Reserve Officer Commissioning Program (ROCP) Officer and Reserve Personnel Readiness

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Distribution

Photography Credit: Officer candidates from Class 220 recite the Oath of Office during their commissioning ceremony on November 24, 2015, at the National Museum of the Marine Corps in Triangle, Virginia. These new second lieutenants now head to The Basic School (photo by Ida Irby).

Approved by: **April 2017**

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Abstract

During Operations Iraqi Freedom and Enduring Freedom, the Marine Corps had to augment active component (AC) officers to fill vacant platoon leader billets at activated Selected Marine Corps Reserve (SMCR) units. In 2006, the Reserve Officer Commissioning Program (ROCP) was created to recruit non-prior-service officers into the SMCR. This study looks at the performance of the ROCP candidates and their effect on SMCR personnel readiness. We find that ROCP candidates perform similarly to their AC counterparts and tend to affiliate with the SMCR beyond their initial obligations—particularly if they have active-duty (AD) experience. We also found a positive relationship between the presence of lieutenants at SMCR units and the retention of nonobligor enlisted Marines. We recommend that the Marine Corps explore opportunities to expand ROCP recruiting sources, provide ROCP officers with AD experience, and continue to monitor ROCP officers' career development as the program matures.

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Executive Summary

In 2006, the Marine Corps created the Reserve Officer Commissioning Program (ROCP) to mitigate its Selected Marine Corps Reserve (SMCR) company-grade officer shortfalls. Before 2006, the Marine Corps relied only on officers transitioning from the active component (AC) to fill reserve component (RC) officer billets. During Operations Iraqi Freedom and Enduring Freedom, when SMCR units were being activated to support the AC, the Marine Corps had to augment these SMCR units with AC officers to staff vacant platoon leader billets—bringing the SMCR company-grade officer shortage to the attention of the Commandant of the Marine Corps. Now that the program is 10 years old, the Deputy Commandant, Manpower and Reserve Affairs, has asked CNA to analyze the performance of ROCP officers and examine the effect of the ROCP on personnel readiness. Overall, our analysis indicates that:

- ROCP officer candidates and officers perform similarly to their AC counterparts at Officer Candidate School (OCS) and The Basic School (TBS).[1]

- The Marine Corps has a positive return on its investment in the development of ROCP officers in the form of active-duty (AD) experience tours in that ROCP officers with AD experience tend to affiliate longer than those without it.

- The ROCP has increased company-grade officer staffing, and there is a positive relationship between having lieutenants at SMCR units and enlisted nonobligors' retention.

Although we found positive program effects, there are some areas for improvement. We recommend the following:

- Explore ways to encourage more enlisted Marines to seek reserve officer opportunities through the Meritorious Commissioning Program-Reserve (MCP-R) and the Reserve Enlisted Commissioning Program (RECP). Expanding these ROCP accession programs will help to guard against Officer Candidate Course-Reserve (OCC-R) recruiting constraints in times of AC accession growth. In addition, OCC-R prior-enlisted Marines are more likely to commission than

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[1] ROCP has not been around long enough to compare promotion rates to major, and almost all ROCP lieutenants were promoted to captain if they completed their obligations.

their non-prior-enlisted OCC-R counterparts or their OCC-ground prior-enlisted counterparts, providing additional returns to investing in MCP-R and RECP expansions.

- Investigate why candidates who complete OCS do not accept commissions. We found a decreasing trend in the commissioning rate of OCC-R candidates who completed OCS. The Marine Corps may find that candidates need more information or mentoring about being a reserve officer to encourage them to accept commissions.

- Continue to offer AD experience tours and maintain an inventory of potential AD opportunities for reserve officers. These opportunities are investments into ROCP officers' professional careers that are reaped through continued SMCR affiliation and effective reserve officer leadership. These opportunities also should be open to non-ROCP officers because they provide greater AC-RC integration.

- Monitor ROCP officers' career progression. The ROCP is relatively young, so the Marine Corps should monitor ROCP officers' command selection and promotion rates as more cohorts reach those career milestones to ensure that it is maximizing its return on its ROCP investments.

The ROCP has accomplished what the Marine Corps initially intended: it fills SMCR company-grade officer shortfalls. We intend for our recommendations to help that success continue and to provide reserve officers with the opportunities to achieve their Marine career aspirations.

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Glossary

AC	Active Component
AD	Active Duty
ACT	American College Test
AFQT	Armed Forces Qualification Test
AR	Active Reserve
BIC	Billet Identification Code
CO	Commanding Officer
DC, M&RA	Deputy Commandant, Manpower and Reserve Affairs
FY	Fiscal Year
GPA	Grade Point Average
IMA	Individual Mobilization Augmentee
MCP-R	Meritorious Commissioning Program-Reserve
MCRC	Marine Corps Recruiting Command
MCRISS	Marine Corps Recruiting Information Support System
MCTFS	Marine Corps Total Force System
NCO	Noncommissioned Officer
NPS	Non-Prior Service
NROTC	Naval Reserve Officer Training Corps
OCC-R	Officer Candidate Course-Reserve
OCS	Officer Candidates School
PFT	Physical Fitness Test
PLC	Platoon Leaders Class
PMOS	Primary Military Occupational Specialty
PS	Prior Service
PSM	Propensity Score Matching

RC	Reserve Component
RECP	Reserve Enlisted Commissioning Program
ROCP	Reserve Officer Commissioning Program
SAT	Scholastic Assessment Test
SelRes	Selected Reserve
SMCR	Selected Marine Corps Reserve
SNCO	Staff Noncommissioned Officer
TBS	The Basic School
TFDW	Total Force Data Warehouse
USNA	United States Naval Academy

Introduction

Until 2006, all Marine Corps Selected Reserve (SelRes) officers had Marine Corps active component (AC) experience and were what the Corps calls prior-service (PS) Marines.[2] Under the PS-officer construct, the Marine Corps achieved its highest level of SelRes company-grade officer staffing—about 60 percent—in the mid-1990s, after a decrease in Marine Corps AC endstrength. However, SelRes company-grade staffing declined steadily through the late 1990s to just over 20 percent in 2007. During this time, the Marine Corps was activating Selected Marine Corps Reserve (SMCR) units to support Operations Iraqi Freedom and Enduring Freedom and had to augment these units with AC officers to staff vacant platoon leader billets. To address the reserve company-grade officer shortfall, in 2006 the Commandant of the Marine Corps directed the Deputy Commandant, Manpower and Reserve Affairs (DC M&RA), to create the Reserve Officer Commissioning Program (ROCP), which allows non-prior-service (NPS) Marines—those who were never in the AC—to affiliate with the SelRes. Company-grade officer staffing levels increased following ROCP implementation and exceeded 80 percent at the end of FY14. Anecdotally, the feedback of SMCR commanding officers (COs) regarding ROCP officers is positive with respect to performance and retention, but there has been no objective analysis to support this feedback. DC M&RA asked CNA to conduct an in-depth study of the ROCP, the performance of the lieutenants commissioned through the program, and the program's effect on the total force in terms of SMCR unit readiness as measured by staffing levels and retention.

Background

Prior research shows that fewer than 100 officers transition from the AC to the reserve component (RC) each month, and fewer than half of these officers tend to affiliate with the SelRes [1]. The majority of the transitioning officer population is made up of captains and above, implying that the number of PS lieutenants available for SMCR recruitment is small. Furthermore, the most junior officers transitioning

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[2] The Marine Corps SelRes includes the Active Reserve (AR) program, Selected Marine Corps Reserve (SMCR), and Individual Mobilization Augmentee (IMA) programs.

from the AC are the least likely to affiliate with the SMCR [1]. These trends explain why the Marine Corps had to use NPS officer recruiting to alleviate its reserve company-grade officer shortfalls.

The ROCP is supported by the following three recruiting programs [2-3]:

- *Meritorious Commissioning Program-Reserve (MCP-R):* Under MCP-R, unit COs may nominate qualified AC and Active Reserve (AR) enlisted Marines to apply for Officer Candidates School (OCS) for eventual commissioning as unrestricted officers in the SelRes. A qualified Marine must have at least 75 college credit hours or an associate degree and demonstrate exceptional leadership potential (per his or her CO's observations and recommendation).

- *Reserve Enlisted Commissioning Program (RECP):* Similar to the MCP-R, the RECP allows SMCR enlisted Marines who have demonstrated exceptional leadership potential and who hold bachelor's degrees to apply for OCS and subsequent commissioning as unrestricted reserve officers.

- *Officer Candidates Course-Reserve (OCC-R):* Civilians, other service enlisted members, and enlisted Marines in the Ready Reserve who have earned bachelor's degrees may apply to attend OCS via a Marine Corps Recruiting Command (MCRC) Officer Selection Officer.

Table 1 shows the number of officer accessions by commissioning source and fiscal year from FY09 to FY15; AC-to-RC accessions include people who were recruited for the AC but signed an RC commission, a switch that occurred sometime between recruitment and commissioning. The vast majority of reserve officer accessions came through ROCP, with almost all accessions going through the OCC-R pipeline.[3] During a 2015 operational planning team session, MCRC explained that prior-enlisted ask recruiters more than their career planners about commissioning opportunities [6].

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[3] In addition to the ROCP, the Marine Corps recruits PS Marines via PS recruiters and the Direct Affiliation Program. The PS recruiting program recruits PS Marines from the Individual Ready Reserve. The Direct Affiliation Program recruits AC Marine officers who are nearing the end of AC service [4-5].

Table 1.   Reserve officer accessions, FY09-FY15

Commission source	FY09	FY10	FY11	FY12	FY13	FY14	FY15
MCP-R	1	3	0	0	0	0	0
RECP	1	1	2	3	2	0	1
OCC-R	59	97	89	124	144	123	132
AC to RC	0	8	7	7	5	15	7
Total	61	109	98	134	151	138	140

Source: Reserve Officer Commissioning Program Brief 2015 [7].

In the SMCR, ROCP officers perform the role of platoon leaders at their units. In the past, when company-grade officer shortfalls were high, enlisted personnel—noncommissioned officers (NCOs) and staff NCOs (SNCOs)—were assigned to these billets, reducing SMCR readiness levels. The ROCP was intended to mitigate this misalignment. Some opponents of the ROCP argued that active-duty (AD) experience was critical to the development of lieutenants and, therefore, reserve lieutenants would not have the same levels of expertise as their AC counterparts. When ROCP began in 2006, operational tempo was high and RC personnel were activated regularly, providing young lieutenants with opportunities to go on active duty. As operational tempo has fallen, however, these opportunities have become more limited. As a response, in January 2017, the Marine Corps issued guidance that establishes one-year AD experience tours as part of the ROCP [8]. ROCP lieutenants can volunteer for one-year AD experience tours, which begin after the lieutenants check in with their SMCR units and are assigned to billet identification code (BICs) per the BIC assignment policy [2]. For those who choose to complete AD tours, M&RA identifies AD opportunities commensurate with the lieutenants' grades and primary military occupational specialties (PMOSs), and the AC commands receiving ROCP lieutenants are required to employ them "according to the billet they have been assigned" [8]. In this study, we will examine how many SMCR lieutenants have AD experience, the length of these experience tours, and the relationship between AD experience tours and ROCP officers' SMCR continuation behavior.

This report

We present our analysis of the ROCP in three parts. In the first part, we compare ROCP candidates with their AC counterparts. We examine the characteristics of these groups at OCS, and we test for differences between ROCP and AC candidates' OCS attrition and commissioning rates. Next, we examine whether RC officers have different grade point averages (GPAs) than their AC counterparts at The Basic School (TBS). We examine these outcomes to test whether the ROCP accesses the same quality of officer as the AC and to identify ways in which the Marine Corps can improve ROCP candidate outcomes at OCS and TBS.

The second part of our analysis examines the characteristics of ROCP officers most likely to complete their initial four-year obligations in the SMCR. We also examine the rates at which ROCP officers continue to affiliate with the SMCR past their initial obligations. Of particular interest to this part of our analysis is whether ROCP officers with AD experience tours are more or less likely to complete their initial obligations and continue to affiliate with the SMCR.

The third part of our analysis focuses on the effect the ROCP had on SMCR personnel readiness. We examine how company-grade staffing has changed since the ROCP's inception and whether enlisted retention improves when lieutenants are assigned to units. The hypothesis is that enlisted Marines, particularly NCOs and SNCOs, are more likely to remain affiliated with the SMCR if the units have better leadership and they are doing jobs aligned with their paygrades instead of performing jobs that need to be done when a lieutenant billet is gapped.

In the final section of the report, we summarize our findings and recommendations.

ROCP and AC Candidates' Characteristics

Before presenting our analysis of ROCP and non-ROCP candidates' performance, we describe these populations and their characteristics. Differences in population characteristics may indicate population differences in OCS attrition rates, commissioning rates, or TBS performance. For example, if we find lower female representation among ROCP candidates, we may expect that group to have lower OCS attrition than non-ROCP candidates, on average, since women tend to attrite from OCS at higher rates than men.

We identify OCS attendees by component code in the Total Force Data Warehouse (TFDW) monthly snapshot files for FY09 to FY15. We merge these data with personnel data from the Marine Corps Recruiting Information Support System (MCRISS) to identify which candidates were recruited through OCC or OCC-R. Because ROCP offers only ground contracts, we include only OCC ground candidates in our comparison group.[4]

In the next subsections, we describe the OCS candidate population and note differences in the number and demographic characteristics of OCC and OCC-R candidates.

Number of OCS candidates

Figure 1 shows the number of OCC and OCC-R ground candidates at OCS in each fiscal year from FY09 to FY15. In these seven years, there were a total of 1,179 OCC-R candidates and 3,369 OCC ground candidates. FY09 had the most OCC/OCC-R ground candidates, and FY13 had the fewest. These years correspond to the Marine Corps' increase in its AC endstrength between FY08 and FY12. The number of candidates increased after FY13 as the Marine Corps began moving toward its new steady-state AC endstrength.

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[4] We exclude OCC air and law candidates from our analysis.

Figure 1. Number of OCC-R and OCC ground candidates, FY09–FY15

	FY09	FY10	FY11	FY12	FY13	FY14	FY15
■ OCC-R	79	149	139	181	225	196	210
■ OCC ground	1,026	584	528	294	162	245	530
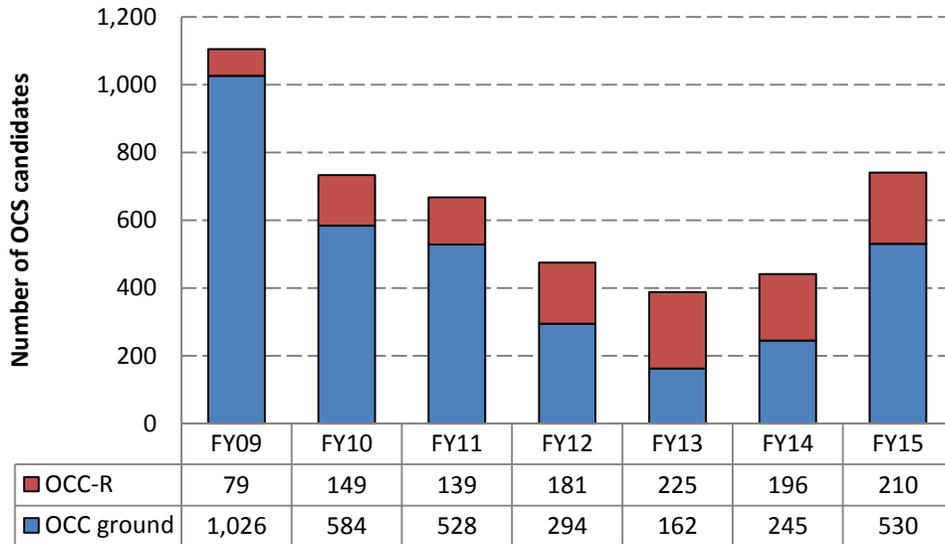
Source: CNA tabulations using FY09–FY15 TFDW and MCRISS data.

OCC-R candidates made up 7 percent of OCC/OCC-R ground candidates in FY09 when the program was relatively new and 58 percent in FY13 when the Marine Corps slowed commissions as its AC endstrength shrank and its RC endstrength remained unchanged. In FY15, the Marine Corps had 740 OCC/OCC-R ground candidates, of which 28 percent were OCC-R. If the Marine Corps were to continue on its path of a steady-state AC endstrength of 182,000 in FY17, we would expect less fluctuation in the percentage of ROCP candidates than observed over the past 7 years [9]. However, if an AC endstrength increase is authorized without an increase in RC endstrength, OCC-R representation may decrease as the Marine Corps focuses on making more AC officers. The Marine Corps will need to balance its AC and RC officer recruiting missions if endstrength changes are authorized.

MCRC is responsible for recruiting candidates for the AC and RC. MCRC's ability to increase the number of OCC-R candidates is constrained by its recruiting resources and the number of OCS seats available for ROCP candidates. When the AC grows, MCRC relies on the OCC program to turn out candidates quickly because the other officer accession pipelines—Platoon Leaders Class (PLC), Naval Reserve Officer Training Corps (NROTC), and the United States Naval Academy (USNA)—take several

years to produce one candidate [10].[5] Therefore, to ensure stable ROCP production in the event of an AC endstrength buildup, the Marine Corps should identify ways to improve production out of the other ROCP pipelines. Specifically, this means finding ways to encourage enlisted Marines to seek commissions and to encourage those seeking a commission to apply for the MCP-R and RECP. This would involve getting unit leaders and career planners to promote these programs more and to actively encourage Marines to participate.

Candidates' demographic characteristics

Table 2 shows average characteristics of OCC-R and OCC ground candidates. We use boldface type to indicate statistically significant differences between the populations. Our comparison of the OCC-R and OCC ground candidate populations indicates several differences that may correlate with future performance, such as OCS attrition rates, commissioning rates, and TBS outcomes.[6]

Table 2.   Demographic characteristics of OCC-R and OCC ground candidates, FY09–FY15

Characteristic	OCC-R[a]	OCC ground
Female	**3.9%**	19.9%
Race/ethnicity		
Non-Hispanic white	**71.9%**	74.8%
Non-Hispanic minority race	**14.9%**	14.9%
Hispanic	**13.2%**	10.3%
Age at OCS		
Average age	**25.3**	24.5
Age > 26	**29.7%**	18.7%
Marital/dependents status		
Single, no dependents	86.0%	85.0%
Married or with dependents	14.0%	15.0%
Have Scholastic Assessment Test (SAT) score	64.5%	62.2%
Average SAT score[b]	1344.6	1366.6

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[5] PLC, NROTC, and the USNA identify candidates early in their college careers and must wait for them to graduate before commissioning, whereas OCC and OCC-R identify college graduates who can potentially commission within a few months of completing the application process.

