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**NAVAL POSTGRADUATE SCHOOL  
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**THESIS**

**A STATISTICAL ANALYSIS OF THE IMPACT OF  
MARITAL STATUS ON NUCLEAR SUBMARINE OFFICER  
RETENTION**

by

Matthew F. Phelps

June 2001

Thesis Co - Advisors:

J. Eric Fredland  
Stephen L. Mehay

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**A STATISTICAL ANALYSIS OF THE IMPACT OF MARITAL STATUS ON  
NUCLEAR SUBMARINE OFFICER RETENTION**

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Lieutenant, United States Navy  
B.S., United States Naval Academy, 1995


Submitted in partial fulfillment of the  
requirements for the degree of

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## ABSTRACT

This thesis develops multivariate logit models to estimate the impact of marital status and the independent effect of dependent children on nuclear submarine officer retention beyond the minimum service requirement (MSR). Using data from the Navy History Promotion File, the Naval Officer Fitness Report Summary File and the Officer Loss File, logit models are specified to analyze the probability of nuclear submarine officer retention beyond the MSR. The probabilities are modeled as functions of marital and dependency status, commissioning source, undergraduate major, age and early performance evaluations. The findings reveal that being married with dependent children at the O-3 promotion board, being older at commissioning, being commissioned via an enlisted commissioning program and being recommended for accelerated promotion at least once as an O-2 are all positive indicators of submarine officer retention beyond the MSR. Being commissioned via the Reserve Officer's Training Corps (ROTC) and the Officer Candidate School (OCS) are negatively associated with submarine officer retention. Based upon the research results, recommendations are made to conduct further research to determine retention elasticities of submarine officers based on dependency status to determine the most cost-effective means of improving junior officer retention.





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## I. INTRODUCTION

The goal of this thesis is to statistically investigate the relationship between marital status and nuclear submarine officer retention in the United States Navy, and to assess the implications of any observed relationship for current defense manpower policies. The objective of this study is to provide policy-makers with useful information that may be applied to address the growing retention problem within this specialized core of naval officers.

### A. BACKGROUND

In the nuclear submarine community an officer's first contractual obligation is completed at five years of active naval service. At this point, the submarine officer's military obligation is complete, allowing him to choose between civilian job opportunities and continued service in the U. S. Navy. Since the early 1990's, nuclear submarine officer retention beyond this initial obligation has become an issue of increased concern. In fact, during this time, financial bonuses for service continuation have been raised twice, and department head tour lengths have increased from 36 months to 39 months in an effort to keep submarines adequately manned with highly skilled nuclear-trained officers.

According to Naval Nuclear Power representatives within the Bureau of Naval Personnel, recent separation rates for single nuclear submarine officers are much higher than those of their married counterparts. In fact, the data provided by these representatives illustrate a very significant difference in retention by marital status for all nuclear submarine officers commissioned in the early 1990's. For example, data

provided for all nuclear submarine officers commissioned in 1993 show that only 32.9% of single officers continued in active naval service beyond their initial contractual obligation. On the other hand, 63.1% of the officers who were married prior to five years of active service retained beyond this same obligation. (Per phone conversation with submarine community manager, November 2000) Similar trends describe all of the officers commissioned during the first half of that decade.

Throughout the years, the U. S. Navy has tailored its manpower policies and programs to meet the needs of married sailors, officers and their families. However, with these apparent retention differences between married and single submarine officers, senior officials within the U. S. Navy now believe that marital status itself, as well as the manpower policies affecting married officers and their families, has now become a significant retention factor.

## **B. OBJECTIVES**

This thesis statistically investigates the relationship between marital status and submarine officer retention beyond the first contractual obligation to determine if there is any observed relationship and, if so, whether marital status or corollary factors such as early performance evaluations, commissioning source, or undergraduate major are more significant in explaining retention. If, after accounting for these additional factors, marital status remains significantly related to retention, current manpower policies and programs may need to be examined for their potential influence on retention behavior. For example, differences in tangible benefits such as increased pay, military housing, separation allowances, healthcare and commissary privileges may promote a feeling of inequity between specific groups of submarine officers. As a result, policy-makers may



need to reconsider the effect on retention behavior caused by differences in these benefits between married and single officers.

### **C. RESEARCH QUESTIONS**

As stated, the goal of this study is to statistically investigate the relationship between marital status and nuclear submarine officer retention, and to assess the implication of any observed relationship for current defense manpower policies. Therefore, the research questions addressed in this study are: (1) What is the statistical relationship between marital status and officer retention in the nuclear submarine force, holding other retention factors constant? (2) What is the relationship between dependent children and officer retention in the nuclear submarine force? (3) What performance and demographic factors are correlated with retention? and (4) Which manpower policies within the submarine community appear to influence retention differences between married and single officers?

### **D. SCOPE, LIMITATIONS AND ASSUMPTIONS**

The nuclear submarine officer community is the focus of this study due to the recent increase in losses of junior officers following their first contractual obligation. Marital status is examined as a predictor of retention to help policy-makers address current retention difficulties.

Retention variables examined in this data set describe all nuclear submarine officers commissioned between 1977 and 1991. Retention beyond the initial contractual obligation is defined as a binary variable. Marital status is only examined at the end of this contractual obligation (5 years of active service), and will be defined as currently

married or currently not married. The first analysis will examine the difference in retention between those currently married and those who are single. A second analysis will attempt to determine a separate independent effect of marital status and the presence of dependent children. Marital status will be interacted with dependent children to create three separate categories. The length of marriage and age of dependent children are not analyzed.

