	0.00392	-0.00725
	(0.0243)	(0.0374)	(0.0396)	(0.0433)	(0.0486)	(0.0416)
Cohort FY01	-0.0100	-0.00625	-0.00888	-0.0144	-0.00541	-0.00449
	(0.0235)	(0.0359)	(0.0368)	(0.0404)	(0.0466)	(0.0399)
Cohort FY02	-0.151***	-0.152***	-0.177***	-0.195***	-0.179***	-0.172***
	(0.0243)	(0.0367)	(0.0366)	(0.0400)	(0.0470)	(0.0410)
Cohort FY03	-0.412***	-0.395***	-0.414***	-0.425***	-0.376***	-0.401***
	(0.0244)	(0.0352)	(0.0341)	(0.0367)	(0.0457)	(0.0387)
Subs	-0.0120	-0.0100	-0.0215	-0.0163	-0.00330	0.00280
	(0.0226)	(0.0344)	(0.0337)	(0.0356)	(0.0495)	(0.0364)
Special Forces	0.0618*	0.0304	0.0969**	0.0766	0.120**	0.00953
	(0.0337)	(0.0543)	(0.0442)	(0.0484)	(0.0602)	(0.0605)

Aviator	-0.0590***	-0.0833***	-0.0651***	-0.0693***	-0.0521*	-0.0814***
	(0.0147)	(0.0226)	(0.0222)	(0.0239)	(0.0302)	(0.0248)
The logarithm of Average Annual Out-of-State Tuition (per $1000)		0.0389*				0.00464
		(0.0228)				(0.0375)
Percent Admitted			-0.00093			-0.00204
			(0.000786)			(0.00130)
SAT				0.00268		-0.00391
				(0.00996)		(0.0117)
ACT					-0.0103	
					(0.0143)	
Observations	5,346	2,480	2,908	2,589	1,466	2,098
Pseudo R2	0.128	0.114	0.119	0.123	0.103	0.118

Standard errors in parentheses
***p<0.01,
**p<0.05,
*p<0.1

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VI. CONCLUSIONS

Marrying the data from IPEDS and DMDC provided a great opportunity to compare data that tells an insightful story and opens the door to many more inquires. The concept of validating or developing a metric that can assign a value to different standards of education is useful for the military but also pivotal in the civilian world. Analyzing promotion rates and retention are only two small aspects of job performance that can be critiqued and utilized in future studies. Tuition costs, selectivity, and SAT scores just start to frame the different characteristics an institution might possess that affects career performance in graduates.

The perceived value added by elite schools still plays a role in the decision of retention but has no statistical significance on the ability to promote. The United States Navy employs individuals from a very diverse set of schools, majors, and demographics. This diversity assists in the isolation of effects from a specific schooling experience and the value that it adds to a career. Results from this analysis show that choice in school has less effect on career success then commission source, date of commissioning, the community joined, and changes in household demographics.

The push for free education has challenged the current system and forced society to question the value of expensive institutions. This study finds that tuition expense has the greatest effect on the MSR Retention rate. Graduates who attend more expensive institutions are more likely to leave after completing their contractual service time and enter a civilian work force. This likely has to do with the name recognition and branding power of the institution in the civilian job market. The Navy does not value one institution's graduates over another and equally supports all commissioned officers. Promotion to O-4 regressions demonstrate that the value added from increased tuition costs assist more in civilian job procurement than the actual work place skills developed and improved job performance within the Navy.

SAT and ACT test scores are used by institutions interchangeably and designed to identify the academic quality of the applicants. Accepting that IPEDS has some missing

data from reporting schools, the SAT test scores are more significant than ACT test scores. The variances between the two tests could be linked to demographics of students taking the test, institutions' demographics, or an indication that the tests are indeed not equally interchangeable. The top 25^{th} percentile of an institution's student body is a significant indicator of retention probability. Schools that select top SAT performers produce graduates that are more likely to separate throughout their first ten years of service. This could also be due to better civilian opportunities for graduates of schools with high achieving students. As with all the educational variables, when assessing actual job performance via O-4 promotions, SAT and ACT scores are not statistically significant and indicate no added value to the probability of promotion.

