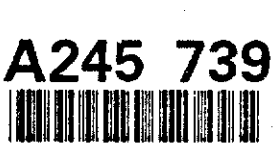
1991-12

An analysis of the impact of graduate education on the performance and retention of general unrestricted line officers

Jordan, Susan Sturm

Monterey, California. Naval Postgraduate School



NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

AN ANALYSIS OF THE IMPACT OF GRADUATE EDUCATION ON THE PERFORMANCE AND RETENTION OF GENERAL UNRESTRICTED LINE OFFICERS

by

Susan Sturm Jordan

December, 1991

Thesis Co-Advisors: Stephen L. Mehay
William R. Bowman

Approved for public release; distribution is unlimited

(Unclassified)
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DCLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b. OFFICE SYMBOL (*If Applicable*) 36	7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c. ADDRESS (*city, state, and ZIP code*) Monterey, CA 93943-5000	7b. ADDRESS (*city, state, and ZIP code*) Monterey, CA 93943-5000
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 6b. OFFICE SYMBOL (*If Applicable*)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (*city, state, and ZIP code*)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (*Include Security Classification*)
AN ANALYSIS OF THE IMPACT OF GRADUATE EDUCATION ON THE PERFORMANCE AND RETENTION OF GENERAL UNRESTRICTED LINE OFFICERS

12. PERSONAL AUTHOR(S)
Jordan, Susan S.

13a. TYPE OF REPORT	13b. TIME COVERED FROM TO	14. DATE OF REPORT (*year, month, day*)	15. PAGE COUNT
Master's Thesis		December 1991	102

16. SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government

17. COSATI CODES			18. SUBJECT TERMS (*continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUBGROUP	Graduate Education, Postgraduate Education, General Unrestricted Line Officers, Masters's Degree, Promotion, Retention.

19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

This thesis focuses on the impact of graduate education on the promotion performance and retention of General Unrestricted Line Officers. Logistic models are developed to determine the effects of a graduate degree from the Naval Postgraduate School and other sources on the probability of promotion to Lieutenant Commander and Commander, and on retention up to the Lieutenant Commander and Commander levels. Results indicate that graduate education has a positive impact on the probability of promotion to Lieutenant Commander, with Naval Postgraduate School showing a stronger effect than other education sources. No significant effect was noted for promotion to Commander. Graduate education was found to have a significantly negative impact on retention prior to the Lieutenant Commander selection point. Results for retention at the Commander selection level were inconclusive. It is recommended that further research be done concerning the impact of graduate education on other officer communities.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT [X] UNCLASSIFIED/UNLIMITED [ ] SAME AS RPT. [ ] DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Stephen L. Mehay	22b. TELEPHONE (Include Area Code) (408) 646-2643 22c. OFFICE SYMBOL 54Mp

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted SECURITY CLASSIFICATION OF THIS PAGE

Approved for public release; distribution is unlimited.

An Analysis of the Impact of Graduate Education on the Performance and Retention of General Unrestricted Line Officers

by

Susan S. Jordan

Lieutenant Commander, United States Navy

BS, Lincoln University of Missouri, 1979

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1991

Author: [redacted]
Susan S. Jordan

Approved by: [redacted]
Stephen L. Mehay, Thesis Advisor

[redacted]
William R. Bowman, Co-Advisor

[redacted]
David R. Whipple, Chairman
Department of Administrative Sciences

ABSTRACT

This thesis focuses on the impact of graduate education on the promotion performance and retention of General Unrestricted Line Officers. Logistic models are developed to determine the effects of a graduate degree from the Naval Postgraduate School and other sources on the probability of promotion to Lieutenant Commander and Commander, and on retention up to the Lieutenant Commander and Commander levels. Results indicate that graduate education has a positive impact on the probability of promotion to Lieutenant Commander, with Naval Postgraduate School showing a stronger effect than other education sources. No significant effect was noted for promotion to Commander. Graduate education was found to have a significantly negative impact on retention prior to the Lieutenant Commander selection point. Results for retention at the Commander selection level were inconclusive. It is recommended that further research be done concerning the impact of graduate education on other officer communities.

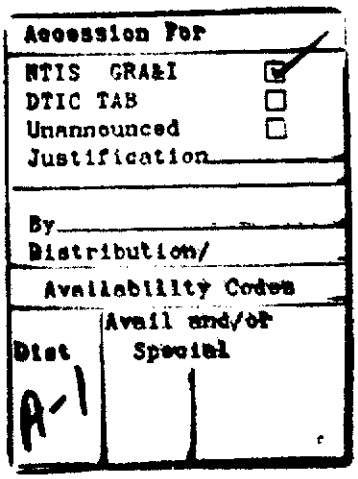


TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

The benefits of graduate education have been acknowledged by the Navy for many years. Graduate education encourages "higher levels of professional knowledge and technical competence; provides incentives for recruitment and retention of personnel with ability, dedication and capacity for growth; and recognizes educational aspirations of individuals." [Ref. 1]

In order to encourage its officers to obtain graduate education, the Department of Defense (DOD) offers several educational programs. One such program, the Naval Postgraduate School, "exists for the sole purpose of increasing combat effectiveness of the Navy and Marine Corps. It accomplishes this by providing post-baccalaureate degree. . . programs in a variety of subspecialty areas not available through other institutions." [Ref. 2] Other DOD-sponsored schools include the Air Force Institute of Technology and the Defense Intelligence College.

In those instances where an appropriate curriculum is not available at a DOD-sponsored school to meet a valid subspecialty requirement, the use of a civilian university is authorized at Navy expense. [Ref. 1] A list of approved

civilian institutions appear annually in OPNAVNOTE 1520 [Ref. 3].

In addition to Navy-funded programs, an officer may choose to pursue a graduate degree at his/her own expense. In this case, the officer attends an institution of his/her choosing on a not-to-interfere basis with his/her normal duties. If he/she should choose to receive acknowledgement of the degree for a Navy subspecialty code, he/she must request approval in accordance with the Manual of Navy Officer Manpower and Personnel Classification [Ref. 4].

The attainment of a graduate degree in the Navy is useful in partially fulfilling the requirements as a proven subspecialist in a particular field. Although one can also become a proven subspecialist through repeated tours of duty in a specific area of expertise, the most common path to this goal is through graduate education. Since designation as a proven subspecialist is a criteria for promotion to higher paygrades (i.e., Commander and Captain), the attainment of a graduate degree is critical to success in the Navy.

B. OBJECTIVE

The objective of this thesis is to compare the effects of graduate education on General Unrestricted Line Officers' (Gen URL) probability of promotion and of leaving the Navy. Specifically, individuals with degrees from the Naval

Postgraduate School are compared to those with degrees from other sources, (including both Navy- and self-funded programs), and to those without a graduate degree. The effects of graduate education are evaluated using multivariate analytical techniques.

C. SCOPE, LIMITATIONS, ASSUMPTIONS

The General Unrestricted Line Officer community is chosen for this study because the career path for Gen URLs, unlike the Surface Warfare community, is not based around specific technical/warfare qualifications. Rather, "strong performance in both leadership and subspecialty billets is the traditional path to career success . . .". [Ref. 5] Consequently, attainment of a graduate degree can provide the Gen URL officer with an advantage in achieving career path requirements. Other communities also have a requirement to attain proven subspecialist designations; however, subspecialty attainment is not as critical to promotion as it is in the Gen URL community.

A potential limitation of this study is that the majority of officers in the senior paygrades of the Gen URL community are women who fit a relatively standard profile. (i.e., most are white and single, with no dependents). The distribution of Gen URLs by demographic categories is provided in Tables 7 - 10 of Chapter III. Historically, the males in the community automatically transferred in to the

community for a variety of reasons, including family hardships, medical and academic disqualifications from other communities and failure to obtain required warfare qualifications. (This practice was changed as a result of the 1987 Women's Study Group and since 1990 the Gen URL community selectively accepts transfers into the community on a case-by-case basis). [Ref. 6] As a result, most males have not been strong competitors for promotion to the higher paygrades and, therefore, are not well represented in the dataset for the promotion model for Commanders. This, in turn, results in a lack of variation in the characteristics of the senior Gen URL officers included in the sample and may inhibit a thorough analysis of their probability of promotion or of leaving the Navy.

D. ORGANIZATION OF THE STUDY

Chapter II contains a review of human capital investment theory and how it relates to graduate education. It also includes a review of pertinent literature on graduate education and retention. Chapter III describes the formulation and content of the data sets studies and an explanation of the research methodology utilized. Chapter IV presents the results from the multivariate analysis. Chapter V includes conclusions derived from the multivariate analysis and recommendations for further research.

II. REVIEW OF LITERATURE

A. HUMAN CAPITAL INVESTMENT THEORY

When discussing an officer's decision to obtain graduate education, one can do so in terms of Becker's theory of human capital investment. [Ref. 7] The theory of human capital is based on the assumption that education, training, and some on-the-job work experiences are investments that have an immediate cost and that yield a future stream of returns. Costs are normally incurred in the form of direct expenses (e.g., tuition, books, etc.) and the opportunity cost to the individual (i.e., foregone earnings). From the employer's perspective, if the initial costs can be recovered with an acceptable rate of return over the worker's remaining (expected) employment in the form of increased productivity, then the investment will be undertaken. From the employee's viewpoint, as long as his portion of the investment expense is recovered with an acceptable increase in earnings/benefits, then he will choose to undertake the investment.

Although all aspects of human capital investment theory can be related to the military, for purposes of this study, only one specific type of human capital investment will be discussed, that of graduate education for naval officers.

The decision to invest in graduate education can be discussed in terms of three characteristics: (1) the specificity of the investment to the Navy; (2) the means of financing; and (3) the timing of the investment.

First, human capital investments can be either general or firm-specific in nature. General investments in graduate education are those that increase the productivity of the individual with any employer, including the Navy. In the case of naval officers, a graduate degree in Business Administration or Psychology, for example, could be considered a general investment because it could enhance an individual's productivity in other organizations. Firm-specific human capital investments, on the other hand, increase the individual's productivity only in a specific organization/firm. An example of firm-specific graduate education could be a Master's Degree in Anti-Submarine Warfare Although a few of the courses in this graduate program could be considered general human capital investment, the program mostly enhances the officer's benefit to the Navy.

A second characteristic of human capital investment is the means of financing the investment. When obtaining graduate education in the Navy, one has several options. One can undertake fully-funded graduate education, full-time funded graduate education or self-funded graduate education. Those considered fully-funded attend graduate school full-

time at the Naval Postgraduate School or other approved Department of Defense or civilian institution. All educational expenses are paid by the Department of the Navy and the individual continues to receive full pay and allowances. In return for this investment, the individual "owes" the Navy an active duty obligation period "equal to three times the number of months of such education completed during the first year of graduate school. . ." [Ref. 8]. Education exceeding 12 months is repaid on a month-for-month basis. [Ref. 1] In addition, "officers who have received Navy funded graduate education will serve one tour in a validated subspecialty position as soon as possible, but not later than the second tour following graduation." [Ref. 1] Thus, while the Navy pays the direct costs of the education, as well as the opportunity costs, the individual also incurs a "cost" in the form of additional obligated service.

Individuals in full-time funded programs attend school full-time and receive full pay and benefits, but tuition is paid by the individual or by a non-Navy funded scholarship. [Ref 1]. Any individual attending a graduate education program for 26 weeks or more is considered to be in a full-time Navy funded program and is subject to the same active service obligation indicated above.

An individual may, of course, choose to obtain a graduate degree at his own expense. This must be done on a not-to-interfere basis with one's regular duties. Once a

degree is obtained, the officer is under no additional service obligation to the Navy, since the Navy did not contribute to the investment expense.

Regardless of the type of educational investment (i.e., general or firm-specific), if the individual receives Navy funding for graduate education, he is required to complete additional service. In this way, the Navy gets a return on its investment in the officer who is presumed to be more productive during the obligated period.

