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CORRELATES OF RETENTION AND PROMOTION FOR USNA GRADUATES, (U)
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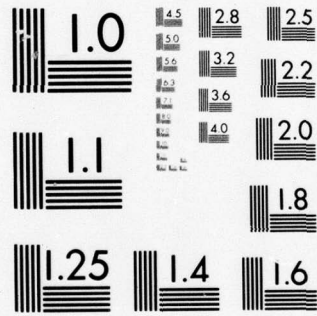
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6 CORRELATES OF RETENTION AND PROMOTION
FOR USNA GRADUATES

10 Wendi Felix

14 CNA - Professional Paper-176 ✓

11 March 1977

12 43p.

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ACKNOWLEDGEMENT

The author wishes to acknowledge the contributions of Dr. Harry Gilman to the study. It was Dr. Gilman's idea to relate retention and promotion to class rank and graduate education, and the data was collected under his supervision. The author is solely responsible for the method of analysis and the conclusions drawn.

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CORRELATES OF RETENTION AND PROMOTION FOR USNA GRADUATES

SUMMARY OF FINDINGS

The Navy spends over \$70,000 to produce one officer from the Naval Academy. Later on, it spends additional money to provide these officers with graduate education. The question arises as to whether the Navy retains the top graduates and whether these graduates are more likely to be the most successful officers. Furthermore, does the Navy benefit from the graduate education it provides by retaining these officers and does this investment provide the Navy with more successful officers?

To answer these questions data was collected for all graduating members of the classes of 1947 and 1950. Retention and promotion tables were constructed and regression equations estimated.

Based on the regression equations, the findings of this paper are:

1. Officers graduating in the fourth quartile appear most likely to stay to 5.5 years of service and least likely to stay beyond 10.5 years of service. Generally, officers graduating in the first quartile are most likely to stay beyond 10.5 years.

2. The relationship between graduate education and retention is unclear. For the class of 1947, officers with graduate education at year 16.5 are more likely to stay to 20.5 years of service; for the class of 1950, those with graduate education are less likely to stay to 20.5 years of service. Overall, the findings suggest a slightly negative relationship between graduate education and retention.

3. Early promotion to Lieutenant Commander is positively related to career retention.

4. Officers in the first quartile are more likely to be promoted to Lieutenant Commander, Commander, and Captain than officers in the fourth quartile. The difference is widest for Captain selection.

5. The evidence suggests that possession of a graduate degree increases the likelihood of being promoted to Commander and Captain, but graduate education short of a degree does not.

6. Early promotion to Lieutenant Commander increases an officer's probability of being promoted to Captain by over 19 percentage points.

7. Officers from the lowest quartile are not only the most likely to fail selection and be forced out, they also appear to be the most likely to leave voluntarily after 10.5 years of service.

8. Although officers with advanced degrees are the most likely to be promoted and permitted to continue their career, they are the most likely to leave voluntarily.

9. There are no differences between unrestricted line, restricted line, and staff officers in promotion and retention beyond 10.5 years. Significant differences in retention were found in the early years, but caution is warranted in interpreting these results. The officer designation used in the analysis was the most recent one. Therefore, many of the officers included in the staff or restricted line may not have actually been in those categories during all the time periods.

INTRODUCTION

At present, the Navy spends over \$70,000 to produce one officer from the United States Naval Academy (reference 1). The training at the Naval Academy is designed to prepare midshipmen for successful careers as officers in the U.S. Navy. Students are ranked according to how well they assimilate this training. But do successful students become successful Naval officers in terms of retention and promotion? If not, the Navy must reconsider the type of training it performs and its measure of successful indoctrination.

The Navy also sends officers to graduate school for advanced training. The Navy is concerned with the retention and promotion record of these officers. If they do not stay in the Navy or fail at promotion, the Navy should reconsider the value of graduate school training to the Navy.

To examine these issues, this paper looks at the careers of two United States Naval Academy classes: 1947 and 1950. Information on Academy class standing at graduation, level of graduate education, most recent officer designation, early promotion to Lieutenant Commander, and yearly rank was collected for each graduating member of the two classes. The study is unique in that the two cohorts are followed through the completion or near completion of their Naval careers. Previous studies have relied on the cross-sectional analysis of officers on active duty at a

given time, treating the cross-section as if it were a single cohort. In this study, the officers in each cohort have the same source and were exposed to the vicissitudes of war and peace, changes in Navy policy, and changes in outside economic factors at exactly the same time in their career.

Of equal interest, the data is easily accessible. The data was gleaned from three registers distributed by the Naval Academy and the Bureau of Naval Personnel. To our knowledge, these registers have not been previously used for promotion and retention analysis. The registers and the data extracted from them are discussed in appendix A.

In the first section of this paper, we cross tabulate retention and promotion rates by class standing and graduate education. Next, regression equations are estimated. Equations are estimated for retention in six intervals over an officer's career and for promotion to Lieutenant Commander, Commander, and Captain.