Selectivity is an interesting blend of indicators between the cost of tuition and an institution's student body SAT scores. Low acceptance rates are perceived to indicate superior performing institutions because of their demand and selection of quality applicants. Some institutions even pride themselves on the ability to reject large amounts of applications. A theory may suggest institutions that accept diverse and large populations, while producing competitive graduates, operate at a higher level of quality than institutions that focus on a more elite, narrow applicant pool. However, that is outside the scope of this analysis.

Selectivity maintains statistical significance when determining retention probability but is not significant when examining a benchmark promotion. When introduced as the only new variable, selectivity suggests that the higher the acceptance rate of the institution, the more likely the graduate is to continue their military career. This changes when all the educational variables are added to the model. When controlling for tuition costs and SAT scores, the estimates show that graduates from highly selective schools are more likely to leave the service. This change in sign indicates that the institutional characteristics investigated are all interrelated. When used alone, college selectivity includes many dimensions of selectivity. When included in models that control for SAT scores, selectivity most likely picks up selection on criteria other than of academic nature.

An individual's personal decision to continue serving in the military is influenced by the educational institution that was chosen. This is a pulling effect generated by the perceptions, beliefs, and biases within the civilian labor market than a pushing effect from within the Navy. The Navy does not offer preferred positions, alternative pay structure, or added benefits to graduates from certain institutions, therefore the effect must come from alternative opportunities in the civilian labor market. There are no statistically significant findings from this study that suggest that elite schools influence promotions to O-4.

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VII. RECOMMENDATIONS

This analysis uses the available data sets as a probe into a larger discussion about educational institutions' effects upon job performance and long-term career success. A larger sample of school data needs to be procured from IPEDS and missing observations can be researched or estimated. Officers in the United States Military are still the best demographic to examine and test hypothesis regressions with. Officer recruitment require the same standards and are non-discriminatory of degree, major, or institutions. No matter the community or year of cohort, the officers are evaluated the same way, using the same fitness report system.

Often when comparing different educational institutions, a student's natural talents and predisposition to success must be accounted for. Two of the main commissioning sources for naval officers are the Naval Academy and NROTC program in which both track and account for pre-college demographics. This data includes ACT and SAT test scores, high school performance, and demographics for hometowns and households. The students' journey through the education system is tracked and recorded as the officer candidates prepare for service. Upon graduation, the candidates are commissioned as officers and join a community where their career will start.

Every officer, in every community, at every rank throughout the entire Navy, are evaluated with the same system and are assessed for promotion the same way. This homogenous and uniform system ensures that all data collected is non-bias and compatible. If this data could be procured and merged, it would be simple to assess the effects that educational institutions have upon job performance and advancement opportunities while still accounting for an individual's fixed effects that skew an institutions quality. The institutions can be assessed by the same metrics outlined in this analysis or expanded to assist the Navy with recruitment, scholarship awards, and talent management.

Civilian labor markets would utilize the report to better assess the value of specific institutions. Prospective students would be able to assess institutions that best fit their needs, desires, and budgets while maximizing returns. Employers will have a metric in

which to evaluate new hires value based on the applicant's choice of school instead of subjective perceptions. Educational institutions utilizing the findings will be able to develop curriculum and practices best suited to maximize graduates labor utility. Parents will have statistical facts influencing decisions instead of social perceptions driving unethical behavior. There is clear value to extending the scope of this study with more data and detailed outcomes.

