

AD-754 105

THE EFFECT OF THE BONUS ON THE RETENTION
OF NUCLEAR-QUALIFIED SUBMARINE OFFICERS

Elliot S. Wetzler

Institute for Defense Analyses

Prepared for:

Assistant Secretary of Defense (Manpower and
Reserve Affairs)

September 1972

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

AD754105

P-879

THE EFFECT OF THE BONUS ON THE RETENTION OF NUCLEAR-QUALIFIED SUBMARINE OFFICERS

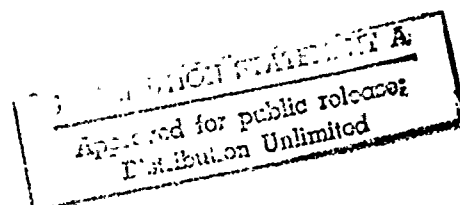
Elliot Wetzler

September 1972

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151



INSTITUTE FOR DEFENSE ANALYSES
PROGRAM ANALYSIS DIVISION



IDA Log No. HQ 72 14362
Copy 77 of 125 copies

ACCESSION for	
HT13	White Section ☒
DDO	Buff Section ☐
UNRECORDED	☐
JUSIFICATION	
BY	
DATE OF AVAILABILITY CODES	
DATE	APPROVAL SPECIAL
A	

The work reported in this document was conducted under Contract No. DAHC 15 68 C 0342 for the Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs). The publication of this IDA Paper does not indicate endorsement by the Department of Defense nor should the contents be construed as reflecting the official position of that office.

This document has been approved for public release and sale; its distribution is unlimited.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION
INSTITUTE FOR DEFENSE ANALYSES		UNCLASSIFIED
		2b. GROUP
3. REPORT TITLE		
THE EFFECT OF THE BONUS ON THE RETENTION OF NUCLEAR-QUALIFIED SUEMARINE OFFICERS		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
None		
5. AUTHOR(S) (First name, middle initial, last name)		
Elliot S. Wetzler		
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September 1972	41	4
8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)	
DAHC-15-68C-0342	Paper P-879	
b. PROJECT NO		
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.		
10. DISTRIBUTION STATEMENT		
This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY
		Assistant Secretary of Defense Manpower and Reserve Affairs
13. ABSTRACT		
This paper examines the quantitative effect of a continuation bonus on the retention of nuclear-qualified submarine officers. The study analyzes the retention response of officers to the bonus (1) for all sources of commission, (2) for NROTC Regulars, and (3) for Naval Academy graduates. In addition to the measurement of the pay elasticity of each officer group, the paper presents a discussion of the cost-effectiveness of the bonus in terms of the additional expenditure required to obtain an additional man-year of service.		

DD FORM 1473
NOV 68

UNCLASSIFIED

Security Classification

I

LINK A

LINK B

LINK C

ROLE

WT

NAME	ROLE
Mr. J. Edgar Hoover	Director
Mr. Clegg	Chief of Bureau
Mr. Glavin	Chief of Bureau
Mr. Ladd	Chief of Bureau
Mr. Nichols	Chief of Bureau
Mr. Rosen	Chief of Bureau
Mr. Tracy	Chief of Bureau
Mr. Carson	Chief of Bureau
Mr. Egan	Chief of Bureau
Mr. Gurnea	Chief of Bureau
Mr. Hendon	Chief of Bureau
Mr. Pennington	Chief of Bureau
Mr. Quinn	Chief of Bureau
Mr. Nease	Chief of Bureau
Mr. Gandy	Chief of Bureau

WT

	ROLE
1.	Chairman
2.	Vice Chairman
3.	Secretary
4.	Treasurer
5.	Member
6.	Member
7.	Member
8.	Member
9.	Member
10.	Member
11.	Member
12.	Member
13.	Member
14.	Member
15.	Member
16.	Member
17.	Member
18.	Member
19.	Member
20.	Member
21.	Member
22.	Member
23.	Member
24.	Member
25.	Member
26.	Member
27.	Member
28.	Member
29.	Member
30.	Member
31.	Member
32.	Member
33.	Member
34.	Member
35.	Member
36.	Member
37.	Member
38.	Member
39.	Member
40.	Member
41.	Member
42.	Member
43.	Member
44.	Member
45.	Member
46.	Member
47.	Member
48.	Member
49.	Member
50.	Member
51.	Member
52.	Member
53.	Member
54.	Member
55.	Member
56.	Member
57.	Member
58.	Member
59.	Member
60.	Member
61.	Member
62.	Member
63.	Member
64.	Member
65.	Member
66.	Member
67.	Member
68.	Member
69.	Member
70.	Member
71.	Member
72.	Member
73.	Member
74.	Member
75.	Member
76.	Member
77.	Member
78.	Member
79.	Member
80.	Member
81.	Member
82.	Member
83.	Member
84.	Member
85.	Member
86.	Member
87.	Member
88.	Member
89.	Member
90.	Member
91.	Member
92.	Member
93.	Member
94.	Member
95.	Member
96.	Member
97.	Member
98.	Member
99.	Member
100.	Member

WY

P-879

THE EFFECT OF THE BONUS ON THE RETENTION OF NUCLEAR-QUALIFIED SUBMARINE OFFICERS

Elliot Wetzler

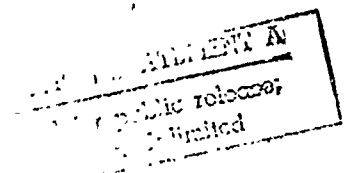
September 1972



INSTITUTE FOR DEFENSE ANALYSES
PROGRAM ANALYSIS DIVISION
400 Army-Navy Drive, Arlington, Virginia 22202

Contract DAHC15 68 C 0342

II



FOREWORD

In order to arrest the growing shortage of junior nuclear-trained submarine officers (grades O-2 and O-3), Public Law 91-20 authorized the Navy to provide a special continuation pay for nuclear submarine officers. Qualified officers who committed themselves to four years of additional service received a \$15,000 bonus payable in equal installments over the four years. This paper, completed under Contract DAHC-15-68C-0342, analyzes the quantitative effect of this bonus on retention of nuclear-qualified submarine officers (1) for all sources of commission, (2) for NROTC Regulars, and (3) for Naval Academy graduates.

The situation presented special methodological problems that precluded the use of econometric techniques in the analysis. This paper therefore contains an evaluation of the effects of the bonus in terms of estimated changes in retention rates, pay elasticities, the additional cost per additional man-year, etc., without assigning statistical properties to these estimates.

Two methods were used to calculate pay elasticity--one based on changes in the retention rate, and the other based on the bonus acceptance rate. For the first method, a pay elasticity of .833 for all sources was obtained. This is a much lower value than that obtained in other studies of first-term (nonsubmarine) officer retention. Another interesting finding was that pay elasticities were much higher for NROTC Regular officers than for Naval Academy graduates.

A measure of the cost-effectiveness of the bonus is the additional cost per additional man-year obtained from the bonus. To make this calculation, the results obtained for both the retention rate and bonus-acceptance rate are used. A comparison then is made of the cost-effectiveness of the bonus with the 1971 military pay increase.

In the Epilogue, the issue is raised of increasing the initial class size as a potentially more efficient way of obtaining the required number of officers.