CROSS TABULATIONS

Retention and Promotion Rates by Class Standing

The data source records retention at the middle of the year of service. Tables 1 and 2 present retention rates at 5.5, 10.5 and 20.5 years of service by quartile for the classes of 1947 and 1950. In addition, table 1 includes retention rates at 25.5 years for the class of 1947. The fourth quartile is the most likely

TABLE 1
CLASS OF 1947 RETENTION RATES, BY QUARTILE^a

Quartile	Years of Service ^b				
	0.5	5.5	10.5	20.5	25.5
1	1.00 (189)	.688 (130)	.550 (104)	.429 (81)	.307 (58)
2	1.00 (192)	.667 (128)	.526 (101)	.359 (69)	.286 (55)
3	1.00 (178)	.652 (116)	.522 (93)	.360 (64)	.253 (45)
4	1.00 (169)	.704 (119)	.556 (94)	.302 (51)	.178 (30)
Total Class	1.00 (728)	.677 (493)	.538 (392)	.364 (265)	.258 (188)

TABLE 2
CLASS OF 1950^c RETENTION RATES, BY QUARTILE

Quartile	Years of Service ^b			
	0.5	5.5	10.5	20.5
1	1.00 (126)	.794 (100)	.698 (88)	.524 (66)
2	1.00 (108)	.676 (73)	.574 (62)	.389 (42)
3	1.00 (105)	.667 (70)	.581 (61)	.419 (44)
4	1.00 (99)	.808 (80)	.616 (61)	.354 (35)
Total Class	1.00 (438)	.734 (323)	.621 (272)	.427 (187)

^aKey: retention rate
(number of graduates)

^bAcademy graduation is in June. Data in reference 2 is recorded as of December 31 of each year. The first year of service is therefore recorded as being only six months long and the subsequent years represent 1-1/2 instead of 1, 2-1/2 instead of 2, etc., years of service.

^c164 graduates in this class were commissioned in the U.S. Air Force and are not included in the analysis. Their quartile distribution was as follows: Quartile 1 = 29, Quartile 2 = 40, Quartile 3 = 47, and Quartile 4 = 48.

to remain in the Navy to 5.5 years of service. For the class of 1947, its retention is only slightly above the higher quartiles. For the class of 1950, the difference is sizeable, particularly when compared with the second and third quartiles. The fourth quartile appears to be the least likely to remain to 20.5 years of service and beyond. For both classes, retention generally declines as rank in class decreases. As we will observe later, this reflects, to some degree, poorer promotion rates of officers in the lower quartiles.

Table 3 presents promotion rates to Lieutenant Commander, Commander, and Captain by quartile for the class of 1947. To each rank, the first quartile has the highest promotion rate and the fourth quartile the lowest. The promotion rate to Lieutenant Commander varies from a high of 98% for the first quartile to a low of 88% for the fourth; to Commander it varies from a high of 89% for the first quartile to a low of 64% for the fourth; and to Captain it varies from a high of 88% for the first quartile to a low of 63% for the fourth. Table 4, for the class of 1950, confirms these findings. There is only one reversal in the positive relationship between quartile and promotion success. The third quartile does better than the second at promotion to Lieutenant Commander and Commander for both classes and to Captain for the class of 1950.

Summarizing, we see a relationship between class standing and retention in the later years, with the top quartile having the highest retention rate and the fourth quartile the lowest.

TABLE 3

CLASS OF 1947

OF THOSE STAYING 1 YEAR ABOVE ZONE, PROMOTION RATES TO LIEUTENANT
COMMANDER, COMMANDER, AND CAPTAIN, BY QUARTILE^a

<u>Quartile</u>	<u>Lieutenant Commander^b</u>	<u>Commander</u>	<u>Captain</u>
1	.980 (95)	.890 (81)	.881 (59)
2	.920 (92)	.761 (70)	.815 (53)
3	.944 (85)	.852 (69)	.786 (44)
4	.880 (81)	.641 (50)	.630 (29)
Total Class	.931 (353)	.789 (270)	.791 (185)

TABLE 4

CLASS OF 1950

OF THOSE STAYING 1 YEAR ABOVE ZONE, PROMOTION RATES TO LIEUTENANT
COMMANDER, COMMANDER, AND CAPTAIN, BY QUARTILE^a

<u>Quartile</u>	<u>Lieutenant Commander^b</u>	<u>Commander</u>	<u>Captain</u>
1	1.00 (88)	.914 (74)	.935 (58)
2	.935 (58)	.828 (48)	.658 (25)
3	.984 (60)	.879 (51)	.727 (32)
4	.918 (56)	.765 (39)	.567 (17)
Total Class	.963 (262)	.855 (212)	.759 (132)

^a Key: promotion rate (number of graduates on active duty and eligible for promotion).

^b For Lieutenant Commander, the in-zone year is used because virtually all officers were promoted by 1 year above zone.

Those who graduated in the top quartile are most likely to be promoted to Lieutenant Commander, Commander and Captain; those who graduated in the bottom quartile are least likely.

Retention and Promotion by Graduate Education

Prior to 1962, advanced degrees were not reported in the data source. Up to that year, we know if the officer received some graduate education, but not how much or if a degree was awarded. When degrees were finally recorded, the year of the degree, if received prior to 1962, was marked as 1962. Therefore, in order to use the graduate education variable we had to use graduate education whether a degree was awarded or not. After 1962, we use both forms of graduate education, with and without degrees. Because of limited sample size, we could examine graduate education only beyond 10.5 years of service.