APPENDIX

Table 11. MSR Retention Probit Regression

VARIABLES	(1) MSR Retention	(2) Tuition Cost	(3) Selectivity	(4) SAT Test Scores	(5) ACT Test Scores	(6) All Variables
Female	-0.463***	-0.391***	-0.422***	-0.418***	-0.328***	-0.366***
	(0.0490)	(0.0706)	(0.0620)	(0.0645)	(0.0914)	(0.0757)
Married at 2 Years of Service	0.388***	0.366***	0.344***	0.335***	0.407***	0.396***
	(0.0434)	(0.0679)	(0.0576)	(0.0599)	(0.0878)	(0.0730)
Child/ren at 2 Years of Service	0.267***	0.169***	0.186***	0.194***	0.114	0.171**
	(0.0475)	(0.0650)	(0.0641)	(0.0672)	(0.0837)	(0.0693)
Black Non-Hispanic	0.270***	0.196*	0.163*	0.0756	0.201	0.0954
	(0.0682)	(0.102)	(0.0883)	(0.0943)	(0.128)	(0.114)
Asian	-0.0194	-0.120	-0.0675	-0.0469	-0.187	-0.0830
	(0.0832)	(0.128)	(0.109)	(0.114)	(0.162)	(0.136)
Hispanic	-0.0387	0.0768	-0.00277	-0.0189	-0.0840	0.0423
	(0.0675)	(0.108)	(0.0868)	(0.0889)	(0.139)	(0.113)
Other/Unknown Race	1.459*	0.0761	0.0907	0.110	-0.0332	0.0969
	(0.794)	(0.164)	(0.136)	(0.142)	(0.214)	(0.176)
ROTC	-0.294***	-1.172***	-0.295***	-0.213***	-1.404***	-1.210***
	(0.0486)	(0.133)	(0.0607)	(0.0587)	(0.225)	(0.142)
OCS/OTS/PLC	-0.0222	-0.502***	0.434***	0.469***	-0.686***	-0.542***
	(0.0523)	(0.144)	(0.0855)	(0.0850)	(0.237)	(0.155)
Other/Direct Commissioning	-1.470*					
	(0.787)					
Cohort FY00	-0.0867	-0.170*	-0.200**	-0.147	-0.147	-0.150
	(0.0661)	(0.0936)	(0.0897)	(0.0932)	(0.116)	(0.0992)
Cohort FY01	-0.175***	-0.0400	-0.0487	-0.0191	-0.00232	-0.0275
	(0.0639)	(0.0986)	(0.0896)	(0.0926)	(0.123)	(0.104)
Cohort FY02	-0.341***	-0.222**	-0.273***	-0.259***	-0.233*	-0.232**
	(0.0624)	(0.0949)	(0.0845)	(0.0877)	(0.119)	(0.101)
Cohort FY03	-0.427***	-0.302***	-0.355***	-0.351***	-0.282**	-0.322***
	(0.0626)	(0.0945)	(0.0841)	(0.0867)	(0.120)	(0.0995)
Subs	0.195***	0.433***	0.363***	0.395***	0.373***	0.481***
	(0.0450)	(0.0750)	(0.0594)	(0.0611)	(0.0951)	(0.0795)
Special Forces	0.418***	0.265**	0.492***	0.504***	0.437***	0.257*
	(0.0952)	(0.131)	(0.112)	(0.115)	(0.165)	(0.137)

Average Annual Out-of-State Tuition		-0.278***				-0.160
		(0.0686)				(0.126)
Percent Admitted			0.00798***			-0.0102**
			(0.00223)			(0.00415)
SAT				-0.0877***		-0.127***
				(0.0257)		(0.0378)
ACT					-0.0732*	
					(0.0377)	
Constant	0.697***	4.038***	0.350***	1.530***	2.232***	4.754***
	(0.0662)	(0.674)	(0.0932)	(0.340)	(0.441)	(1.165)
Observations	5,586	2,569	3,335	3,088	1,524	2,263
Pseudo R2	**0.0766**	**0.155**	**0.113**	**0.110**	**0.141**	**0.162**
Standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1				