ACKNOWLEDGMENTS

In writing this paper, I have benefitted from the activities of colleagues at IDA and individuals at the Pentagon. Dr. Edmund Mantell obtained necessary data and provided the original framework for this paper. Especially valuable suggestions and advice were furnished by Dr. Gary Nelson. Captain James Campbell, in particular, and Lt. Cmdr. Stephen Hodge, Mr. Alan Fechter, Mr. Peter Ogloblin and Miss Adrienne Kessler were instrumental in obtaining necessary information and in providing useful advice. Dr. Robert Kuenne, the reviewer of this paper, supplied very valuable suggestions. Miss Phyllis Hamrick provided helpful editorial assistance.

CONTENTS

I	INTRODUCTION	1
II	METHODOLOGY	5
	A THE THEORY OF OCCUPATIONAL CHOICE	5
	B STATISTICAL METHODOLOGY	6
	C THE ELASTICITY OF SUPPLY	8
III	CALCULATING THE EFFECTS OF THE ENLISTMENT BONUS	11
	A CHOOSING CONTROL GROUPS AND TEST GROUPS	11
	B RESULTS	13
IV	EFFECTIVENESS OF BONUS	23
	A RATIONALE	23
	B CALCULATION	24
	C COMPARISON OF BONUS WITH NOVEMBER 1971 PAY INCREASE.	26
V	EPILOGUE	29
	APPENDIX - PRESENTATION OF DATA	A-1

Preceding page blank

FIGURE

- | | |
|---|----|
| 1 Projected Retention Rate of Typical Year Group, Over Time, With and Without a Bonus | 23 |
|---|----|

TABLES

- | | |
|--|-----|
| 1 Navy-Wide Officer Retention Rates at Minimum Service Requirement Plus Two Years | 3 |
| 2 Number of Nuclear-Trained Submarine Officers Reaching EAOS | 3 |
| 3 Obligated Service for Nuclear Submarine Regular Officers | 12 |
| 4 Bonus Acceptance and Retention Rates for Pre-Bonus and Post-Bonus Experience, All Sources | 15 |
| 5 Bonus Acceptance and Retention Rates for Pre-Bonus and Post-Bonus Experience, Naval Academy | 16 |
| 6 Bonus Acceptance and Retention Rates for Pre-Bonus and Post-Bonus Experience, NROTC Regular | 17 |
| 7 Proportionate Change in Retention Rate | 18 |
| 8 Indices of Average Income of Military and Civilian Personnel (1968 = base year) | 18 |
| 9 Pay Elasticities | 21 |
| 10 Navy-Wide and Nuclear Submarine Officer Retention Rates at Minimum Service Requirement Plus Two Years | 30 |
| 11 Aggregate Nuclear Submarine Officers, FY 1963 - FY 1970 | 30 |
| A1 Officers Receiving the Continuation Bonus, by Source and Year Group | A-5 |
| A2 Officers Not Receiving the Continuation Bonus, by Source and Year Group | A-5 |
| A3 Voluntary Losses, by Source and by Year Group | A-6 |
| A4 Initial Year Groups | A-6 |
| A5 Time Profile of Voluntary Losses, by Year Group, Aggregated Over All Sources | A-7 |
| A6 Retention Rates for All Sources | A-8 |
| A7 Survival Rates Aggregated Over All Sources | A-8 |
| A8 Retention Rates for Naval Academy Graduates | A-9 |
| A9 Retention Rates for NROTC Regular Officers | A-9 |

I. INTRODUCTION

This paper analyzes the effect of a \$3,750-per-year retention bonus on the first-term retention behavior of nuclear-qualified submarine officers. The bonus was instituted in 1969 because the Navy was concerned about the growing shortage of experienced nuclear-trained junior submarine officers. As stated in the 1971 Quadrennial Review of Military Compensation:*

The situation of nuclear submarine officer manning had become so critical in 1969 that a new temporary special pay for junior nuclear submarine officers (grades O-2 and O-3) was authorized by Congress. The purpose of this pay was to stem the rising rate of voluntary resignations, which was threatening to make impossible the deployment of some nuclear submarines.

The amount of the bonus was authorized at \$15,000, and eligibility was specified by SECNAV Instruction 7220.65 (1 July 1969). To be eligible for the continuation pay, unrestricted line officers must meet the following criteria:

- (1) They must be on active duty, and thereby entitled to pay.
- (2) They must be currently designated "qualified in submarines".
- (3) They must be currently qualified for duty in connection with supervision, operation, and maintenance of naval nuclear propulsion plants.
- (4) They must have been initially commissioned on or after 1 July 1960.
- (5) They must not have completed ten years of commissioned service at the time of application.

* Study of Flight Pay (Crewmember) and Submarine Duty Pay. Report of the 1971 Quadrennial Review of Military Compensation. Office of the Assistant Secretary of Defense (Manpower and Reserve Affairs) August 1971.

The critical shortage was reflected in a Navy-wide decline in officer retention rates between 1967 and 1970. Retention rates for the period are presented in Table 1. These data show retention rates at minimum service requirement (MSR) plus two years (MSR + 2).^{*} Navy-wide retention of officers at MSR + 2 fell from 23 percent in FY 1967 to 19 percent in FY 1970.

However, the situation among nuclear-trained submarine officers was the result of other factors in addition to the moderate Navy-wide decline in the retention rate. One of these factors was the large increase five years earlier in the class size of officers being trained for duty aboard nuclear submarines.^{**} Year Group 1962 had an initial class size (less involuntary losses) of 141 as compared to the 1963 and 1964 Year Groups which had initial class sizes (less involuntary losses) of 196 and 233, respectively. Another reason was the change in the composition of year groups. Later year groups included personnel who entered nuclear submarine training schools after less than two years of active service in the Navy. Since personnel with less than two years service could be expected to have a much lower retention rate than those who had been on active duty for longer periods, any retention goals based on the retention behavior of earlier year groups would be over-optimistic. Finally, a change in policy reduced the End of Authorized Obligated Service (EAOS) from 5½ years for Year Group 1963 to 4 years for the Year Group 1964.

Since, typically, the heaviest losses occur immediately following the EAOS, heavy losses for Year Groups 1963 and 1964 overlapped. Table 2 illustrates this point. It gives the number of officers reaching their EAOS in FYs 1966 through 1971.

^{*} It is usual to examine retention at MSR + 2 years because some officers who leave do not do so immediately after their MSR has been met.

^{**} If class size is restricted, class membership may be limited to those showing greatest ability and motivation. If class size is expanded, less highly motivated candidates will be accepted.

Table 1. NAVY-WIDE OFFICER RETENTION RATES AT MINIMUM SERVICE REQUIREMENT PLUS TWO YEARS

Fiscal Year	Retention Rate (Percent)						
	USNA	NROTC Regular	NROTC Contract	OCS	ROC	NESEP	All Sources
1967	73	31	15	15	28	100	23
1968	64	32	13	12	37	55	21
1969	54	30	10	12	18	73	21
1970	45	24	12	9	14	62	19

Table 2. NUMBER OF NUCLEAR-TRAINED SUBMARINE OFFICERS REACHING EAOS

Year Group	Fiscal Year					
	1966	1967	1968	1969	1970	1971
61	55 ^a	56 ^a				
62		67 ^a	67 ^a			
63			96 ^a	96 ^a		
64			233			
65				270		
66					228	
67						219
Totals	55	123	396	366	228	219
a. The number of officers in year groups with an EAOS of 5½ years are assumed to be divided roughly equally between the fiscal year represented by YG + 5 and the fiscal year represented by YG + 6.						

II. METHODOLOGY

A. THE THEORY OF OCCUPATIONAL CHOICE

There is a well-established body of economic theory relating to the reenlistment decision of military personnel. The theory has been fruitfully applied in many empirical studies, noteworthy recent examples being the studies contained in the "Gates Commission Report". The theory can be outlined in the following way.