Table 5 displays selected retention rates by graduate education for the class of 1947. By 10.5 years, 24% of the class had some graduate training (94/388). For officers on active duty at 10.5 years, there is no difference in retention to 16.5 years between those with some graduate education and those without. There is a large difference in retention from 16.5 to 20.5 years of service between officers who received graduate education and those who did not. Officers with some graduate education, but no degree, had a 14 percentage point higher retention to 20.5 years of service than those without; officers with advanced degrees had

TABLE 5

CLASS OF 1947

RETENTION RATES OF GRADUATES AT 16.5, 20.5, AND 25.5 YEARS
OF SERVICE, BY GRADUATE EDUCATION^a

<u>Length of Service</u>	<u>Active</u>	<u>Inactive</u>
10.5 to 16.5 ^b		
No graduate education	.884 (260)	.116 (34)
Some graduate education ^c	.883 (83)	.117 (11)
Advanced degree	-	-
10.5 to 20.5		
No graduate education	.680 (198)	.320 (93)
Some graduate education	.728 (67)	.272 (25)
Advanced degree	-	-
16.5 to 20.5		
No graduate education	.692 (117)	.308 (52)
Some graduate education	.837 (51)	.163 (10)
Advanced degree	.898 (97)	.102 (11)
20.5 to 25.5		
No graduate education	.685 (63)	.315 (29)
Some graduate education	.705 (31)	.295 (13)
Advanced degree	.734 (94)	.266 (34)

^aKey: retention rate
(number of graduates).

^b16.5 is the in-zone year for Commander promotion.

^cThis includes only those graduates who did not receive advanced degrees.

a 21 percentage point higher retention to 20.5 years of service than those without. Officers with advanced degrees at year 20.5 appear most likely to remain in the Navy to year 25.5.

Table 6 presents the cross tabulation of graduate education with retention for the class of 1950. Those who receive graduate education by 10.5 years of service have a slightly lower retention to year 15.5 and a 12 percentage point lower retention to year 20.5. Those receiving graduate education by the 15.5 year of service are the least likely to stay to year 20.5. Thus, the relationship of graduate education to retention beyond the Commander promotion point appears to differ for the two classes. This will be examined further in the next section.

Next, we examined the relationship between graduate education and promotion. Table 7, for the class of 1947, suggests that officers with graduate education are more likely to be promoted to Lieutenant Commander and Commander. Possession of an advanced degree enhances even further an officer's likelihood of being promoted to Commander. To Captain, officers with advanced degrees do far better than those with only some graduate education or none.

Table 8 presents promotion success by graduate education for the class of 1950. There is no relationship between promotion to Lieutenant Commander and graduate education. Of officers on active duty one year above the Commander zone, those with advanced degrees appear to have the highest promotion success; those with some graduate education the lowest. This relationship is maintained for Captain promotion. Officers with graduate education but no

TABLE 6
 CLASS OF 1950
 RETENTION RATES OF GRADUATES AT 15.5 AND 20.5 YEARS
 OF SERVICE, BY GRADUATE EDUCATION^a

<u>Length of Service</u>	<u>Active</u>	<u>Inactive</u>
10.5 to 15.5 ^b		
No graduate education	.948 (127)	.052 (7)
Some graduate education ^c	.925 (124)	.075 (10)
Advanced degree		
10.5 to 20.5		
No graduate education	.769 (100)	.231 (30)
Some graduate education	.654 (87)	.346 (46)
Advanced degree		
15.5 to 20.5		
No graduate education	.800 (60)	.200 (15)
Some graduate education	.705 (43)	.295 (18)
Advanced degree	.764 (84)	.236 (26)

^aKey: retention rate
 (number of graduates).

^b15.5 is the in-zone year for Commander promotion.

^cThis includes only those graduates who did not receive advanced degrees.

TABLE 7

CLASS OF 1947

OF THOSE STAYING 1 YEAR ABOVE ZONE, PROMOTION RATE TO LIEUTENANT COMMANDER,
COMMANDER, AND CAPTAIN, BY GRADUATE EDUCATION^a

	Lieutenant Commander ^b		Commander		Captain	
	Promoted	Not promoted	Promoted	Not promoted	Promoted	Not promoted
No graduate education	.912 (218)	.088 (21)	.687 (112)	.313 (51)	.724 (55)	.276 (21)
Some graduate education ^c	.964 (135)	.036 (5)	.806 (50)	.194 (12)	.706 (24)	.294 (10)
Advanced degree	-	-	.923 (108)	.077 (9)	.935 (106)	.065 (18)

^aKey: promotion rates
(number of graduates).

^bFor Lieutenant Commander, we examined in-zone promotion because virtually all officers had been promoted by one year above zone.

^cThis includes only officers who did not receive advanced degrees.