Finally, the third characteristic of human capital investment is the timing of the investment. From the officer's viewpoint, greater returns from an investment in graduate education are realized the sooner the investment is undertaken. Consequently, an officer's record is considered by the Graduate Education Selection Board at any time between the third and tenth year of commissioned service. The earlier the investment is made, the longer the period of time over which prior investment costs can be recouped. From the Navy's perspective, the timing is not as critical because an additional service obligation is incurred regardless of when the degree is received. However, it is important that the Navy provide its officers with graduate education prior to the time when that knowledge would be needed for a particular billet/job.

B. GRADUATE EDUCATION RESEARCH

Although the benefits of graduate education to the Navy have been acknowledged and documented, [Ref. 1], research on this area has been limited. Significant work on graduate education was done by Lockman, Cymrot, Richardson and Murray (1986) [Ref. 9]. Although not a quantitative analysis, their study does provide useful statistics to document the Navy's emphasis on graduate education and to help quantify its value to the individual and the organization.

Lockman et al looked at the graduate education levels and specialty fields of Naval officers in key leadership and management billets. These figures were compared to those of managers of civilian firms, U.S. Navy civil servants, foreign military services and other U.S. military services. In addition, they discussed subspecialty coding of at-sea billets and Systems Acquisition Management Education, which are unrelated to this thesis.

Overall, the level of graduate education in the Navy compared well to that of corporate managers and to high level Navy civil servants. At the graduate level, the officers and the corporate managers are on a par at about 20 percent, and the URL and civil service levels are 16 percent. Specific figures are provided in Table 1. However, the Navy utilized graduate education more extensively than the civilian community. Further, the Navy invests more in training and educating its officers than do civilian firms

or civil service. On the other hand, graduate education in the civilian sector and the federal civil service tended to be used for specific jobs, whereas in the Navy, it was utilized in a variety of assignments and responsibilities.

They also compared graduate education between the U.S. and foreign militaries. The Soviet and West German militaries were found to have higher rates of officer graduate education than the U.S. Navy. But their purposes and the utilization of graduates significantly differed from ours. The Soviet program had a high political content, while the West German program was viewed as beneficial to society at large since many of their officers return to the civilian community.

TABLE 1
EDUCATIONAL LEVELS IN THE NAVY AND LARGE CIVILIAN ORGANIZATIONS

	<Bachelor's	Bachelors	Master's +	Doctorate	= Postgraduate
Adjusted officer corp	4	75	21	<1	21
URL	1	83	16	<1	16
Navy civil service	37	42	14	2	16
Civilian firm average	34	45	17	3	20

Compared to other services, all of which have fully funded, full-time graduate education programs, the Navy had

the highest percent load ratio of officers with graduate education to officer end strength of any service, with a ratio of 1.75 graduate educated officers per 1,000 end strength. (Load ratios are computed by dividing the number of officers in graduate education programs annually by the number of active duty officers). Comparative figures are provided in Table 2.

TABLE 2
INTERSERVICE GRADUATE EDUCATION LOAD RATIOS

	Load*		Active Officers(000)#		Load Ratio(%)	
	FY 75	FY 85	FY 75	FY 85	FY 75	FY 85
USN	1,234	1,236	65.5	70.6	1.88	1.75
USAF	1,570	1,326	105.0	108.2	1.50	1.23
USA	1,049	1,160	102.6	109.4	1.02	1.06
Total	3,862	3,722	273.1	288.2	1.32	1.21

* *Military Manpower Training Report*
\# *FYDP*

In discussing the Navy's return on its investment in officer graduate education, the authors echoed some problems that appeared in other studies, specifically, selectivity bias and calculating the true return on one's investment. First, since selection for graduate education is competitive, the more capable officers tend to be selected. [Ref. 10] Therefore, comparing productivities of officers with and without graduate education would tend to overstate

the benefits. Those with graduate education are likely to be evaluated as more capable even without the advanced degree.

Second, the effect of graduate education on retention is uncertain. Part of the benefit of graduate education is Navy- specific and encourages officers to stay in the Navy. However, graduate education also improves general skills (e.g., in leadership and management) and makes officers more marketable to civilian employers.

Third, graduate education can significantly enhance an officer's problem solving abilities, thereby increasing his productivity. But because this effect is difficult to measure it is often overlooked or underestimated when calculating a return on an investment in education.

Lockman et al clearly indicate that measuring the productivity of leaders and managers is not an easy task. However, measurable differences can be observed in promotion, retention, and subordinate performance.

They also briefly discussed graduate education and performance. They attempted to measure performance through fitness reports, but found insufficient variation in markings to provide substantial results. They also analyzed promotion and retention patterns for officers on the Officer Master File as of March 1985 with eight to 30 years' length of service. No direct causal relationship could be established. However officers with graduate education

tended to be promoted faster and stayed in the Navy longer than those who did not. Finally, they also compared the readiness measures on Material Condition Index (MCI) scores for ship CO's and XO's with and without graduate education. They found that ships whose CO/XO had graduate education had Planned Maintenance System (PMS) scores five points higher than those without graduate education. PMS scores, in turn, were a significant contributor to MCI scores. The magnitude of the relationship was as high as that found between measures of personnel resources and material condition in a related Center for Naval Analysis study done in 1986. [Ref. 11]

The study by Lockman et al provides a general framework of information about graduate education in the Navy. The most specific and detailed analysis of the benefits of graduate education was done by Cymrot in 1986. [Ref 10]

The basis of human capital investment theory states that additional education makes officers more productive. Three common indicators of productivity are: performance within rank, retention, and promotion. Cymrot specifically addressed the issue of the effect of graduate education on promotion. He developed a technique for determining at least a portion of the marginal benefit to the Navy from additional graduate education. (Increased promotion rates being only one component of the marginal benefit).

Cymrot looked at data on Naval officers on active duty in March 1985 who had length of service (LOS) between eight and 30 years, the timeframe when most officers have completed graduate education through their retirement. He did not, however, include a variable indicating specifically when a graduate degree was obtained. Further, he focused on Unrestricted Line (URL), Restricted Line (RL), and Staff Corps officers. Limited Duty Officers were eliminated because of the small number of observations available.

The data that Cymrot utilized did not include officers who had left active duty prior to 1985. Consequently, he acknowledges that there could be differences in characteristics between those who stayed in the Navy and those who left, which could bias the results.

In determining the partial effect of graduate education on the probability of promotion (the dependent variable), he developed a logit model using the following categories of independent variables: personal characteristics, previous experience and performance indicators, and Navy structural variables. The personal characteristics included age, sex (MALE =1), race (WHITE=1), and a dummy variable indicating if an officer had a graduate degree (GRAD ED = 1). The GRAD ED variable was most important in Cymrot's study, but the other variables were necessary to control for other factors that also could influence promotion.

Since officers selected for graduate education may have been selected because of their superior promotability, one cannot state unequivocally that graduate education "caused" some individuals to promote at higher rates than non-graduate educated officers. To deal with this potential selectivity bias, Cymrot included variables reflecting previous experience and performance, based on time in rank and service continuity. The time-in-rank variable (TINRANK) measured the number of months spent in ranks below the current rank being studied, and captured the rate of an officer's previous promotion. Cymrot included the previous promotion rate variable to reflect some inherent differences in productivity among officers that is unrelated to the effects of graduate education.

The service continuity variable (DROPOUT=1) was used to identify those with discontinuous Naval service. It was anticipated that those who left the Navy and later returned would have a different level of productivity than an officer with continuous service. Initially, one would expect the effect to be negative because leaving the Navy may lead to a depreciation of talents. However, it may be that officers who leave the Navy have unique characteristics that make them more productive both in and out of the Navy.

The designator dummy variables were included as structural variables and were coded as URL (base case), RL, and STAFF. These were included to see the differences in the

probability of promotion between designators. The observations were grouped by four promotion points and respective LOS groupings: LT to LCDR (LOS 8 - 14), LCDR to CDR (LOS 14 - 21), CDR to CAPT (LOS 20 - 26), CAPT to FLAG (LOS 25 - 30). Each LOS group was analyzed separately. Cymrot's results are depicted in Table 3. Additional logit regressions were run to determine the effect of graduate education on promotion probabilities at each LOS year. These probabilities appear in Table 4.

TABLE 3. DETERMINANTS OF PROMOTION BY GROUPS OF LOS

Independent Variables	Promotion to LCDR LOS 8-14	CDR LOS 14-21	CAPT LOS 20-26	FLAG LOS 25-30
INTERCEPT	-6.346 (5.93)	7.672 (7.04)	-4.160 (2.91)	-2.424 (.03)
GRAD ED	1.130 (16.55)	.425 (6.62)	.673 (6.70)	-.002 (.01)
T IN RANK 01	-.186 (5.99)	-.460 (34.10)	-.019 (1.42)	.020 (.57)
T IN RANK 02	-.069 (4.15)	-.192 (21.89)	.173 (7.74)	-.002 (.03)
T IN RANK 03		-.054 (10.75)	-.196 (20.38)	-.133 (3.88)
T IN RANK 04			-.042 (6.95)	-.183 (8.29)
T IN RANK 05				-.124 (9.23)
DROPOUT	3.132 (21.61)	.501 (4.15)	.740 (3.74)	.261 (.47)
WHITE	.063 (.69)	.121 (.81)	-.515 (1.42)	8.147 (.09)
MALE	.368 (2.87)	.281 (1.24)	.378 (.84)	-1.227 (1.58)
AGE	.118 (7.20)	.064 (2.96)	.129 (3.37)	.152 (1.62)
STAFF	-1.133 (15.04)	-.209 (2.53)	-.100 (.68)	-1.356 (2.48)
RL	-.716 (7.27)	-.067 (.72)	.032 (.24)	-.342 (.74)
LOS	.779 (35.25)	.311 (11.36)	.374 (7.94)	.487 (3.28)
N	9923	8554	3624	1444
Log likelihood	-4049.5	-3451.1	-1403.0	-194.1
X	5500.6	4918.5	2204.7	333.6

TABLE 4
CHANGE IN PROMOTION PROBABILITIES
FROM GRADUATE EDUCATION BY LOS AND RANK

LOS	LCDR	CDR	CAPT
8	.559		
9	.034		
10+	.181		
11	.185		
12	.191		
13	.223		
14	.143	.077	
15		.074	
16+		.077	
17		.070	
18		.091	
19		.052	
20		.123	
21		.033	.098
22+			.119
23			.158
24			.093
25			.292
26			.138

Cymrot found the GRAD ED variable to be positive and significant for all selection points (LT to LCDR, LCDR to CDR, etc.) except from CAPT to flag rank. His results indicated that graduate education increased the probability of promotion to LCDR by 26%, to CDR by 10.6%, to CAPT by 16.5% and the Flag by 0%. Two alternative explanations were offered for these results. First, graduate education could have increased an officer's productivity, thereby increasing his chances of getting promoted. This is especially important since control variables were included to account for his previous experiences. Alternatively, the graduate

education selection committee did a good job in selecting "promotable" officers to attend graduate school. Cymrot felt the first explanation was more credible because of his controlling for previous time-in-rank. The TINRANK variables had consistently negative and significant coefficients, indicating that the less time spent in previous paygrades (the faster promotions came), the more likely an officer is to get promoted to the next rank.

Of the personal characteristics variables, only AGE had a significant impact on promotion -- older officers were more likely to get promoted to a higher grade than younger ones. Neither sex nor race had a consistent impact, though males were more likely to get promoted to LCDR than females.

By designator, URL officers were found to be more likely to be promoted to LCDR than RL or STAFF. But above that level, there was no significant difference between URL and RL. However, both categories were more likely than STAFF to be promoted to higher ranks. LOS was positive and significant for all levels, but this was anticipated because one of the criteria for promotion is length of service.

The DROPOUT variable had a surprising result. It was positive and significant for all ranks but the Flag levels. In the civilian labor market one would tend to believe that an inconsistent work record would decrease one's chances of promotion. However, results of this study showed broken service did not prove detrimental to one's probability of

promotion in the Navy. Cymrot felt that this could be because the sample of people who leave and return is not random, but rather that they may all exhibit above average ability. However, since officers who left the Navy before 1985 are not included in this study, one cannot definitively conclude that the effects shown by the DROPOUT variable are indeed reflective of actual activity.

Cymrot also considered the effect of graduate education on below-zone promotions. His results showed that graduate education helped in getting early promotion as well as ensured eventual promotion in-zone.