Consider an individual who must make a reenlistment decision. He will consider the following three factors, among others, before making his decision: (1) the second-term Navy pay he can expect, (2) the civilian pay that he might receive if he does not reenlist, and (3) the weight he attaches to his feelings (positive or negative) about the nonpecuniary aspects of a military career. If his military pay were to be increased while his civilian opportunities remained constant, he would be more likely to reenlist. The converse is also true. Therefore, both second-term military pay and civilian expectations affect reenlistment behavior.

An employed individual in evaluating the opportunity to change employment takes into account the costs of the transition.** Thus, his nonpecuniary preferences determine the level of income in his current job that would be required to make him indifferent to remaining there or accepting the contemplated job. This income level is

* Studies Prepared for the President's Commission on an All-volunteer Armed Force, November 1970, often referred to as the "Gates Commission Report". See especially the studies by Nelson, Wilburn, and Grubert and Weiher that are included in the report.

** The military services pay direct transition costs, such as moving expenses for men leaving the service. Hence, transition costs are less important to service personnel than they are to civilians.

called the "critical value" of the current job income. Likewise, each submariner facing the reenlistment decision has a critical value of military income based on his civilian opportunity income and his taste for military life. For the individual, it is not possible to observe this critical value directly, but his choice and the alternative income streams offered him can be observed. Nuclear-trained submarine officers can be grouped together by year group, and variations in the continuation behavior of each group can be examined as the alternative income streams vary. For the sample period considered in this study, the most dramatic variation in the earnings streams comes about as a consequence of the establishment of a special continuation bonus that was first offered in FY 1970. The economic theory of the reenlistment decision suggests that a study of continuation behavior before and after the bonus will indicate the supply responsiveness of nuclear submarine officers to a change in the price offered for their services.

B. STATISTICAL METHODOLOGY

A different statistical methodology than that used in previous studies of reenlistment behavior must be used for the nuclear-trained submarine community for several reasons. First, within a nuclear-trained submarine year group there is no significant variation in pay. Second, because of the selection process, all members of the year group are college graduates; hence, there is no significant variation in measures of education. Third, since most, if not all, members volunteered for reasons unrelated to the draft, changes in draft pressure that affect behavior in other military communities are less significant here. For these reasons, statistical cross section analysis is not possible. Since variations within a year group are small, we must use the year group as the unit of observation. The effect of the bonus will be determined by variations in year group behavior.

It is impossible to apply econometric techniques such as a time-series regression analysis to determine the effect of the bonus. It

is also difficult to establish a suitable control group. Some of the reasons for these difficulties are listed below:

- (1) Because the nuclear submarine program has a short history (the first class to graduate with over 100 students was Year Group 1959), and because the first-term commitment has been four or more years (depending on the particular year group being discussed), the number of annual observations of continuation behavior is small.
- (2) Because the bonus was instituted in FY 1970, only a few annual post-bonus observations are available.
- (3) The composition of participants in the nuclear-trained submarine program has shifted over time. In the earlier years (before FY 1963), many of the participants had more than two years of prior service in the Navy before entering the nuclear submarine training program. Another change has been the downward shift over time in the proportion of participants who came from the Naval Academy or from NROTC Regular programs.*
- (4) The first-term continuation rates have tended to fall for the Navy as a whole over the last five years.*
- (5) A new policy instituted in February 1967 which became effective on 1 June 1967 deferred for one year** the time at which a resigner from the nuclear-trained submarine community could leave the Navy.†

The specific method used in analyzing the data bases entails the computation of retention rates, pay elasticities, and the additional number of man-years per dollar of bonus. The task of determining the effect of the bonus, therefore, is one of comparing the retention

* From a statistical standpoint, adding variables to account for changes in composition within the nuclear-submarine community and for the decline in Navy-wide continuation rates reduces the already limited number of "degrees of freedom".

** In Year Group 1967, the deferral was six months.

† By Navy policy, an officer could resign four to six months before the end of minimum obligated service. However, under the new policy he would not be released from the Navy until one year after his minimum obligated service. If an officer submitted a resignation after his EAOS, he would be released one year after the date of submission. For some individuals, the new policy may have meant that they must submit their resignations earlier than they would have otherwise. Thus, it is difficult to associate changes in the level of losses in a particular year with particular effects such as the bonus.

behavior of a group eligible to receive the bonus with a comparable control group not affected by the bonus.

C. THE ELASTICITY OF SUPPLY

Before turning to the question of determining which year group to use as a control, a brief discussion of various measures of (arc) pay elasticity may be helpful. The general formula for a (arc) pay elasticity is:

$$\epsilon = \frac{\Delta R/R}{\Delta P/P} = \frac{\text{percentage change in retention rate (R)}}{\text{percentage change in pay (P)}}$$

where

ϵ = (arc) pay elasticity of the retention rate

R = retention rate

ΔR = change in retention rate

P = pay

ΔP = change in pay

The formula most frequently applied in military manpower studies is

$$\epsilon = \frac{(R_2 - R_1)/R_1}{(P_2 - P_1)/P_1},$$

where

R_2 = retention rate after pay change

R_1 = retention rate before pay change

P_2 = pay after pay change

P_1 = pay before pay change

The main difficulty with this measure is that different elasticities are obtained when the effects of a pay increase are compared with those of a pay decrease of the same size, even though the manpower response may be identical in size. The use of the initial (before

the pay change) values of retention rate and pay as bases causes this discrepancy.

A formula that avoids the problem of inconsistent elasticities uses the average values (arithmetic means) of manpower and pay for the base. This formula is

$$\epsilon = \frac{(R_2 - R_1) / \frac{1}{2}(R_2 + R_1)}{(P_2 - P_1) / \frac{1}{2}(P_2 + P_1)} .$$

When this definition is applied, the same elasticity occurs for a given size pay and manpower change, regardless of whether pay is increased or decreased. This formula is used in our calculations.

A third formula sometimes used is

$$\epsilon = \frac{\log(R_2/R_1)}{\log(P_2/P_1)} ,$$

where log is the logarithm of the variable. This formula uses the geometric rather than the arithmetic mean as the base. If we assume a log-linear relationship between the retention rate and pay ($R = aP^\epsilon$), this implies that the third specification has the convenient property of a constant pay elasticity for all levels of pay. One minor drawback, however, is that for relationships which are not log-linear, the calculation of this elasticity requires the use of a table of logarithms.

III. CALCULATING THE EFFECTS OF THE ENLISTMENT BONUS

A. CHOOSING CONTROL GROUPS AND TEST GROUPS

We now turn to the question of a suitable control group. Since Year Group 1961 was the first one eligible to receive the bonus, it seems plausible to use as control groups the year groups prior to 1961. In fact, however, the year groups prior to 1961 represent a heavily biased sample that is not comparable to a sampling of subsequent year groups. This bias results from the fact that virtually all submariners in year groups prior to 1961 were committed to a Navy career at the time they entered the nuclear training program. All were regular officers who had been preselected for the nuclear program. Almost all had several years prior service in the Navy, either in surface ships or diesel submarines. At the time they were selected for nuclear training, all of these officers indicated their intention of continuing in the Navy as careerists. If these officer samples were to be used as control groups, their exceedingly high continuation rates (resulting from preselection) would suggest that the continuation bonus was having the opposite of the desired effect. The preselection of officers also occurred for some officers in Year Groups 1961, 1962, and 1963.