TABLE 8
CLASS OF 1950
OF THOSE STAYING 1 YEAR ABOVE ZONE, PROMOTION RATE TO LIEUTENANT COMMANDER,
COMMANDER, AND CAPTAIN, BY GRADUATE EDUCATION^a

	Lieutenant Commander ^b		Commander		Captain	
	Promoted	Not promoted	Promoted	Not promoted	Promoted	Not promoted
No graduate education	.963 (131)	.037 (5)	.857 (66)	.143 (11)	.705 (31)	.295 (13)
Some graduate education ^c	.963 (131)	.037 (5)	.750 (42)	.250 (14)	.647 (22)	.353 (12)
Advanced degree	-	-	.904 (104)	.096 (11)	.823 (79)	.177 (17)

^aKey: promotion rates (number of graduates).

^bFor Lieutenant Commander, we examined in-zone promotion because virtually all officers had been promoted by one year above zone.

^cThis includes only officers who did not receive advanced degrees.

advanced degree have a 6 percentage point lower probability of being promoted, and those with advanced degrees have an 18 percentage point higher probability of being promoted than those without graduate education.

When we cross tabulated graduate education by class standing we found class standing positively related to graduate education for all promotion zones examined. The first quartile always had the greatest percentage of officers with graduate education. The percentage of officers with graduate education decreases as class standing declines. In the next section, we evaluate the relationship of graduate education to promotion and retention, holding class standing constant.

REGRESSION RESULTS

Introduction

In this section, we estimate regression equations for promotion and retention. This permits us to isolate the effects of one variable, holding other possible explanatory variables constant. The candidate explanatory variables are class standing, graduate education, designation, and below-zone promotion to Lieutenant Commander. The regression equations estimated are specified in appendix B.

Individual designations were not used because the sample sizes became very small. Instead, we divided the designations into unrestricted line, restricted line, and staff. Graduate education was defined two ways. First, it includes graduate work regardless

of whether or not a degree was awarded. In a second set of regressions, it includes only advanced degrees. This second set of regressions covered the time periods after 1962, the first year advanced degrees are recorded.

We report regression results both with class standing as the only explanatory variable and with all independent variables included. Comparison of the results permits us to examine both the total effect of class standing and the direct effect when other variables are controlled for.

Retention Regression Findings

In all regressions, the fourth quartile is the base group. A positive (negative) coefficient for a quartile suggests it has a higher (lower) retention than the fourth quartile. When the other variables are included, unrestricted line officers, officers without graduate education, and officers not promoted early to Lieutenant Commander are the base populations.

Tables 9 and 10 present the retention regression results. When quartile is the only explanatory variable (regressions 1 through 6 in table 9 and 1 through 5 in table 10), those in the fourth quartile seem to be the most likely to stay to 5.5 years and least likely to stay beyond 10.5 years. For the class of 1950, the second and third quartiles have significantly lower retention than the fourth quartile up to year 5.5. From years 5.5 to 10.5, there appears to be no relationship between quartile and retention for the class of 1947 and a 10 percentage point higher retention rate for the top three quartiles of the class of 1950.

TABLE 9
CLASS OF 1947
REGRESSION RESULTS FOR RETENTION RATES THROUGH 25.5 YEARS OF SERVICE^a

Number of cases	Length of service From To	Quartile			Restricted line	Staff education	Graduate education	Advanced degree	Early promotion LCDR	Constant	R ²	MSE
		1	2	3								
1	728 0 5.5	-.016 (.33)	-.037 (.76)	-.052 (1.04)					.704	.002	.219	
2	487 5.5 10.5	-.010 (.204)	-.015 (.295)	.005 (.10)					.810	.0004	.158	
3	388 10.5 16.5 ^b	.055 (1.20)	.074 (1.60)	.056 (1.18)					.837	.007	.103	
4	338 16.5 ^b 20.5	.229 (3.62)*	.079 (1.26)	.129 (1.99)*					.671	.040	.164	
5	383 10.5 20.5	.242 (3.66)*	.123 (1.86)	.151 (2.22)*					.560	.035	.208	
6	264 20.5 25.5	.157 (1.96)*	.220 (2.66)*	.126 (1.50)					.577	.028	.202	
7	728 0 5.5	-.091 (1.84)	-.037 (1.40)	-.053 (1.07)	.402 (6.19)*	.182 (3.53)*			.677	.031	.207	
8	487 5.5 10.5	-.046 (.87)	-.032 (.63)	.002 (.04)	.168 (2.85)*	-.089 (1.56)			.817	.026	.155	
9	388 10.5 16.5	.056 (1.10)	.071 (1.51)	.056 (1.20)	.062 (1.18)	-.078 (1.60)	-.034 (.76)		.847	.020	.102	
10	338 16.5 20.5	.124 (1.73)	.014 (.21)	.083 (1.27)	-.041 (.60)	-.054 (.79)	.164 (3.23)*	.171 (1.72)	.650	.078	.160	
11	383 10.5 20.5	.216 (2.94)*	.113 (1.63)	.142 (2.09)*	.087 (1.14)	-.085 (1.23)	-.051 (.80)	.221 (2.01)*	.572	.053	.206	
12	264 20.5 25.5	.134 (1.49)	.208 (2.40)*	.109 (1.27)	-.040 (.48)	-.032 (.36)	.017 (.27)	.219 (1.87)	.576	.043	.202	
13	338 16.5 20.5	.128 (1.76)	.023 (.34)	.099 (1.52)	-.034 (.50)	-.071 (1.03)	.153 (2.68)*	.188 (1.86)	.675	.069	.161	
14	264 20.5 25.5	.130 (1.44)	.206 (2.40)*	.109 (1.29)	-.040 (.49)	-.035 (.39)	.026 (.42)	.221 (1.89)	.577	.044	.202	

^aKey: Regression coefficient
(t values)

^bThis is the year for in-zone Commander promotion.