To determine the Navy's return on its investment in graduate education, Cymrot compared the marginal benefit to the marginal cost. Utilizing the equation:

$$E(MB)t = MP1\ (p_i^g - p_i^n)\ (a_i - a_{i-1})$$

where MP^1 = the marginal product at LOS 1 (in this case equivalent to the MP for LT at LOS 8)

p_i^g = the probability of promotion for graduate educated officers

p_i^n = the probability of promotion for non-graduate educated officers

a_i = a productivity index at each rank = MP_i/MP^1

and information from Tables (4) and (5), he estimated the benefit to be between 15 and 40 percent of the productivity of a Lieutenant at LOS 8. (Table 5 shows the value of the a_i's for the ranks and LOSs relevant in this study using the 1985 pay tables. The elements of the table are determined

by dividing the base pay for each rank and LOS by the base pay for lieutenants with LOS 8.) The majority of the marginal cost of graduate education is the time the officer spends in school. For most programs, officers spend approximately 18 to 24 months in school at LOS 6 or 7. Assuming an officer's time at LOS 6 or 7 is approximately equal to that at LOS 8, the marginal cost of graduate education would be 18 to 24 months, while the marginal benefit resulting from increased promotion was determined to be only 2 to 5 months. However, as Cymrot also pointed out, one would need to determine the other components of the benefits (e.g., increased productivity within rank and increased retention) in order to estimate the full benefit of graduate education to the Navy. Only then can an accurate comparison of marginal costs to benefits be made.

TABLE 5
BASE PAY AT DIFFERENT RANKS AND LOS
RELATIVE TO BASE PAY OF LIEUTENANTS AT LOS 8

LOS	LT	LCDR	CDR	CAPT
8	1.000	1.036		
9	1.000	1.036		
10	1.054	1.106		
11	1.054	1.106		
12	1.106	1.168		
13	1.106	1.168		
14	1.133	1.222	1.293	
15	1.133	1.222	1.293	
16		1.275	1.390	
17		1.275	1.390	
18		1.310	1.470	
19		1.310	1.470	
20		1.310	1.514	1.674
21		1.310	1.514	1.674
22			1.567	1.771
23			1.567	1.771
24			1.567	1.771
25			1.567	1.921
26			1.567	1.921

Utilizing human capital investment theory, Steiner (1987) [Ref. 12] also tried to measure the benefits to the Navy and the individual officer of investing in graduate education. As a "proxy" for an officer's marginal productivity, he calculated survivor rates and time in rank (TIR) between promotions for three groups: Navy funded Master's degree, self-funded Master's degree, and non-Master's. His results showed that Navy-funded degree graduates stayed in the Navy longer and were promoted faster than either of the two remaining groups.

Utilizing data from the Officer Master File and Naval Postgraduate School student records, he looked at Unrestricted Line (URL) officers in LOS 3-15. (The LOS range reflected when the majority of URL officers received their graduate education). Data elements/independent variables utilized were: designator, gain/loss indicator, Separation Program Designator (Loss Code), Promotion History/Date of Rank, and Educational Information(Year, Sponsor, Major).

He calculated survivor rates for each cohort using the following formula:

$$E[G_i] = E\{X_i/n] = 1/n\ E[X_i\} = n*g_i/n = g_i$$

where G_i = survivor rate at i = $(X_i\ /n)$
n = original number in a cohort
X_i = the number that are still in the system in future period i
g_i = the probability that an individual survives i years

His results from calculating survivor rates indicated that almost all Navy-funded graduate degree recipients remain in the service "within the prescribed minimum obligation of service dictated by DOD policy", i.e., they fulfilled their additional service obligation. Further analysis also revealed that 88% separated from the service due to either expiration of their term of service or mandatory retirement. Of those who retired, less than 10% failed to select for promotion to higher ranks for LOS 15 and below. A majority of non-Navy funded graduates

separated within the first two years after graduation. A significant number of officers witnout Master's Degrees separated during the first year after completion of their commissioning source minimum service obligation.

In testing for statistical differences in TIR, he utilized sample means and sample standard deviations from each promotion category (i.e., 0-3 to 0-4, 0-4 to 05, 05 to 06) and compared the differences for those with fully funded versus self-funded graduate education.

His hypothesis was:

H_o : $u_{i1} - u_{i2} = 0$ (null hypothesis)
H_1 : $u_{i1} - u_{i2} \neq 0$ (alternative hypothesis)

with the test statistic:

$$z = \frac{Y_{i1} - Y_{i2}}{\sqrt{\frac{\sigma_{i1}^2}{n} + \frac{\sigma_{i2}^2}{n}}}$$

and rejection region = Reject H_o if $|z| > z_{\alpha/2}$

Results of the TIR tests showed that, for promotion from 0-3 to 0-4, Navy-funded graduate officers are promoted on the average, nearly two months sooner than the other comparison groups. Also, when determining the number of officers being promoted, both the Navy-funded and self-funded graduate officer totals outnumbered the non-Master's

officers by a ratio of two to one. (This was due to the large number of non-Master's officers who leave the service prior to eligibility for O-4). Results for promotion from O-5 to O-6 indicated that a Navy-funded graduate officer was promoted on average nearly six months sooner than a non-Master's officer and three months sooner than a self-funded graduate officer.

In determining who benefits from an investment in graduate education, Steiner stated that both the Navy and the individual benefit. The Navy benefits significantly because officers who receive fully funded graduate education are estimated to remain in the Navy longer than either of the other two categories. The URL officer benefits because of the faster promotion times for officers with a graduate degree.

C. RETENTION RESEARCH

The subject of retention and attrition in the military has been studied extensively throughout the years. Many studies focus on the reasons why people choose to leave the Navy. Others focus on the behavior of those leaving the Navy and attempt to determine a similar pattern of characteristics. Most retention studies focus on the enlisted force. Because this study is focused upon the retention behavior of officers, only retention studies on officers will be cited.

Research by Lowell (1987) [Ref. 13] focused on career orientation of officers, specifically the issue of female naval officers. He looked at the effects of biodemographic, personal, tenure, economic, civilian alternatives and job related factors on female officers' turnover decisions.

Utilizing the 1985 DOD Survey of Officer and Enlisted Personnel, he conducted a binary logit analysis to determine the effects of the above listed variable categories on short and long term career intentions. Officers were divided into two groups: Group I - those with five or less YOS; Group II - those with greater than five but less than 10 YOS.

The final logit models tested 20 independent variables. Results, by group, indicated:

Group I - Older women were more likely to be career oriented than younger women. The effects of race, education, family status and most job related factors were insignificant. Job Satisfaction, however, was negative and significant at the .01 level. Of the designator variables, those in occupations other than GEN URL, Aviation, and Supply appeared to be career oriented.

The personal influence variable TASTE was significant, indicating that individuals with strong taste for the military will make it a career; more or less a self-selection process.

Additional results indicated that USNA graduates were strongly career oriented; those with more time in the Navy

tended to stay for 20 years; and those who felt they had good civilian job opportunities were less likely to stay for a career.

Group II - The variables for job factors showed that Promotion Opportunities and Family Satisfaction had the most significant effect on career orientation. As with Group I, both TASTE and TENURE were also significant.

When comparing the two groups, both AGE and EDUC changed from positive in Group I to negative in Group II. While not significant, the pattern indicated to Lowell that the older and more experienced (educated) a woman became, the less likely she was to stay in the Navy.

Though statistically insignificant, the Family Status variables indicated that a female officer married to a service member with children was more likely to leave the Navy, the longer she remained in the Navy. However, the military couple without children appeared, in the long term, to indicate that the female officer would stay for a career.

Among job factor variables, the shift in significance from Job Satisfaction in Group I to Promotion Opportunities in Group II suggested that promotion opportunities had a more significant effect on career orientation over time.

Lowell's overall results suggested that women in the Navy have few real career opportunities and tend to leave the service due to lack of billets and promotion opportunities. Since the time of his research, efforts have

been made to expand the billets and promotion opportunities for women in all designators. Additional research would be necessary to determine if attitudes and retention behavior have changed as a result of these efforts.

D. RELATED RESEARCH

Related research has been done on the effect of commissioning sources on performance, promotion, and retention in the Navy. In 1990 the Congressional Budget Office (CBO) did a study to determine if cost differentials from different commissioning sources were related to differences in performance of officers. [Ref. 14] They measured performance in three ways: (1) length of time on active duty after commissioning; (2) time to promotion; and (3) rate of involuntary separation from active service. CBO determined that, in costs to DOD, the service academies were the most expensive, with the Naval Academy costing $153,000 per graduate. This cost is three to four times higher than that of NROTC and eight to 15 times higher than OCS.

In terms of performance, the study found that, in general, academy graduates remain in the service longer than officers from other commissioning programs. USNA graduates, on average, served two months longer than NROTC scholarship graduates and 16 months longer than NROTC contract graduates. In terms of promotions, there was virtually no difference among the various commissioning sources for

promotions to O-3. However, promotion time to O-4 did reveal some differences. OCS graduates were promoted approximately three months "slower" than officers from either of the other sources. And at the senior ranks, results showed that nearly one half of all Navy Admirals were commissioned through the Naval Academy. This study did not delineate whether non-selects were included in this model, however.

Rates of involuntary separation were found to be low across the board (< 1.0%), however, they were somewhat lower for NROTC graduates than for USNA or OCS graduates. Again, we don't know if non-selects were included in this model. They may have chosen to leave voluntarily before being "forced" out. If so, these results could underestimate the true results.

Although CBO provided no specific recommendations in this study, they emphasized the need for policy makers to review marginal costs and returns on investment to determine what proportion of new officers should come from the various training programs in the future.

Foster (1990) [Ref. 15] also studied differences in performance and retention by commissioning source. He analyzed the relative productivity of Naval officers from the various commissioning sources based on fitness reports. His data set included officers of all communities commissioned between 1977 and 1987 with current paygrades

ranging from 0-1 to 0-4. (Females were eliminated due to small sample sizes).

In determining "productivity", he developed two performance indices. One, based on work by Bowman (1990), defined an individual as a superior performer (the dependent variable) if he received the highest evaluation on the three elements of the fitness report: recommendation for promotion, command desirability, and overall mission contribution/evaluation. A binary variable was coded "one" for superior performers and "zero" otherwise. The second index was based on work by Neumann (1989) and was constructed by calculating the percentage of times when the officer was recommended for early promotion during the entire period he was observed.

Using multivariate (logit) analysis with the Bowman index and OLS regression analysis with the Neumann index, Foster found that Naval Academy graduates tended to have a higher probability of being rated superior performers compared to officers from other commissioning sources. The largest difference in performance, using Bowman's dependent variable, was found in the submarine community where NROTC graduates were five percentage points less likely to be rated superior than USNA graduates. Reviewing the proportion of early promotion recommendations also found USNA graduates ahead of others but only by a small margin.

NROTC and OCS graduates averages four and six percentage points, respectively, behind USNA graduates.

Although the differences were small, Foster's results showed that USNA graduates did outperform officers from other commissioning sources.

The relevance of these studies to this current thesis is in the importance of controlling for commissioning source when constructing a model on the effect of graduate education on promotion and retention. Since studies have shown significant differences in performance by commissioning source, these differences must be controlled prior to making any conclusions about the effects of graduate education.

III. DATA AND METHODOLOGY

A. THE DATA

The data sets used in this study are developed from the Officer Promotion History Data Files and the Officer Master Record Files (OMRF) and maintained at the Defense Manpower Data Center in Monterey, CA. The Officer Promotion History File contains demographic, educational, experience, and selection board data on all officers, both active and reserve, in paygrades 0-2 (LTJG) through 0-7 (RADM) and are archived beginning in Fiscal Year 1981. The files utilized are developed to take advantage of a specific subset of background information created by Dr. William Bowman, U.S. Naval Academy, (Navy Officer Background Data File) and were current through Fiscal Year 1990. Loss data are utilized from the Officer Master Loss File (OMLF), a separate file maintained at DMDC. These data are derived from officers commissioned between 1970 and 1982 and who have left the Navy at any time following commission (through 31 December 1990). Only seven data elements are extracted for this study. These are included in Table 6.