Since legislation establishing the continuation bonus was not enacted until FY 1970, it is possible to use the retention behavior of some of the year groups with EAOS prior to FY 1970 as control groups. Because of the policy of deferring resignations for one year, a necessary condition for a control group is the lapse of at least one year between EAOS and FY 1970. It is necessary to take account of the variation in the period of obligated service when selecting control groups. Table 3 lists the various periods of obligated service by year group.

Table 3. OBLIGATED SERVICE FOR NUCLEAR
SUBMARINE REGULAR OFFICERS

Year Group	Years of Obligated Service
1963 and earlier	5½
1964 to 1967	4
1968 USNA	5
Other	4
1969 USNA and NROTC(R)	5
Other	4

Because it is impossible to use econometric techniques to study the effect of continuation pay, we have devised two noneconometric methods as alternatives. Both methods use the behavior of Year Groups 1963 and 1964 to measure first-term continuation rates in the absence of a bonus. Perhaps more emphasis should be placed on the results obtained by using Year Group 1964, because the EAOS for Year Group 1964 is only four years, while it is five years and six months for Year Group 1963. Thus, the EAOS is six months later for Year Group 1963, which means, given the delay of a year between date of resignation and date of loss that was instituted in 1967, the behavior of Year Group 1963 may reflect a mixture of pre-bonus and post-bonus behavior (i.e., using Year Group 1963 may underestimate the effect of the bonus). However, this is probably not the case, since the greatest loss occurred in FY 1970, the year the bonus was instituted. Thus, the loss in FY 1970 is included in the cumulative loss of personnel for purposes of calculating pre-bonus retention rates. Furthermore, withdrawals of resignations were counted as losses for purposes of calculating pre-bonus retention behavior. If FY 1970 losses had been excluded, then estimated pre-bonus retention

rates would have been much higher and the estimated effect of the bonus would have been much less. Likewise, if either Year Group 1961 or 1962 had been used to calculate pre-bonus retention behavior, then pre-bonus retention rates would have been much higher. This would be true even if all officers with more than two years service were excluded from Year Groups 1961 and 1962. It could therefore be argued that we have underestimated pre-bonus retention rates and thus overestimated the effect of the bonus. However, because our estimated effect of the bonus is much less than that generally accepted, and because of the special problems associated with the data, we believe our results do not overestimate the effect of the bonus, but reflect the best estimate of its effect. The behavior of Year Group 1966 measures the continuation rates under conditions of a bonus.* No pre-bonus behavior is reflected by Year Group 1966, because virtually all resignations were submitted after the bonus had taken effect. If Year Group 1965 instead of Year Group 1966 were used for measuring post-bonus behavior, then post-bonus retention rates would be lower and the estimated effect of the bonus would be much less than that shown by our results.

B. RESULTS

The first method of assessing the impact of the bonus described in Section A compares the retention rate of Year Group 1966 with the retention rates of Year Groups 1963 and 1964. The cumulative losses up to and including FY 1970 are added to the number of withdrawals of resignations in FY 1970 for Year Group 1963 or 1964 to obtain an estimate of the number of losses in the absence of a bonus. It is assumed that withdrawal of resignations in FY 1970 was due primarily to the bonus. The estimated loss in the absence of a bonus divided by the original size of the year group yields the cumulative retention rate without a bonus for Year Groups 1963 or 1964. For Year Group 1966,

* Year Group 1965 is excluded because its inclusion would give an unrealistically low effectiveness to the bonus.

the cumulative losses up to and including FY 1972* are divided by the original size of the year group to give the cumulative retention rate with a bonus. Withdrawals of resignations for Year Group 1966 are not included, since such withdrawals by FY 1972 would be for reasons not connected with the bonus. These calculations are made for all sources combined, and separately for both Naval Academy and NROTC Regular officers.

The second method of measuring the impact of the bonus establishes the proportion between the original size of the year group and the number accepting the bonus, but is less similar than the first to methods used in other reenlistment studies and is probably less desirable for calculating pay elasticities. The second method uses data on the number of officers who accepted the bonus. In this procedure, the number of officers in Year Group 1963 or 1964 who withdrew their resignations in FY 1970 is subtracted from the cumulative number of officers who accepted the bonus in Year Groups 1963 or 1964 in FY 1970. In Year Group 1966, the number of officers who accepted the bonus is divided by the size of the initial year group. This number is a minimum cumulative retention rate projected for several years, on the basis of the number of officers accepting the bonus. Acceptance of the bonus commits the acceptee to four years of additional service. The estimate is a minimum or lower-bound estimate because some officers who have continued but have not yet accepted the bonus will be likely to do so in the future. Since the number of officers who continue but who have not accepted the bonus is small, this projected future retention rate should be close to the actual future retention rate.

A comparison of results obtained by applying the first and second methods for (1) all sources combined, (2) for the Naval Academy, and (3) for NROTC Regular officers, shows that these methods yield consistent results (Tables 4, 5, and 6). In a comparison of the retention rates, the data indicated that the retention rate for all

* Some of the loss data available for FY 1972 represented not actual losses but anticipated losses based on resignation data.

Table 4. BONUS ACCEPTANCE AND RETENTION RATES FOR PRE-BONUS
AND POST-BONUS EXPERIENCE, ALL SOURCES

Statistic		Retention Rate	Acceptance Rate
Year Group 1963 (Pre-Bonus)			
Original size of group	193	.383	
Cumulative loss (1970)	115		
Withdrew resignation after bonus was offered	<u>4</u>		
Cumulative loss plus withdrawn resignations	<u>119</u>		
Retained	74		
Accepted bonus (up to and including 1970)	64		
Number accepting bonus minus withdrawn resignations	62		
Year Group 1964 (Pre-Bonus)			
Original size of group	233	.408	
Cumulative loss (1970)	131		
Withdrew resignation after bonus was offered	<u>7</u>		
Cumulative loss plus withdrawn resignations	<u>138</u>		
Retained	95		
Accepted bonus (up to and including 1970)	74		
Number accepting bonus minus withdrawn resignations	67		
Year Group 1966 (Post-Bonus)			
Original size of group	228	.491	
Cumulative loss (1972)	<u>116</u>		
Retained	112		
Accepted bonus (up to and including 1970)	86		

Table 5. BONUS ACCEPTANCE AND RETENTION RATES FOR PRE-BONUS
AND POST-BONUS EXPERIENCE, NAVAL ACADEMY

Statistic		Retention Rate	Acceptance Rate
Year Group 1963 (Pre-Bonus)			
Original size of group	93		
Cumulative loss (1970)	44		
Withdrew resignation after bonus was offered	<u>2</u>		
Cumulative loss plus withdrawn resignations	<u>46</u>		
Retained	47	.505	
Accepted bonus (up to and including 1970)	40		
Number accepting bonus minus withdrawn resignations	38		.409
Year Group 1964 (Pre-Bonus)			
Original size of group	136		
Cumulative loss (1970)	64		
Withdrew resignation after bonus was offered	<u>4</u>		
Cumulative loss plus withdrawn resignations	<u>68</u>		
Retained	68	.500	
Accepted bonus (up to and including 1970)	56		
Number accepting bonus minus withdrawn resignations	52		.382
Year Group 1966 (Post-Bonus)			
Original size of group	117		
Cumulative loss (1972)	<u>52</u>		
Retained	65	.556	
Accepted bonus (up to and including 1970)	47		.402