Table 12. Ten Year Retention Probit Model

VARIABLES	Ten Year Retention	Tuition Cost	Selectivity	SAT Test Scores	ACT Test Scores	All Variables
Female	-0.269***	-0.251***	-0.256***	-0.283***	-0.270***	-0.325***
	(0.0512)	(0.0728)	(0.0647)	(0.0677)	(0.0934)	(0.0780)
Married at 6 Years of Service	0.345***	0.331***	0.308***	0.300***	0.252***	0.325***
	(0.0356)	(0.0523)	(0.0459)	(0.0480)	(0.0669)	(0.0561)
Child/ren at 6 Years of Service	0.424***	0.401***	0.381***	0.369***	0.417***	0.395***
	(0.0407)	(0.0584)	(0.0534)	(0.0566)	(0.0746)	(0.0634)
Black Non-Hispanic	0.271***	0.374***	0.371***	0.259***	0.457***	0.280**
	(0.0700)	(0.104)	(0.0918)	(0.0998)	(0.130)	(0.117)
Asian	0.143*	0.318**	0.155	0.179	0.282	0.369**
	(0.0829)	(0.135)	(0.110)	(0.114)	(0.176)	(0.144)
Hispanic	0.0389	-0.0477	0.0190	-0.0190	0.0111	-0.126
	(0.0635)	(0.0967)	(0.0831)	(0.0863)	(0.128)	(0.103)
Other/Unknown Race	0.404	6.934***	5.025	5.131	0.447**	5.688
	(0.813)	(0.155)	(114.6)	(115.0)	(0.203)	(141.4)
ROTC	-0.0434	-0.625***	-0.112**	-0.0371	-0.700***	-0.560***
	(0.0404)	(0.0692)	(0.0512)	(0.0512)	(0.0939)	(0.0745)
OCS/OTS/PLC	0.208***	-0.0666	0.471***	0.519***	-0.131	-0.0270
	(0.0413)	(0.0749)	(0.0617)	(0.0631)	(0.101)	(0.0821)
Other/Direct Commissioning	-0.160	-6.529	-4.499	-4.618		-5.286
	(0.807)	(0)	(114.6)	(115.0)		(141.4)
Cohort FY00	-0.0440	-0.0731	-0.0398	-0.0174	-0.129	-0.0384
	(0.0547)	(0.0776)	(0.0765)	(0.0818)	(0.0979)	(0.0843)
Cohort FY01	0.0908*	0.271***	0.165**	0.150*	0.352***	0.267***
	(0.0527)	(0.0792)	(0.0736)	(0.0782)	(0.102)	(0.0856)
Cohort FY02	0.320***	0.462***	0.445***	0.453***	0.496***	0.487***
	(0.0530)	(0.0794)	(0.0729)	(0.0778)	(0.100)	(0.0865)
Cohort FY03	0.379***	0.462***	0.480***	0.497***	0.436***	0.491***
	(0.0546)	(0.0790)	(0.0733)	(0.0780)	(0.100)	(0.0855)
Subs	-0.557***	-0.404***	-0.390***	-0.340***	-0.463***	-0.337***
	(0.0484)	(0.0733)	(0.0635)	(0.0661)	(0.100)	(0.0784)
Special Forces	0.220**	0.375**	0.409***	0.425***	0.647***	0.349**
	(0.102)	(0.150)	(0.120)	(0.124)	(0.195)	(0.159)
Aviator	0.256***	0.263***	0.491***	0.552***	0.268***	0.334***
	(0.0380)	(0.0563)	(0.0499)	(0.0523)	(0.0716)	(0.0610)
Average Annual Out-of-State Tuition		-0.142**				-0.234**
		(0.0574)				(0.102)
Percent Admitted			0.00425**			-0.0107***
			(0.00180)			(0.00345)

SAT				-0.0791***		-0.0879***
				(0.0230)		(0.0309)
ACT					-0.0537	
					(0.0341)	
Constant	-0.0330	1.541***	-0.494***	0.507*	0.733**	3.686***
	(0.0598)	(0.552)	(0.0863)	(0.303)	(0.341)	(0.954)
Observations	7,597	3,580	4,441	4,014	2,171	3,061
Pseudo R2	0.101	0.148	0.139	0.144	0.155	0.157

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13. Promote to O-4 Probit Model