TABLE 6

LOSS FILE DATA ELEMENTS

Social Security Number (scrambled)
Grade at Separation
Community Designator
Separation Program Designator
Inter-Service Separation Code
Date of Separation
Active-Reserve Status at Separation

Because the focus of this study is on General Unrestricted Line Officers, those officers with the designator 1100 or 1105 created the initial set of files from which all others are created. Additionally, the officers are categorized into three groups of General URL officers: those appearing before the Lieutenant, Lieutenant Commander, and Commander selection boards. This was done to determine if any significant differences occur between the effects of graduate education on selection boards at different paygrades.

Two files for each category are compiled for this study to determine the probability of leaving the Navy and the probability of being promoted. The first file, called "LEAVERS", consists of General URL officers who either leave

the General URL community prior to the LCDR selection boards (available only in LCDR file) or leave the Navy voluntarily.

The second file, called "STAYERS", consists of officers who remain in the Navy as General URL officers, those who transferd into the General URL community, as well as those who leave the Navy involuntarily prior to the LCDR/CDR selection board. (Specific steps taken to construct these files are detailed in Appendix A).

The purpose of separating involuntary leavers from voluntary leavers is to model voluntary separation/promotion behavior in the General URL community more accurately. Those who leave the Navy, or the community, involuntarily are known to leave because of poor performance. Individuals who leave due to poor health, retirement, or who die are excluded completely from the study (52 obs). In this manner, STAYERS include those who are promoted and retained in the Navy as well as those who stay to a promotion board and are passed over along with those whose poor performance caused earlier separation. In this way, those officers who leave the Navy voluntarily are separated from all others in this study.

The numbers of observations in the STAYERS and LEAVERS files are provided in Table 7.

TABLE 7
NUMBERS OF OBSERVATIONS IN SAMPLES

	"STAYERS"		"LEAVERS"	
LCDR	Pooled	Women-Only	Pooled	Women-Only
	1040	838	2345	1657
CDR	Pooled	Women-Only	Pooled	Women-Only
	404	365	790	751

B. METHODOLOGY

1. The Models

Logistic regression models are used in this study to explain the probability of voluntarily leaving the Navy separate from the joint probability of voluntarily staying and being promoted. This technique is commonly used when the dependent variable is binary, (1 = leave; 0 = stay or 1 = promote; 0 = passed over). The logit model is associated with the cumulative logistic probability function where, if P_i is the probability of leaving/promoting and X_i . . ., X_n is a set of explanatory variables. The form of the general equation is:

$$P_I F(Z_i) = \frac{1}{1 + e^{-(\alpha + \Sigma\beta_i X_i)}}$$

In this notation, e represents the base of natural logarithms, P_i is the probability that an individual will make a certain choice given X_i. Logit analysis will provide the estimates of the parameters α and β. [Ref.16]

2. Variables

a. *Dependent Variables*

The dependent variable used for the retention model is constructed using the Separation Program Designator codes from the Officer Master Record Files (Loss variables). Specifically, the codes indicating a voluntary separation or release from the Navy are categorized as LEAVE = 1, otherwise LEAVE = 0. These codes and the numbers of observations associated with each are included in Table 8.

TABLE 8
SEPARATION PROGRAM DESIGNATOR CODES

TYPE OF SEPARATION	CODES	NUMBER OF OBSERVATIONS
Voluntary Resignations	FBK	490 (47.3%)
	FDF	12 (1.1%)
	FND	4 (0.3%)
Voluntary Releases	MBK	282 (27.2%)
	MDF	8 (00.7%)
	MFF	2 (00.2%)
	MGP	6 (00.5%)
	MND	231 (22.3%)

These codes can be found in NMPCINST 1910.1B [Ref 17]

The dependent variable used for the promotion model is constructed from the "performance" variable from

the Officer Promotion History File--Navy Officer Background Data. In this file, PERFORMANCE = 1 if the officer was an early select

PERFORMANCE = 2 if the officer was an in zone select

PERFORMANCE = 3 if the officer was an in zone pass

PERFORMANCE = 4 if the officer was a late select

PERFORMANCE = 5 if the officer was a late pass

The dependent variable PROMOTE = 1 if the performance variable equalled 1 or 2, otherwise PROMOTE = 0. The "late select" performance code, PERFORMANCE = 4, and "late pass" performance code, PERFORMANCE = 5, were omitted because the majority of those passed over initially leave voluntarily or are involuntarily forced out after failing to select above zone.

b. Independent Variables

The independent variables included in this study could be grouped into two general categories: variables representing demographic and personal attributes of the officers, and variables representing educational background. The independent variables used in each model are identically constructed, although not all variables are included in both models. The distribution of observations by independent variables is included in Tables 9 - 12.

TABLE 9
DISTRIBUTION OF LCDR "STAYERS" BY INDEPENDENT VARIABLES

LCDR STAYERS (pooled sample)		
MALE	202	(19.4%)
FEMALE	838	(80.6%)
	1040	(100.0%)
USNA	56	(05.3%)
ROTCS	108	(10.3%)
OSOURCE	36	(03.5%)
OCSROTC	840	(80.4%)
	1040	(99.5%)
NOKIDS	792	(76.2%)
MARDEPS	210	(20.2%)
DIVONE	38	(03.7%)
	1040	(100.0%)
WHITE	912	(87.6%)
BLACK	28	(02.7%)
OTHER	100	(09.9%)
	1040	(99.9%)
PGSCH	129	(12.4%)
OTHERED	171	(16.4%)
	300	(18.8%)
TECH	487	(40.1%)
NONTECH	622	(59.9%)
	1040	(100.0%)
GTECH	64	(06.2%)
GNONTECH	236	(22.6%)
	300	(28.8%)
TUGNTG	375	(36.1%)
TUGTG	47	(04.5%)
NTUGNTG	601	(57.8%)
NTUGTG	17	(01.6%)
	1040	(100.0%)
n = 1040		

LCDR STAYERS (Female only)		
FEMALE	838	
USNA	28	(03.3%)
ROTCS	50	(05.8%)
OSOURCE	9	(01.1%)
OCSROTC	751	(89.0%)
	838	(99.2%)
NOKIDS	685	(81.7%)
MARDEPS	122	(14.6%)
DIVONE	31	(03.7%)
	838	(100.0%)
WHITE	749	(89.3%)
BLACK	18	(02.2%)
OTHER	71	(08.4%)
	838	(99.9%)
PGSCH	128	(15.3%)
OTHERED	154	(18.4%)
	282	(33.7%)
TECH	317	(37.8%)
NONTECH	521	(62.2%)
	838	(100.0%)
GTECH	60	(07.2%)
GNONTECH	222	(26.4%)
	282	(33.6%)
TUGNTG	277	(33.1%)
TUGTG	43	(05.1%)
NTUGNTG	501	(59.8%)
NTUGTG	17	(02.0%)
	838	(100.0%)
n = 838		

TABLE 10
DISTRIBUTION OF LCDR "LEAVERS" BY INDEPENDENT VARIABLES

LCDR LEAVERS (pooled sample)			LCDR LEAVERS (Female only)		
MALE	688	(29.3%)	FEMALE	1657	
FEMALE	1657	(70.7%)			
	2345	(100.0%)			
USNA	129	(05.5%)	USNA	68	(04.0%)
ROTCS	361	(15.3%)	ROTCS	133	(07.8%)
OSOURCE	196	(08.4%)	OSOURCE	48	(02.9%)
OCSROTC	1659	(70.5%)	OCSROTC	1410	(84.8%)
	2336	(99.7%)		1657	(99.5%)
NOKIDS	1927	(82.2%)	NOKIDS	1455	(87.8%)
MARDEPS	361	(15.4%)	MARDEPS	154	(09.3%)
DIVONE	57	(02.4%)	DIVONE	48	(02.9%)
	2345	(100.0%)		1654	(100.0%)
WHITE	2109	(89.9%)	WHITE	1509	(91.0%)
BLACK	78	(03.3%)	BLACK	32	(01.9%)
OTHER	158	(06.7%)	OTHER	116	(07.0%)
	2161	(99.9%)		1657	(99.9%)
PGSCH	150	(06.4%)	PGSCH	142	(08.6%)
OTHERED	294	(12.5%)	OTHERED	215	(13.0%)
	444	(18.9%)		357	(21.6%)
TECH	1055	(45.0%)	TECH	601	(36.3%)
NONTECH	1268	(54.1%)	NONTECH	1040	(62.8%)
	2323	(99.1%)		1641	(99.1%)
GTECH	138	(05.9%)	GTECH	81	(04.9%)
GNONTECH	303	(12.9%)	GNONTECH	273	(16.5%)
	441	(18.8%)		354	(21.4%)
n = 2345			*n = 1657*		

TABLE 11
DISTRIBUTION OF CDR "STAYERS" BY INDEPENDENT VARIABLES

CDR STAYERS (pooled sample)		
MALE	39	(09.7%)
FEMALE	365	(90.3%)
	404	(100.0%)
USNA	3	(00.7%)
ROTCS	21	(05.2%)
OSOURCE	6	(01.5%)
OCSROTC	374	(92.5%)
	404	(99.9%)
NOKIDS	303	(75.0%)
MARDEPS	84	(20.8%)
DIVONE	17	(04.2%)
	404	(100.0%)
WHITE	368	(91.0%)
BLACK	9	(02.2%)
OTHER	27	(06.6%)
	404	(99.8%)
PGSCH	92	(22.8%)
OTHERED	127	(31.4%)
	219	(54.2%)
TECH	130	(32.2%)
NONTECH	274	(67.7%)
	404	(99.9%)
GTECH	31	(07.7%)
GNONTECH	188	(46.5%)
	219	(54.2%)
TUGNTG	111	(27.5%)
TUGTG	19	(04.7%)
NTUGNTG	262	(64.9%)
NTUGTG	12	(03.0%)
	404	(100.0%)

n = 404

CDR STAYERS (Female only)		
FEMALE	365	
USNA	0	(00.0%)
ROTCS	8	(02.2%)
OSOURCE	4	(01.1%)
OCSROTC	353	(96.6%)
	365	(99.9%)
NOKIDS	290	(79.5%)
MARDEPS	61	(16.7%)
DIVONE	14	(03.8%)
	365	(100.0%)
WHITE	338	(92.6%)
BLACK	7	(01.9%)
OTHER	20	(05.4%)
	365	(99.9%)
PGSCH	87	(23.8%)
OTHERED	122	(33.4%)
	209	(57.3%)
TECH	115	(31.5%)
NONTECH	250	(68.4%)
	365	(99.9%)
GTECH	29	(07.9%)
GNONTECH	180	(49.3%)
	209	(57.2%)
TUGNTG	98	(26.8%)
TUGTG	17	(04.7%)
NTUGNTG	238	(65.2%)
NTUGTG	12	(03.3%)
	365	(100.0%)

n = 365

TABLE 12
DISTRIBUTION OF CDR "LEAVERS" BY INDEPENDENT VARIABLES

CDR LEAVERS (pooled sample)			CDR LEAVERS (Female only)		
MALE	39	(04.9%)	FEMALE	751	
FEMALE	751	(95.1%)			
	790	(100.0%)			
USNA	3	(00.4%)	USNA	0	(00.0%)
ROTCS	21	(02.7%)	ROTCS	8	(01.1%)
OSOURCE	6	(00.8%)	OSOURCE	4	(00.5%)
OCSROTC	760	(96.1%)	OCSROTC	739	(98.3%)
	790	(99.9%)		751	(99.9%)
NOKIDS	689	(87.2%)	NOKIDS	676	(90.0%)
MARDEPS	84	(10.6%)	MARDEPS	61	(08.1%)
DIVONE	17	(02.2%)	DIVONE	14	(01.9%)
	790	(100.0%)		751	(100.0%)
WHITE	703	(88.9%)	WHITE	673	(89.6%)
BLACK	26	(03.3%)	BLACK	23	(03.1%)
OTHER	61	(07.7%)	OTHER	55	(07.3%)
	790	(99.9%)		751	(100.0%)
PGSCH	478	(60.5%)	PGSCH	473	(63.0%)
OTHERED	127	(16.1%)	OTHERED	122	(16.2%)
	605	(76.6%)		595	(79.2%)
TECH	516	(65.0%)	TECH	501	(66.7%)
NONTECH	271	(34.3%)	NONTECH	247	(32.9%)
	787	(99.3%)		748	(99.6%)
GTECH	417	(52.8%)	GTECH	415	(55.3%)
GNONTECH	188	(23.8%)	GNONTECH	180	(24.0%)
	605	(76.6%)		595	(79.3%)
n = 790			*n = 751*		

The demographic/background variables are described below:

Race: Three variables are constructed for this category: WHITE = 1 if race = white, otherwise WHITE = 0 (base case); BLACK = 1 if race = black, otherwise BLACK = 0;
OTHER = 1 if race = other, otherwise OTHER = 0.