[6] Table 7 in Appendix A shows average OCS attrition rates, commissioning rates, and TBS outcomes by demographic group.

Characteristic	OCC-R[a]	OCC ground
Have Armed Forces Qualification Test (AFQT) score	**42.1%**	36.4%
Average AFQT score[b]	84.3	84.6
Prior enlisted	11.6%	10.9%
Contract waivers		
Age waiver	**9.8%**	6.2%
Aptitude waiver	0.2%	0.4%
Dependents waiver	2.5%	3.1%
Traffic waiver	**14.6%**	10.3%
Drugs waiver	16.2%	16.9%
Tattoo waiver	**14.2%**	20.5%
Drop waiver	**4.7%**	2.3%
Serious waiver	1.7%	1.8%
Physical waiver	0.2%	0.0%
Any waiver	41.0%	42.4%
MCRISS physical fitness test (PFT) score	276.8	275.9
OCS season[c]		
Summer class	**31.6%**	23.1%
Fall class	**37.0%**	32.9%
Winter class	**31.5%**	44.0%
Number of candidates	1,179	3,369

Source: CNA tabulations using FY09-FY15 TFDW and MCRISS data.

[a.] Boldface statistics indicate that the OCC-R and OCC ground distributions are statistically different at the 5-percent level. A T-test was used for binary outcomes and a post-linear regression Wald test was used for nonbinary outcomes.

[b.] Reported averages are for those with an SAT, American College Test (ACT), or AFQT score on record. ACT scores were converted to SAT scores according to SAT-ACT conversion table (http://blog.prepscholar.com/act-to-sat-conversion).

[c.] During this period, OCC-R and OCC ground candidates did not attend a spring OCS.

First, we find that female representation among OCC-R candidates is one-fifth of that among OCC ground candidates. Women made up almost 20 percent of OCC ground candidates and only 4 percent of OCC-R candidates.[7] A major contributor to the lower female representation among OCC-R candidates is the emphasis the ROCP has on recruiting to fill reserve ground combat occupations. These occupations were opened to women in December 2015 [12]. Women generally have higher OCS attrition, lower commissioning rates, and lower TBS outcomes than men. Therefore, if gender were the only factor that predicts future outcomes, we might expect OCC-R

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[7] The female OCS attrition rate is almost twice the rate for men (see Appendix A, Table 7), so female representation of AC officer corps gains is much lower at 7 percent [11].

candidates to have lower OCS attrition rates, higher commissioning rates, and higher TBS outcomes than OCC ground candidates.

In addition to having lower female representation, OCC-R candidates are more racially and ethnically diverse than OCC ground candidates. Almost 75 percent of OCC ground candidates were non-Hispanic white compared with 72 percent of OCC-R candidates. On average, racial and ethnic minorities have worse OCS attrition, commissioning, and TBS outcomes than non-Hispanic whites (see Appendix A). These relationships suggest that OCC-R candidates may have higher OCS attrition rates, lower commissioning rates, and lower TBS performance scores than their OCC ground counterparts, countering the positive effects of having fewer women discussed earlier.

Other demographic differences of interest for OCS attrition are the facts that OCC-R candidates tend to be older than OCC ground candidates and that they attend OCS in the summer as opposed to the winter or fall. Older candidates tend to have higher OCS attrition rates than younger candidates, while summer attendees tend to have the lowest attrition rates, on average (see Appendix A). These are countering relationships; therefore, OCS attrition rates may be similar for OCC-R and OCC ground candidates, on average. The age and OCS season differences also may result in commissioning differences because older candidates and those who attend OCS in the summer are less likely, on average, to take a commission (see Appendix A).

Table 2 also shows the percentage of OCC-R and OCC ground candidates with different types of contract waivers. We find that candidates with waivers (such as age, traffic, tattoo, and drop) tend to accept commissions at lower rates and perform worse than nonwaivered candidates at TBS, on average (see Appendix A).

Summary

We have established that the OCC-R and OCC ground candidates are not identical and the ways in which they differ may affect overall OCC-R and OCC production. Given the varying relationships between demographic characteristics and OCS attrition, commissioning rates, and TBS outcomes, our analysis of these outcomes will need to account for differences in Marines' demographic characteristics. In the next section, we describe our methodology and present our findings regarding whether reserve candidates have different OCS and TBS outcomes than their AC counterparts.

OCS and TBS Outcomes

In this section, we analyze differences in OCS and TBS outcomes between RC and AC officer candidates and commissioned officers. We describe our methods for estimating these differentials, given the demographic differences established in the previous section, and then present our findings.

Data and methodology

For our analysis of candidates' performance, we used the TFDW and MCRISS data on the OCC-R and OCC ground officer candidates who attended OCS between FY09 and FY15. From these data, we are able to identify which OCC-R and OCC ground candidates completed OCS.

For our analysis of TBS performance outcomes, we merge TBS performance data with the TFDW-MCRISS dataset of OCC-R and OCC ground candidates, which allows us to compare the TBS GPAs of OCC-R and OCC ground candidates who accepted reserve commissions.[8] Since some candidates may switch components between OCS and commissioning, we identify RC and AC officers at TBS by the component code on their first TBS TFDW snapshot. We analyze differences between RC and AC officers' academic, leadership, military skills, and overall GPAs.

We analyze whether there is a statistically significant ROCP differential in OCS attrition and TBS performance by conducting three types of analyses for each outcome of interest. First, we examine whether we can observe differences in *average* OCS attrition rates and TBS performance measures. We present these data graphically and perform basic statistical tests on the differences in the means.

Second, we perform regression analysis. As noted in the previous section, the OCC-R and OCC ground candidate populations are demographically different, and these differences are correlated with OCS and TBS outcomes. Regression analysis allows us to estimate the ROCP differential accounting for these demographic differences. For

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[8] We also examined differences in class rank. The results were very similar to our GPA findings, so we exclude them for brevity's sake. Class rank results are available on request.

binary outcomes, such as OCS attrition, we estimate probabilities as a logistic function of whether the candidate/officer went through the ROCP and of the demographic characteristics listed in Table 2. In addition, we include controls for the OCS or TBS class attended because there may be unobservable factors that are specific to the class attended that may be correlated with the outcomes. For example, differences in instructor style or OCS and TBS leadership personalities may result in differences across OCS and TBS classes.

Regression analysis also allows us to examine the relationships between observable characteristics and the outcomes of interest. That is, we can determine whether someone's race/ethnicity or age is significantly correlated with OCS attrition and TBS performance. In addition, we can interact our binary variable of ROCP status (i.e., OCC-R candidate at OCS or RC officer at TBS) with each demographic characteristic to test whether the relationships between demographic characteristics and the outcome of interest are different for ROCP and AC personnel.

Regression analysis, however, cannot account for differences in people's decisions to go into the ROCP, and these differences may be correlated with the OCS and TBS outcomes. There may be some unobservable factors that affect a person's decision to pursue becoming a reserve officer that also are correlated with whether he or she passes OCS, signs a commission, or performs well at TBS. If we do not account for these *selection* factors, our regression-estimated ROCP differentials may be picking up these differences in addition to the true ROCP differential. In other words, our estimates will be biased. We use propensity score matching (PSM) to mitigate selection bias.

PSM is the third type of analysis that we conduct for each outcome of interest. PSM compares the outcomes of ROCP personnel with similar AC personnel by matching them based on their propensity score, which represents the likelihood of being in the ROCP (i.e., an OCC-R candidate at OCS or an RC officer at TBS). We estimated propensity scores as a logistic function of the demographic characteristics in Table 2 and the fiscal year of either OCS or TBS attendance. We used the estimated propensity scores to match ROCP and AC personnel such that the demographic characteristics of the two groups are similar, which allow us to compare outcomes between the two groups and get a less biased estimate of the ROCP differential.[9]

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[9] There are several ways to match ROCP and AC personnel based on propensity scores [13-15]. We applied kernel PSM, which requires that the ROCP and AC population share the same propensity score distributions, minimizing the amount of data dropped from the analysis. Kernel PSM matches ROCP personnel to the remaining AC personnel, but it weights people based on how similar their propensity scores are to a ROCP personnel. That is, AC personnel who have more similar propensity scores to the ROCP personnel are given the most weight.

Findings

OCS attrition differences

Figure 2 shows FY09-FY15 attrition rates, by fiscal year, for OCC-R and OCC ground candidates. Between FY09 and FY12, OCC-R candidates had higher attrition rates than OCC ground candidates; in more recent years, OCC-R candidates have had similar or lower attrition rates. In FY13—the year with the most OCC-R candidates— 29 percent of OCC-R candidates and 33 percent of OCC ground candidates attrited from OCS. The largest differences in OCS attrition were in FY10 (in favor of OCC-R candidates) and FY15 (in favor of OCC ground candidates). Although there has been fluctuation in attrition rates from fiscal year to fiscal year for both ROCP and non-ROCP candidates, over the whole seven-year period, average attrition rates were identical for these two groups (30 percent).

Figure 2.   OCC-R and OCC ground OCS attrition rates, FY09-FY15

	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY09-FY10
OCC-R	38.0%	30.9%	33.1%	27.6%	28.9%	33.2%	26.2%	30.3%
OCC ground	33.1%	27.4%	27.8%	25.2%	33.3%	31.8%	31.5%	30.3%
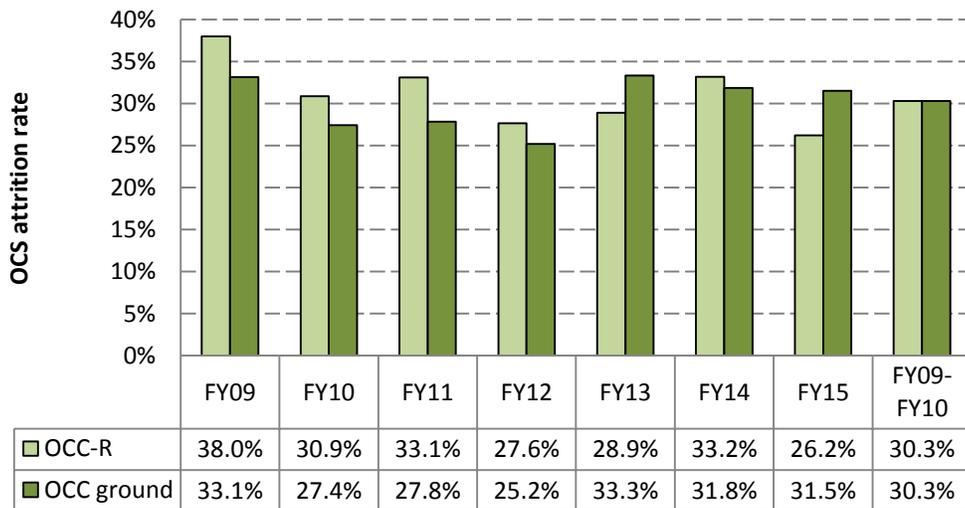
Source: CNA tabulations using FY09-FY15 MCRISS and TFDW data.

Because FY-to-FY comparisons may be masking some trends, we also compared the OCC-R representation among OCS attrites from a particular OCS class to the OCC-R representation in that class to see if OCC-R candidates are overrepresented or underrepresented among attrites, an indication that OCC-R candidates attrite more or less than OCC ground candidates. These results are shown in Figure 3. In the figure, each green diamond represents an OCS classes. The x-axis indicates the OCC-R representation in the class; the y-axis indicates the OCC-R representation among

OCS attrites. The green line is the trend line through the scatterplot; the black line represents the 45-degree line, indicating where OCC-R representation is equal across the two groups. If OCC-R candidates were overrepresented among attrites, the green trend line would lie above the black 45-degree line; if they were underrepresented, the green line would lie below the black line. Although the scatterplot suggests that OCC-R candidates are overrepresented among OCS attrites, a statistical test indicates that the slopes of the green and black lines are not statistically different, suggesting that OCC-R candidates are no more or less likely to attrite from OCS than OCC ground candidates.

Figure 3.   Comparison of OCC-R representation between OCS attendees and OCS attrites, by OCS class, FY09-FY15[a]
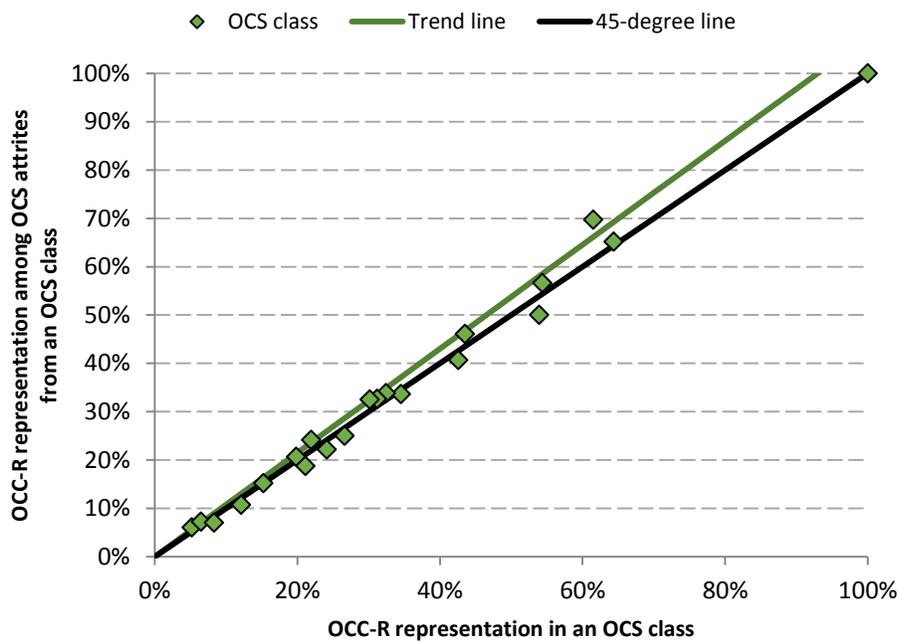
Source: CNA tabulations using FY09-FY15 MCRISS and TFDW data.
[a.] An F-test that the slopes of the trend line and the 45-degree line are different failed (p-value > 0.05). We conclude that the slopes are similar.

Our regression and PSM analyses also indicate no statistical difference between OCC-R and OCC ground candidate OCS attrition.[10] However, the regression analyses we performed separately on OCC-R and OCC ground candidates indicate that gender,

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[10] Full regression results are provided in Appendix B, and PSM results are shown in Appendix C.

race, marital/dependent status, having a traffic waiver, and PFT scores are statistically correlated with OCC-R OCS attrition. Table 3 shows the statistically significant relationships (positive or negative) between demographic characteristics and OCS attrition for the OCC-R and OCC ground populations (the first two data columns) and whether the effect is higher or lower for OCC-R candidates than it is for OCC ground candidates (the third data column). These differences are important because they could indicate that there are unobservable characteristics correlated with the observable characteristics that are different between OCC-R and OCC ground candidates.

Table 3.   Statistically significant relationships between demographic characteristics and OCS attrition, by OCC-R and OCC ground

Characteristic	OCC-R candidates[a]	OCC ground candidates[a]	OCC-R compared with OCC ground[b]
Female	Positive	Positive	Not stat. sig.[c]
Non-Hispanic minority	Not stat. sig.	Positive	Not stat. sig.
Hispanic	Not stat. sig.	Positive	Not stat. sig.
Married/with dependents	Not stat. sig.	Negative	More positive
Traffic waiver	Negative	Negative	Not stat. sig.
MCRISS PFT score	Negative	Negative	Not stat. sig.

Source: CNA estimates using FY09-FY15 MCRISS and TFDW data.

[a.] A negative (positive) point estimate indicates that the group has a statistically lower (higher) probability of commissioning than the omitted category, all else equal. Regression includes controls for demographic characteristics and TBS class.

[b.] The interaction term point estimate was negative (positive), indicating that OCC-R candidates with the characteristic are less (more) likely than OCC ground candidates to commission, all else equal. Regressions include a control for whether the candidate was OCC-R or OCC ground, demographic characteristics, and the interaction of the OCC-R/OCC variable with each demographic characteristic. The cells represent the direction and significance level of the estimate on the interaction terms.

[c.] Not stat. sig. stands for not statistically significant.

We find that the relationship between OCS attrition and being married or having dependents is statistically different between OCC-R and OCC ground candidates: OCC-R candidates who are married or have dependents are more likely to attrite than OCC ground candidates, but they are no more or less likely to attrite than OCC-R candidates who are not married and do not have dependents. OCC-R candidates who are married or have dependents may value their time away from their spouses and wives (and potentially civilian jobs) differently than OCC ground candidates relative to the service commitment. For example, OCC-R candidates may think that the payoff of graduating OCS to receive a part-time career in the Marine Corps as a reservist is less than OCC ground candidates who will have full-time careers.