^cSignificant at the .05 level.
A t-value greater than 1.96 is significant at the 5% level.
A t-value greater than 1.64 is significant at the 10% level.

TABLE 10

CLASS OF 1950

REGRESSION RESULTS FOR RETENTION RATES THROUGH 20.5 YEARS OF SERVICE^a

Number of cases	Length of service		Quartile			Restricted line	Graduate education degree	Constant	R ²	MSF
	From	To	1	2	3					
1 438	0	5.5	-.014 (.246)	-.132 (2.17)*	-.141 (2.31)*		.808	.022	.191	
2 321	5.5	10.5	.118 (2.18)*	.111 (1.89)	.109 (1.86)		.763	.019	.129	
3 268	10.5	15.5 ^b	.112 (2.76)*	.083 (1.91)	.131 (3.01)*		.852	.040	.058	
4 246	15.5 ^b	20.5	.152 (1.98)*	.064 (.78)	.099 (1.21)		.673	.017	.183	
5 263	10.5	20.5	.221 (2.93)*	.115 (1.41)	.185 (2.25)*		.574	.035	.201	
6 438	0	5.5	-.066 (1.10)	-.129 (2.14)*	-.129 (2.13)*	-.096 (3.75)*	.800	.060	.184	
7 321	5.5	10.5	.085 (1.50)	.098 (1.65)	.108 (1.84)	.054 (.74)	.755	.029	.128	
8 268	10.5	15.5 ^b	.119 (2.68)*	.094 (2.05)*	.133 (3.05)*	.021 (.41)	.864	.054	.058	
9 246	15.5	20.5	.194 (2.35)*	.103 (.12)	.116 (1.40)	-.005 (.01)	.717	.027	.183	
10 263	10.5	20.5	.294 (3.60)*	.179 (2.12)*	.196 (2.41)*	-.022 (.23)	.625	.073	.196	
11 246	15.5	20.5	.178 (2.10)*	.082 (.94)	.103 (1.24)	-.021 (.22)	.680 (.43)	.019	.184	

^aKey: regression coefficient
(t-value)

^bThis is the year for in-zone Commander promotion.

*Significant at the .05 level.
A t-value greater than 1.96 is significant at the 5% level.
A t-value greater than 1.64 is significant at the 10% level.

Retention beyond 10.5 years of service appears to be related to class standing. Those in the fourth quartile are the least likely to remain in the Navy. Generally, those in the first quartile are the most likely to stay. The difference, however, between the first quartile and the second and third quartiles is usually smaller than the difference between these quartiles and the fourth quartile.

A link between class rank and retention has been confirmed statistically. But the reason for this link is not established. Are those in the higher quartile more likely to attend graduate school and is it merely this advanced education that is related to retention? Or is it the distribution of officers into the restricted line and staff that creates this link? Regressions 7-14 and 6-11 in tables 9 and 10, respectively, suggest that the link is more direct. When these other variables are held constant, class rank remains related to retention.

Officers in the restricted line have higher retention than officers in the unrestricted line to year 10.5 for both year groups. This relationship weakens for retention to later years. Staff officers from the class of 1947 are more likely to stay to year 5.5. For the class of 1950, on the other hand there is a sizeable, although insignificant, negative coefficient. Staff officers, in both classes, have retention similar to unrestricted line officers beyond 5.5 years. Although the majority of coefficients are negative, none are significant. Caution, however, is

warranted in interpreting these results. The officer designation assigned was the most recent one. Therefore, many of the officers included in staff or restricted line designations may not have actually been in those categories during all the time periods. This is of less concern when interpreting the later years' results.

Graduate education, when it includes graduates without advanced degrees, has an ambiguous relationship to retention. In the two cases it is significant, the effects are opposite. For the class of 1947, there is a strong positive effect from 16.5 to 20.5 years (regression 10, table 9). For the class of 1950, in general, there is a strong impression that the relationship is negative; those with graduate education are more likely to leave. For the class of 1947, defining graduate education to include advanced degrees only does not alter the findings. For the class of 1950, the negative relationship weakens.

Officers in the class of 1947 with below-zone promotion to Lieutenant Commander have a 22 percentage point higher retention from 10.5 to 20.5 years of service (regression 11, table 9). For officers on active duty at 20.5 years, early promotion to Lieutenant Commander falls slightly short of being significant at the 5% level in predicting retention to 25.5 years of service. It still shows, however, that graduates with early Lieutenant Commander promotion have a 22 percentage point higher retention rate to 25.5 years of service (regression 12). It should be noted that early promotion to Lieutenant Commander is always significant at the

10% level. Because few officers were selected early for promotion in the class of 1950, we were not able to include this variable in that year's regressions.