Age: This is a continuous variable indicating the individual's age at time of commissioning. Age ranged from 20 to 35.

Sex: MALE = 1 if gender = male, otherwise MALE = 0

Commissioning Source: Four variables define this category:
OCSROTC = 1 if Commissioning Source = Officer Candidate School or Naval Reserve Officer Training Course - College Program, otherwise OCSROTC = 0 (base case); USNA = 1 if Commissioning Source = U. S. Naval Academy, otherwise USNA = 0; ROTCS = 1 if Commissioning Source = Naval Reserve Officer Training Program - Scholarship, otherwise ROTCS = 0; and OSOURCE = 1 if Commissioning Source = Direct Appointment or NESEP, otherwise OSOURCE = 0.

Marital/Dependent Status: Three variables are used in this category:
NOKIDS = 1 if member is single or married with no dependents, otherwise NOKIDS = 0 (base case); MARDEPS = 1 if

member is married with one or more children, otherwise MARDEPS = 0; DIVONE = 1 if member is divorced or separated with one or more children, otherwise DIVONE = 0.

The educational background variables are defined as follows:

Undergraduate Degree Major: Two variables are used in this category:

TECH = 1 if the individual's undergraduate major is engineering, math, computer science, operations analysis, or natural/biological science, otherwise TECH = 0.

NONTECH = 1 if the individual's undergraduate major is social sciences, arts, humanities, management, economics, education, etc., otherwise NONTECH = 0.

Undergraduate Grade Point Average: The variable GPA is included as a continuous variable to determine the effects of one's GPA on eventual promotion in or separation from the Navy. The variable ranged from 1 with a GPA less than 2.0, to a 6 with a GPA greater than 3.6.

Mathematics Qualification Code: The variable MQC is included as a continuous variable to determine the effects of one's academic record in mathematics-related courses on eventual promotion in or separation from the Navy. The variable ranged from a 1 with no math courses with a grade higher than C to a 7 indicating significant post-calculus courses with a grade of B or better.

Technical Qualification Code: The variable TQC is included as a continuous variable to determine the effects of one's academic record in physics based engineering courses on eventual promotion in or separation from the Navy. The variable ranged from a 1 with no physics courses to a 6 with upper division engineering/ physical science major with a B+ average or better.

Graduate Education: The variable GRADED = 1 if the individual has a Masters degree, otherwise GRADED = 0.

For those with a graduate degree, two additional variables are utilized:

PGSCH = 1 if the individual received his/her degree from the Naval Postgraduate School, otherwise PGSCH = 0.

OTHERED = 1 if the individual received his/her graduate degree from an institution other than the Naval Postgraduate School, otherwise OTHERED = 0.

Graduate School Major: Two variables are defined in this category:

GTECH = 1 if the individual has a Master's Degree in engineering, mathematics, computer science, operations analysis or natural/biological sciences, otherwise GTECH = 0.

GNONTECH = 1 if the individual has a Master's Degree in social sciences, arts, humanities, management, economics, education, etc., otherwise GNONTECH = 0.

Combinations of Undergraduate and Graduate School Major: Four variables are used in this category to capture the combined effects of undergraduate major and graduate major:

NTUCNTG = 1 if the individual has both non-technical undergraduate and graduate degrees, otherwise NTUGNTG = 0.

NTUGTG = 1 if the individual has a non-technical undergraduate degree and a technical graduate degree, otherwise NTUGTG = 0.

TUGNTG = 1 if the individual has a technical undergraduate degree and a non-technical graduate degree, otherwise TUGNTG = 0.

TUGTG = 1 if the individual has both technical undergraduate and graduate degrees, otherwise TUGTG = 0.

The basic models estimated in this study are as follows:

LCDR STAYERS - Pooled Sample

PROMOTE = f (MALE + USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

LCDR STAYERS - Women Only Sample

PROMOTE = f (USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

LCDR LEAVERS - Pooled Sample

LEAVE = f (MALE + USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

LCDR LEAVERS - Women Only Sample

LEAVE = f (USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

CDR STAYERS - Pooled Sample*

PROMOTE = f (MALE + ROTCS + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

CDR STAYERS - Women Only Sample*

PROMOTE = f (ROTCS + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

CDR LEAVERS - Pooled Sample*

LEAVE = f (MALE + ROTCS + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH)

CDR LEAVERS - Women Only Sample*

LEAVE = f (ROTCS + OTHER + DIVONE + MARDEPS + AGE + PGSCH
+ OTHERED + GPA + TECH)

Additional models, referred to as "Model 2", are also estimated for these samples. Results are presented in Appendix B.

* Variables that were deleted from these models were due to small numbers of observations in the files.

IV. RESULTS

Maximum likelihood (logit) regression models are estimated using the dependent variables "PROMOTE" for the promotion model and "LEAVE" for the retention model. Each model is estimated for a pooled sample of LCDRs or CDRs for both men and women, and a separate model for females alone. Two samples are utilized to attempt to capture the effects of including males in the Gen URL community. Appendix B presents the complete results of estimating the models.

Likelihood ratio tests are conducted to determine if the basic models are affected by the addition of specified explanatory variables. Appendix C explains how these tests are conducted along with the test results.

The coefficients of the independent variables in the estimated logit equations are transformed into probabilities by setting the explanatory (dummy) variables equal to zero and solving for the predicted probability. In this manner, the probability of being promoted or leaving is established for a reference individual (base case). In both models, the reference individual is a white female with no dependents who is commissioned through Officer Candidate School at age 24, has a non-technical undergraduate degree, and does not have a graduate degree. By changing the value of any single explanatory (dummy) variable from zero to one, computing the

new probability of being promoted or leaving, and then taking the difference between the two probabilities, a "delta" for each variable is obtained. This delta represents the change in the probability of being promoted or leaving the Navy when one of the explanatory variables is altered from the base case while leaving all other variables unchanged.

This section will present general results of both the LCDR promotion and retention models, followed by a discussion of the CDR models.

A. PROMOTION TO LCDR

1. Education

In the pooled sample of the basic promotion model for LCDRs, Naval Postgraduate School (NPS) graduate education has a significantly positive impact on the probability of promotion, (i.e., an officer with a graduate degree from NPS is 29% more likely to be promoted than an officer with no graduate degree). Although not statistically significant, an officer with a graduate degree from other sources is also 15% more likely to be promoted than an officer with no degree. These effects on promotion are increased to 31% and 18%, respectively, in the women-only sample. These results are presented in Table 13.

When variables for type of graduate degree (GTECH) and Technical Qualification Code (TQC) are included in the

model, (Model 2), the impact of graduate education in both samples, while still positive, is no longer significant. Complete results of this model are presented in Appendix B.

The variable GPA is not statistically significant, but does have a consistently positive coefficient in both models and samples. Likewise, the TECH variable is consistently negative, albeit statistically insignificant.

TABLE 13
CHANGE IN PROMOTION PROBABILITY FOR EDUCATION VARIABLES

VARIABLE	POOLED		WOMEN-ONLY	
	BASIC	MODEL 2	BASIC	MODEL 2
PGSCH	29.24%*	28.44%	31.44%*	23.56%
OTHERED	15.32%	15.62%	15.46%	18.66%
GPA	3.39%	2.89%	4.99%	3.39%
TECH	-6.87%	-10.57%	-8.48%	-12.2%
GTECH	--	0.59%	--	-13.43%
TQC	--	4.41%	--	7.40%

Source: See Tables B.1.A. - B.2.B. in Appendix B for complete listing of logit coefficients and transformed "deltas".

* = .05 level of confidence
** = .01 level of confidence

2. Commissioning Source

Commissioning source variables are also included in the promotion models for LCDR. These variables show inconsistent and insignificant impacts on the probability of promotion, however, the results are worthy of discussion.

In the pooled sample, all three commissioning source variables, USNA, ROTCS, and OSOURCE, have negative effects on the probability of promotion to LCDR. In essence, officers from these commissioning sources are less likely to be promoted to LCDR than an OCS graduate. However, these variables are not statistically significant in any model. The specific statistics on these variables are presented in Table 14.

Results of the women-only sample yield slightly different results. In this model, both USNA and OSOURCE still have negative effects on the probability of promotion. The ROTCS variable, however, is positive. Again, these variables lack statistical significance.

TABLE 14
CHANGE IN PROMOTION PROBABILITY BY COMMISSIONING SOURCE

VARIABLE	POOLED		WOMEN-ONLY	
	BASIC	MODEL 2	BASIC	MODEL 2
USNA	-14.6%	-20.45%	1.49%	-8.10%
ROTCS	-14.10%	-17.04%	7.58%	2.68%
OSOURCE	-15.59%	-22.60%	2.23%	-2.60%

Source: See Tables B.1.A. - B.2.B. in Appendix B for complete listing of logit coefficients and transformed "deltas".

* = .05 level of confidence
** = .01 level of confidence

3. Other Factors

The promotion model for LCDRs also controls for various demographic characteristics, such as race, marital/dependent status, age, etc. Again, none of these variables are statistically significant, however they represent possible trends that are worthy of discussion.

The marital/dependent status variables DIVONE and MARDEPS have a consistently negative impact on the probability of promotion to LCDR, however the degree of

impact varies greatly between the pooled and women-only samples. In the pooled sample, officers divorced/separated with dependents are 2.9% less likely to be promoted than single officers without dependents, while the married officer with dependents is 11.4% less likely to be promoted. In the women-only sample, however, divorced/separated officers are 11.7% less likely to promote and those married with dependents are only 4.3% less likely to promote. These results are depicted in Table 15, but are difficult to interpret based on lack of statistical significance.

The race variables have a very small impact on the probability of promotion to LCDR. However, it is interesting to note that the variable BLACK is consistently negative, while the OTHER variable is positive in the pooled sample and negative in the women-only sample. These results are also depicted in Table 15.

TABLE 15
CHANGE IN PROMOTION PROBABILITY BY OTHER FACTORS

VARIABLE	POOLED		WOMEN-ONLY	
	BASIC	MODEL 2	BASIC	MODEL 2
MALE	-37.63%**	-38.78%**	---	---
BLACK	-1.21%	-2.16%	-2.25%	-5.53%
OTHER	1.43%	2.12%	-2.00%	-1.94%
DIVONE	-2.91%	-2.65%	-11.66%	-10.74%
MARDEPS	-11.36%	-11.57%	-4.25%	-4.16%

Source: See Tables B.1.A. - B.2.B. in Appendix B for complete listing of logit coefficients and transformed "deltas".

* = .05 level of confidence
** = .01 level of confidence

Additional educational variables, such as Math Qualification Code and a combined variable to account for type of undergraduate major and graduate major together were included in the models. However, they did not significantly affect the probability of promotion; therefore, they were not included in the final model being estimated.

B. RETENTION TO LCDR SELECTION BOARD

1. Education

In the basic pooled retention model for LCDRs, NPS graduate education has a statistically significant negative impact on the probability of leaving the Navy (i.e., an officer with an NPS degree is 37% less likely to leave the

Navy than an officer with no degree). In addition, an officer with a graduate degree from other sources is also 22% less likely to leave the Navy than an officer with no degree. When the variables GTECH and TQC are added to the model, the effects of the PGSCH and OTHERED variables increase to 39% and 27%, respectively, and remain statistically significant. Similar results occurred in the women-only sample, with both PGSCH and OTHERED variables exhibiting significant negative effects on the probability of leaving the Navy. These probability figures are presented in Table 16.