Commissioning differences

As a check, we also looked to see that OCS graduates accepted commissions. We find that some OCC-R and OCC ground candidates who completed OCS did not accept commissions (i.e., we observe an OCS graduation flag but not a commission date). Figure 4 shows the FY09-FY15 commissioning rates for OCC-R and OCC candidates who completed OCS. Between FY09 and FY11, OCC-R graduates had higher commissioning rates than OCC ground graduates but, in more recent years, OCC-R graduates had lower commissioning rates. The FY13-FY15 OCC-R cohorts also had lower commissioning rates than previous OCC-R cohorts. In FY12, for example, 95 percent of OCC-R OCS graduates accepted commissions, but, in FY14 and FY15, only 88 and 85 percent accepted commissions, respectively. Over the whole seven-year period, the commissioning rate for OCC-R OCS graduates was slightly lower than that for OCC ground candidates: 91 percent versus 92 percent.[11]

Figure 4.   Commissioning rate given OCS completion, OCC-R and OCC ground candidates, FY09–FY15

	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY09-FY15
OCC-R	93.9%	91.3%	94.6%	95.4%	90.6%	88.5%	85.2%	90.8%
OCC ground	90.5%	89.4%	90.6%	95.9%	98.1%	95.2%	95.0%	92.2%
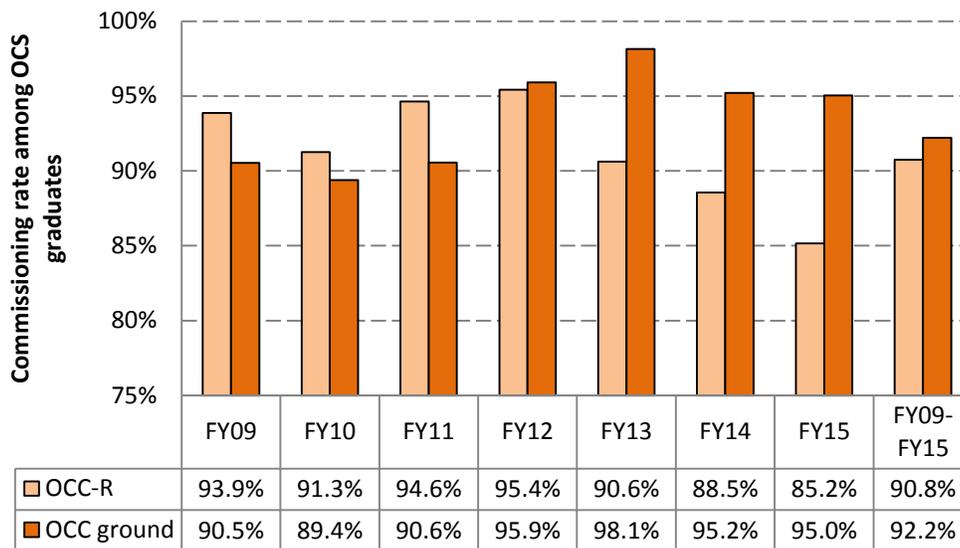
Source: CNA tabulations using FY09-FY15 MCRISS and TFDW data.

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[11] The difference between the commissioning rates is not statistically significant (p-value > 0.05).

Given that there is a small but statistically significant difference in OCC-R and OCC ground commissioning rates, we estimated the relationships between demographic characteristics and commissioning separately for the OCC-R and OCC ground populations to determine if there are particular groups that are driving these differences. Table 4 summarizes the direction of the statistically significant relationships we estimated using regression analysis.

Table 4.   Statistically significant relationships between demographic characteristics and accepting a commission, by OCC-R and OCC ground

Characteristic	OCC-R candidates[a]	OCC ground candidates[a]	OCC-R compared to OCC ground[b]
Non-Hispanic minority	Negative	Not stat. sig.[c]	More negative
Hispanic	Not stat. sig.	Not stat. sig.	Not stat. sig.
Age	Negative	Not stat. sig.	Not stat. sig.
Drop waiver	Negative	Negative	Not stat. sig.
MCRISS PFT score	Positive	Not stat. sig.	Not stat. sig.
Prior enlisted	Positive	Positive	Positive

Source: CNA estimates using FY09-FY15 MCRISS and TFDW data.

[a.] A negative (positive) point estimate indicates that the group has a statistically lower (higher) probability of commissioning than the omitted category, all else equal. Regression includes controls for demographic characteristics and TBS class.

[b.] The interaction term point estimate was negative (positive), indicating that OCC-R candidates with the characteristic are less (more) likely than OCC ground candidates to commission, all else equal. Regressions include a control for whether the candidate was OCC-R or OCC ground, demographic characteristics, and the interaction of the OCC-R/ OCC variable with each demographic characteristic. The cells represent the direction and significance level of the estimate on the interaction terms.

[c.] Not stat. sig. stands for not statistically significant.

We find that non-Hispanic minorities are less likely to commission than their non-Hispanic white counterparts and significantly less likely to commission than their non-Hispanic minority OCC ground counterparts. This is important to note because the OCC-R population is relatively small, and the minority population has made up almost one-fifth of every OCC-R cohort in recent years. We also find that OCC-R prior-enlisted Marines are more likely to accept commissions than their OCC-ground prior-enlisted counterparts. These findings suggest that there may be intangibles associated with demographic groups that factor into the decision to accept a reserve commission despite having graduated from OCS. For example, prior-enlisted Marines may have a better sense of what it means to be a reserve officer than someone with no Marine Corps experience. Providing more information about what it means to be a reserve officer—the roles, responsibilities, experiences, and opportunities available—

may increase commissioning rates. This information could come through recruiters or the Marine Corps could have the ROCP liaison from Reserve Affairs talk to candidates at OCS.[12]

In addition, the finding that OCC-R prior-enlisted candidates accept commissions at higher rates than their non-prior-enlisted OCC-R counterparts indicates that our recommendation to expand ROCP's prior-enlisted accession pipelines to provide stability to the reserve officer accession pipeline would have an added benefit of reducing losses between OCS graduation and commissioning, increasing reserve officer accessions.

TBS differences

We have established that OCC-R candidates are no more or less likely than their OCC ground counterparts to attrite from OCS, but they are slightly less likely to accept commissions. The next portion of our analysis focuses on officers' performance at TBS. For this analysis, we identify officers as RC or AC based on their first component code at TBS. In our data, we found that 70 of the 746 OCC-R candidates who commissioned accepted AC commissions (9.4 percent) and 7 of the 2,166 OCC ground candidates who commissioned accepted RC commissions (0.3 percent). (Recall that officer candidates are not obligated until they commission, so some candidates may be able to switch components depending on availability.[13] Some of these movements are countered by the end of TBS: of the 683 officers who started TBS in the RC, 18 (2.6 percent) were in the AC at the end of TBS; 64 (2.9 percent) of the 2,229 officers who started TBS in the AC were in the RC at the end of TBS. ROCP officers who are in the top 5 percent of their class are given the option to switch to the AC. The Marine Corps should monitor these movements in the future, particularly in cases of an AC endstrength buildup, to ensure that it is not hollowing out its RC officer pipeline.

Having identified TBS officers as RC or AC at the start of TBS, we can compare their TBS outcomes. We begin by comparing average GPAs by TBS fiscal-year cohorts. In

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[12] Focus groups with ROCP officers who attended the 2012 and 2013 ROCP Leadership Weekend revealed issues with recruiters not having good information about the reserve experience and limited training on reserve-specific issues at TBS [16-17].

[13] During the first years of the AC endstrength drawdown, the AC officer accession mission was decreased, and the Marine Corps offered candidates in the pipeline for AC contracts RC contracts to keep faith. Some of the switches we observe may be individuals who took an RC contract because an AC contract was not available, and they were able to pick up an AC commission either before TBS or at TBS.

Figure 5 through Figure 8, we show the average TBS GPA by RC, AC, and fiscal year, for FY09 to FY15.

Figure 5.   Average academic TBS GPA, by component, FY09–FY15
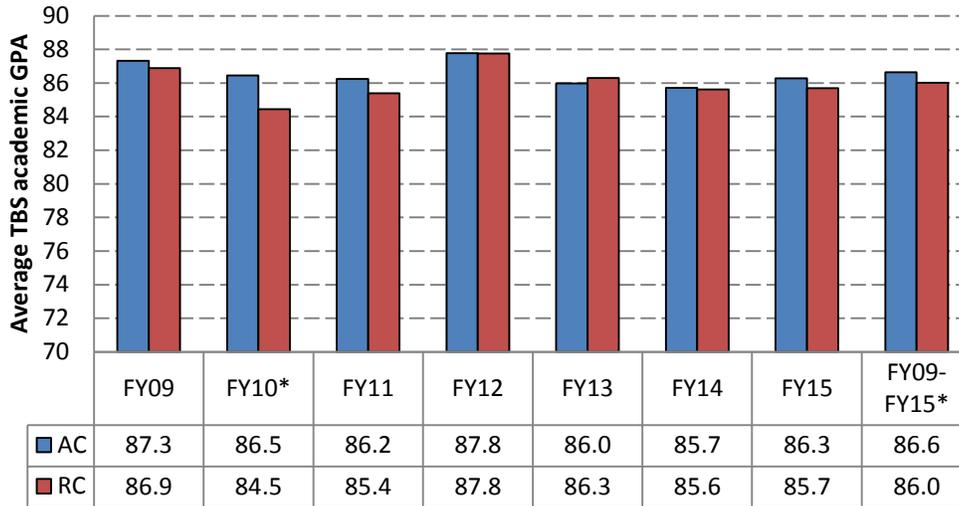
	FY09	FY10*	FY11	FY12	FY13	FY14	FY15	FY09-FY15*
AC	87.3	86.5	86.2	87.8	86.0	85.7	86.3	86.6
RC	86.9	84.5	85.4	87.8	86.3	85.6	85.7	86.0

Source: CNA tabulations using FY09-FY15 TFDW data. An asterisk (*) indicates a statistically significant difference between the AC and RC average (T-test p-values < 0.05).

Figure 6.   Average leadership TBS GPA, by component, FY09–FY15
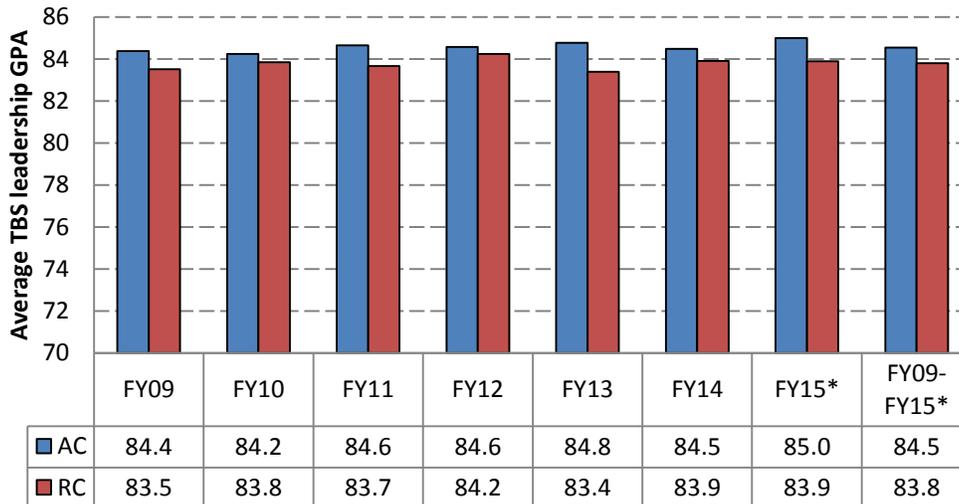
	FY09	FY10	FY11	FY12	FY13	FY14	FY15*	FY09-FY15*
AC	84.4	84.2	84.6	84.6	84.8	84.5	85.0	84.5
RC	83.5	83.8	83.7	84.2	83.4	83.9	83.9	83.8

Source: CNA tabulations using FY09-FY15 TFDW data. An asterisk (*) indicates a statistically significant difference between the AC and RC average (T-test p-values < 0.05).

Figure 7.   Average military skills TBS GPA, by component, FY09–FY15
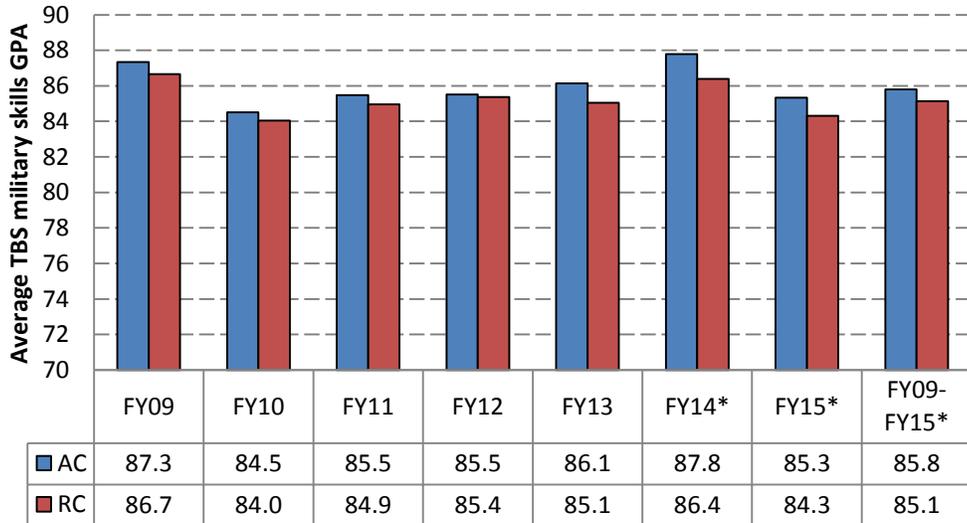
	FY09	FY10	FY11	FY12	FY13	FY14*	FY15*	FY09-FY15*
AC	87.3	84.5	85.5	85.5	86.1	87.8	85.3	85.8
RC	86.7	84.0	84.9	85.4	85.1	86.4	84.3	85.1

Source: CNA tabulations using FY09-FY15 TFDW data. An asterisk (*) indicates a statistically significant difference between the AC and RC average (T-test p-values < 0.05).

Figure 8.   Average overall TBS GPA, by component, FY09–FY15
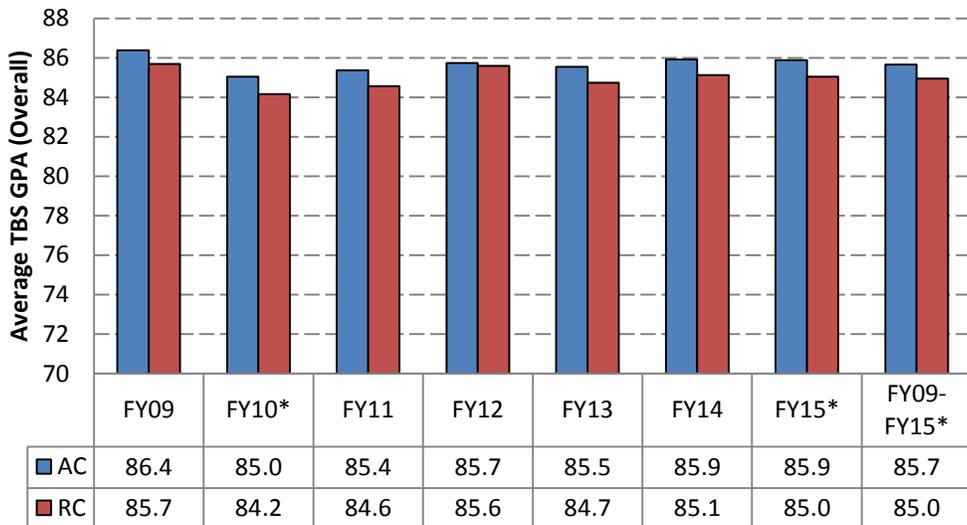
	FY09	FY10*	FY11	FY12	FY13	FY14	FY15*	FY09-FY15*
AC	86.4	85.0	85.4	85.7	85.5	85.9	85.9	85.7
RC	85.7	84.2	84.6	85.6	84.7	85.1	85.0	85.0

Source: CNA tabulations using FY09-FY15 TFDW data. An asterisk (*) indicates a statistically significant difference between the AC and RC average (T-test p-values < 0.05).

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Over all years, we find that RC officers had TBS GPAs that were between 0.6 and 0.7 point lower than AC officers' GPAs on average. However, within fiscal years, RC officers' average TBS GPAs generally are not statistically different from those of AC officers, but there are some exceptions. For example, focusing on the overall TBS GPA, we find that the RC and AC TBS GPAs are statistically different for the FY10 and FY15 cohorts only. We also see that the average overall and leadership TBS GPAs are relatively stable year to year, while average academic and military skills TBS GPAs fluctuate more.

As with OCS attrition and commissioning rates, we are concerned that being an RC officer is correlated with other observable characteristics and that analyses of average GPAs hide these relationships. Therefore, we estimated linear regression models to estimate the RC differentials accounting for demographic differences. To account for selection into the RC, we also estimated the differential using PSM. We summarize our regression and PSM results in Table 5; we also present the average GPA for AC officers to provide context for our estimates, as they represent the difference between RC and AC officer TBS GPAs.[14]

Table 5.   Average and standard deviation of AC officers' TBS GPAs and linear-regression-estimated and PSM-estimated RC GPA differentials

	AC officers		Estimated RC differential[a]	
	Average	Standard deviation	Linear regression	PSM
Academic	86.9	4.3	-0.59	-0.91
Leadership	85.0	5.4	-0.97	-1.12
Military skills	86.0	4.2	-0.70	-0.86
Overall	86.0	3.7	-0.73	-0.97

Source: CNA estimates using FY09-FY15 MCRISS and TFDW data. Regressions also control for demographic characteristics and TBS class fixed effects.

[a.] N = 2,548 and all estimates are statistically different from zero at the 5-percent level. Estimates represent the estimated difference between RC and AC officers' average TBS GPAs.

We find that RC officers' GPAs are statistically lower than those of AC officers, on average. RC overall TBS GPAs are almost 1 point lower, on average. A one-point differential represents a difference between an 86.0 and an 85.0 overall TBS GPA—both GPAs represent a B average. We estimate similarly sized differences in academic, leadership, and military skill TBS GPAs. So, although the estimated

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[14] See Table 10 through Table 13 in Appendix B for full linear regression results.

differences between AC and RC officers' TBS GPAs are statistically significant, they are relatively small differences, and it is up to the Marine Corps to decide if these differences are cause for concern and warrant further investigation.[15]

To help explain these small but statistically significant differentials, we ran another regression model where we included interaction terms between the RC-officer variable with each demographic variable to determine whether RC demographic groups have different outcomes than their AC counterparts. We summarize these findings in Table 6. Hispanics tend to have lower GPAs than their non-Hispanic white counterparts in both the RC and AC populations, but we find that Hispanic RC officers' academic, leadership, and overall TBS GPAs are significantly lower than those of their Hispanic AC counterparts. This is an important relationship to note because RC officers are more likely to be Hispanic than AC officers (12.5 percent versus 10.3 percent). We also find that RC officers with drop waivers—those who attempted OCS at least twice before graduating—have similar TBS GPAs to RC officers without drop waivers, but AC officers with drop waivers tend to have statistically lower GPAs than AC officers without drop waivers. This difference is notable because more RC officers had drop waivers than AC officers: 3.4 percent versus 2.1 percent. At this time, the Marine Corps should not be concerned about having drop-waivered officer candidates applying for the ROCP, but it may want to continue to monitor these relationships to ensure that they do not change in the future, particularly as AC competitiveness fluctuates over time.