Table 6. BONUS ACCEPTANCE AND RETENTION RATES FOR PRE-BONUS
AND POST-BONUS EXPERIENCE, NROTC REGULAR

Statistic		Retention Rate	Acceptance Rate
Year Group 1963 (Pre-Bonus)			
Original size of group	80	.288	
Cumulative loss (1970)	55		
Withdrew resignation after bonus was offered	<u>2</u>		
Cumulative loss plus withdrawn resignations	<u>57</u>		
Retained	23		
Accepted bonus (up to and including 1970)	20		
Number accepting bonus minus withdrawn resignations	18		
Year Group 1964 (Pre-Bonus)			
Original size of group	90	.256	
Cumulative loss (1970)	64		
Withdrew resignation after bonus was offered	<u>3</u>		
Cumulative loss plus withdrawn resignations	<u>67</u>		
Retained	23		
Accepted bonus (up to and including 1970)	15		
Number accepting bonus minus withdrawn resignations	12		
Year Group 1966 (Post-Bonus)			
Original size of group	78	.449	
Cumulative loss (1972)	<u>43</u>		
Retained	35		
Accepted bonus (up to and including 1970)	27		

Table 7. PROPORTIONATE CHANGE IN RETENTION RATE

Year Group	Change in Retention Rate ($R_2 - R_1$)		Base (average) Retention Rate $\frac{1}{2}(R_2 + R_1)$		Proportionate Change in Retention Rate ($R_2 - R_1$)/ $\frac{1}{2}(R_2 + R_1)$	
	First Method	Second Method	First Method	Second Method	First Method	Second Method
All Sources, 1963	.108	.084	.437	.353	.247	.238
All Sources, 1964	.084	.107	.449	.341	.186	.314
Naval Academy, 1963	.050	.007	.530	.405	.095	.017
Naval Academy, 1964	.056	.019	.528	.392	.105	.049
NROTC Regular, 1963	.161	.121	.368	.286	.438	.424
NROTC Regular, 1964	.193	.213	.352	.240	.549	.888

Table 8. INDICES OF AVERAGE INCOME OF MILITARY AND CIVILIAN PERSONNEL (1968 = base year)

Category	Index of Income		
	1968	1969	1970
Military, 0-3, between six and eight years of service, receiving Regular Military Compensation and submarine pay	100.0	108.5	114.3
Civilian, head of household, 25 to 34 years old, four years of college, (C_1)	100.0	103.0	110.4
Civilian, head of household, 25 to 34 years old, five or more years of college, (C_2)	100.0	111.5	118.8

sources went up from 40.2 percent for Year Group 1964 to 49.1 percent for Year Group 1966. For the Naval Academy officers, however, retention only increased from 50.0 percent of Year Group 1964 to 55.6 percent of Year Group 1966. On the other hand, retention rates rose sharply for NROTC Regulars, rising from 25.6 percent of Year Group 1964 to 44.9 percent of Year Group 1966. The behavior of Year Group 1963 followed the same pattern as Year Group 1964.

A comparison of bonus-acceptance rates shows that the projected retention rate for all sources increased from 28.8 percent for Year Group 1964 to 39.5 percent for Year Group 1966. The projected retention rate of the Naval Academy graduates showed a small increase, 38.2 percent of Year Group 1964, compared with 40.2 percent of Year Group 1966. For NROTC Regulars, the projected retention rate rose from 13.3 percent to 34.6 percent.

The results presented in Tables 4, 5, and 6 are used to calculate the proportionate change in retention rates. This calculation is shown on Table 7. The proportionate change in retention rates, in conjunction with the proportionate change in pay, is used to obtain the pay elasticities using the second formula given in the text.

In 1970, annual average Regular Military Compensation (RMC) for O-3's with over six (but not over eight) years of service was \$12,772. Additional annual submarine duty pay for O-3's with over six years of service was \$2,160. Therefore, total annual compensation without the bonus was \$14,932. With a \$3,750-per-year bonus, annual compensation was \$18,682. Thus, there was a 22.3 percent increase in pay as a result of the bonus, i.e.,

$$(P_2 - P_1) / \bar{P} = 3,750 / \frac{1}{2}(14,932 + 18,682) = .223 .$$

This calculation assumes that the ratio of military pay (excluding the bonus) to civilian pay (M/C) did not change over time. Table 8 presents indices of annual military and civilian pay for comparable military and civilian groups from 1968 to 1970. The index of military to civilian pay (1968 = 100), is shown below.

<u>Ratio</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>
M/C ₁	100.0	105.3	103.5
M/C ₂	100.0	97.3	96.2

If we assume that individuals in the civilian group comparable to nuclear-trained submariners had four years of college, then military pay relative to civilian pay was 3.5 percent higher in 1970 than in 1968 (with 1968 as a base). To make this computation consistent with our pay elasticity computation, however, the base must be a simple average of the annual values for 1968 and 1970. Thus, the increase in M/C₁ would be 3.44 percent [i.e., $3.5/\frac{1}{2}(100 + 103.5)$]. If we assume the comparable civilian group had five or more years of college, then the increase in relative military pay, using the simple average of 1968 and 1970 as the base, is -3.87 percent [i.e., $-3.8/\frac{1}{2}(100 + 96.2)$]. Both of these changes are small relative to the pay change resulting from the bonus. The overall pay change using the four-years-of-college result is 23.07 percent ($.223 \times 103.44$). The five-plus-years-of-college result is 21.44 percent ($.223 \times 96.13$).

The pay elasticity of the bonus equals the percent change in retention rate per one percent change in pay $\left(\left[\frac{R_2 - R_1}{\bar{R}} \right] \div \left[\frac{P_2 - P_1}{\bar{P}} \right] \right)$. Table 9 gives pay elasticities by source and method, assuming that the ratio of military to civilian pay did not change between 1968 and 1970.

As shown in Table 9, the pay elasticity for all sources is between .83 and 1.41. These are lower estimates than the 2.0 reenlistment pay elasticity cited in the Gates Commission Report. This result may be due to the lower initial reenlistment rates of communities examined in that report. It also may be due to the better civilian alternatives for nuclear-trained personnel. For Naval Academy personnel, a pay elasticity of only .47 or less is obtained. This may be due to the relatively high retention rate that occurs even in the absence of a bonus. By contrast, the pay elasticity of 1.90 or greater for NROTC Regulars may reflect the relatively low pre-bonus retention rates.

Table 9. PAY ELASTICITIES^a

Method	Year Group 1963	Year Group 1964
<u>All Sources</u>		
First ^b	1.105	.833
Second	1.065	1.408
<u>Naval Academy</u>		
First ^b	.424	.472
Second	-.076	.221
<u>NROTC Regular</u>		
First ^b	1.963	2.458
Second	1.901	3.979
a. To obtain pay elasticities using the four-years-of-college result, increase pay elasticities by 3.4 percent. To obtain results using the five-or-more-years-of-college result, reduce pay elasticities by 3.9 percent. b. As already indicated in the text, when making a comparison with elasticities obtained from other studies, the elasticities obtained by the first method should be used.		

IV. EFFECTIVENESS OF BONUS

A. RATIONALE

One way to measure the cost-effectiveness of the bonus is to calculate the additional cost per additional man-year. Since the same calculation can be made for the November 1971 pay increase, a logical basis is established for comparing these two situations or for comparing other situations involving pay changes. The increase in man-years as a result of the bonus is shown by the shaded area in Figure 1.