TABLE 16
CHANGE IN RETENTION PROBABILITY FOR EDUCATION VARIABLES

VARIABLE	POOLED		WOMEN-ONLY	
	BASIC	MODEL 2	BASIC	MODEL 2
PGSCH	-36.95%*	-38.75%*	-31.27*	-42.44%*
OTHERED	-21.90%**	-26.93%**	-22.28%**	-29.65%**
GPA	5.47%	3.83%	2.70%	4.18%
TECH	-3.22%	-9.00%	-5.34%	-9.34%
GTECH	--	36.08%	--	25.77%
TQC	--	5.34%	--	4.45%

Source: See Tables B.3.A. - B.4.B. in Appendix B for complete listing of logit coefficients and transformed "deltas".

* = .05 level of confidence
** = .01 level of confidence

2. Commissioning Source

Commissioning source variables are also included in the LCDR retention models. These variables exhibit insignificant effects on the probability of leaving the Navy, however the trends are interesting to note here.

In the pooled sample, all three commissioning source variables, USNA, ROTCS, and OSOURCE, have positive coefficients. However, when additional educational control variables are added to the model, (e.g., GTECH and TQC) the coefficients for USNA and ROTCS remain positive while the OSOURCE variable becomes negative.

In the women-only sample, both USNA and ROTCS have positive coefficients, but the OSOURCE variable is negative. These results remain consistent when additional educational control variables are added to the model. The commissioning source probability results are provided in Table 17.

TABLE 17
CHANGE IN RETENTION PROBABILITY BY COMMISSIONING SOURCE

VARIABLE	POOLED		WOMEN-ONLY	
	BASIC	MODEL 2	BASIC	MODEL 2
USNA	14.22%	8.07%	24.57%	18.74%
ROTCS	10.73%	4.60%	13.12%	11.19%
OSOURCE	2.37%	-10.85%	-9.03%	-19.46%

Source: See Tables B.3.A. - B.4.B. in Appendix B for complete listing of logit coefficients and transformed "deltas".

* = .05 level of confidence
** = .01 level of confidence

3. Other Factors

The retention models also control for various demographic characteristics, such as marital/dependent status, race, age, etc. Although the majority of these variables have insignificant effects on the probability of leaving the Navy, the MARDEPS variable is consistently significant in all cases.

In both the pooled and women-only samples, the variable indicates that officers married with dependents are 28% and 25%, respectively, less likely to leave the Navy than an officer with no dependents. When additional educational control variables are added to the models, these percentages show an increased effect to 33% and 29%, respectively. The other marital/dependent status variable, DIVONE, although not statistically significant, is

consistently negative in all models. These results are included in Table 18.

The race variables have an insignificant effect on the probability of leaving the Navy, with consistently negative coefficients in both samples.

TABLE 18
CHANGE IN RETENTION PROBABILITY BY OTHER FACTORS

VARIABLE	POOLED		WOMEN-ONLY	
	BASIC	MODEL 2	BASIC	MODEL 2
MALE	18.45%**	13.56%	---	---
BLACK	-0.23%	-1.77%	-29.11%	-4.81%
OTHER	-3.67%	-2.58%	-3.76%	-4.34%
DIVONE	-29.21%	-29.42%	-23.10%	-29.65%
MARDEPS	-28.43%**	-29.16%**	-25.17%**	-32.70%**

Source: See Tables B.?.A. - B.4.B. in Appendix B for complete listing of logit coefficients and transformed "deltas".

* = .05 level of confidence
** = .01 level of confidence

As with the promotion models, additional educational variables were included in the retention models. However, these variables did not significantly affect the probability of leaving the Navy; therefore they were not included in the final models being estimated.

C. PROMOTION TO CDR

Similar promotion models were run for both CDR samples. Unfortunately, these models do not provide conclusive results for the probability of promotion to CDR. General results concerning the graduate education variables are provided below.

In the promotion models for CDRs, both samples, those with a degree from NPS are approximately 14% more likely to be promoted than those without a degree. Likewise, a graduate degree from other sources increases the probability of promotion by approximately 9.5%. However, none of the variables have a statistically significant effect on the probability of promotion to CDR in either the pooled or women-only samples. Results of these estimations appear in Tables B.5.A. and B.5.B. of Appendix B.

Additional educational variables were added to the models to try to improve the explanatory power of the estimates. However, based upon likelihood ratio tests, these variables did not significantly contribute to the basic model.

D. RETENTION TO CDR SELECTION BOARD

The results from the CDR retention models are unreliable due to a lack of sufficient variation in LEAVE versus STAY behavior (i.e., only 47 of 790, 6%, actually left the Navy voluntarily). Results of the estimations are included in

Tables B.6.A. and B.6.B of Appendix B., but will not be discussed here.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Graduate Education

It is apparent from the results of the estimations that graduate education has a positive and significant effect on the probability of being promoted to Lieutenant Commander (LCDR) in the General Unrestricted Line (Gen URL) community. Further, a degree from the Naval Postgraduate School (NPS) appears to have a much stronger influence on promotion than a graduate degree from other sources. This would appear to indicate that a degree from the Naval Postgraduate School is more credible in the eyes of selection boards than a graduate degree from civilian institutions, regardless of how funded. Of course, these results are limited only to Gen URL officers and may not be consistent for other communities.

Although it is not statistically significant in every model, the OTHERED variable still shows that obtaining a graduate degree, regardless of source, has a positive effect on promotion. These results are not surprising, because of the requirement for Gen URLs to work toward proven subspecialist designations in order to be successful. As long as one obtains the appropriate subspecialty code for

the graduate degree, one is not prohibited from acquiring the proven subspecialist designation and, therefore, not excluded from promotion opportunities based upon degree source.

It is somewhat surprising to note that the effects of graduate education are not significantly higher for the women-only sample than for the pooled sample. It was anticipated that, because males are less competitive in the Gen URL community overall, the attainment of a graduate degree would not significantly increase his chances of promotion. This may be due to the fact that we are dealing with junior paygrades and the stiff competition may not be revealed until the higher paygrade selection boards.

The other educational control variables that were included provided no statistically significant effects. However, grade point average is consistently positive, indicating that those with higher undergraduate grades may be more likely to be promoted to LCDR. Likewise, those with a technical undergraduate major may be less likely to be promoted than those with a non-technical major. This is somewhat surprising when considering that nearly 40% of the observations have technical undergraduate majors. However, this effect could be due to the generally non-technical requirements for promotion in the Gen URL community. Emphasis has historically been on performance in leadership tours. Specific technical expertise is not a prerequisite

to obtaining most Gen URL leadership billets at the LCDR and below level. In the recent past, more emphasis has been placed on attaining technical skills; however, this is primarily focused on graduate degree major selection and proven subspecialty designation, not on leadership, per se.

In the retention model for LCDRs, graduate education, again, has a statistically significant effect. In all samples, both an NPS degree and a degree from other sources significantly decreases the probability of leaving the Navy. The effect of NPS is not surprising because of the additional service obligation incurred. The reasons for the strength of the OTHERED variable is not as clear. Some of the individuals in this category may have received Navy funding for their education and therefore, have incurred the same "payback" commitment as NPS graduates. This would account for some of the strong negative effects shown here. However, a number of these individuals probably attained their graduate degree at their own expense and incurred no additional obligation to the Navy. The impact of this group on the strength and direction of the OTHERED coefficient is unknown.

As occur in the promotion models, the educational control variables are not statistically significant, but are consistent in their effects on the probability of leaving. Grade point average is positive, indicating that individuals with higher undergraduate grades are more likely to leave

the Navy. And TECH is negative, indicating that those with a technical undergraduate degree are less likely to leave the Navy. While these results are consistent throughout all LCDR retention models, they are inconsistent with the effects shown in the promotion models. The reasons for this disparity are unclear.

The results of the estimations for the Commander promotion model were disappointingly insignificant. In the graduate education variables, over 50% of the samples have graduate degrees, most of which were received through sources other than NPS. Although the variables indicate that individuals with graduate education are more likely to promote to CDR than those without, the effects are not statistically significant.

This may have occurred due to the lack of variation in the characteristics of individuals included in the sample. As discussed in the introduction, the vast majority of these individuals fit into a very similar pattern (i.e., white, female, single, no dependents, OCS graduates, with non-technical educations). There are simply not enough differences between them to adequately model. The results could also indicate that promotion to CDR is based upon factors that are not specifically included here, such as fitness reports and/or some other measure of performance in critical leadership billets.

2. Commissioning Source

The commissioning source variables had unexpected effects on the probability of promotion to LCDR in the pooled sample. Even though not statistically significant, it was not expected that the commissioning source variables would have negative coefficients. This may be due to the fact that nearly half of the Gen URLs commissioned through the non-OCS sources are males. As will be discussed later, gender appears to have a negative effect on the probability of promotion, and these effects may somehow be extended through the commissioning source variables as well.

In the LCDR retention models, commissioning source variables showed positive, but insignificant effects on the probability of leaving the Navy in the pooled sample. However, in the women-only samples, the OSOURCE variable was consistently negative. This is probably due to the fact that most officers commissioned through these sources have prior enlisted service and are more career-oriented because of their time-in-service.

3. Other Variables

The effects of gender on the probability of promotion to LCDR are not surprising. Males are 39% less likely to be promoted to LCDR. This is most likely a consequence of the small number of males in the community (20%), as well as their reasons for entering the community

in the first place (e.g., family hardships). As the Gen URL community exercises its new selectivity options to admit other designators into the community, this trend may change.

The demographic control variables (i.e., race and marital/dependent status) showed insignificant effects on the probability of promotion to LCDR. This may be due to the small number of observations in these categories when compared to the base case, (i.e., roughly 80% of the samples are single with no dependents, and 88% are white).

In the LCDR retention models, the demographic control variables for marital/dependent status were much stronger than anticipated. The variable MARDEPS was statistically significant in all models, indicating that individuals with families are less likely to leave the Navy, at least at this point in their career. This may simply be due to the fact that the Navy provides a family with a steady income and numerous benefits, which may not be easily duplicated in the civilian sector. If the variable continues to be significant at higher paygrades, then additional interpretations may be necessary. Although the DIVONE variable did have a negative coefficient, it is unclear why those divorced/separated with dependents were not significantly less likely to leave the Navy. These individuals may also have familial obligations that the Navy's benefits would ease. Additional research on the

characteristics of these individuals would be needed to adequately answer these questions.

B. RECOMMENDATIONS

Based upon the results of these thesis, the following actions are recommended:

1. Publicize the results of this thesis to Gen URL community managers and manpower policy-makers. The information concerning the effects of graduate education and degree source may influence Gen URL officer selection to Naval Postgraduate School billets in the future. As a minimum, it will provide support to the request for additional billets at NPS for the Gen URL officer community.

2. Review the results concerning commissioning source variables on the probability of promotion and retention in the Navy. At the time of this study less than 15% of the Gen URL officers were commissioned through USNA and ROTCS and those that did were less likely to be promoted and more likely to leave the Navy. Either this indicates that quality officers commissioned through these sources are not selecting the Gen URL community, or that the officers from these sources are simply not competitive with OCS graduates in this community. In either case, the Gen URL community should review this issue to determine if this indicates a selection criterion problem or a community reputation problem at these commissioning source institutions.

3. Publicize the results of this thesis to the Naval Postgraduate School admissions and manpower officials to ensure they are aware of the strong impact the institution has on the careers of Gen URL officers.

Before a final determination can be made concerning the value of graduate education to the Gen URL officer, additional research is recommended in several areas.

First, an analysis of Navy-funded graduate education versus self-funded graduate education would better determine the effect of graduate education on the probability of promotion. Although the OTHERED variable in this study proves some information about this effect, it does not differentiate between education that incurs and obligation and education obtained at the officer's expense. An attempt was made to identify these categories in this study using education Sponsor Codes. However, the data file had too many missing values to be reliable.

Second, one might model promotion probability at the senior paygrades, (i.e., CDR and CAPT) for those Gen URL officers with proven subspecialist designations to determine the effect of this designation on promotion. As promotion opportunities diminish and competition increases, it would be interesting to see if the "technical expertise" gained through this designation significantly enhances one's rob ability of promotion.