Overall, we find that RC officers tend to have lower outcomes than AC officers at TBS. As more RC officers progress past the rank of captain, the Marine Corps may want to investigate the effect of TBS outcomes on career progression to determine whether these differences at TBS are important to reserve officers' careers. Right now, the ROCP is still too young to conduct such analysis because not enough time has passed for the first few ROCP cohorts to reach the promotion point for major.

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[15] TBS performance has been linked to future career outcomes for AC officers [18-19].

Table 6. Statistically significant AC-RC differences in the relationship between demographic characteristics and TBS GPAs[a]

Characteristic	TBS GPA			
	Academic	Leadership	Military skills	Overall
Non-Hispanic minority	Not stat. sig.[b]	Not stat. sig.	Not stat. sig.	Not stat. sig.
Hispanic	More negative	More negative	Not stat. sig.	More negative
Drop waiver	Less negative	Not stat. sig	Not stat. sig	Less negative

Source: CNA linear regression estimates using FY09-FY15 MCRISS and TFDW data.

[a.] Each column represents a different regression model estimating the GPA of interest as a function of whether the officer is in the RC or AC, demographic characteristics, interaction of the RC/AC variable and each demographic characteristic, and TBS class fixed effects. Each cell indicates whether the difference in the relationship between the characteristic and the GPA of interest is statistically different between the RC and AC officer populations. Relationships not shown were not statistically significant in any specification. A negative (positive) point estimate indicates that the group has a statistically lower (higher) probability of commissioning than the omitted category, all else equal.

[b.] Not stat. sig. stands for not statistically significant.

Summary

We have shown that the number of OCC-R candidates has fluctuated with the size of the AC, and that OCC-R candidates tend to complete OCS at the same rates as their OCC ground counterparts but commission at lower rates. We also found that RC officers tend to have lower TBA GPAs, on average, than their AC counterparts. Our findings suggest the following:

- To ensure that AC candidates do not crowd out OCC-R candidates in times of high AC recruiting, the Marine Corps should explore ways to encourage enlisted Marines to apply for the ROCP through MCP-R and RECP. This will increase the stability of the supply of ROCP candidates through the pipeline. Furthermore, our analysis indicates that OCC-R prior-enlisted Marines are more likely to commission than either their non-prior-enlisted OCC-R counterparts or their OCC ground prior-enlisted counterparts, providing further returns to investing in MCP-R and RECP expansions.

- Not all OCS graduates accept commissions. Among OCC-R candidates, non-Hispanic minorities, who have made up one-fifth of recent OCC-R cohorts, are less likely to commission after completing OCS. If the current trend of lower-than-average commissioning rates among ROCP candidates persists, the Marine Corps should investigate why candidates, such as non-Hispanic minorities, do not follow through with commissioning. It may find that these Marines need additional monitoring toward the end of OCS to accept commissions.

- RC officers tend to have slightly lower TBS GPAs than their AC counterparts, all else equal. In the future, after the ROCP has matured to the point where ROCP officers are reaching the promotion point for major, the Marine Corps should investigate the relationship between TBS performance and promotion to determine whether TBS performance differences have a similar effect on RC officers' career progression as they do on AC officers' careers.

In the next section, we look at RC officers' continuation behaviors.

ROCP Officer Continuation Analysis

In this section, we examine ROCP officers' SMCR affiliation behaviors. First we describe the data in more detail. Then we present our findings.

Data and methodology

For our analysis of ROCP officers' SMCR affiliation behavior, we merge the dataset we created to examine TBS outcomes to identify ROCP officers (those in the RC at the end of TBS) with SMCR personnel data from the Marine Corps Total Force System (MCTFS). With these data, we can observe how long ROCP officers were affiliated with SMCR units, changes in their PFT scores, whether they have AD experience, and the amount (in months) of AD experience. This dataset contains 627 ROCP officers who commissioned between FY09 and FY15.

Because the ROCP program is relatively young, there are not enough ROCP officers in the data to examine behaviors past the 5-year (i.e., 60-month) mark. Therefore, we examine the following three outcomes:

- *Initial obligation completion*: How many ROCP officers serve in the SMCR for at least 48 months?

- *54-month continuation*: How many ROCP officers continue to 54 months of service in the SMCR?

- *60-month continuation*: How many ROCP officers continue to 60 months of service in the SMCR?

We analyze initial obligation completion rates for the officers who commissioned before December 2011 (four years before the last month of our data), 54-month continuation rates for the officers who commissioned before July 2011, and 60-month continuation rates for the officers who commissioned before December 2010.

Like our analysis of OCS, commissioning, and TBS outcomes, we perform more than one type of analysis. First, we examine trends in averages. Second, we conduct regression analysis to determine which groups of Marine officers are more or less likely to continue in the SMCR. Of particular interest in these analyses is whether

ROCP officers with AD experience (identified by an AD component code in MCTFS) have better attrition and continuation rates than ROCP officers without AD experience.

Our regression results indicate that AD experience is highly correlated with ROCP officer SMCR attrition and continuation. However, similar to our previous analysis, we are concerned that, because officers volunteer for AD experience tours, our regression estimates are biased if there are unobservable factors that are correlated with accepting AD experience tours and SMCR affiliation behavior. To mitigate selection biases, we conduct PSM. The results of our PSM analysis are very similar to our regression analysis. Because we can apply PSM to only the binary treatment (having AD experience or not), we only present the results from our regression analyses, which also allow us to test whether ROCP officers with more AD experience have different initial obligation completion and SMCR continuation rates than those with less AD experience. For the interested reader, we provide our PSM results in Appendix C.

In the next subsection, we present our analysis. We begin by showing trends in ROCP officers' obligation completion and continuation rates.

Findings

Continuation trends

Figure 9 shows the average initial obligation completion rate and the average 54-month and 60-month continuation rates for ROCP officers. We find that most ROCP officers complete their initial obligations and continue in the SMCR for some period afterwards. We found that almost 17 percent of ROCP officers did not complete their initial obligations in the SMCR,[16] 66 percent of ROCP officers were still in the SMCR 54 months after they commissioned, and 55 percent were still in the SMCR after 60 months. The green bars in Figure 9 show the percentage of ROCP officers who completed their initial obligations and were still in the SMCR at 54 months and 60 months after their commission dates. For these officers, we see high continuation rates: 85 percent stayed to 54 months, and 72 percent stayed to 60 months. These attrition and continuation rates are positive indicators for the health of the SMCR company-grade force.

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[16] Some officers may change to AC commissions, which would be SMCR losses but would produce zero losses/gains for the Marine Corps' total force.

Figure 9.   Average ROCP officer initial obligation completion and SMCR
             continuation rates, FY09-FY11
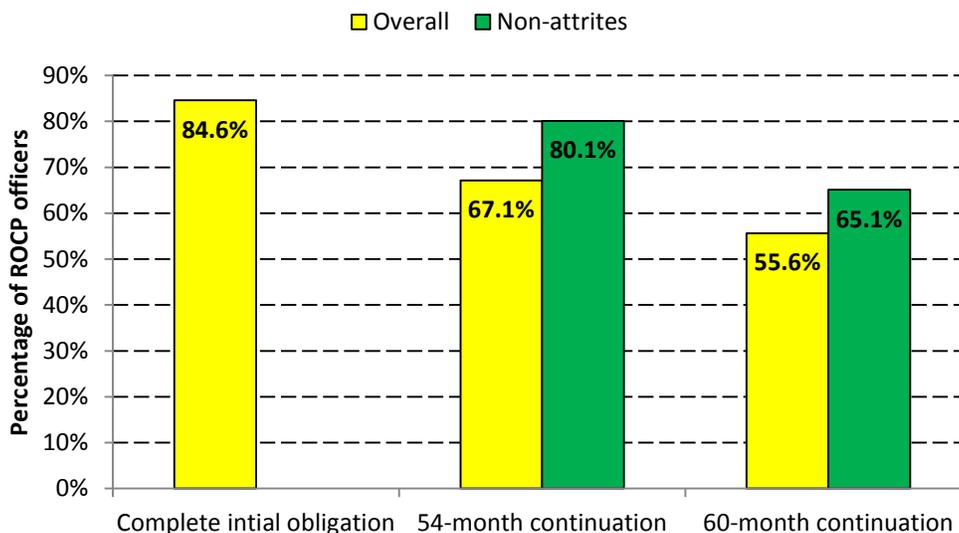
Source: CNA tabulations using FY09-FY15 MCRISS, TFDW, and MCTFS data.

When we estimated initial obligation completion and SMCR continuation as a function of ROCP officers' demographic and service characteristics, we found that only one variable was statistically and significantly correlated with both outcomes: having AD experience.[17] In the next subsection, we show how AD experience and SMCR attrition and continuation are correlated.

AD-experience tours and SMCR continuation

Before getting into the findings from our regression analysis, it is helpful to understand how many ROCP officers have AD experience and how long they were on AD. Figure 10 shows, by commission fiscal year for the FY09-FY14 cohorts, the number and percentage of ROCP officers by whether they have AD experience.[18] The percentage of ROCP officers with AD experience decreased from 95 percent for FY09

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[17] The results of our regression models are presented in Appendix B.

[18] We exclude the FY15 cohort because we are concerned that they may not have had enough time to complete TBS and begin their AD experience tours before the end of the analysis period.

ROCP officers to about 30 percent for FY13 officers; only 12 percent of FY14 officers had AD experience. The number of ROCP officers with AD experience is a function of officers' willingness to do AD experience tours as well as the number of AD opportunities in the Marine Corps. The decline in the percentage of ROCP officers with AD experience is due to earlier cohorts having more time to gain AD experience and the fact that AD opportunities declined over this period as the Marine Corps left Iraq and reduced its presence in Afghanistan [8].

Figure 10. Number and percentage of ROCP officers with and without AD experience, by commission FY, FY09-FY14 ROCP cohorts
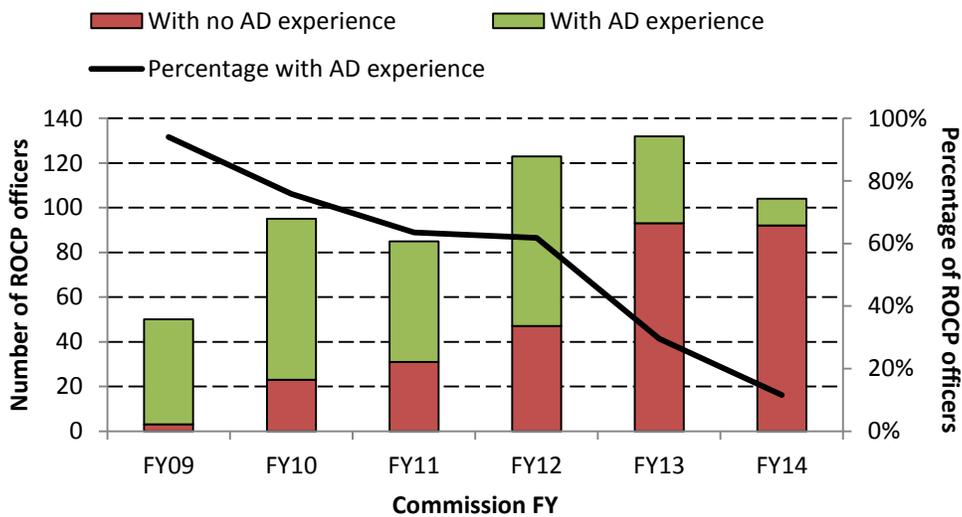
Source: CNA tabulations using FY09-FY15 MCRISS, TFDW, and MCTFS data. AD experience identified by component codes KM and CF in MCTFS.

We also examined trends in the length of ROCP officers' AD experience tours. In Figure 11, we see that the earlier cohorts not only were more likely to have AD experience, but they also tended to have more AD experience. Over 83 percent of FY09 ROCP officers with AD experience were on AD for 12 months or more, while none of the FY14 ROCP officers with AD experience were on AD for this much time. Later cohorts have had less time to gain AD experience, so this explains some of the decline in AD experience amounts.

Figure 11. Months of AD experience, by commission FY, FY09-FY14 ROCP cohorts
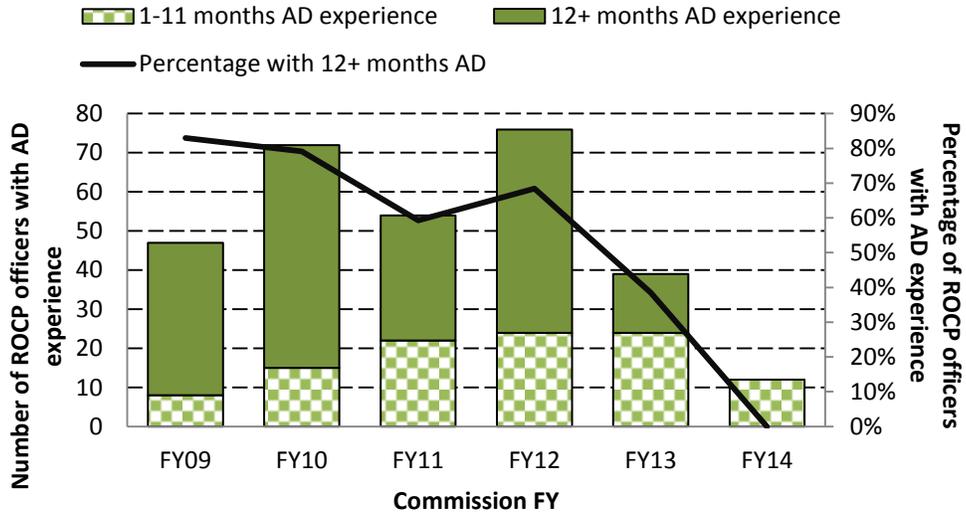
Source: CNA tabulations using FY09-FY15 MCRISS, TFDW, and MCTFS data. AD experience identified by component codes KM and CF in MCTFS.

Using regression analysis, we tested whether ROCP officers with any amount of AD experience or with more AD experience have different initial obligation completion and SMCR continuation rates than those with no AD experience. Figure 12 and Figure 13 show the results of estimating these models. Figure 12 shows predicted SMCR completion and continuation probabilities by whether officers have any AD experience—that is, what continuation and continuations rates would look like if every officer had the same AD experience (none or some). Figure 13 shows the completion and continuation rates for ROCP officers with varying amounts of AD experience (none, less than 12 months, and 12 or more months). Our models estimate that ROCP officers who have AD experience are almost 16 percentage points more likely than ROCP officers without AD experience to complete their initial obligations, almost 29 percentage points more likely to reach 54 months of SMCR service, and over 29 percentage points more likely to reach 60 months of SMCR, all else equal.

Figure 12.   Predicted ROCP officer initial obligation completion and 54-month and 60-month continuation rates, by AD experience
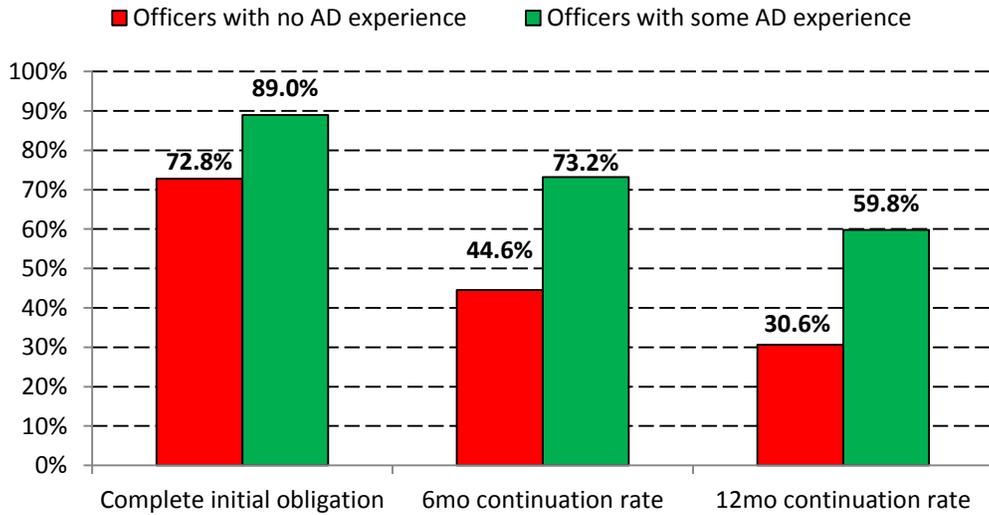
Source: CNA estimates from logistic regressions using FY09-FY15 MCRISS, TFDW, and MCTFS data. AD experience identified by component codes KM and CF in MCTFS.

Figure 13.   Predicted ROCP officer initial obligation completion and 54-month and 60-month continuation rates, by AD experience category
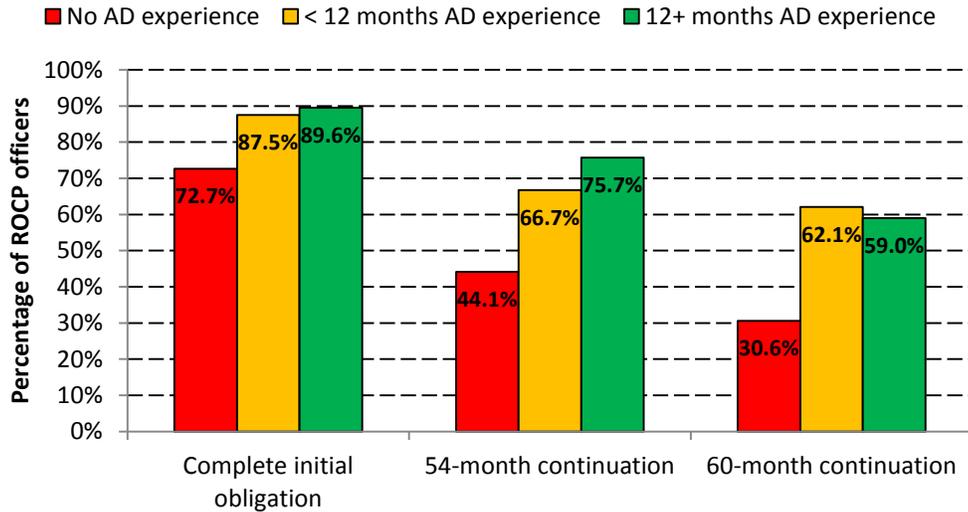
Source: CNA estimates from logistic regressions using FY09-FY15 MCRISS, TFDW, and MCTFS data. AD experience identified by component codes KM and CF in MCTFS. Differences in estimated rates for officers with less than 12 months AD experience and those with 12 or more months AD experience are not statistically significant.