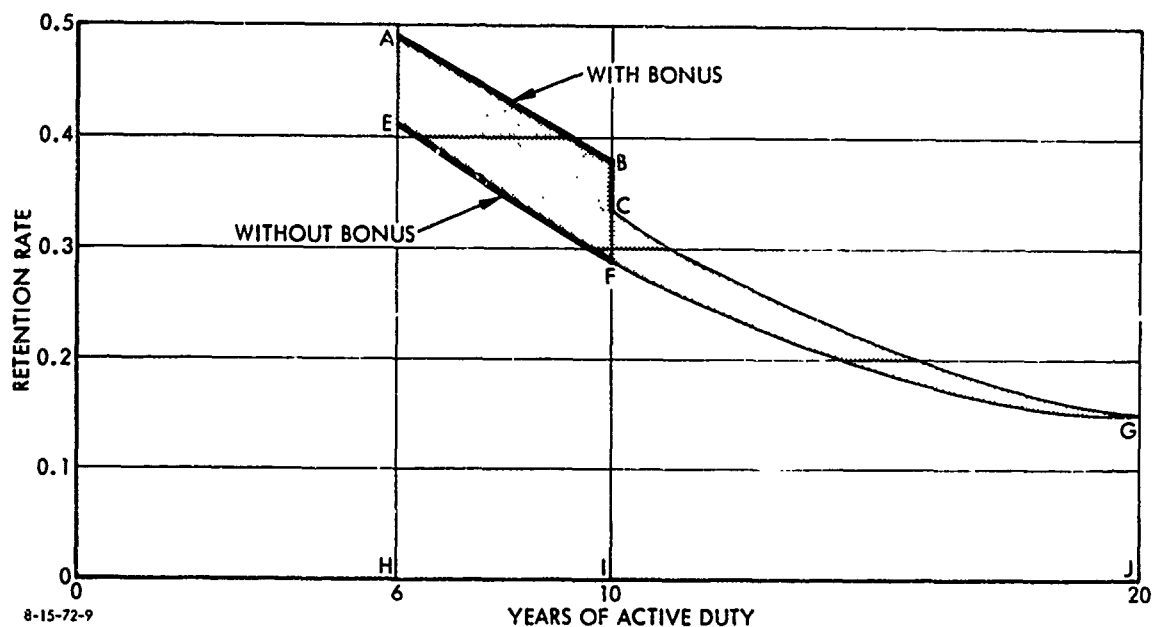


Figure 1. PROJECTED RETENTION RATE OF TYPICAL YEAR GROUP, OVER TIME, WITH AND WITHOUT A BONUS

The gain in man-years from the bonus actually represents two gains. The first, and obvious, gain is officers who are retained for four years as a consequence of receiving the bonus. A second gain occurs because some of these officers will be retained after their bonus lapses because of the increase in the present value of their retirement benefits that occurred during the four years they received the bonus. The first gain is shown by the area EABF and the second by area CFG in Figure 1.

B. CALCULATION

The increase in man-years with the bonus in effect is shown by the area between the lines AB and EF on Figure 1. The values for the points A, B, E, and F on Figure 1 are as follows:

<u>All Sources</u>	<u>Six-Year Point^a</u>	<u>Ten-Year Point^b</u>
With Bonus	.491 (A)	.377 (B)
Without Bonus	<u>.408 (E)</u>	<u>.288 (F)</u>
Difference	.083	.089

a. Year Group 1966 and Year Group 1964 retention rates for all sources.

b. Year Group 1966 and Year Group 1964 bonus-acceptance rates for all sources.

The six-year retention rate (points A and E) is given by the results obtained from the first method, i.e., officers retained divided by the original number in the year group. The ten-year retention rate (points B and F) is given by the results of the second method, i.e., officers accepting the bonus divided by the number in the original year group. The ten-year retention rate is not identical to the six-year rate because some officers who are continuing without the bonus will decide to leave the Navy. When we use the values given in the tabulation above, area EABF on Figure 1 is .344.* We assume

* This assumes the lines AB and EF are linear. $HI \times 1/2 [(A - E) + (B - F)] = 4 \times 1/2 [.083 + .089] = .344.$

that the same retention rate with or without a four-year bonus occurs at retirement age (20 years of service).^{*} One plausible, but pessimistic, retention assumption is that the retention rate will be reduced by the amount AE at the beginning of the no-bonus years. Another plausible assumption is that some of those who remained because of the bonus will continue without the bonus because of the higher present value of their retirement benefits. An optimistic retention assumption would be that half of those who would have left without the bonus (i.e., $1/2AE$) remain because of retirement benefits. The area CGF is given by $IJ \times 1/2CF$.^{**} This translates as $IJ \times 1/2(BF - AE)$ in the pessimistic case and $IJ \times 1/2(BF - 1/2AE)$ in the optimistic case.

<u>Area</u>	<u>Pessimistic Assumption</u>	<u>Optimistic Assumption</u>
CGF	.120	.328
EABF	<u>.380</u>	<u>.344</u>
Total	.500	.672

The additional cost (C), undiscounted, as a consequence of the bonus is the per-man cost of the bonus times the average retention rate with the bonus (i.e., average of retention rates A and B on Figure 1).[†] This average retention rate is used because all officers, whether they would have continued with or without the bonus, will receive the bonus by signing up for it. Therefore, the

^{*} Other reasonable assumptions could be made, but they probably would not significantly affect the numerical value of the calculation.

^{**} This makes the specific assumption that the area CGF is one-half the enclosed area formed by a line parallel to FG starting at point C.

[†] The RMC paid to officers who remained because of the bonus is neither included nor considered an additional cost of the bonus.

additional cost undiscounted, is \$6,510 (i.e., \$15,000 x $\frac{1}{2}$ [.491 + .377]). The discounted cost of the bonus is

$$\$6,510 \sum_{t=1}^4 (1-d)^{t/4},$$

where d = discount rate per annum. With a 10 percent discount rate, C discounted is \$5,038. The additional costs per additional man-year which result when the additional cost is divided by total area are shown in the tabulation below.

<u>Assumption</u>	<u>No Discount</u>	<u>10 Percent Discount</u>
Pessimistic	\$13,020	\$10,076
Optimistic	\$ 9,688	\$ 7,497

C. COMPARISON OF BONUS WITH NOVEMBER 1971 PAY INCREASE

We now consider the effect of the November 1971 pay increase on additional cost per additional man-year. This pay increase primarily affected first-term enlisted men. To simplify the problem, we will only consider the effect on enlistees and will assume no pay increase after the first term. If we project available data, it appears that first-term service-wide enlistments will increase by 35 percent from the pay increase. The pre-pay reenlistment rate is about 20 percent. A pessimistic reenlistment assumption would be that none of the additional enlistees will reenlist. An optimistic reenlistment assumption is that the additional enlistees will reenlist at the same rate as the pre-pay-increase enlistees. Under either reenlistment assumption, we assume that the number of enlistments staying for 20 years in service is the same as the pre-pay-increase level. These assumptions, shown below, are made to maintain comparability with the assumptions used in the bonus case.

<u>Increase</u>	<u>Pessimistic Assumption</u>	<u>Optimistic Assumption</u>
Reenlistments ^a	0	.56 ^b
Enlistments ^a	<u>1.40</u>	<u>1.40</u>
	1.40	1.96

a. This is the increase in the index of man-years, e.g., if the number of men increases by 35 percent, the increase in the index of men is .35. Multiplying the index of increase in men by the number of years involved gives the increase in the index of man-years.

b. This equals .5 x reenlistment rate (.2) x increase in enlistments (.35) x number of years from initial reenlistment date to retirement (16). The .5 enters into this calculation because of our assumption about the number of enlistees with 20 years of service.

The average increase in cost per additional man is the product of the average annual increase in Regular Military Compensation,* the number of enlistees, and the number of years of enlistment (1,340 x 1.35 x 4). This cost is estimated to be \$7,236; with a 10 percent discount rate per year, this amounts to \$5,599. These results, in terms of additional cost per additional man-year, are summarized below.