VARIABLES	Promoted to O4	Tuition Cost	Selectivity	SAT Test Scores	ACT Test Scores	All Variables
Female	-0.0891	-0.139	-0.138	-0.169*	-0.107	-0.168
	(0.0696)	(0.0999)	(0.0904)	(0.0958)	(0.129)	(0.110)
Married at 6 Years of Service	0.394***	0.335***	0.346***	0.360***	0.313***	0.334***
	(0.0457)	(0.0662)	(0.0591)	(0.0622)	(0.0841)	(0.0711)
Child/ren at 6 Years of Service	0.0509	0.0262	0.0718	0.0862	0.0435	0.0445
	(0.0472)	(0.0659)	(0.0620)	(0.0662)	(0.0848)	(0.0719)
Black Non-Hispanic	-0.0951	-0.0851	-0.141	-0.123	-0.0235	-0.0568
	(0.0776)	(0.107)	(0.101)	(0.115)	(0.131)	(0.126)
Asian	0.0293	-0.0459	0.0121	0.0532	-0.0341	-0.0134
	(0.103)	(0.150)	(0.141)	(0.146)	(0.202)	(0.157)
Hispanic	-0.0363	-0.0167	0.0511	0.0566	0.00570	-0.0228
	(0.0819)	(0.129)	(0.114)	(0.121)	(0.163)	(0.142)
Other/Unknown Race	-3.442	-0.132	-0.133	-0.158	-0.0623	-0.170
	(96.77)	(0.161)	(0.144)	(0.154)	(0.224)	(0.179)
ROTC	-0.0284	-0.289***	-0.0611	-0.0772	-0.238**	-0.303***
	(0.0503)	(0.0762)	(0.0650)	(0.0664)	(0.0988)	(0.0832)
OCS/OTS/PLC	-0.0274	-0.176**	0.0233	-0.0222	-0.150	-0.239***
	(0.0501)	(0.0782)	(0.0700)	(0.0729)	(0.104)	(0.0866)
Cohort FY00	0.0618	-0.0210	-0.0286	-0.0119	0.0114	-0.0215
	(0.0796)	(0.111)	(0.111)	(0.122)	(0.141)	(0.123)
Cohort FY01	-0.0317	-0.0186	-0.0252	-0.0403	-0.0156	-0.0133
	(0.0736)	(0.107)	(0.104)	(0.113)	(0.134)	(0.118)
Cohort FY02	-0.451***	-0.430***	-0.481***	-0.528***	-0.493***	-0.484***
	(0.0690)	(0.100)	(0.0975)	(0.106)	(0.125)	(0.111)
Cohort FY03	-1.166***	-1.091***	-1.123***	-1.154***	-1.019***	-1.108***
	(0.0688)	(0.0985)	(0.0966)	(0.105)	(0.126)	(0.109)
Subs	-0.0377	-0.0297	-0.0604	-0.0457	-0.00952	0.00836
	(0.0704)	(0.102)	(0.0937)	(0.0987)	(0.143)	(0.109)
Special Forces	0.211*	0.0933	0.299**	0.229	0.388*	0.0286
	(0.125)	(0.172)	(0.150)	(0.155)	(0.226)	(0.183)
Aviator	-0.189***	-0.252***	-0.187***	-0.197***	-0.152*	-0.245***
	(0.0473)	(0.0691)	(0.0645)	(0.0688)	(0.0891)	(0.0757)
Average Annual Out-of-State Tuition (per $1000)		0.116*				0.0138
		(0.0682)				(0.112)
Percent Admitted			-0.000267			-0.00607
			(0.00224)			(0.00388)
SAT				0.00757		-0.0117
				(0.0281)		(0.0348)

ACT					-0.0297	
					(0.0413)	
Other/Direct Commissioning	3.309					
	(96.77)					
Constant	0.933***	0.0101	0.849***	0.784**	1.193***	1.298
	(0.0806)	(0.652)	(0.121)	(0.375)	(0.411)	(1.056)
Observations	5,346	2,480	2,908	2,589	1,466	2,098
Pseudo R2	0.128	0.114	0.119	0.123	0.103	0.118
Standard errors in parentheses						

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