When we examine initial obligation completion and continuation rates by the amount of AD experience, we see that all increase with months of AD experience.[19] Our findings suggest that ROCP will continue to improve company-grade officer staffing levels because ROCP officers stay in the SMCR beyond their initial obligation. The return on investment to AD experience tours, therefore, is the increase in SMCR company-grade staffing levels and the increased knowledge and skill levels of SMCR lieutenants.

Summary

In this section, we explored the SMCR affiliation behavior of ROCP officers. We found that relatively few ROCP officers leave the SMCR before the end of their initial obligations, and most continue beyond their initial obligations. Furthermore, we found that continuation rates are positively related to ROCP officers having AD experience. We recommend that the Marine Corps continue to invest in AD experience tours for its reserve officers. Investment in lieutenants is returned by more experienced lieutenants in the SMCR and improved company-grade level staffing levels because of their continued affiliation. In the next section, we show how company-grade staffing has improved in the SMCR since the inception of the ROCP, and we explore a potential second-order effect of having more lieutenants in the SMCR: their effect on enlisted Marines' continuation behavior.

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[19] The estimated differences between attrition and continuation rates for those with 1 to 11 months of AD experience and those with 12 or more months of AD experience are not statistically significant at the 5-percent level.

SMCR Personnel Readiness Analysis

In the final phase of our analysis, we assess how ROCP has affected SMCR staffing levels. First, we show how company-grade officer staffing has improved since ROCP began. Then, we explore the effect of having SMCR first and second lieutenants at SMCR units on SMCR enlisted Marines' retention.

To supplement our quantitative analysis, we conducted focus groups with SMCR officers and enlisted Marines at six SMCR units. At each site, we conducted discussions with company-grade officers (some who commissioned through ROCP), SNCOs, and NCOs. When they were available, we also met with the units' leadership teams (i.e., commanding officers, executive officers, sergeants major, or first sergeants) and inspector-and-instructor (I&I) staff. All discussion focused on (1) the leadership differences between company-grade officers with and with AD experience, (2) how company-grade officers contribute to unit readiness and the costs associated with not having company-grade officers on hand, (3) how company-grade officers affect enlisted retention, and (4) suggestions for how to improve the ROCP.

Company-grade officer staffing levels

Figure 14 illustrates how company-grade officer staffing has changed since 2006. As shown, before 2006, the number of company-grade officers in the SMCR was falling; since 2006 and the creation of ROCP, the number of company-grade officers has risen. In FY16, officer staffing was higher than it had been 20 years before. In FY95, the SMCR had fewer than 1,000 company-grade officers and was at 60 percent staffing. The number of SMCR officers was lowest in FY07, at just over 300 company-grade officers, and only 21 percent of SMCR company-grade billets were filled. Since FY07, the number of SMCR company-grade officers has grown to over 1,200, and staffing was at 78 percent in FY16. Thus, the ROCP has helped to achieve healthier company-grade officer levels in the SMCR.

Figure 14. SMCR company-grade officers and percentage staffing by FY, FY95-FY16[a]
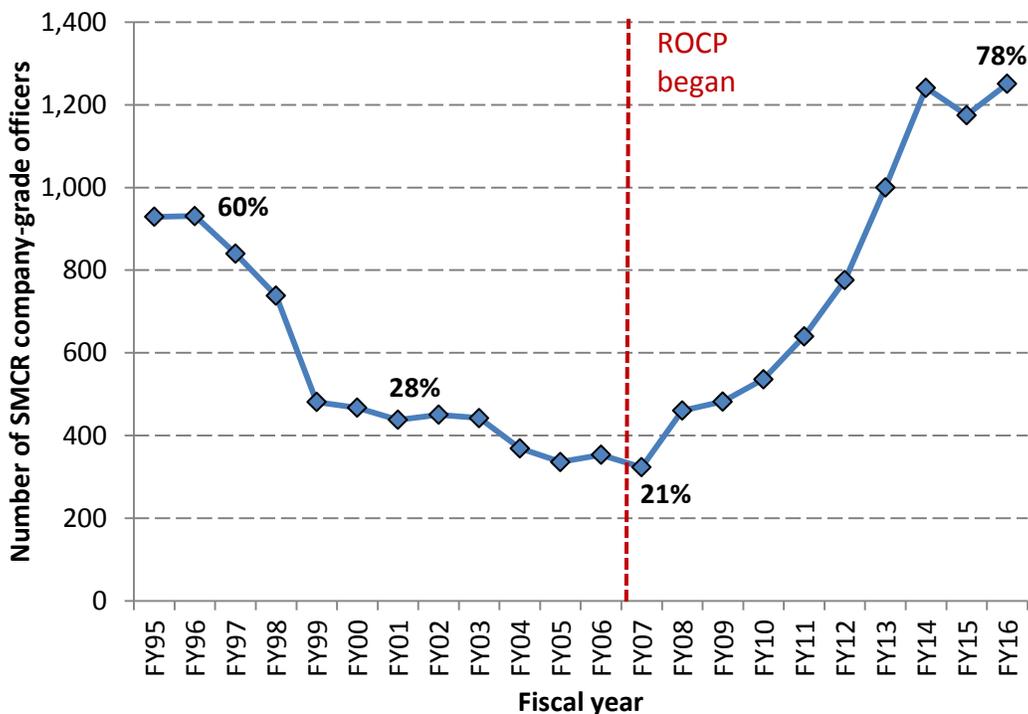
[a.] Percentages reflect company-grade officers on hand compared with total company-grade officer billet requirements.

In general, participants in our focus group discussion thought that the ROCP was a good program if the alternative was going back to having few company-grade officers in the SMCR. Although there was agreement that SNCOs and NCOs could step in during drill weekends and training events when company-grade officers were not available, most acknowledged that having company-grade officers would improve the efficiency and planning associated with these events, given their training. Most agreed that company-grade officers with AD experience would be better for unit readiness because these officers know the Marine Corps' culture and are familiar with its processes and procedures; however, several participants acknowledged that there is a short learning curve for learning reserve processes.

In addition, almost all participants felt that AD experience should be *required* training for ROCP officers. Participants did not believe that drilling one weekend a month and two weeks of annual training provided enough time for lieutenants to develop leadership skills and establish MOS credibility. Some participants also were

concerned that not having AD experience would hurt officers' career progression, limiting their competitiveness for command and promotion. In addition, some participants were concerned about ROCP officers' ability to command if they do not have AD experience. The ROCP is still relatively young, so it is not possible to analyze command selection and promotions to the rank of major and above. We recommend that the Marine Corps monitor and analyze these outcomes as the ROCP continues to mature and ROCP officers begin reaching these career milestones.

The Marine Corps' January 2017 guidance regarding the one-year experience tours was well received among the relatively *few* who knew about it. Focus group participants, however, stressed that the AD experience had to be MOS-specific and not just sitting on a staff. ROCP officers need to be learning their MOSs and building leadership skills so that, when they return to their SMCR units, they are able to execute their roles and responsibilities effectively and efficiently, thereby positively contributing to unit readiness. The Marine Corps' guidance on AD experience tours for reserve officers does stipulate that the "gaining commands are required to ensure [that] ROCP lieutenants are employed according to the billet they have been assigned to within their reporting orders" [8]. The Marine Corps should monitor reserve officers' AD experience tours to ensure adherence to this guidance.

Enlisted retention

Next, we examine how having lieutenants in SMCR units affects enlisted retention. One hypothesis is that lieutenants improve enlisted retention because they provide leadership for junior enlisted Marines, and NCOs and SNCOs are free to dedicate their time to performing the jobs of their ranks and grades as opposed to doing both their NCO or SNCO duties and filling gaps when there is not a lieutenant at the unit.

Data and methodology

For this analysis, we use reserve MCTFS end-of-month snapshot files from October 2005 to December 2015 to identify enlisted Marines who affiliated with the SMCR during this period and track their affiliation with the SMCR units each month. For each enlisted Marine, we identify whether there was a first and/or second lieutenant assigned to his or her unit in that month.[20] Since the likelihood of leaving the SMCR is a function of both observed characteristics and time spent in the SMCR, we use

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[20] We identified units by reporting unit code (RUC).

survival analysis techniques to estimate the relative effect on Marines' retention decisions of being at a unit with a first or second lieutenant.[21] We include in our models Marines' demographic characteristics, such as their gender, race/ethnicity, marital/dependent status, obligor status, prior-AC status, occupation, AD status, units' Census division, and the fiscal year they joined the SMCR. We also include month controls to account for factors affecting all SMCR Marines at any given point in time. Lastly, we stratify our analysis by SMCR unit to allow each unit to have a different underlying retention trend. We interpret survival analysis results as the likelihood that a Marine at a unit with a lieutenant leaves the SMCR relative to the likelihood that a Marine at a unit without a lieutenant leaves, all else equal. That is, we compare the probability of leaving for two Marines who are otherwise similar at the same unit when that unit had a lieutenant and when it did not.

Findings

First, we used our survival model to estimate the odds of leaving the SMCR for enlisted Marines at SMCR units with lieutenants relative to that of enlisted Marines at units without lieutenants. Our estimates did not indicate a difference in loss rates. However, it could be that some groups of enlisted Marines respond more positively to having lieutenants at units. Therefore, we estimated separate models for obligors and nonobligors (those contracted to serve in the SMCR versus those who have the ability to leave of their own accord). These models indicate that nonobligors at units with lieutenants have higher retention rates than nonobligors at units without lieutenants. We used our models to estimate the survival curves, which represent the probability that a Marine reaches t months of service in the SMCR, for Marines at units with and without lieutenants, respectively.

Figure 15 shows the estimated survival curves for obligors (primarily junior enlisted Marines) at units with lieutenants (the red area curve) and without (the blue curve). Obligor retention at units with lieutenants is about 5.5 percent less than it is for obligors at units without lieutenants. Averaging the differences in retention rates across all months translates to about a negative 0.8-percentage-point difference.

Figure 16 shows the estimated survival curves for nonobligors (primarily SNCOs and NCOs) at units with lieutenants (the red area curve) and without (the blue curve). Nonobligor retention at units with lieutenants is about 6.5 percent more than it is for nonobligors at units without lieutenants. Averaging the differences in retention rates across all months translates to about a positive 1.0-percentage-point difference.

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[21] See Appendix D for additional details about survival analysis.

Figure 15.   Estimated survival curves for obligated enlisted Marines at units with and without lieutenants
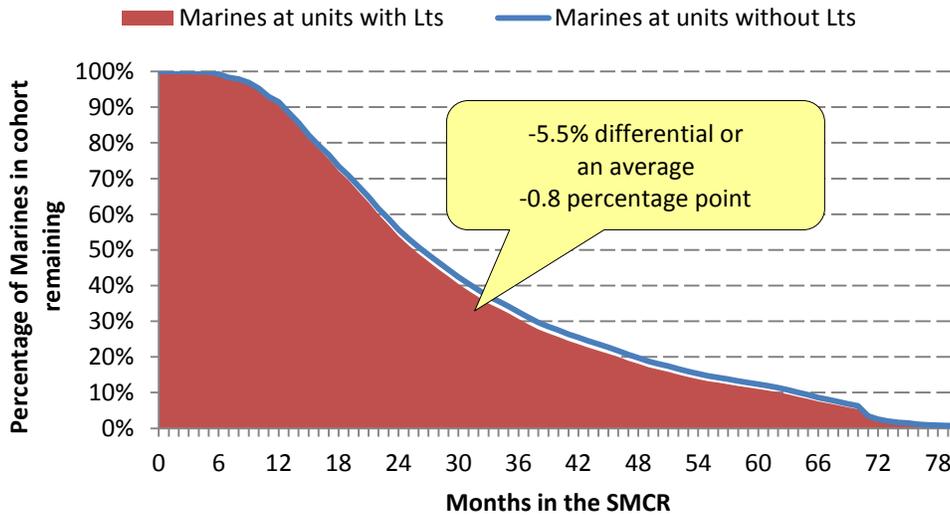
Source: CNA Cox survival estimates using Jan. 2005 through Dec. 2015 MCTFS end-of-month snapshot files.

Figure 16.   Estimated survival curves for nonobligated enlisted Marines at units with and without lieutenants
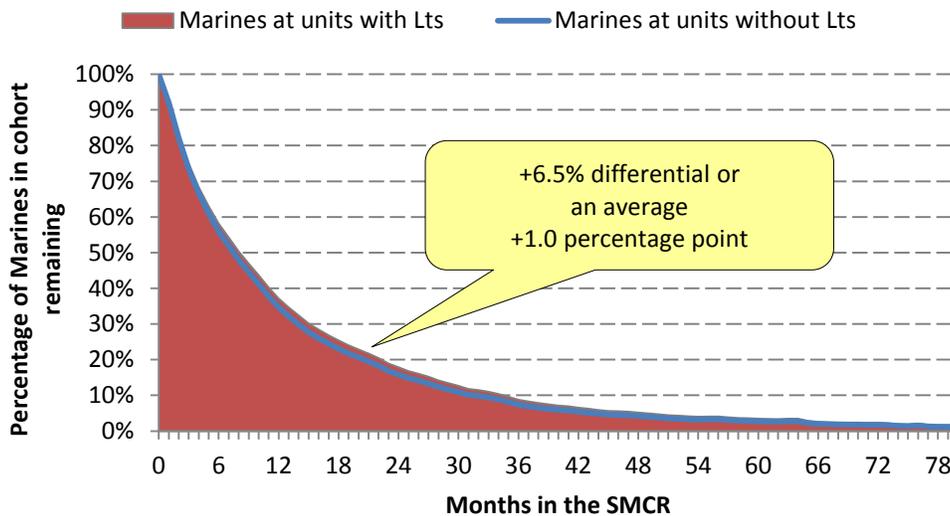
Source: CNA Cox survival estimates using Jan. 2005 through Dec. 2015 MCTFS end-of-month snapshot files.

When asked how lieutenants affect enlisted retention, most of our focus participants felt that they had little role outside of contributing to unit morale. Marines are willing to continue to affiliate if they get satisfaction from being reservists and if reserve obligations do not conflict with other life priorities (e.g., family, school, or civilian job responsibilities). Most participants felt that good leadership was officer dependent, but those who were present for their Marines and successfully managed drill weeks to maximize training time were the most effective. Some SNCOs also mentioned that there are benefits associated with having an officer who could represent their shop at the leadership table: they could do the job without a company-grade officer, but it was an easier and smoother process with one. Several focus group participants also mentioned that officers have a large administrative role. Therefore, if having lieutenants in units translates into better manpower management, on average, then the negative effect on obligor retention could reflect better manpower management (i.e., clearing the roles of nonparticipants or more adherence to the BIC assignment policy).

Summary

In terms of personnel readiness, we find that the ROCP has had positive effects on the health of the SMCR's company-grade officer staffing and on SMCR nonobligor retention rates. Focus group discussions indicate that AD experience is important to the development of officers as good SMCR leaders, which is critical to unit readiness, morale, and retention.

Recommendations

Overall, our analysis of the ROCP program suggests that ROCP participants perform similarly to their AC counterparts at OCS and TBS and that the program has had a positive effect on SMCR readiness. ROCP has helped to increase company-grade officer staffing, and nonobligor enlisted retention is higher at units with lieutenants. Despite these positive findings, there are ways that we believe that the Marine Corps can improve its management of the ROCP. Five recommendations follow:

1. We recommend that the Marine Corps explore ways to encourage more enlisted Marines to seek reserve officer opportunities through the MCP-R and RECP. Expanding these accession programs will help guard against recruiting shortages in times of AC accession growth. The fastest way the Marine Corps can make officers is through the OCC program. So, if the AC needs to build up, it may require more OCS seats, which limits the availability of seats for the RC. Furthermore, our analysis indicates that OCC-R prior-enlisted Marines are more likely to commission than either their non-prior-enlisted counterparts or their OCC ground prior-enlisted candidates, providing further returns to investing in MCP-R and RECP expansions.

2. There has been a slight downward trend in the percentage of OCC-R candidates accepting commissions after completing OCS. If this trend persists, the Marine Corps should investigate why candidates do not follow through with commissioning. It may find that candidates require more information or mentoring on what it will be like as a reserve officer than they are currently receiving.

3. Given the strong positive correlation between ROCP officers' continuation and having AD experience, we recommend that the Marine Corps continue to offer such opportunities to its reserve officers. These opportunities are an investment into young lieutenants' professional careers that are rewarded with continued affiliation. In addition, these types of tours provide greater AC-RC integration, which is needed in times of conflict when the demand for RC augmentation is high.

4. Monitor ROCP officers' AD experience tours to ensure adherence to Marine Corps guidance that these officers be employed in a manner that aligns with their grade and PMOS. Focus group participants felt that AD experience tours that follow this guidance will improve officers' abilities to positively contribute

to unit readiness because being on the job everyday (as opposed to one weekend a month) speeds up the learning processes, making them more effective and efficient at their jobs when they are with a drilling SMCR unit. In other words, it maximizes the Marine Corps' return on its investment.