<u>Assumption</u>	<u>No Discount</u>	<u>10 Percent Discount</u>
Pessimistic	\$5,169	\$3,999
Optimistic	\$3,692	\$2,857

The cost of the bonus relative to the pay increase is shown in the tabulation below.

* This average is difficult to calculate because it depends on promotion rates, family size, etc.

<u>Assumption</u>	<u>Ratio</u>
Pessimistic	2.52
Optimistic	2.62

We now come to a matter of judgment. Since a nuclear-trained submarine officer has more training and experience than an enlistee, and, presumably, is more valuable to the Navy, a larger value should be placed on his retention. But the question of how much more valuable he is remains a matter of opinion. If a man-year for a nuclear-trained submarine officer is considered to be worth more than 2.62 enlistee man-years, the bonus is more efficient than the November pay increase, but if the officer man-year is considered to be worth less than 2.52 enlistee man-years, the pay increase is more efficient than the bonus.

V. EPILOGUE

The evidence shown on Table 10 indicates that, even in the absence of a bonus, retention rates from all sources for nuclear-trained submarine officers would be much higher than Navy-wide officer retention rates. Since a much larger portion of nuclear-trained submarine officers come from the Naval Academy and NROTC Regulars, it is necessary to examine the retention rates from these two sources separately. Retention rates of Naval Academy graduates both Navy-wide and in the nuclear submarine community are similar. The retention rate for NROTC Regulars in the nuclear submarine community was higher than Navy-wide retention rates in 1968 and 1969, but was approximately the same in 1970. Thus, in terms of Navy-wide retention rates, there is no special nuclear submarine problem associated with nuclear submarine officers. A retention problem occurs because the initial class sizes of nuclear submarine officers are too small. As shown by Table 11, the major problem appears to be the high percentage of applicants who are not accepted for the nuclear submarine training program.

This raises the question of which is the more efficient way of increasing the number of nuclear-trained submarine officers. It depends on the cost of increasing the original input versus the cost of higher retention rates.* If the additional training cost per additional man-year from a larger accepted and graduated nuclear-trained submarine class is over \$13,020, then using the bonus is unambiguously the more efficient method. If the additional training cost per additional man-year is less than \$7,497, a larger initial input is unambiguously more efficient.

* We assume that the resulting productivity per man remains the same, regardless of the method used.

Table 10. NAVY-WIDE AND NUCLEAR SUBMARINE OFFICER RETENTION
RATES AT MINIMUM SERVICE REQUIREMENT PLUS TWO YEARS

Fiscal Year	Academy		NROTC Regular		All Sources	
	Navy- wide	Nuclear Submarine	Navy- wide	Nuclear Submarine	Navy- wide	Nuclear Submarine
1968	64	60	32	55	21	58
1969	54	58	30	41	21	50
1970	45	42	24	23	19	33

Table 11. AGGREGATE NUCLEAR SUBMARINE
OFFICERS, FY 1963 - FY 1970

Category	Number	Percent of Authorized Space
Applicants	5,516	179.1
Accepted	2,675	86.9
Graduated	2,112	68.6
Spaces Authorized	3,080	100.0
Source: The 1971 Quadrennial Review of Military Compensation, Tables III-23 and III-24.		

I

in between these two values, the more efficient way depends on the reenlistment assumption (optimistic or pessimistic) and the discount rate used.

APPENDIX

PRESENTATION OF DATA

The data available for the analysis described in this paper can be characterized in a variety of ways. For our purposes, it is convenient to classify the data into three mutually exclusive sets:

- S_1 The set of nuclear-qualified submarine officers on active duty who are drawing the special continuation pay.
- S_2 The set of nuclear-qualified submarine officers on active duty who are not drawing the special continuation pay bonus.
- S_3 The set of persons who are nuclear-qualified submarine officers not on active duty in the Navy.

The aggregation of data sets S_1 , S_2 , and S_3 represents the nuclear submarine community, past and present. Within each of the data sets it has been possible to obtain specific information on individuals. In the case of sets S_1 and S_2 , the data were extracted from the Officer Master Tape which consists of a continuously current inventory of active duty officers.* The data extracted from the Master Tape for sets S_1 and S_2 are listed below.

- File number
- Year Group (first two digits)
- Source Code (current)
- Activity Mission Code
- Rank
- Education Level

* Active Duty Officer Automated Record as documented in NAVPERS 15921B (13 July 1971).

These six items of information are obtained for every officer in sets S_1 and S_2 . This information enables us to construct an inventory of the current force structure of the nuclear submarine community cross-referenced by seniority and source. The two items of greatest importance are the year group and the source code. The year group indicates the fiscal year of first commissioning and the source code the program under which the officer first receives a Navy commission. Listed below are seven source codes applicable to the nuclear-trained submarine community:

- United States Naval Academy (USNA)
- Merchant Marine
- NROTC Regular
- NROTC Contract
- Officers Candidate School (OCS)
- Reserve Officer Candidate (ROC)
- Navy Enlisted Scientific Education Program (NESEP)

Of these seven sources, only two, the Naval Academy and NROTC Regular have been quantitatively significant in the past. However, the quantitative significance of some of the other categories has increased in the last several years.

The data contained in S_3 are listed below:*

- File Number
- Year Group
- Source Code
- Loss Code
- Date of Loss
- Activity Mission Code
- Rank at Loss

With the exception of the Loss Code datum, the meanings of the data are defined in the ADOAR documentation manual or are self-evident.

* Data obtained from NAVPERS B12.

The Loss Code represents the reason for separation from the Navy. There are a total of nine such codes as listed below:

- Resignation
- Released from active duty (applicable to Reserves)
- Death or physical disability
- Nonvoluntary or nonqualified
- Designator change
- Retirement
- Reason unknown
- BURKE program (diesel loss)
- Forced attritions

The data enable us to examine the voluntary loss patterns of every year group in the nuclear submarine community cross-classified by source and by reason for loss.

The data in sets S_1 and S_2 , and S_3 can be cross-classified and displayed in a variety of ways to reveal the distinguishing characteristics of each data set. To facilitate discussion, we have disaggregated the nuclear submarine community, by source, within each of eight year groups, beginning with Year Group 1961. A display of these cross-classifications tells nothing about the continuation behavior of various segments of the year groups, but it will indicate the gross qualitative composition of the officer community.

The data in this Appendix were modified as follows:

- (1) Individuals with loss codes 3 or 4 are not included in the sample.
- (2) Those who had at least two years prior service in the Navy before entering the nuclear training program for Year Groups 1961, 1962, and 1963 are excluded from the sample.
- (3) Individuals who are now treated officially as part of Year Groups 1961, 1962, and 1963, but who were originally part of a later year group have been included in their original year group. This shifting of year-group status is occasionally used as a means of accelerating promotion.

- (4) Records appearing on both the loss tapes and the continuation tapes were excluded from the continuation tapes.

Officers holding regular commissions represent nearly all of those receiving the continuation bonus.

Table A2 is the analogue for Table A1 for the data set S_2 (officers not receiving the continuation bonus). The number of individuals in each Year Group 1961 through 1966 not receiving the bonus is considerably smaller than the number receiving the bonus. This is not surprising, since officers in set S_2 voluntarily incur not only the opportunity cost of military service, but also forego the present value of the \$15,000 bonus. The sole benefit accruing to these officers is their ability to apply for resignation any time after their initial EAOS.