One might also choose to replicate this study on Gen URL officers in LCDR and CDR paygrades five years from now. With the changing demographics in society, the officers appearing before the selection boards in the future may exhibit more diversity in background and expertise. This may provide more informative results concerning the value of graduate education to the Gen URL officer.

Finally, other Unrestricted Line communities have similar requirements to achieve the proven subspecialist designation at some point in their careers. These communities are vastly larger than the Gen URL community and include more diversity in characteristics. Because they have stringent "warfare" qualifications to obtain throughout their careers, graduate education may be viewed as an "interruption" in their career path. Therefore, it would be interesting to determine the effects of graduate education on their promotion probabilities.

LIST OF REFERENCES

1. U.S. Department of the Navy, Chief of Naval Operations, "Graduate Education," OPNAV Instruction 1520.23A, 14 March 1986, pps. A-1 - A-2.

2. U.S. Department of the Navy, Secretary of the Navy, "Policies on Graduate Education for Military Officers," SECNAV Instruction 1524.2A, 27 March 1989, p. 1.

3. U.S. Department of the Navy, Chief of Naval Operations, "Fully Funded Graduate Education Programs, FY-92", OPNAV Notice 1520, 25 April 1991.

4. U.S. Department of the Navy, "Manual of Navy Officer Manpower and Personnel Classification," NAVPERS 15839G, 2 March 1990, Volume I, pps. I-B-1 to I-B-10 and Volume II, pps. II-D-1 to II-D-6.

5. U.S. Department of the Navy, Navy Officer Career Planning Guidebook, NAVPERS 15605, FY90 edition, p. 12.

6. U.S. Department of the Navy, Chief of Naval Operations, "Navy Study Group's Report on Progress of Women in the Navy," 5 December 1987, pps. ES-11 - 2-35.

7. Becker, Gary Human Capital, New York: National Bureau of Economic Research, 1975.

8. U.S. Department of Defense, "Policy on Graduate Education for Military Officers," DOD Directive 1322.10, 31 August 1990, p. G-1.

9. Lockman, Robert F., Cymrot, Donald J., Richardson, Michael A., and Murray, Martha S., "Officer Graduate Education in the Navy," Center for Naval Analyses, Alexandria, VA, April 1986.

10. Cymrot, Donald J., "Graduate Education and the Promotion of Officers," Center for Naval Analyses, Alexandria, VA, March 1986.

11. Lurie, Philip M., "Relating Personnel to the Material Condition of Surface Combatants," Center for Naval Analyses, Alexandria, VA, January 1986.

12. Steiner, Kenneth W., Navy-Funded Graduate Education: Do the Navy and URL Officer Benefit?, Master's Thesis, Naval Postgraduate School, Monterey, CA, 1986.

13. Lowell, Richard W., An Analysis of the Factors Affecting the Career Orientation/Turnover Behavior of Female Naval Officers, Master's Thesis, Naval Postgraduate School, Monterey, CA, December 1987.

14. Congressional Budget Office, "Officer Commissioning Programs: Costs and Officer Performance," Washington, D.C., June 1990.

15. Foster, Michael J., An Analysis of the Relative Productivity of Officers from Different Accession Sources, Master's Thesis, Naval Postgraduate School, Monterey, CA, June 1990.

16. Pindyck, Robert and Rubinfeld, Daniel, Econometric Models and Economic Forecasts, 2nd ed., (San Francisco: McGraw-Hill Book Company, 1981) pps. 270-280.

17. U.S. Department of the Navy, Naval Military Personnel Command, "Certificate of Release or Discharge from Active Duty, DD Form 214", NMPC Instruction 1900.1B, 11 September 1986.

18. Judge, George G., Hill, R. Carter, Griffiths, William E., Lutkepohl, Helmut, and Lee, Tsoung-Chao, Introduction to the Theory and Practice of Econometrics, 2nd ed., John Wiley & Sons, Inc., 1988, pps. 99-104.

BIBLIOGRAPHY

Becker, Gary , Human Capital, New York: National Bureau of Economic Research, 1975.

Bowman, William R., "Are Service Academies Worth the Cost? Recent Findings for Navy Warfare Officers", paper prepared for the IUS Biennial Conference, Baltimore, MD, 11-13 October 1991.

Congressional Budget Office, "Officer Commissioning Programs: Costs and Officer Performance," Washington, DC, June 1990.

Cymrot, Donald J. "Graduate Education and the Promotion of Officers," Center for Naval Analyses, Alexandria, VA, March 1986.

Ehrenberg, Ronald G. and Smith, Robert S., Modern Labor Economics: Theory and Public Policy, 3rd ed., Scott, Foresman, and Company, 1988.

Foster, Michael J., An Analysis of the Relative Productivity of Officers from Diffeent Accession Sources, Master's Thesis, Naval Postgraduate School, Monterey, CA, June 1990.

Judge, George G., Hill, R. Carter, Griffiths, William E., Lutkepohl, Helmut, and Lee, Tsoung-Chao, Introduction to the Theory and Practice of Econometrics, 2nd ed., John Wiley & Sons, Inc., 1988.

Lockman, Robert F., Cymrot, Donald J., Richardson, Michael A., and Murray, Martha S., "Officer Gradute Education in the Navy," Center for Naval Analyses, Alexandria, VA, April 1986.

Lowell, Richard W., An Analysis of the Factors Affecting the Career Orientation/Turnover Behaivor of Female Naval Officers, Master's Thesis, Naval Postgraduate School, Monterey, CA, December 1987.

Lurie, Philip M., "Relating Personnel to the Material Condition of Surface Combatants," Center for Naval Analyses, Alexandria, VA, January 1986.

Pindyck, Robert and Rubinfeld, Daniel, Econometric Models and Economic Forecasts, 2nd ed., (San Francisco, CA: McGraw-Hill Book Company, 1981).

Steiner, Kenneth W., Navy-Funded Graduate Education: Do the Navy and the URL Officer Benefit?, Master's Thesis, Naval Postgraduate School, Monterey, CA, 1986.

U.S. Department of Defense, "Policy on Graduate Education for Military Officers," DOD Directive 1322.10, 31 August 1990.

U.S. Department of the Navy, Chief of Naval Operations, "Graduate Education," OPNAV Instruction 1520.23A, 14 March 1986.

U.S. Department of the Navy, Chief of Naval Operations, "Fully Funded Graduate Education Programs, (FY-92)", OPNAV Notice 1520, 25 April 1991.

U.S. Department of the Navy, Chief of Naval Operations, Navy Study Group's Report on Progress of Women in the Navy, 5 December 1987.

U.S. Department of the Navy, "Manual of Navy Officer Manpower and Personnel Classification", NAVPERS 15839G, Volume I and Volume II, 2 March 1990.

U.S. Department of the Navy, Naval Military Personnel Command, " Certificate of Release or Discharge from Active Duty, DD Form 214", NMPC Instruction 1900.1B, 11 September 1986.

U.S. Department of the Navy, Navy Oficer Career Planning Guidebook, NAVPERS 15605, FY90 edition.

U.S. Department of the Navy, Secretary of the Navy, "Policies on Graduate Education for Military Officers," SECNAV Instruction 1524.2A, 27 March 1989.

APPENDIX A

CONSTRUCTION OF FILES

All files are constructed using data from Officer Promotion History Files, Officer Master Record Files, and Officer Master Loss Files. Officers who left the Navy for medical/disability reasons or death were deleted prior to construction of the files used in this study.

1. LCDR "STAYERS" FILE

This file is constructed using the Officer Promotion History (OPH) file of all officers who appear before the Lieutenant selection boards in fiscal years 1981 through 1987, the file of all officers who appear before the Lieutenant Commander selection board in fiscal years 1985 through 1990, and the officers from the Officer Master Loss file (OML) who leave the Navy during the years 1981 through 1990.

The file of Lieutenants (LT) is modified to include only officers with the designator 1100 or 1105. This file is merged with the Lieutenant Commander (LCDR) file by (scrambled) social security number to obtain a file of General Unrestricted Line (Gen URL) officers who had remained in the Navy and the community through selection to LCDR. This file also include officers who have entered the

Gen URL community at any time prior to the LCDR selection board.

To identify the Gen URL officers who leave the Navy prior to LCDR, the LT file is merged with the OML file of all officers who leave the Navy. From this file, separation program designator codes are obtained and decoded to determine those who have left the Navy involuntarily. A separate file of these officers is then created.

To create the final LCDR "STAYERS" file, the merged LT/LCDR Gen URL file is merged with the involuntary leavers file. This file consists of 1070 observations. After deleting observations with missing values, the final number of observations in the pooled LCDR STAYERS file used to model promotion is 1040.

2. LCDR "LEAVERS" FILE

This file is constructed using the OPH file of all officers appearing before the LT selection board in fiscal year 1981 through 1987, the file of all officers appearing before the LCDR selection board in fiscal year 1985 through 1990, and the OML file of all officers leaving the Navy between the years 1981 and 1990.

The file of LTs is modified to include only those officers with the designator 1100 or 1105. This file is then merged with the OML file to obtain a file of LT Gen URL officers who leave the Navy. From this file, separation

program designator codes are obtained and decoded to determine those who leave the Navy voluntarily.

To identify those officers who have left the Gen URL community prior to the LCDR selection board, the LT Gen URL file is merged with the LCDR file in which all LCDR 1100/1105's have been deleted. Once merged, the Prior Designator variable is reviewed to identify those LCDRs who had previously been 1100/1105s. A new file of these observations is created.

To obtain the final LCDR "LEAVERS" file, the voluntary leavers file is added to the prior Gen URL file. This file contains 1275 observations. To run the retention model, the pooled LCDR "LEAVERS" file is added to the pooled LCDR "STAYERS" file and includes 2345 observations.

3. CDR "STAYERS" FILE

This file is constructed using the OPH file of only those Gen URL officers who appear before the LCDR selection board in fiscal year 1981 to 1987, the file of Gen URL officers appearing before the Commander (CDR) selection board in fiscal year 1986 to 1990, and those Gen URL officers from the OML file who leave the Navy during the years 1976 to 1987.

The LCDR Gen URL file is merged with the CDR Gen URL file by (scrambled) social security number to obtain a file of Gen URL officers who remain in the Navy and the community through selection to Commander. This file also includes any

officers who enter the Gen URL community prior to selection for CDR.

To identify those Gen URL officers who leave the Navy prior to the CDR selection board, the LCDR Gen URL file is merged with the OML file. From this file, separation program designator codes are obtained and decoded to identify those who leave the Navy involuntarily. These involuntary leavers are placed into a separate file.

To construct the final CDR "STAYERS" file, the merged LCDR/CDR Gen URL file is merged with the involuntary leavers file. This file consists of 430 observations. After deleting those observations with missing values, the final pooled CDR "STAYERS" file used to model promotion consists of 404 observations.

4. CDR "LEAVERS" FILE

This file is created using the OPH file of all Gen URL officers appearing before the LCDR selection board from fiscal year 1981 to 1987, and the OML file of all Gen URL officers who leave the Navy during the years 1976 to 1987.

The LCDR Gen URL file is merged with the Gen URL OML file to obtain a file of LCDR Gen URLs who leave the Navy. From this file, separation program designator codes are obtained and decoded to identify those who leave the Navy voluntarily.

Those officers who leave the Gen URL community prior to the CDR selection board are unidentifiable in these files.

Therefore, the final CDR "LEAVERS" file is created using the merged LCDR Gen URL/Voluntary leavers files referred to above. This file consists of 386 observations. To run the retention model, the pooled CDR "LEAVERS" file is added to the pooled CDR "STAYERS" file and includes 790 observations.