5. We recommend that the Marine Corps monitor ROCP officers' career progression. The ROCP is still relatively new; few ROCP officers have reached critical career milestones, such as command screening and promotion to major. As more ROCP officers reach these milestones, the Marine Corps should monitor ROCP officers' outcomes to ensure that it is providing ROCP officers the opportunities necessary for their career development. For example, the Marine Corps should track how ROCP officers' AD experience, or lack thereof, affects their competitiveness for command and promotion. Continued analysis will be necessary to determine if program improvements are necessary to maximize the Marine Corps' return on its ROCP investments.

The ROCP has done what the Marine Corps intended for it to do: fill its SMCR company-grade officer shortfalls. Our recommendations are meant to improve the Marine Corps' ability to see that success continues so that it can maintain its operational readiness. However, the ROCP program is still relatively new, so the Marine Corps should continually assess the program and its effectiveness to determine if it is continuing to meet the Marine Corps' SMCR requirements.

Appendix A: OCS, Commissioning, and TBS Outcomes by Demographic Characteristic

Table 7 presents average OCS attrition rates, commissioning rates, and TBS academic, leadership, military skills, and overall GPAs and class ranks for OCC-R and OCC ground candidates between FY09 and FY15 by demographic characteristic. Boldface type indicates that the averages are statistically different across the subgroups within a demographic category (e.g., gender is divided into male and female; race/ethnicity is divided into non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Hispanic, and other).

Table 7.   Average OCS attrition rates, commissioning rates, and TBS academic, leadership, military skills, and overall GPAs, by demographic characteristic, FY09-FY15 OCC-R and OCC ground candidates[a]

Characteristic		OCS attrition rate	Commissioning rate	TBS GPAs			
				Academic	Leadership	Military skill	Overall
Average		30.3%	91.8%	86.5	84.3	85.6	85.5
Gender	Male	**26.9%**	**92.9%**	**86.7**	**84.7**	**85.8**	**85.8**
	Female	**48.3%**	**84.1%**	**84.2**	**81.4**	**84.2**	**83.1**
Race/ethnicity	White	**29.4%**	**92.5%**	**86.8**	**84.7**	**86.0**	**85.8**
	Black	**42.1%**	**83.3%**	**84.1**	**82.3**	**83.6**	**83.4**
	Hispanic	**30.8%**	**91.3%**	**85.5**	**83.4**	**84.6**	**84.6**
	Asian	**33.5%**	**88.7%**	**86.2**	**82.1**	**84.2**	**84.2**
	Other	**22.2%**	**95.5%**	**85.6**	**81.4**	**85.9**	**85.4**
	Unknown	**20.0%**	**100.0%**	**85.4**	**85.6**	**85.5**	**85.5**
Age at OCS	26 or younger	**22.8%**	91.9%	**86.6**	84.4	**85.8**	85.6
	Older than 26	**26.8%**	91.6%	**86.1**	84.3	**84.9**	85.1
Marital/dependent status	Single, no dependents	**24.3%**	91.9%	86.4	84.2	85.6	**85.4**
	Married or with dependents	**19.6%**	91.2%	87.0	85.4	85.8	**86.1**
Waivered	None	31.3%*	**93.5%**	**86.7**	84.4	**85.8**	85.6
	Any	28.9%*	**89.6%**	**86.2**	84.2	**85.4**	85.3
Age waiver	No	**29.8%**	92.0%	**86.5**	84.4	**85.7**	85.5
	Yes	**36.3%**	88.9%	**85.6**	84.0	**84.3**	84.5
Dependent waiver	No	30.3%	91.8%	86.5	84.3	85.6	85.5
	Yes	31.1%	91.4%	86.1	84.9	85.0	85.4

Characteristic		OCS attrition rate	Commissioning rate	TBS GPAs			
				Academic	Leadership	Military skill	Overall
Traffic waiver	No	**31.0%**	92.0%	86.5*	84.4	85.7*	85.5
	Yes	**24.5%**	90.3%	86.0*	84.1	85.2*	85.2
Drug waiver	No	30.8%	92.1%	86.5	84.3	85.6*	85.5
	Yes	27.5%	90.4%	86.5	84.5	85.9*	85.5
Tattoo waiver	No	30.5%	**92.5%**	**86.6**	84.4	**85.7**	85.5*
	Yes	29.2%	**89.1%**	**86.1**	84.3	**85.3**	85.2*
Drop waiver	No	30.4%	**92.4%**	**86.5**	**84.4**	**85.7**	**85.5**
	Yes	26.0%	**73.2%**	**84.7**	**82.7**	**83.7**	**83.8**
Serious waiver	No	30.3%	91.7%*	86.5	84.3	85.6	85.5
	Yes	31.6%	98.1%*	86.7	84.5	85.7	85.6
MCRISS PFT score[b]	<267	**40.8%**	**90.5%**	**86.4**	**83.4**	**85.4**	**85.0**
	267-280	**31.8%**	**91.8%**	**86.2**	**83.8**	**85.1**	**85.0**
	281-290	**26.8%**	**92.6%**	**86.4**	**84.4**	**85.5**	**85.5**
	>290	**21.9%**	**95.5%**	**86.9**	**85.6**	**86.4**	**86.3**
	Missing	**21.7%**	**44.4%**	**87.5**	**84.3**	**86.7**	**85.9**
Prior-enlisted	No	30.7%*	92.1%	86.4	**84.1**	85.6	**85.4**
	Yes	26.6%*	90.0%	86.7	**86.6**	85.5	**86.3**
OCS class	Summer	**19.1%**	**88.4%**	**85.7**	**83.6**	**84.7**	**84.6**
	Winter	**25.3%**	**93.3%**	**86.8**	**85.0**	**84.9**	**85.7**
	Fall	**25.1%**	**93.0%**	**86.7**	**84.3**	**86.8**	**85.8**
SAT score[b, c]	<1130	**29.5%**	92.4%	**85.0**	83.6	84.8	84.6
	1131-1270	**26.6%**	91.8%	**87.3**	84.8	86.0	86.0
	1271-1560	**25.9%**	94.0%	**88.7**	85.3	86.9	86.8
	1561+	**32.9%**	91.8%	**86.9**	84.5	86.1	85.9

Characteristic		OCS attrition rate	Commissioning rate	TBS GPAs			
				Academic	Leadership	Military skill	Overall
AFQT score [b, d]	<80	35.8%	88.9%	**83.9**	**84.0**	**84.2**	**84.2**
	81-85	32.7%	88.4%	**84.5**	**83.9**	**84.3**	**84.5**
	86-93	30.3%	90.9%	**85.3**	**83.9**	**84.8**	**84.7**
	94+	29.4%	91.6%	**87.4**	**85.0**	**86.1**	**86.1**
Number of observations		4,548	3,171	2,852			

Source: CNA tabulations using FY09-FY15 MCRISS and TFDW data.

[a.] Bolded statistics indicate that the distributions within a category (e.g., gender) are statistically different at the 5-percent level; an asterisk (*) indicates that distributions are statistically different at the 10-percent level. A T-test was used for binary outcomes; a post-linear regression Wald test was used for nonbinary outcomes.

[b.] Categories represent actual data quartiles.

[c.] ACT scores were converted to SAT scores according to an SAT-ACT conversion table (http://blog.prepscholar.com/act-to-sat-conversion). ACT and SAT scores are not available for all candidates. We report the averages for the 2,857 candidates at OCS, 2,068 OCS graduates, and 1,879 officers at TBS with SAT or ACT scores.

[d.] AFQT scores are not available for all candidates. We report the averages for the 1,722 candidates at OCS, 1,168 OCS graduates, and 1,023 at TBS with AFQT scores.

Appendix B: Regression Results

OCS attrition

Table 8 shows the results of estimating four models for OCS attrition. We estimate logit regression models to analyze OCS attrition because this technique is appropriate for analyzing binary variables. We estimate four models. First, we estimate OCS attrition as a function of whether candidates are in OCC-R, demographic characteristics, and OCS class. Second, we estimate the same model for just OCC-R candidates. Third, we estimate the model for just OCC ground candidates. Fourth, we estimate the same model with the addition of the interaction of the OCC-R variable with each of the demographic variables to determine whether the demographic relationships are statistically different between OCC-R and OCC ground candidates.

We present the results as odds ratios—the ratio of the probability that people with the characteristic of interest attrite from OCS and the probability that people in the omitted group attrite. For example, in the first column of estimates in Table 8, we estimate that women are 3.1 times more likely than men (the omitted group) to attrite from OCS. Subtracting 1 from the odds ratio and multiplying by 100 gives the percentage change in the probabilities: women are 210 percent more likely than men to attrite. For each estimate, we show the corresponding p-value; p-values less than 0.05 indicate that the estimate is statistically different from 1 (i.e., that group is statistically more or less likely to attrite than the omitted group). The p-value for the estimate on being female is less than 0.05, so we conclude that women are statistically more likely than men to attrite from OCS because the point estimate (3.1) is greater than 1.

Table 8.   Estimated relative odds of attriting from OCS and the corresponding p-values, by demographic characteristic

Characteristic	OCC-R and OCC ground		OCC-R		OCC ground		OCC-R and OCC ground	
	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value
OCC-R	1.166	0.134					0.877	0.986
Female	3.086	0.000	3.497	0.001	3.153	0.000	3.067	0.000
Race/ethnicity								
Non-Hispanic minority	1.367	0.003	1.256	0.278	1.419	0.005	1.418	0.005
Hispanic	1.292	0.031	1.146	0.543	1.379	0.021	1.388	0.021
Age	0.989	0.964	0.975	0.957	1.007	0.933	0.975	0.933
Age^2	1.001	0.769	1.001	0.902	1.001	0.739	1.002	0.739
Married w/ dependents	0.646	0.000	1.065	0.775	0.513	0.000	0.516	0.000
Age waiver	1.100	0.592	0.860	0.639	1.275	0.247	1.286	0.247
Traffic waiver	0.694	0.005	0.622	0.047	0.714	0.040	0.725	0.040
Drug waiver	1.041	0.701	1.023	0.916	1.054	0.660	1.055	0.660
Tattoo waiver	0.819	0.057	0.818	0.399	0.812	0.087	0.818	0.087
Drop waiver	0.710	0.163	0.651	0.274	0.710	0.294	0.713	0.294
Other waivers	1.142	0.473	1.164	0.672	1.147	0.510	1.155	0.510
MCRISS PFT score	1.025	0.000	1.024	0.032	1.027	0.000	1.027	0.000
MCRISS PFT $score^2$	1.000	0.000	1.000	0.023	1.000	0.000	1.000	0.000
Prior enlisted	0.820	0.122	0.761	0.287	0.894	0.412	0.883	0.412
OCC-R x female							1.136	0.735
OCC-R x non-Hispanic minority							0.874	0.579
OCC-R x Hispanic							0.834	0.487
OCC-R x age							0.969	0.955
OCC-R x age^2							1.000	0.970
OCC-R x married w/ dependents							2.004	0.009
OCC-R x age waiver							0.688	0.326
OCC-R x traffic waiver							0.861	0.600
OCC-R x drug waiver							0.959	0.863
OCC-R x tattoo waiver							0.990	0.968
OCC-R x drop waiver							0.940	0.902
OCC-R x other waivers							0.980	0.961
OCC-R x PFT score							0.995	0.676

Characteristic	Analysis population							
	OCC-R and OCC ground		OCC-R		OCC ground		OCC-R and OCC ground	
	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value
OCC-R x PFT score^2							1.000	0.218
OCC-R x prior enlisted							0.844	0.565
Number of observations	4,142		1,069		3,073		4,142	
Pseudo R^2	0.062		0.052		0.079		0.067	

Source: CNA logistic regression results using FY09-FY15 MCRISS and TFDW data. Regressions also included OCS class fixed effects.

Commissioning

Table 9 shows the commissioning regression results. Once again, because our outcome variable is binary (commissioned or did not commission), we estimate the probability of commissioning as a logistic function. We estimate four models that are identical in structure to the OCS attrition models we estimated. We present the results of the logistic regressions as odds ratios, which describe the odds of taking a commission relative to that of the omitted category. For example, in Table 9, we see that non-Hispanic minorities are 0.8 times as likely as non-Hispanic whites to take a commission (the p-value is greater than 0.05, so it is not statistically different from zero). Another way to interpret this odds ratio is as a percentage, by subtracting 1 from the odds ratio and multiplying it by 100. For example, non-Hispanic minorities are 20 percent less likely than non-Hispanic whites to accept commissions.

Table 9.　Estimated relative odds of taking a commission and the corresponding p-values, by demographic characteristic

Characteristic	Analysis population							
	All		OCC-R		OCC ground		All	
	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value
OCC-R	0.629	0.021					3.890	0.156
Race/ethnicity								
Non-Hispanic minority	0.802	0.315	0.482	0.045	0.887	0.691	1.099	0.751
Hispanic	0.980	0.938	0.712	0.427	1.098	0.795	1.166	0.666
Age	0.345	0.102	0.051	0.019	0.496	0.432	0.592	0.550
Age^2	1.022	0.096	1.057	0.024	1.016	0.383	1.012	0.490
Married w/ dependents	0.960	0.867	1.232	0.647	0.824	0.506	0.825	0.506
Age waiver	0.619	0.201	0.584	0.364	0.702	0.508	0.687	0.478

Characteristic	Analysis population							
	All		OCC-R		OCC ground		All	
	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value	Odds ratio	p-value
Traffic waiver	0.821	0.368	0.598	0.158	0.878	0.662	0.889	0.690
Drug waiver	0.908	0.617	0.623	0.171	1.160	0.552	1.103	0.693
Tattoo waiver	0.927	0.700	1.174	0.720	0.819	0.376	0.752	0.202
Drop waiver	0.142	0.000	0.167	0.000	0.141	0.000	0.120	0.000
Other waivers	2.282	0.070	0.918	0.907	2.881	0.092	2.853	0.094
MCRISS PFT score	1.009	0.114	0.997	0.775	1.016	0.031	1.013	0.060
MCRISS PFT score^2	1.000	0.870	1.000	0.116	1.000	0.346	1.000	0.549
Prior-enlisted	0.851	0.500	2.435	0.136	0.521	0.017	0.551	0.027
OCC-R x non-Hispanic minority							0.467	0.097
OCC-R x Hispanic							0.678	0.474
OCC-R x age							0.139	0.184
OCC-R x age^2							1.035	0.241
OCC-R x married w/ dependents							1.695	0.331
OCC-R x age waiver							1.011	0.988
OCC-R x Traffic waiver							0.738	0.505
OCC-R x drug waiver							0.602	0.221
OCC-R x tattoo waiver							2.305	0.082
OCC-R x drop waiver							1.494	0.497
OCC-R x other waivers							0.509	0.481
OCC-R x PFT score							0.985	0.220
OCC-R x PFT score^2							1.000	0.121
OCC-R x prior enlisted							5.240	0.012
Number of observations	2,793		747		2,046		2,793	
Pseudo R^2	0.115		0.222		0.106		0.135	

Source: CNA logistic regression results using FY09-FY15 MCRISS and TFDW data. Regressions also included OCS class fixed effects.

TBS outcomes

Table 10 through Table 13 show the regression results for TBS academic, leadership, military skills, and overall GPA, respectively. Each table has three sets of results. In the first column of each set is the estimated difference in the GPA for the given group compared with the omitted group (e.g., Hispanics versus non-Hispanic whites) from estimating GPA as a linear function of demographic controls. The second column of each set is the p-value associated with each estimate. For example, from the first set of results in Table 10, we estimate that, on average, RC officers have

academic TBS GPAs that are 0.6 point lower than AC officers (the omitted group) all else equal; the p-value on this estimate is less than 0.05, so we conclude that the estimated difference is statistically different from zero.

Table 10. Estimated difference (Diff.) in academic TBS GPAs and corresponding p-values, by demographic characteristic

| Characteristic | Analysis population | | | | | | | |
| | All | | RC officers | | AC officers | | All | |
	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
RC officer	-0.588	0.005					-23.249	0.195
Non-Hisp. minority	-1.356	0.000	-1.002	0.157	-1.416	0.000	-1.468	0.000
Hispanic	-1.121	0.000	-1.864	0.000	-0.798	0.030	-0.803	0.026
Age	-0.890	0.360	0.476	0.715	-1.335	0.232	-1.253	0.260
Age^2	0.016	0.402	-0.009	0.732	0.024	0.282	0.022	0.315
Married w/ dependents	0.719	0.004	1.391	0.023	0.676	0.001	0.652	0.002
Age waiver	-0.751	0.129	-1.528	0.017	-0.504	0.530	-0.436	0.591
Traffic waiver	-0.337	0.145	-0.107	0.884	-0.373	0.258	-0.385	0.239
Drug waiver	0.143	0.563	-0.509	0.298	0.345	0.243	0.382	0.196
Tattoo waiver	-0.549	0.059	0.627	0.390	-0.753	0.007	-0.754	0.007
Drop waiver	-1.024	0.089	1.298	0.061	-2.920	0.000	-2.729	0.000
Other waivers	-0.395	0.330	0.168	0.809	-0.624	0.164	-0.635	0.140
MCRISS PFT score	-0.033	0.001	-0.041	0.021	-0.032	0.004	-0.032	0.003
MCRISS PFT score^2	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000
Prior enlisted	0.456	0.078	0.552	0.468	0.469	0.055	0.480	0.052
RC x non-Hisp. minority							0.374	0.641
RC x Hispanic							-1.206	0.016
RC x age							1.596	0.259
RC x age^2							-0.028	0.319
RC x married w/ dependents							0.512	0.348
RC x age waiver							-0.928	0.426
RC x traffic waiver							0.020	0.982
RC x drug waiver							-0.865	0.088
RC x tattoo waiver							1.106	0.097
RC x drop waiver							3.940	0.000
RC x other waivers							0.966	0.221
RC x PFT score							-0.003	0.891

Characteristic	Analysis population							
	All		**RC officers**		**AC officers**		**All**	
	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
RC x PFT score²							0.000	0.826
RC x prior enlisted							0.042	0.955
No. of officers	2,548		654		1,894		2,548	
R²	0.116		0.158		0.122		0.127	

Source: CNA linear regression results using FY09-FY15 MCRISS and TFDW data. Regressions also included TBS class fixed effects.