Table A1 displays the data for officers receiving the continuation bonus (set S_1). As was the case with the data set S_1 , data set S_2 is dominated by Naval Academy graduates. It is not surprising that the numbers of Naval Academy graduates shown in Table A2 is large, because these officers will not be eligible for the bonus until 1973. Similarly, most NROTC Regular officers commissioned in FY 1968 will not be eligible for the bonus until late in FY 1972.

Table A3 is the loss counterpart of Tables A1 and A2. Table A3 lists the sources of those nuclear-qualified officers with more than two years's service who voluntarily choose to leave the Navy.*

Officers holding regular commissions such as Naval Academy graduates, and NROTC officers exhibit comparable loss profiles. That they should do so is noteworthy because of the clear preponderance of Naval Academy graduates in the original year groups.

By aggregating the data in Tables A1, A2, and A3, we can construct a source characterization of each year group from 1960 through 1968. This characterization is displayed on Table A4.

* Voluntary losses are defined as all losses except those recorded as "Death or Physical Disability" and "Nonvoluntary" or "Nonqualified." Some, perhaps most, of the losses falling in the second category may be a disguised form of voluntary loss. It is not possible to ascertain the magnitude of the bias, if any, which such a misclassification would impart to the test statistics.

- 36 -

Table A1. OFFICERS RECEIVING THE CONTINUATION
BONUS, BY SOURCE AND YEAR GROUP

Source Group	Year Group							
	1961	1962	1963	1964	1965	1966	1967	1968
Regular Officers								
USNA	33	40	40	56	63	47	43	0
NROTC								
Regular	12	20	20	15	19	27	14	7
NESEP	0	2	2	3	8	10	11	16
Reserve Officers								
OCS	0	1	1	0	1	1	2	2
NROTC								
Contract	0	0	0	0	1	0	0	1
ROC	1	0	1	0	0	1	0	1
Merchant								
Marine	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	46	63	64	74	92	86	70	27

Table A2. OFFICERS NOT RECEIVING THE CONTINUATION
BONUS, BY SOURCE AND YEAR GROUP

Source Group	Year Group							
	1961	1962	1963	1964	1965	1966	1967	1968
Regular Officers								
USNA	0	0	5	5	4	18	50	115
NROTC								
Regular	0	0	1	3	1	8	16	49
NESEP	0	0	0	0	0	0	0	0
Reserve Officers								
OCS	0	0	0	0	1	0	0	7
NROTC								
Contract	0	0	0	0	0	0	0	11
ROC	0	0	0	0	0	0	0	10
Merchant								
Marine	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
TOTAL	0	0	6	9	6	26	66	193

-37-

Table A3. VOLUNTARY LOSSES, BY SOURCE AND BY YEAR GROUP

Source Group	Year Group							
	1961	1962	1963	1964	1965	1966	1967	1968
Regular Officers								
USNA	43	33	48	75	79	52	27	0
NROTC Regular	22	35	59	72	82	43	38	11
NESEP	0	1	0	0	1	4	1	0
Reserve Officers								
OCS	1	2	2	2	6	12	12	9
NROTC Contract	0	0	3	1	4	4	5	1
ROC	0	0	1	0	0	1	0	0
Merchant Marine	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTAL	66	70	123	150	172	116	83	21

Table A4. INITIAL YEAR GROUPS

Source Group	Year Groups							
	1961	1962	1963	1964	1965	1966	1967	1968
Regular Officers								
USNA	76	73	93	136	146	117	120	115
NROTC Regular	34	55	80	90	102	78	68	67
NESEP	0	2	2	3	9	14	12	16
Reserve Officers								
OCS	1	3	13	2	8	13	14	18
NROTC Contract	0	0	3	1	5	4	5	13
ROC	0	0	2	1	0	2	0	11
Merchant Marine	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
TOTAL	111	133	193	233	270	228	219	241

From FY 1961 through FY 1965 one can observe the steady buildup in the nuclear submarine community. The buildup reflects the rapid increase in the number of commissioned nuclear submarines during this period.

Table A5 presents the time profile of voluntary losses, by year group, for all sources. Using this table and Table A4, the retention and survival rates for all sources can be calculated. These are shown on Tables A6 and A7, respectively. Tables A8 and A9 show, respectively, the retention rates for Naval Academy graduates and NROTC Regular officers by year group and year of loss.

Table A5. TIME PROFILE OF VOLUNTARY LOSSES, BY YEAR GROUP, AGGREGATED OVER ALL SOURCES

Fiscal Year of Loss	Year Group								Total
	1961	1962	1963	1964	1965	1966	1967	1968	
1965	0	0	0	0	0	0	0	0	0
1966	2	0	0	0	0	0	0	0	2
1967	28	0	0	0	0	0	0	0	28
1968	12	21	2	3	0	0	0	0	38
1969	14	28	16	59	8	0	0	0	125
1970	7	14	97	69	88	15	0	0	290
1971	2	6	8	17	66	51	12 ^a	0	162
1972	<u>1</u>	<u>2</u>	<u>0</u>	<u>2</u>	<u>9</u>	<u>50</u>	<u>70</u>	<u>21</u>	<u>155</u>
TOTAL	66	71	123	150	171	116	82	21	800
a. Year Group 1967 was deferred only six months to December 1971.									

-39-

Table A6. RETENTION RATES FOR ALL SOURCES

Fiscal Year of Loss	Year Groups							
	1961	1962	1963	1964	1965	1966	1967	1968
1965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1966	.982	1.000						
1967	.730	1.000	1.000	1.000				
1968	.622	.843	.990	.987	1.000			
1969	.496	.634	.907	.734	.970	1.000		
1970	.432	.530	.404	.438	.641	.934	1.000	
1971	.414	.485	.363	.365	.396	.711	.945	1.000
Number in Initial Year Group	111	134	193	233	270	228	219	241

Table A7. SURVIVAL RATES AGGREGATED OVER ALL SOURCES^a

Fiscal Year of Loss	Year Group							
	1961	1962	1963	1964	1965	1966	1967	1968
1965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1966	.982							
1967	.743	1.000	1.000	1.000				
1968	.852	.843	.990	.987	1.000			
1969	.797	.752	.916	.743	.970	1.000		
1970	.873	.835	.446	.596	.660	.934	1.000	
1971	.958	.915	.897	.833	.619	.761	.945	1.000
Number in Initial Year Group	111	134	193	233	270	228	219	241
a. Survival Rate equals number of persons remaining in year T+1 divided by number remaining in year T.								

-40-

Table A8. RETENTION RATES FOR NAVAL ACADEMY GRADUATES

Fiscal Year of Loss	Year Group							
	1961	1962	1963	1964	1965	1966	1967	1968
1965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1966	.987							
1967	.750	1.000						
1968	.645	.890	1.000	1.000				
1969	.539	.712	.989	.816	1.000			
1970	.474	.616	.527	.529	.739	1.000	1.000	
1971	.447	.575	.484	.456	.486	.829	.783	1.000
Number in Initial Year Group	76	73	93	136	146	117	120	115

Table A9. RETENTION RATES FOR NROTC REGULAR OFFICERS

Fiscal Year of Loss	Year Group							
	1961	1962	1963	1964	1965	1966	1967	1968
1965	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1966	.971							
1967	.676	1.000	1.000	1.000				
1968	.559	.818	.988	.967	1.000			
1969	.382	.545	.925	.622	.990	1.000		
1970	.353	.418	.313	.289	.510	.987		
1971	.353	.364	.263	.211	.245	.654	1.000	1.000
Number in Initial Year Group	34	55	80	90	102	78	68	67