In conclusion, we have found a negative relationship between class rank and retention to 5.5 years of service. Beyond 10.5 years of service, there is a consistently strong positive relationship between class rank and retention. This relationship remains intact when graduate education, early promotion to Lieutenant Commander, and designation classification (unrestricted line, restricted line or staff) are corrected for. The relationship between graduate education and retention is less clear-cut. A positive relationship exists only for retention from the Commander zone to 20.5 years for the class of 1947. In general, those with a graduate education have a slightly lower retention rate than those without graduate education. Finally, early promotion to Lieutenant Commander is positively related to career retention.

Promotion Rate Regression Findings

Regression equations were estimated for promotion rates to Lieutenant Commander, Commander, and Captain using the independent variables mentioned above. For promotion to Commander and Captain, we examined promotion rates for those graduates who were active one year above zone. For Lieutenant Commander, we examined the year the graduates were in-zone for promotion because virtually all graduates in both classes had been promoted by one year above zone.

Tables 11 and 12 present the results. When class rank is the only independent variable, the first quartile always has significantly higher promotion rates than the fourth quartile, the difference being widest for Captain selection. Thus, for the class of 1950, of those surviving to the Lieutenant Commander zone, the first quartile had an 8 percentage point higher probability of being promoted than the fourth quartile (regression 1, table 12); of those surviving to one year past the Captain zone, the first quartile had a 37 percentage point higher probability of being promoted (regression 3, table 12). When compared with the second and third quartile, the fourth quartile always had lower promotion rates. When the other variables are added, the dominance of the top quartile remains. The magnitude of the differences declines somewhat for the class of 1947 and increases slightly for two of three of the class of 1950 regressions.

Promotion appears to be independent of our broad designation categories. None of the coefficients are significant, although most of the signs are negative.

Having graduate education generally does not increase an officer's probability of being promoted. The only exception is Commander promotion for the class of 1947. Officers in this class with graduate education had an 18 percentage point higher probability of being selected for promotion to this rank (regression 5, table 11). When only advanced degrees are considered, the variable is consistently positive. Three out of four of the coefficients are significant at the 10% level. The evidence

TABLE 11
 CLASS OF 1947^a
 REGRESSION RESULTS FOR PROMOTION RATES TO LIEUTENANT COMMANDER, COMMANDER, AND CAPTAIN

Number of cases	Rank	Quartile			Restricted officer	Staff officer	Graduate education	Advanced degree	Below zone LCDR	Constant	R ²	MSE
		1	2	3								
1	379	LCDR	.099 (2.70)*	.040 (1.09)	.064 (1.72)				.880	.020	.063	
2	342	CDR	.249 (4.05)*	.120 (1.95)	.211 (3.33)*				.641	.053	.159	
3	234	CAPT	.250 (3.26)*	.185 (2.39)*	.155 (1.95)				.630	.046	.161	
4	379	LCDR	.081 (1.99)*	.028 (.74)	.062 (1.66)	.041 (.96)	-.061 (1.55)	.019 (.63)	-.884	.033	.063	
5	342	CDR	.172 (2.55)*	.069 (1.09)	.177 (2.81)*	-.072 (1.08)	.006 (.10)	.175 (3.61)*	.602	.089	.155	
6	234	CAPT	.182 (2.14)*	.152 (1.88)	.129 (1.60)	.086 (1.04)	-.042 (.50)	.037 (.60)	.619	.067	.160	
7	342	CDR	.166 (2.45)*	.071 (1.14)	.194 (3.11)*	-.078 (1.17)	-.020 (.29)	.196 (3.71)*	.628	.091	.154	
8	234	CAPT	.162 (1.93)	.132 (1.66)	.130 (1.64)	.071 (.87)	-.057 (.67)	.197 (1.79)	.604	.079	.158	

^a Key: regression coefficient (t-value)

*Significant at .05 level
 A t-value greater than 1.96 is significant at the 5% level.
 A t-value greater than 1.64 is significant at the 10% level.

TABLE 12
CLASS OF 1950^a

REGRESSION RESULTS FOR PROMOTION RATES TO LIEUTENANT COMMANDER, COMMANDER, AND CAPTAIN

Number of cases	Rank	Quartile 1	Quartile 2	Quartile 3	Restricted officer	Staff officer	Graduate education	Degree	Constant	R ²	MSE
1	272	LCDR	.082 (2.64)*	.017 (.52)	.066 (1.94)				.912	.033	.035
2	248	CDR	.149 (2.38)*	.063 (.93)	.115 (1.70)				.765	.025	.123
3	174	CAPT	.369 (4.06)*	.091 (.91)	.161 (1.66)				.567	.109	.167
4	272	LCDR	.081 (2.38)*	.022 (1.89)	.067 (1.97)*	.034 (1.01)	.022 (.05)	-.020 (.87)	.922	.038	.035
5	248	CDR	.171 (2.52)*	.080 (1.13)	.120 (1.76)	-.032 (.49)	-.031 (.39)	-.027 (.51)	.779	.028	.124
6	174	CAPT	.391 (4.06)*	.095 (.91)	.160 (1.64)	-.098 (1.07)	-.035 (.30)	.045 (.59)	.545	.116	.169
7	248	CDR	.128 (1.85)	.042 (.59)	.103 (1.52)	-.080 (1.18)	-.074 (.93)	.097 (1.83)	.765	.025	.123
8	174	CAPT	.370 (3.82)*	.084 (.81)	.161 (1.66)	-.124 (1.33)	-.054 (.47)	.104 (1.51)	.537	.126	.167

^a Key: regression coefficient (t-value)

*Significant at .05 level
A t-value greater than 1.96 is significant at the 5% level.
A t-value greater than 1.64 is significant at the 10% level.

suggests that possession of a graduate degree increases the likelihood of being promoted to Commander and Captain, but graduate education short of a degree does not.