Table 11. Estimated differences (Diff.) in leadership TBS GPAs and corresponding p-values, by demographic characteristic

Characteristic	Analysis population							
	All		**RC officers**		**AC officers**		**All**	
	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
RC officer	-0.972	0.287					-22.25	0.461
Non-Hispanic minority	-1.925	0.294	-1.471	0.033	-2.250	0.000	-2.185	0.000
Hispanic	-1.675	0.348	-2.803	0.000	-1.393	0.001	-1.336	0.001
Age	-0.849	0.969	0.293	0.884	-1.265	0.300	-1.222	0.308
Age²	0.016	0.019	-0.006	0.882	0.024	0.324	0.023	0.335
Married w/ dependents	0.802	0.313	0.324	0.684	0.963	0.009	1.025	0.006
Age waiver	-0.925	0.587	-0.924	0.176	-1.008	0.208	-0.959	0.229
Traffic waiver	-0.335	0.289	0.596	0.444	-0.700	0.054	-0.670	0.064
Drug waiver	0.227	0.241	0.718	0.140	0.066	0.815	0.052	0.850
Tattoo waiver	-0.069	0.261	0.416	0.564	-0.190	0.509	-0.230	0.418
Drop waiver	-1.125	0.792	-0.720	0.449	-1.508	0.183	-1.486	0.157
Other waivers	-0.189	0.459	-0.273	0.787	-0.236	0.654	-0.245	0.634
MCRISS PFT score	-0.061	0.013	-0.050	0.034	-0.064	0.000	-0.066	0.000
MCRISS PFT score²	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000
Prior enlisted	2.630	0.416	3.220	0.001	2.542	0.000	2.518	0.000
RC x non-Hispanic minority							0.892	0.285
RC x Hispanic							-1.258	0.050
RC x age							1.465	0.536
RC x age²							-0.027	0.553

| Characteristic | Analysis population | | | | | | | |
| | All | | RC officers | | AC officers | | All | |
	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
RC x married w/ dependents							-0.843	0.298
RC x age waiver							0.012	0.991
RC x traffic waiver							1.130	0.207
RC x drug waiver							0.781	0.153
RC x tattoo waiver							0.748	0.323
RC x drop waiver							0.740	0.479
RC x other waivers							0.014	0.990
RC X PFT score							0.022	0.318
RC x PFT score^2							0.000	0.335
RC x prior enlisted							0.679	0.397
N	2,548		654		1,894		2,548	
R^2	0.109		0.129		0.109		0.116	

Source: CNA linear regression results using FY09-FY15 MCRISS and TFDW data. Regressions also included TBS class fixed effects

Table 12.   Estimated differences (Diff.) in military skill TBS GPA and corresponding p-values, by demographic characteristic

| Characteristic | Analysis population | | | | | | | |
| | All | | RC officer | | AC officers | | All | |
	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
RC officer	-0.742	0.005					-4.192	0.803
Non-Hispanic minority	-1.295	0.000	-1.397	0.001	-1.348	0.000	-1.323	0.000
Hispanic	-1.343	0.000	-1.755	0.003	-1.218	0.000	-1.183	0.000
Age	0.391	0.622	0.546	0.640	0.300	0.747	0.478	0.607
Age^2	-0.011	0.487	-0.013	0.569	-0.010	0.603	-0.013	0.473
Married w/ dependents	0.659	0.008	0.925	0.049	0.660	0.006	0.655	0.006
Age waiver	-0.421	0.324	-1.057	0.011	-0.316	0.592	-0.225	0.705
Traffic waiver	-0.320	0.200	-0.033	0.950	-0.423	0.114	-0.443	0.097
Drug waiver	0.521	0.001	0.463	0.226	0.528	0.000	0.533	0.000
Tattoo waiver	-0.226	0.469	0.692	0.198	-0.412	0.222	-0.441	0.193
Drop waiver	-1.463	0.001	-0.317	0.631	-2.063	0.002	-2.114	0.001
Other waivers	-0.127	0.699	-0.087	0.908	-0.094	0.767	-0.162	0.615

	Analysis population							
	All		RC officer		AC officers		All	
Characteristic	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
MCRISS PFT score	-0.047	0.001	-0.045	0.002	-0.044	0.005	-0.046	0.003
MCRISS PFT score^2	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Prior enlisted	0.278	0.369	0.403	0.568	0.310	0.358	0.316	0.346
RC x non-Hispanic minority							0.019	0.967
RC x Hispanic							-0.626	0.279
RC x age							0.074	0.955
RC x age^2							0.001	0.963
RC x married w/ dependents							0.096	0.823
RC x age waiver							-0.637	0.397
RC x traffic waiver							0.335	0.555
RC x drug waiver							-0.028	0.939
RC x tattoo waiver							1.061	0.034
RC x drop waiver							1.514	0.113
RC x other waivers							0.126	0.876
RC x PFT score							0.001	0.944
RC x PFT score^2							0.000	0.935
RC x prior enlisted							-0.081	0.918
N	2.548		654		1,894		2,548	
R^2	0.262		0.292		0.266		0.266	

Source: CNA linear regression results using FY09-FY15 MCRISS and TFDW data. Regressions also included TBS class fixed effects.

Table 13. Estimated differences (Diff.) in overall TBS GPAs and corresponding p-values, by demographic characteristic

	Analysis population							
	All		RC officers		AC officers		All	
Characteristic	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
RC officer	-0.733	0.000					-18.12	0.349
Non-Hispanic minority	-1.390	0.000	-1.167	0.007	-1.524	0.000	-1.518	0.000
Hispanic	-1.368	0.000	-2.223	0.000	-1.094	0.000	-1.083	0.000
Age	-0.718	0.339	0.282	0.844	-1.079	0.203	-0.978	0.239

| Characteristic | Analysis population | | | | | | | |
| | All | | RC officers | | AC officers | | All | |
	Diff.	p-value	Diff.	p-value	Diff.	p-value	Diff.	p-value
Age^2	0.012	0.414	-0.006	0.819	0.019	0.267	0.017	0.315
Married w/ dependents	0.762	0.001	1.027	0.027	0.764	0.001	0.773	0.001
Age waiver	-0.870	0.019	-1.018	0.008	-0.948	0.069	-0.877	0.088
Traffic waiver	-0.247	0.225	0.101	0.860	-0.388	0.096	-0.385	0.096
Drug waiver	0.179	0.198	0.337	0.346	0.128	0.286	0.135	0.241
Tattoo waiver	-0.293	0.207	0.582	0.291	-0.464	0.053	-0.485	0.044
Drop waiver	-1.094	0.017	0.001	0.998	-1.923	0.004	-1.878	0.003
Other waivers	-0.242	0.422	-0.237	0.670	-0.268	0.409	-0.287	0.369
MCRISS PFT score	-0.046	0.000	-0.045	0.012	-0.046	0.000	-0.047	0.000
MCRISS PFT score^2	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000
Prior enlisted	1.222	0.000	1.472	0.040	1.221	0.000	1.214	0.000
RC X non-Hispanic minority							0.416	0.421
RC x Hispanic							-1.091	0.019
RC x age							1.219	0.419
RC x age^2							-0.022	0.456
RC x married w/ dependents							0.088	0.843
RC x age waiver							-0.040	0.946
RC x traffic waiver							0.358	0.574
RC x drug waiver							0.250	0.418
RC x tattoo waiver							0.978	0.075
RC x drop waiver							1.813	0.026
RC x other waivers							0.115	0.848
RC x PFT score							0.006	0.733
RC x PFT score^2							0.000	0.731
RC x prior enlisted							0.246	0.694
N	2548		654		1894		2548	
R^2	0.153		0.154		0.156		0.159	

Source: CNA linear regression results using FY09-FY15 MCRISS and TFDW data. Regressions also included TBS class fixed effects.

ROCP officer initial obligation completion and continuation rates

We estimate the probability of ROCP officers attriting before the ends of their first obligations (Table 14) and the probability of continuing in the SMCR to 54 and 60 months of commissioned service (Table 15 and Table 16, respectively) as a logistic function of demographic characteristics, AD experience, and commissioning fiscal year. We present the results of two models for each outcome. The two models have two different AD-experienced measures. In the first model, AD experience is measured as a binary: an officer either has AD experience or does not. In the second model, AD experience is measured by three categories: no AD experience, less than 12 months of AD experience, and 12 or more months of AD experience. We present the results of the logistic regressions as odds ratios, which describe the odds of attriting before the end of the initial obligation relative to that of the omitted category. For example, in Table 14, we see that minority ROCP officers are 0.78 times as likely as white ROCP officers to attrite from the SMCR before the ends of their initial obligations (the p-value is greater than 0.05, so it is not statistically different from zero). Another way to interpret this odds ratio is as a percentage, by subtracting 1 from the odds ratio and multiplying it by 100. For example, minority ROCP officers are 22 percent less likely to attrite than male ROCP officers, but this is not statistically different from zero.

Table 14.   Estimated relative odds of attriting before the end of initial obligation and corresponding p-values, by demographic characteristic and AD experience model

| | Model | | | |
| | Binary AD experience | | Categorical AD experience | |
Characteristics	Odds ratio	p-value	Odds ratio	p-value
Minority race/ethnicity	0.776	0.587	0.773	0.582
Married w/ dependents	0.806	0.614	0.792	0.587
Prior-enlisted	1.011	0.984	1.012	0.982
Prior-AC as enlisted	1.098	0.229	2.565	0.228
Ground combat MOS	0.802	0.598	0.789	0.573
AD experience > 0 months	0.325	0.004		
AD experience				
1-11 months			0.373	0.062
12+ months			0.303	0.006
Overall TBS GPA	0.985	0.766	0.986	0.782
2nd class PFT	1.151	0.906	1.187	0.886
Commission FY				

	Model			
	Binary AD experience		**Categorical AD experience**	
Characteristics	**Odds ratio**	**p-value**	**Odds ratio**	**p-value**
2010	0.741	0.650	0.733	0.639
2011	1.283	0.702	1.241	0.742
2012	0.854	0.839	0.828	0.809
N	239		239	
Pseudo R^2	0.065		0.070	

Source: CNA logistic regression results using FY09-FY15 MCRISS, TFDW, and MCTFS data. Regressions also included commission FY fixed effects.

Table 15.   Estimated relative odds of SMCR continuation to 54 months of commissioned service and corresponding p-values, by demographic characteristic and AD experience model

	Model			
	Binary AD experience		**Categorical AD experience**	
Characteristics	**Odds ratio**	**p-value**	**Odds ratio**	**p-value**
Minority race/ethnicity	1.299	0.511	1.325	0.480
Married w/ dependents	1.278	0.510	1.343	0.434
Prior-enlisted	1.447	0.440	1.468	0.425
Prior-AC as enlisted	0.890	0.870	0.885	0.865
Ground combat MOS	0.788	0.502	0.831	0.607
AD experience > 0 months	3.572	0.001		
AD experience				
1-11 months			2.640	0.042
12+ months			4.164	0.001
Overall TBS GPA	0.946	0.255	0.944	0.237
2nd class PFT	2.602	0.427	2.403	0.470
Commission FY				
2010	1.492	0.393	1.540	0.361
2011	1.316	0.586	1.453	0.469
N	184		182	
Pseudo R^2	0.074		0.086	

Source: CNA logistic regression results using FY09-FY15 MCRISS, TFDW, and MCTFS data. Regressions also included commission FY fixed effects.

Table 16. Estimated relative odds of SMCR continuation to 60 months of commissioned service and corresponding p-values, by demographic characteristic and AD experience model

Characteristics	Binary AD experience		Categorical AD experience	
	Odds ratio	p-value	Odds ratio	p-value
Minority race/ethnicity	1.039	0.928	1.041	0.924
Married w/ dependents	1.523	0.289	1.495	0.318
Prior-enlisted	2.022	0.151	2.007	0.156
Prior-AC as enlisted	1.984	0.384	1.975	0.388
Ground combat MOS	1.058	0.884	1.035	0.931
AD experience > 0 months	3.650	0.006		
AD experience				
1-11 months			4.045	0.019
12+ months			3.535	0.009
Overall TBS GPA	0.987	0.804	0.989	0.832
2nd class PFT	0.261	0.288	0.270	0.303
Commission FY				
2010	1.157	0.749	1.149	0.761
2011	0.545	0.272	0.527	0.258
N	152		163	
Pseudo R^2	0.091		0.058	

Source: CNA logistic regression results using FY09-FY15 MCRISS, TFDW, and MCTFS data. Regressions also included commission FY fixed effects.

Appendix C: Propensity Score Matching Results

In our analysis, we are concerned that people who choose to join the Marine Corps as reserve officers are different from those who choose to join as AC officers. In other words, we are concerned about selection bias in estimating the ROCP differentials shown in Appendix B. To alleviate this concern, we used propensity score matching (PSM). This appendix provides greater detail about the PSM method and how we applied it to our data.[22]

PSM basics

PSM requires several important steps [14-15]. In the first stage, the researcher must choose the appropriate variables to include in the propensity score estimate. These variables include observable characteristics that may be correlated with being in the ROCP. We believe that such factors as gender, age, marital/dependent status, waiver status, PFT score, prior-enlisted status, and fiscal year are correlated with the decision to go through the ROCP.

Table 17 reports the first-stage OCC-R and RC officer propensity score models used for the OCS/commissioning and TBS outcome analyses, respectively. We report the estimated odds ratios and their corresponding p-values. Odds ratios greater than 1 with p-values less than 0.05 imply that people with that characteristic have a statistically higher probability of being in OCC-R or an RC officer than people in the omitted category; odds ratios less than 1 with p-values less than 0.05 imply that people with that characteristic have a statistically lower probability. Subtracting 1 from the odd ratio and multiplying it by 100 produces the percentage difference in probabilities. For example, we estimate that non-Hispanic minorities are 26 percent less likely than non-Hispanic whites to be in OCC-R. These estimates are used to predict the probability that each person in the population is in the OCC-R or is an RC

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[22] The text in this section is very similar to the appendix in [22], previous work by one of the authors of this study that also used PSM.

officer. The predicted probabilities are the propensity scores we will use to match the ROCP population to the AC population.

Table 17.   Odds ratios of being in the OCC-R at OCS or an RC officer at TBS

	Outcome of interest			
	OCC-R candidate		RC officer	
Characteristic	Odds ratio	p-value	Odds ratio	p-value
Female	0.074	0.000		
Race/ethnicity				
Non-Hispanic minority	0.738	0.010	0.660	0.007
Hispanic	1.145	0.281	0.992	0.961
Age	1.141	0.000	1.096	0.000
Married/with dependents	0.820	0.114	0.735	0.050
Age waiver	1.452	0.036	1.812	0.010
Traffic waiver	1.444	0.003	1.389	0.029
Drug waiver	1.059	0.609	1.022	0.874
Tattoo waiver	0.997	0.980	1.051	0.732
Drop waiver	1.941	0.002	1.686	0.098
Other waivers	1.017	0.934	1.004	0.986
MCRISS PFT score	0.996	0.000	0.995	0.003
Prior enlisted	0.963	0.779	0.730	0.064
OCS FY				
2010	3.983	0.000	2.059	0.001
2011	4.327	0.000	3.193	0.000
2012	13.043	0.000	7.901	0.000
2013	42.655	0.000	32.98	0.000
2014	20.318	0.000	16.18	0.000
2015	8.105	0.000	6.550	0.000

Source: CNA estimates using FY09-FY15 MCRISS and TFDW data.

Table 18 reports the first-stage AD experience propensity score models used for the SMCR attrition and continuation analysis.

Table 18.   Odds ratios of having AD experience in the SMCR

Characteristic	Odds ratio	p-value
Minority race/ethnicity	0.750	0.435
Married/with dependents	0.666	0.228
Prior-enlisted	1.563	0.338
Prior-AC as enlisted	0.305	0.115
Ground combat MOS	0.768	0.445
Overall TBS GPA	1.035	0.429
2nd class PFT	0.505	0.506
Commission FY		
2010	0.210	.049
2011	0.005	0.004
2012	0.153	.028

Source: CNA estimates using FY09-FY15 MCRISS, TFDW, and MCTFS data.

Next, the researcher must check whether the propensity scores are balanced across the ROCP and AC populations, meaning that the average propensity score of the treatment group is similar to the average propensity score of the control group. If there are portions of the propensity score distributions that do not overlap for either group, those observations are dropped from the analysis. These overlapping regions are called the regions of common support.

After achieving a sufficient propensity score balance, the next step is to choose the appropriate matching technique. There are several options. The most intuitive of the matching alternatives is nearest-neighbor matching. Nearest-neighbor matching is a one-to-one matching technique that minimizes the distance in the propensity scores between the ROCP and AC matches. Although it is intuitive, the nearest-neighbor matching technique has several disadvantages. First, the sort order matters; if there are multiple matches in the AC population with the same minimum distance to the match in the ROCP population, the algorithm chooses the match that is the first unassigned observation. Therefore, the data must be sorted randomly before matches are assigned when using this technique; otherwise, the sort order of the data could drive the outcome. Second, because this is a one-to-one matching technique, any observations not matched are dropped from the analysis. In other words, if there are significantly more people in the ROCP or AC population, a large portion of the data will be dropped. The AC populations are significantly larger than the ROCP populations, so this is of concern.

Another PSM option to overcome some of the drawbacks of nearest-neighbor matching is kernel weighting. Using the kernel PSM technique, each relevant observation in the AC population is assigned a weight for each observation in the

ROCP population based on the absolute distance from the propensity score for each treated individual [14-15]. As [14] explains, this simply means that "higher weights for better matches" are given when calculating the average treatment effect on the treated.

Once matching is complete, the next step is to check to see whether the observed population characteristics are more similar after matching than they were before matching. There are several ways to look at the matching quality: we can look for improved bias ratios, perform t-tests for each characteristic, and examine the fit of these data by observing the degree to which the R-squared value gets smaller. We show these results in Table 19 for matching the OCC-R and OCC ground populations at OCS, in Table 20 for matching the RC and AC officer populations at TBS, and in Table 21 for matching the AD-experienced and non-AD-experienced populations in the SMCR. For all cases, the balance between the ROCP and AC populations is improved by kernel PSM. For matching of the OCC-R candidate to the OCC ground candidate, the average bias is reduced from 17 percent to 2 percent; the majority of the variables pass the t-tests (p-values are greater than 0.05), and the R-squared goes from 0.2 to 0.0. We find similar results for the RC to AC TBS officer matching and the AD-experienced to non-AD-experienced ROCP officer matching.