APPENDIX B
MODEL RESULTS

TABLE B.1.A LOGIT RESULTS FOR LCDR "STAYERS" POOLED SAMPLE (BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	1.28 (2.71)	N/A
MALE	-1.65 (52.97)**	-.3763
USNA	-0.59 (2.55)	-.1460
ROTCS	-0.57 (3.79)	-.1410
OSOURCE	-0.63 (1.48)	-.1559
BLACK	-0.05 (0.01)	-.0121
OTHER	0.06 (0.06)	.0143
DIVONE	-0.12 (0.09)	-.0291
MARDEPS	-0.46 (5.67)	-.1136
AGE	-0.04 (1.59)	N/A +
PGSCH	1.71 (27.43)*	.2924
OTHERED	0.71 (11.01)	.1532
GPA	0.15 (3.25)	.0339
TECH	-0.28 (3.22)	-.0687

N = 1040
Chi-square values in parentheses
* = significant at .01
** = significant at .05

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.1.B LOGIT RESULTS FOR LCDR "STAYERS" POOLED SAMPLE
(MODEL 2)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	1.25 (2.57)	N/A
MALE	-1.74 (35.38)**	-.3878
USNA	-0.83 (4.34)	-.2045
ROTCS	-0.69 (5.27)	-.1704
OSOURCE	-0.92 (2.90)	-.2260
BLACK	-0.09 (0.04)	-.0216
OTHER	0.08 (0.11)	.0212
DIVONE	-0.11 (0.07)	-.0265
MARDEPS	-0.47 (5.77)	-.1157
AGE	-0.03 (1.27)	N/A +
PGSCH	1.69 (18.84)	.2844
OTHERED	0.74 (11.44)	.1562
GPA	0.13 (2.43)	.0289
TECH	-0.43 (6.01)	-.1057
GTECH	0.03 (0.00)	.0059
TQC	0.19 (3.42)	.0441

N = 1040
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.2.A LOGIT RESULTS FOR LCDR "STAYERS" WOMEN-ONLY SAMPLE

(BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	0.93 (1.11)	N/A
USNA	0.06 (0.02)	.0149
ROTCS	0.31 (0.61)	.0758
OSOURCE	0.09 (0.01)	.0223
BLACK	-0.09 (0.03)	-.0225
OTHER	-0.07 (0.07)	-.0200
DIVONE	-0.47 (1.33)	-.1166
MARDEPS	-0.17 (0.59)	-.0425
AGE	-0.03 (1.04)	N/A +
PGSCH	1.58 (24.08)*	.3144
OTHERED	0.80 (11.80)	.1866
GPA	0.22 (5.43)	.0499
TECH	-0.34 (4.05)	-.0848

N = 838
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.2.8 LOGIT RESULTS FOR LCDR "STAYERS" WOMEN-ONLY SAMPLE (MODEL 2)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	0.90 (1.05)	N/A
USNA	-0.36 (0.48)	-.0810
ROTCS	0.13 (0.10)	.0268
OSOURCE	-0.12 (0.02)	-.0260
BLACK	-0.25 (0.20)	-.0553
OTHER	-0.09 (0.09)	-.0194
DIVONE	-0.47 (1.34)	-.1074
MARDEPS	-0.19 (0.71)	-.0416
AGE	-0.03 (0.80)	N/A +
PGSCH	1.78 (19.49)	.2356
OTHERED	0.91 (14.31)	.1546
GPA	0.18 (3.91)	.0339
TECH	-0.53 (7.89)	-.1220
GTECH	-0.58 (1.27)	-.1343
TQC	0.38 (6.49)	.0740

N = 838
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.3.A LOGIT RESULTS FOR LCDR "LEAVERS" POOLED SAMPLE (BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	-0.49 (0.73)	N/A
MALE	0.75 (29.15)**	.1845
USNA	0.58 (5.76)	.1422
ROTCS	0.44 (5.88)	.1073
OSOURCE	0.10 (0.11)	.0237
BLACK	-0.01 (0.00)	-.0023
OTHER	-0.17 (0.65)	-.0367
DIVONE	-1.91 (14.91)	-.2921
MARDEPS	-1.82 (87.38)**	-.2843
AGE	-0.01 (0.23)	N/A +
PGSCH	-4.84 (23.08)*	-.3695
OTHERED	-1.18 (44.58)**	-.2190
GPA	0.23 (17.64)	.0547
TECH	-0.14 (1.48)	-.0322

N = 2345
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level
+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.3.B LOGIT RESULTS FOR LCDR "LEAVERS" POOLED SAMPLE
(MODEL 2)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	-0.46 (0.61)	N/A
MALE	0.54 (13.84)	-.1356
USNA	0.33 (1.68)	.0807
ROTCS	0.19 (1.00)	.0460
OSOURCE	3.49 (2.20)	-.1085
BLACK	-0.08 (0.05)	-.0177
OTHER	-0.11 (0.29)	-.0258
DIVONE	-1.81 (13.46)	-.2942
MARDEPS	-1.77 (82.64)**	-.2916
AGE	-0.006 (0.00)	N/A +
POSCH	-5.84 (30.20)*	-.3878
OTHERED	-1.54 (49.88)**	-.2693
GPA	0.16 (7.95)	.0383
TECH	-0.40 (8.77)	-.0900
GTECH	1.55 (13.67)	.3680
TQC	0.22 (11.68)	.0534

N = 2345
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.4.A LOGIT RESULTS FOR LCDR "LEAVERS" WOMEN-ONLY SAMPLE (BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	-0.82 (1.42)	N/A
USNA	1.02 (10.64)	.2457
ROTCS	0.57 (4.97)	.1312
OSOURCE	-0.46 (0.55)	-.0903
BLACK	-0.12 (0.07)	-.2911
OTHER	-0.18 (0.58)	-.0376
DIVONE	-1.62 (8.59)	-.2310
MARDEPS	-1.93 (37.41)**	-.2517
AGE	-0.18 (0.53)	N/A +
PGSCH	-4.83 (23.01)*	-.3127
OTHERED	-1.56 (49.11)**	-.2228
GPA	0.13 (3.93)	.0270
TECH	-0.26 (3.82)	-.0534

N = 1657
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.4.B LOGIT RESULTS FOR LCDR "LEAVERS" WOMEN-ONLY SAMPLE (MODEL 2)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	-0.90 (1.39)	N/A
USNA	0.76 (5.06)	.1874
ROTCS	0.45 (2.97)	.1119
OSOURCE	-0.95 (2.05)	-.1946
BLACK	-0.21 (0.19)	-.0481
OTHER	-0.18 (0.57)	-.0434
DIVONE	-1.62 (8.57)	-.2965
MARDEPS	-1.94 (37.79)**	-.3270
AGE	0.02 (0.70)	N/A +
PGSCH	-5.47 (24.50)*	-.4244
OTHERED	-1.64 (47.71)**	-.2965
GPA	0.11 (2.56)	.0418
TECH	-0.42 (7.24)	-.0984
GTECH	1.07 (2.72)	-.2577
TQC	0.19 (3.45)	.0445

N = 1657
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.5.A LOGIT RESULTS FOR CDR "STAYERS" POOLED SAMPLE
(BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	1.63 (1.09)	N/A
MALE	-2.07 (14.26)	-.3895
ROTCS	-0.36 (0.35)	-.0891
OTHER	-0.43 (0.84)	-.1060
DIVONE	-0.55 (0.97)	-.1320
MARDEPS	0.13 (0.21)	.0324
AGE	-0.07 (1.22)	N/A +
PGSCH	0.62 (4.51)	.1500
OTHERED	0.39 (2.38)	.0962
GPA	0.52 (0.44)	.0192
TECH	-0.15 (0.44)	-.0374

N = 404
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.5.B LOGIT RESULTS FOR CDR "STAYERS" WOMEN-ONLY SAMPLE (BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	1.83 (1.32)	N/A
ROTCS	-0.06 (0.01)	-.0150
OTHER	-0.55 (1.30)	-.1326
DIVONE	-0.48 (0.74)	-.1189
MARDEPS	-0.007 (0.00)	-.0017
AGE	-0.07 (1.36)	N/A +
PGSCH	0.55 (3.50)	.1353
OTHERED	0.43 (2.71)	.1066
GPA	0.06 (0.27)	.0157
TECH	-0.14 (0.34)	-.0348

N = 365
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.6.A LOGIT RESULTS FOR CDR "LEAVERS" WOMEN-ONLY SAMPLE
(BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	-47.50 (0.39)	N/A
MALE	1.36 (0.00)	.0000
ROTCS	2.06 (0.00)	-.0000
OTHER	-0.72 (0.94)	-.0000
DIVONE	0.06 (0.00)	.0000
MARDEPS	-7.62 (.)	-.0000
AGE	1.19 (1.31)	N/A +
PGSCH	8.55 (.)	.0001
OTHERED	-1.38 (0.00)	-.0000
GPA	-0.97 (0.16)	-.0000
TECH	8.77 (.)	.0001

N = 790
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

TABLE B.6.B LOGIT RESULTS FOR CDR "LEAVERS" WOMEN-ONLY SAMPLE (BASIC MODEL)

VARIABLE	COEFFICIENT	DELTA
INTERCEPT	-47.69 (0.34)	N/A
ROTCS	2.58 (0.00)	.0000
OTHER	-0.72 (0.94)	-.0000
DIVONE	1.27 (0.00)	.0000
MARDEPS	-7.60 (.)	-.0000
AGE	1.19 (1.31)	N/A +
PGSCH	8.73 (.)	.0001
OTHERED	-1.19 (0.00)	-.0000
GPA	-0.97 (0.16)	-.0000
TECH	8.79 (.)	-.0001

N = 751
Chi-square values in parentheses
* = significant at .01 level
** = significant at .05 level

+ Average age was included in the calculation for the base case (intercept) only.

APPENDIX C

LIKELIHOOD RATIO TEST RESULTS

TABLE C.1

LIKELIHOOD RATIO TEST RESULTS FOR LCDR "STAYERS" POOLED MODEL

RESTRICTED MODEL: PROMOTE = MALE + USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH

UNRESTRICTED MODEL: PROMOTE = MALE + USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH + GTECH + TQC

Restricted Likelihood Function	Unrestricted Likelihood Function	Computed Chi-Square Value
1075.01	1071.29	3.72

Critical Chi-Square values (df=2)
9.21 at .01 level of significance
5.99 at .05 level of signficance

TABLE C.2

LIKELIHOOD RATIO TEST RESULTS FOR LCDR "STAYERS"
WOMEN-ONLY SAMPLE

RESTRICTED MODEL: PROMOTE = USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH

UNRESTRICTED MODEL: PROMOTE = USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH + GTECH + TQC

Restricted Likelihood Function	Unrestricted Likelihood Function	Computed Chi-Square Value
898.63	890.93	7.70

Critical Chi-Square values (df=2)
9.21 at .01 level of significance
5.99 at .05 level of signficance

TABLE C.3

LIKELIHOOD RATIO TEST RESULTS FOR LCDR "LEAVERS" POOLED SAMPLE

RESTRICTED MODEL: PROMOTE = MALE + USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH

UNRESTRICTED MODEL: PROMOTE = MALE + USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH + GTECH + TQC

Restricted Likelihood Function	Unrestricted Likelihood Function	Computed Chi-Square Value
2162.38	2131.68	30.70

Critical Chi-Square values (df=2)
9.21 at .01 level of significance
5.99 at .05 level of signficance

TABLE C.4

LIKELIHOOD RATIO TEST RESULTS FOR LCDR "LEAVERS" WOMEN-ONLY SAMPLE

RESTRICTED MODEL: PROMOTE = USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH

UNRESTRICTED MODEL: PROMOTE = USNA + ROTCS + OSOURCE + BLACK + OTHER + DIVONE + MARDEPS + AGE + PGSCH + OTHERED + GPA + TECH + GTECH + TQC

Restricted Likelihood Function	Unrestricted Likelihood Function	Computed Chi-Square Value
1583.15	1576.28	6.87

Critical Chi-Square values (df=2)
9.21 at .01 level of significance
5.99 at .05 level of signficance

INITIAL DISTRIBUTION LIST

	No. of Copies
1. Defense Technical Information Center Cameron Station Alexandria, VA 22304-6145	2
2. Library, Code 52 Naval Postgraduate School Monterey, CA 93943-5002	2
3. General Unrestricted Line Officer Community Manager (PERS-211G) Bureau of Naval Personnel Washington, DC 20370	1
4. Dr. Stephen L. Mehay Administrative Sciences Department, Code 36 Naval Postgraduate School Monterey, CA 93943	1
5. Dr. William R. Bowman Economics Department U.S. Naval Academy Annapolis, MD 21402	1
6. LCDR Susan S. Jordan, USN Officer in Charge Personnel Support Detachment, Oceana Virginia Beach, VA 23460	1