Early promotion to Lieutenant Commander increases an officer's probability of being promoted to Commander and Captain. The difference is sizeable, over 19 percentage points, and barely misses significance at the 5% level.

Summarizing this section, the first quartile generally has the highest promotion success rate and the fourth quartile the lowest. Possession of advanced degrees appears to increase the probability of being promoted to Commander and Captain. In addition, early promotion to Lieutenant Commadner increases the probability of being promoted to Commander and Captain.

Attrition: Voluntary or Involuntary

Those not retained either voluntarily leave the service or are forced to leave because they fail promotion. For the class of 1950, the retention points and promotion zones analyzed are sufficiently close to determine voluntary attrition. Table 13 compares expected promotion and retention rates. The table also points out shortcomings of our procedure. First, we violate the constraint that a rate cannot exceed one. In the one case this occurs, the actual rate was one so that the expected value is very close. Second, there appears to be an inconsistency between two of the Lieutenant Commander promotion rates and the comparable retention rates. In the second quartile only 94.4 percent were

TABLE 13
 CLASS OF 1950 EXPECTED
 PROMOTION AND RETENTION, BY QUARTILE^a

Quartile	LCDR Promotion	10.5 to 15.5 Retention	Difference	CDR Promotion	15.5 to 20.5 Retention	Difference
I	1.003	.983	+ .020	.893	.858	+ .035
II	.944	.958	- .016	.807	.762	+ .045
III	.989	.997	- .008	.868	.783	+ .085
IV	.922	.864	+ .058	.765	.680	+ .085

^a Estimates are from regression equations including designation breakdown. The Lieutenant Commander and 10.5 to 15.5 regressions include graduate education as an independent variable. The Commander and 15.5 to 20.5 regressions include advanced education as an independent variable.

promoted. Given the Navy force-out policy, these are the only officers who can stay to 15.5 years. Yet, we computed that 95.8 percent of these officers survived. We are similarly slightly off for the third quartile. Again, we did not constrain the coefficients and this will occasionally happen.

The differences in the third and sixth columns suggest the percent of officers who could have stayed but left the Navy. To Commander, 89.3 percent of the officers one year above zone and in the top quartile had been selected for promotion. Only 85.8 percent of the officers stayed to 20.5 years of service. All those failing promotion had to leave. Thus, 3.5 percent of these officers left voluntarily. The impression one gets from the table is that officers in the lowest quartile are the most likely to leave voluntarily. Officers from the lowest quartile are, therefore, not only the most likely to fail selection and be forced out, they also appear to be the most likely to leave voluntarily.

Officers with advanced degrees are more likely to leave voluntarily. From table 14, we see that for the class of 1947 all officers without degrees who could stay did stay to 20.5 years of service. Of those with degrees, 3.4% left voluntarily. For the class of 1950, those with degrees were far more likely to leave voluntarily. Although the retention from 15.5 to 20.5 years of service differed by only 3 percentage points, the difference in voluntary attrition is 12.5 percentage points.

TABLE 14
 EXPECTED
 PROMOTION AND RETENTION, BY ADVANCED DEGREE^a

	Class of 1947		Class of 1950		Difference
	CDR Promotion	Retention	CDR Promotion	Retention	
With Degree	.990	.956	.990	.830	+ .160
Without Degree	.794	.803	.893	.858	+ .035

^a Rates are for unrestricted line officers who graduated in the first quartile.

Concluding Remarks

This paper set out to examine the relationship of class standing and graduate education to retention and promotion for USNA graduates. Regression equations were estimated for the classes of 1947 and 1950. We conclude that class standing is related to both retention and promotion. With regard to retention, the first quartile is more likely to stay beyond 10.5 years of service than the fourth for both classes. With respect to promotion, the first quartile has a significantly greater probability of being promoted to Lieutenant Commander, Commander, and Captain than does the fourth quartile. Possessing an advanced degree increases an officer's probability of being selected for promotion to Commander and Captain.

The study was limited to the analysis of a small set of variables. Although a number of these variables were significantly related to retention and promotion, they account for only a small portion of variances. Other variables, such as billet assignments, time at sea, and demographic characteristics would probably account for additional variance, but this data was not available.

Finally, we have not made a systematic effort to compare the two classes. The class of 1947 graduated in June 1946, just after World War II and the class of 1950 graduated at the beginning of the Korean War. It is possible that although the classes are not far apart in time, circumstances such as reductions in forces and fluctuations in the job market affected the classes at different

points in their careers and created differences in their retention and promotion. More generally, each USNA class may have its own unique behavior pattern. In this paper, we have sought to stress the similarities in behavior of two classes. It should be apparent that the similarities are great.