Table 19.   Balance of Marines' observable characteristics before and after PSM of OCC-R and OCC ground candidates at OCS

Characteristic	Sample	Mean		Bias (%)	T-test	
		OCC-R	OCC ground		T-stat	p-value
Female	Unmatched	0.034	0.184	-49.8	-12.24	0.000
	Matched	0.034	0.040	-2.0	-0.75	0.454
Non-Hispanic white	Unmatched	0.714	0.742	-6.3	-1.78	0.076
	Matched	0.715	0.707	1.6	0.37	0.714
Non-Hispanic minority	Unmatched	0.148	0.152	-1.2	-0.33	0.743
	Matched	0.148	0.164	-4.3	-0.97	0.332
Hispanic	Unmatched	0.138	0.106	9.8	2.83	0.005
	Matched	0.137	0.129	2.5	0.55	0.585
Age	Unmatched	25.3	24.5	29.1	8.52	0.000
	Matched	25.2	25.3	-1.6	-0.35	0.728
Married/with dependents	Unmatched	0.149	0.140	2.6	0.74	0.461
	Matched	0.149	0.159	-2.8	-0.62	0.536
Age waiver	Unmatched	0.098	0.061	14.0	4.16	0.000
	Matched	0.095	0.102	-2.6	-0.55	0.580
Traffic waiver	Unmatched	0.147	0.105	12.5	3.65	0.000

Characteristic	Sample	Mean			T-test	
		OCC-R	OCC ground	Bias (%)	T-stat	p-value
	Matched	0.146	0.136	2.8	0.61	0.542
Drug waiver	Unmatched	0.167	0.173	-1.8	-0.52	0.605
	Matched	0.167	0.162	1.5	0.34	0.733
Tattoo waiver	Unmatched	0.141	0.201	-16	-4.37	0.000
	Matched	0.141	0.147	-1.6	-0.39	0.695
Drop waiver	Unmatched	0.048	0.023	13.5	4.18	0.000
	Matched	0.046	0.046	0.2	0.04	0.966
Other waivers	Unmatched	0.046	0.050	-1.9	-0.52	0.606
	Matched	0.046	0.053	-3.2	-0.72	0.473
MCRISS PFT score	Unmatched	274.1	272.1	5.5	1.49	0.136
	Matched	274.1	273.2	2.4	0.46	0.646
Prior enlisted	Unmatched	0.120	0.111	2.8	0.81	0.418
	Matched	0.119	0.138	-6.0	-1.32	0.186
FY09	Unmatched	0.059	0.297	-65.4	-16.28	0.000
	Matched	0.059	0.059	0.1	0.05	0.962
FY10	Unmatched	0.129	0.180	-14.2	-3.87	0.000
	Matched	0.130	0.128	0.3	0.08	0.935
FY11	Unmatched	0.113	0.159	-13.3	-3.63	0.000
	Matched	0.114	0.111	0.7	0.17	0.866
FY12	Unmatched	0.161	0.091	21.1	6.33	0.000
	Matched	0.162	0.169	-2.2	-0.45	0.652
FY13	Unmatched	0.192	0.046	46.1	15.2	0.000
	Matched	0.189	0.180	2.7	0.51	0.609
FY14	Unmatched	0.166	0.074	28.5	8.78	0.000
	Matched	0.166	0.175	-2.8	-0.56	0.575
FY15	Unmatched	0.181	0.153	7.4	2.12	0.034
	Matched	0.181	0.177	1.0	0.23	0.819
Average bias	Unmatched			17.3		
	Matched			2.1		
R^2	Unmatched			0.204		
	Matched			0.002		

Source: CNA estimates using FY09-FY15 MCRISS and TFDW data.

Table 20.   Balance of Marines' observable characteristics before and after PSM of
RC and AC officers at TBS

| Characteristic | Sample | Mean | | | T-Test | |
		RC officer	AC officer	Bias (%)	T-stat	p-value
Non-Hispanic white	Unmatched	0.749	0.773	-5.6	-1.24	0.216
	Matched	0.751	0.737	3.3	0.58	0.559
Non-Hispanic minority	Unmatched	0.127	0.126	0.4	0.08	0.934
	Matched	0.128	0.142	-4.4	-0.77	0.442
Hispanic	Unmatched	0.124	0.101	7.1	1.60	0.109
	Matched	0.122	0.121	0.1	0.02	0.982
Age	Unmatched	25.04	24.53	21.1	4.83	0.000
	Matched	25.01	24.97	1.6	0.29	0.772
Married w/ dependents	Unmatched	0.141	0.153	-3.4	-0.74	0.462
	Matched	0.142	0.154	-3.5	-0.63	0.529
Age waiver	Unmatched	0.084	0.051	13.3	3.12	0.002
	Matched	0.078	0.080	-0.5	-0.08	0.939
Traffic waiver	Unmatched	0.147	0.120	7.8	1.75	0.081
	Matched	0.145	0.146	-0.3	-0.05	0.960
Drug waiver	Unmatched	0.159	0.187	-7.4	-1.60	0.109
	Matched	0.160	0.151	2.4	0.46	0.648
Tattoo waiver	Unmatched	0.139	0.196	-15.4	-3.28	0.001
	Matched	0.137	0.140	-0.7	-0.15	0.885
Drop waiver	Unmatched	0.034	0.016	11.1	2.67	0.008
	Matched	0.032	0.027	3.3	0.54	0.589
Other waivers	Unmatched	0.043	0.052	-4.4	-0.96	0.338
	Matched	0.043	0.051	-3.6	-0.65	0.517
MCISS PFT score	Unmatched	277.28	275.71	5.7	1.17	0.243
	Matched	277.23	275.73	5.4	0.74	0.462
Prior enlisted	Unmatched	0.112	0.122	-3.2	-0.70	0.482
	Matched	0.111	0.119	-2.5	-0.45	0.650
FY09	Unmatched	0.050	0.218	-50.6	-9.88	0.000
	Matched	0.051	0.058	-2.2	-0.58	0.563
FY10	Unmatched	0.119	0.265	-37.6	-7.75	0.000
	Matched	0.120	0.120	-0.1	-0.02	0.984
FY11	Unmatched	0.110	0.165	-15.9	-3.37	0.001
	Matched	0.111	0.103	2.4	0.48	0.634

| Characteristic | Sample | Mean | | | T-Test | |
		RC officer	AC officer	Bias (%)	T-stat	p-value
FY12	Unmatched	0.161	0.106	16.2	3.74	0.000
	Matched	0.162	0.163	-0.4	-0.07	0.944
FY13	Unmatched	0.200	0.033	53.8	14.44	0.000
	Matched	0.195	0.193	0.8	0.12	0.904
FY14	Unmatched	0.168	0.058	35.5	8.83	0.000
	Matched	0.169	0.172	-1.0	-0.14	0.886
FY15	Unmatched	0.191	0.156	9.2	2.07	0.039
	Matched	0.192	0.191	0.3	0.06	0.953
Average bias	Unmatched			16.2		
	Matched			1.9		
R^2	Unmatched			0.153		
	Matched			0.002		

Source: CNA estimates using FY09-FY15 MCRISS and TFDW data.

Table 21. Balance of Marines' observable characteristics before and after PSM of AD-experienced and non-AD-experienced ROCP officers in the SMCR

| Characteristic | Sample | Mean | | | T-Test | |
		AD experience	No AD experience	Bias (%)	T-stat	p-value
Minority race/ethnicity	Unmatched	0.234	0.281	-10.7	-0.74	0.458
	Matched	0.240	0.340	-22.7	-2.04	0.042
Married w/ dependents	Unmatched	0.263	0.348	-17.6	-1.23	0.221
	Matched	0.269	0.251	3.9	0.38	0.705
Prior-enlisted	Unmatched	0.194	0.125	18.9	1.25	0.214
	Matched	0.175	0.237	-16.9	-1.41	0.158
Prior-AC as enlisted	Unmatched	0.034	0.063	-13.1	-0.96	0.337
	Matched	0.035	0.031	1.7	0.19	0.847
Ground combat MOS	Unmatched	0.411	0.438	-5.2	-0.36	0.719
	Matched	0.035	0.031	1.7	0.19	0.847
TBS overall GPA	Unmatched	84.43	83.98	11.7	0.78	0.435
	Matched	84.34	84.79	-11.7	-1.07	0.286
1st class PFT	Unmatched	0.983	0.969	9.1	0.67	0.502
	Matched	0.982	0.995	-8.4	-1.14	0.256

Characteristic	Sample	Mean			T-Test	
		AD experience	No AD experience	Bias (%)	T-stat	p-value
Commission FY 2009	Unmatched	0.166	0.031	46.1	2.77	.006
	Matched	0.146	0.154	-2.6	-0.20	0.844
Commission FY 2010	Unmatched	0.394	0.328	13.7	0.93	0.352
	Matched	0.404	0.389	2.9	0.27	0.790
Commission FY 2011	Unmatched	0.291	0.484	-40.2	-2.82	0.005
	Matched	0.298	0.292	1.3	0.13	0.898
Commission FY 2012	Unmatched	0.149	0.156	-2.1	-0.15	0.884
	Matched	0.152	0.165	-3.6	-0.32	0.746
Average bias	Unmatched			16.4		
	Matched			8.5		
R^2	Unmatched			0.026		
	Matched			0.423		

Source: CNA estimates using FY09-FY15 MCRISS, TFDW, and MCTFS data.

Average treatment effects

Calculating the average effects is the same no matter how we match the ROCP and AC populations. First, we predict the outcomes (Y) the treatment group (i.e., OCC-R, RC at TBS, or with AD experience) would have if it actually had been in the control group (i.e., OCC ground, AC at TBS, or with no AD experience) and estimate the average treatment effect on the treated (ATT):

$$ATT = E[Y_R - Y_A | R = 1]$$

Y_R: Treatment outcome
Y_A: Control outcome
$R = 1$ if in the treatment group, $R = 0$ if in the control group

Next, we predict the outcomes had the control group actually been in the treatment group and estimate the average treatment effect on the untreated (ATU):

$$ATU = E[Y_R - Y_A | R = 0].$$

Then, we average the ATT and ATU to estimate the effect had the whole population been in the treatment group, or the average treatment effect (ATE):

$$ATE = E[Y_R - Y_A].$$

We present the estimated ATT, ATU, and ATE on OCS attrition, commissioning rates, TBS GPAs, and ROCP officer SMCR continuation rates in Table 22. We discuss ATE effects in the main body of the report.

Table 22.   PSM-estimated ROCP and AD experience differentials[a]

	ATT	ATU	ATE	T-stat[b]
ROCP differentials				
OCS outcomes				
Attrition	+3.1pp	+3.4pp	+3.3pp	1.61
Commissioning	-4.2pp	-0.3pp	-1.4pp	3.07
TBS outcomes				
Academic GPA	-0.84p	-0.93p	-0.91p	3.58
Leadership GPA	-1.70p	-0.91p	-1.17p	5.86
Military skills GPA	-1.11p	-0.77p	-0.86p	4.92
Overall GPA	-1.25p	-0.87p	-0.97p	6.19
AD experience differentials				
Attrite from initial obligation	-17.3pp	-14.9pp	-16.0pp	1.74
Continue to 54 months	+23.8pp	+27.0pp	+24.6pp	2.02
Continue to 60 months	+20.4pp	+16.8pp	+29.8pp	1.33

Source: CNA estimates using FY09-FY15 MCRISS, TFDW, and MCTFS data.

[a.] pp stands for percentage points; p stands for points.

[b.] T-statistics greater than 1.96 indicate that the estimate is statistically different from zero at the 5-percent level.

Appendix D: Survival Analysis

Using typical linear regression methods to explain duration (i.e., time-to-loss) data presents a number of practical problems [23-24].[23] The key issue with duration data is that the event (leaving the SMCR) and the characteristics that explain the likelihood of that event (i.e., having AD experience), may be changing over time (i.e., while a Marine is in the SMCR). Survival analysis is a statistical technique developed specifically to handle duration data. Survival analysis allows us to model the likelihood that a particular Marine will leave the SMCR, given that other Marines at the same point in their reserve careers decided to stay.

The proportional hazard model

The basis of survival analysis is the hazard function. For our purpose, the hazard function models the likelihood of loss at time *t* for Marine *j* as a function of time and personal characteristics:

$$h_j(t) = g(t, b_0 + b_1 x_{1j} + \cdots + b_k x_{kj})$$

We use the Cox proportional hazard function, which allows the likelihood of affiliation due to a Marine's personal characteristics (X_j) to shift the baseline hazard rate, $h_0(t)$, which is a common to all Marines:

$$h_j(t|x_j) = h_0 e^{(X_j B_x)}$$

The advantage of the Cox proportional hazard model is that it leaves the baseline hazard rate, $h_0(t)$, unspecified and unestimated. This implies that we do not have to know the exact functional form or constrain the shape of the baseline hazard function to be able to estimate the effect that observable characteristics (the x_j variables) have on the probability of leaving the SMCR. We determine how observable characteristics are associated with the likelihood of affiliation by choosing values for

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[23] The text in this section is very similar to the appendix in [1], previous work by the authors of this study that also used survival analysis.

the coefficients (B_x) in the model that best fit the data. Specifically, we want coefficients that maximize the likelihood of observing the losses that actually occurred at each point in time in our data.

Hazard models are preferred to alternative statistical techniques when dealing with duration data because they are better able to address the various issues that arise when using duration data. Specifically,

- Hazard rate models explicitly represent the stochastic process underlying survival times. The assumptions behind ordinary least squares, probit, logit, and censored region models are not suitable for explaining time-to-affiliation. To be more precise, estimates from hazard rate models compare the likelihood of an event occurring for two otherwise identical individuals or groups (i.e., Marines who left the SMCR versus those who stayed) at the same point in time.

- Hazard models address data-censoring problems, which exist in our data. Specifically, our data exhibit right-censoring, meaning the sample period ends before some Marines have had the chance to affiliate with SMCR units or IMA billets. Hazard models account for these observations and, therefore, avoid biased estimates.

- Hazard models may be used to deal with time-varying characteristics. Time-to-affiliation is likely to depend on a set of personal characteristics and events that may change over time. In hazard models, a Marine's characteristics are reevaluated at each point in time that an SMCR loss can occur.

Interpretation of results

Our hazard model estimates the likelihood of leaving the SMCR as a function of a set of demographic and unit-level characteristics. Results of estimating the hazard model are expressed as hazard ratios—the ratio of two hazard rates. Hazard ratios compare the likelihood of leaving for two Marines who are exactly the same except for a one-unit change in the variable of interest.

The hazard ratio is easiest to interpret for categorical variables. For instance, we include a gender variable in our model that is equal to 1 if the Marine is female and 0 is the Marine is male. For this gender variable, the hazard ratio is the male-to-female ratio of the likelihood to affiliate, holding all other variables at their sample averages. Specifically, for categorical variables:

- A hazard ratio equal to (or close to) 1 indicates that there is no considerable difference in the likelihood of leaving for Marines with the characteristic relative to Marines without it. (That is, if being female has a hazard ratio of 1,

this implies that female Marines are no more likely than male Marines to leave the SMCR.)

- A hazard ratio less than 1 implies that Marines with the characteristic have a lower likelihood of leaving relative to those without the characteristic. (That is, if being female has a hazard ratio of 0.7, this implies that female Marines are 30 percent less likely than male Marines to leave the SMCR.)

- A hazard ratio greater than 1 implies that Marines with the characteristic are more likely to leave relative to those without. (That is, if being female has a hazard ratio of 1.7, this implies that female Marines are 70 percent more likely than male Marines to leave the SMCR.)

The hazard ratio for continuous variables expresses the difference in the relative magnitude of the likelihood of leaving the SMCR for a one-unit increase in the value of the continuous variable. For example, in the case of the PFT score (P), the hazard ratio expresses the relative likelihood of leaving the SMCR when a Marine's PFT score is P+1 to the likelihood of leaving when a Marine's PFT score is P.

When interpreting estimation results, it is also important to consider the p-value of the estimate. The p-value measures the smallest significance level at which we can reject that the estimated hazard ratio is equal to 1. It measures the degree to which we can say with certainty that the likelihoods of leaving the SMCR for Marines with and without a particular characteristic (holding all else constant) are different. Typically, researchers consider p-values of 0.05 or less to indicate statistical significance. Going back to our example of the relative likelihood of leaving the SMCR between male and female Marines, if the p-value associated with the hazard rate is equal to 0.05, we can claim—with 95-percent accuracy—that the likelihood of leaving for female Marines is statistically different from that for male Marines.

Estimates

Table 23 shows the results of estimating the enlisted hazard function for all enlisted Marines and the following subgroups: obligors, nonobligors, junior enlisted Marines (E1-E3), NCOs (E4-E5), and SNCOs (E6-E9). The variable indicating that a Marine is at a unit with a lieutenant passes the proportionality test (p-values are greater than 0.05).

Table 23. Estimated hazard ratios and tests for proportionality for being at a unit with a lieutenant by obligor status and paygrade group

| Population | Average effect of units having lieutenants | | | |
| | Estimate | | Test for proportionality | |
	Hazard ratio	p-value	Rho	p-value
All enlisted Marines	1.002	0.888	-0.000	0.989
Obligor status at join date				
Obligors	1.055	0.012	-0.004	0.538
Nonobligors	0.935	0.006	0.002	0.828
Paygrade at join date				
E1-E3 Marines	1.056	0.008	-0.001	0.862
E4-E5 Marines	0.920	0.002	0.004	0.645
E6-E9 Marines	0.890	0.518	0.008	0.846
Number of Marines	63,101			
Probability > Chi^2	0.000			

Source: CNA Cox survival estimates using Jan. 2005 through Dec. 2015 MCTFS end-of-month snapshot files. All models also include controls for gender, race/ethnicity, grade at first affiliation, marital/dependent status, obligor status for that month, prior-AC status, aviation or ground combat arms occupation, AD status, unit census division, whether BIC alignment was in effect, and the FY the Marine joined the SMCR.

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