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APPENDIX A
DATA BASE SPECIFICATION

The data base consists of information on every Naval Academy graduate from the class of 1947 and 1950. For each graduating member of the class, we recorded class standing, current military status information, officer designation, graduate education, and yearly rank from the year of graduation through December 1973.

The class of 1947 had 821 members and the class of 1950 had 692. We eliminated graduates who had relevant information missing, were discharged upon graduation, joined another military service, or were foreign nationals. The class of 1947 includes 37 graduates who joined the Marine Corps; the class of 1950 includes 160 graduates who joined the Air Force and 48 who joined the Marine Corps.

The data was compiled from two sources. The names and class standing of the original cohort were obtained from The Register of Alumni of the United States Naval Academy, 1845-1973. Although this book contained other information it was not complete and often contradicted what was found in the Annual Register of Commissioned and Warrant Officers of the United States Navy and Reserve Officers on Active Duty. This source was used to obtain all other data on active duty officers. For data pertaining to retirement, we used The Annual Register of Retired Commissioned and Warrant Officers, Regular and Reserve of the United States Navy.

Several of the variables in our data base need explanation and are listed below:

Class Standing

The graduating members of each class are listed according to class standing at the end of their senior year. Class standing as it appears upon graduation is the cumulative standing over four years. Each year academic subjects, aptitude, conduct, and physical education are given different weight factors and then averaged together to give a final class standing for that year.

Quartile Rank

This was determined by dividing the original number of the graduating members of the class by four prior to the elimination of any individuals.

Type of Separation

There are four types of separations:

Resigned

Retired voluntarily

Discharges of all types (honorable, dishonorable, discharge upon graduation), retired disabled, involuntary retirements

Dead or missing in action.

In the regressions, we eliminated any officer who was dead by the end of the time period under examination.

Officer Designation

The most recent designation is used.

Advanced Degree

Advance degree includes MA, MS, LLB, BD, Ph.D., MD, and DDS. For each degree awarded, the year of the degree is the first year it is listed in the Annual Register.

Annual Rank

For each year of service, the graduate's rank was recorded. Rank was obtained from the Annual Register whose information is as of December 31 of each year. Since graduation was in June, rank during the first year of service was the rank attained by six months of service. Second year rank covers the period from six months to 1-1/2 years of service and not from 1 to 2 years. This is true for all subsequent yearly ranks.

Post-Graduate Study Prior to 1962

Prior to 1962, advanced degrees were not recorded in the Annual Register. It only specifies whether the officer had done any post-graduate work of any type and specifies neither length of time of studies nor if a degree was awarded.

Year Post-Graduate Study Began

This is the first year that post-graduate study for a particular individual is listed in the Annual Register.

APPENDIX B

SPECIFICATION OF REGRESSION EQUATIONS
FOR RETENTION AND PROMOTION

The regression equation is of the form:

$$Y_i = B_{i0} + \sum_{j=1}^7 B_{ij} X_{ij} + \epsilon_i$$

where:

$X_{i1} = 1$ if graduate is in the first quartile
 $= 0$ otherwise

$X_{i2} = 1$ if graduate is in the second quartile
 $= 0$ otherwise

$X_{i3} = 1$ if graduate is in the third quartile
 $= 0$ otherwise

$X_{i4} = 1$ if graduate is a restricted line officer
 $= 0$ otherwise

$X_{i5} = 1$ if graduate is a staff officer
 $= 0$ otherwise

$X_{i6} = 1$ if graduate has any graduate education
 $= 0$ otherwise

$X_{i7} = 1$ if graduate was promoted to Lieutenant Commander
below zone
 $= 0$ otherwise

and, for retention,

$Y = 1$ if graduate is on active duty during year in
consideration
 $= 0$ otherwise

and, for promotion,

$Y = 1$ if graduate is promoted one year past zone (in zone
for Lieutenant Commander)
 $= 0$ otherwise

We have chosen the simplest functional form to estimate the relationships. The justification is economy and the lack of a complete data set from which to test a complex model. But we now have two concerns: the extent to which our variance-covariance matrix and coefficient estimates are biased. Ashenfelter (reference 5) has explored the bias in the variance-covariance matrix. He assumes that the linear probability function (the one used in the paper) is correct and then considers the implication of failing to weight the observations. Ashenfelter concludes that ordinary least squares is slightly more conservative, in the sense that we will not reject the null hypothesis when there is sufficient evidence to do so. Comay (reference 6) reports similar results. Although these findings are encouraging, our jubilation is tempered by the lack of theoretical justification for the direction of the bias. We therefore chose to focus our discussion in the text on coefficients significant at the 5% level.

The second area of concern is biasedness in the coefficients. It is known that the dependent variable is always in the closed interval from 0 to 1. Predicted values from the linear probability function can violate this interval. Thus, the function is clearly inappropriate. But to what extent has it biased our conclusions?

Most functions can be written to a first approximation in linear terms. The coefficients in our regression are thus unbiased transformations of logit or probit parameters. Including quadratic terms suggests that if there is a bias, it is in the omission of an

interaction term. The direction, however, is uncertain. In our case, we had no prior reasons to suspect interaction nor a sufficient data base to investigate it. Also, for the regressions with only class standing as the independent variable, there is no bias because the interaction term vanishes.

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