#### **E. ORGANIZATION OF THE STUDY**

This study is organized into five chapters. Chapter II reviews current manpower policies and prior studies related to this research. Chapter III provides a detailed description of the data set utilized for this research. It also presents the hypotheses tested, and fully explains the research methodologies used to construct this study's statistical models. Chapter IV provides the empirical results of the analysis. Chapter V details the conclusions of this study, and provides recommendations for policy and for further research.

## II. LITERATURE REVIEW

As we look to the future, recruiting and retention are two of our biggest challenges, as well as the keys to our success. We are shifting our mindset from one dedicated to managing a shrinking end strength to one focused on aggressively recruiting the highest quality sailors and then encouraging the very best to stay Navy....Satisfactory retention over time will determine the success of our future force and our continued operational readiness.

-- Vice Admiral D.T. Oliver, Chief of Naval Personnel and Deputy Chief of Naval Operations (Manpower and Personnel), on naval recruiting and retention issues, made during a 1998 hearing before the Personnel Subcommittee of the Senate Armed Services Committee on Recruiting and Retention.

As the United States Navy enters the twenty-first century, aggressive recruitment and retention of high quality sailors has become a top priority. Within the submarine force especially, increased attention has been focused on the declining retention rates of junior officers who have reached the end of their minimum service requirement (MSR). As noted by Nakada (1996), there is a relatively large amount of economic literature on enlisted retention behavior, but significantly less research has been conducted on officer retention. Although most researchers agree that increased monetary compensation generally improves both officer and enlisted retention rates, retention rates continue to remain low despite recent increases in basic pay and allowances. Thus, more detailed analyses of the non-pecuniary factors affecting retention are required.

This chapter reviews current Department of Defense manpower policies that are applicable to the monetary compensation, both in pay and benefits, received by a nuclear submarine officer. Additionally, this chapter will describe the conclusions of prior research relevant to this study.

## **A. CURRENT MANPOWER POLICIES**

Most economic models describing military retention behaviors establish a theoretical basis using the Annualized Cost of Leaving (ACOL) methodology. Developed at the Center for Naval Analyses, the ACOL model predicts military retention behavior by estimating the effect of changes in relative civilian and military compensation on the stay/leave decision. Economic retention models like the ACOL methodology assume that individuals seek to maximize utility when choosing whether to stay in the military or leave for the civilian sector (Hogan, 1990). This utility is determined by a simple comparison of the pecuniary and non-pecuniary factors describing military or civilian opportunities. Pecuniary factors consist of tangible aspects such as basic pay, allowances and specialty bonuses. On the other hand, non-pecuniary factors describe intangible job aspects such as family separation, commissary and naval exchange privileges and provisions for health care. Using these two categories for comparison, the models assume that individuals rank and choose occupations that will provide the greatest satisfaction or utility over their working lifetimes (Hogan, 1990).

There are several complex measurement problems and potential biases that limit the ACOL model's usefulness in forecasting actual officer and enlisted retention behavior. Among these problems are the potential biases resulting from unobservable personal tastes, or personal characteristics such as marital status, commissioning source and undergraduate major. These potential biases are typically accounted for with the addition of specific control variables in statistical regression models. Although the addition of such control variables makes the model more accurate in forecasting actual retention rates, little effort is made to determine why they may actually affect the

retention decision. Using the ACOL model as a theoretical framework, this study will examine the significance of selected control variables for nuclear submarine officers; however, it is first necessary to understand the pecuniary factors that also influence retention behavior.

### **1. Basic Pay and Allowances**

All naval officers, whether nuclear trained or not, receive basic pay based entirely on the officer's current rank and cumulative years of service. For cost of leaving comparisons, basic pay levels, as well as future increases are easily estimated by assuming a standard promotion path. Along with basic pay, there are two standard allowances also provided for all officers. First, all officers, regardless of rank or dependency status, are entitled to a full allowance for subsistence (BAS). BAS is provided to offset general subsistence (i. e., food) costs, and is generally considered part of an officer's basic pay. The final component of an officer's basic pay is the allowance provided for housing (BAH). This allowance is provided to pay for monthly housing expenses incurred at each respective duty station. It is payable to all active duty members and varies according to individual rank and dependency status. It is also generally considered part of an officer's basic pay.

From a cost of leaving perspective, potentially significant BAH differences arise due to differences in dependency status. Although BAH also differs by location of an individual's duty station, a married officer, regardless of location, will always receive more money for housing expenses. For example, consider two U. S. Navy Lieutenants (O-3's) serving at the United States Naval Academy located in Annapolis, Maryland. One officer is not married and has no dependents. Using the Navy's basic pay tables

approved for fiscal year 2001, he is entitled to an allowance of \$1111.00 per month for housing. On the other hand, the second officer is married, and is therefore entitled to a BAH that is \$376.00 higher. The married officer, although not senior in grade to the single officer, receives \$1487.00 for housing expenses while the single officer only receives \$1111.00.

Aside from the strict monetary differences, the married officer also has more options for this allowance. He may use it to purchase or rent non-military housing, or he may forfeit the allowance and accept military housing for his family. Conversely, the single officer is not eligible for government quarters. Therefore, he can only use the allowance to purchase or rent non-military housing. Consequently, the lower BAH coupled with fewer options for its use may result in a lower cost of leaving for a single officer contemplating retention in the Navy.

## **2. Special Pays and Allowances**

Submarine Officers are entitled to several types of special pay. First, all submarine officers are entitled to receive submarine duty pay. This specific pay is an incentive for operational submarine duty. It is received by all officers who are attached to an operational submarine or submarine operational command staff, as well as those officers undergoing training preliminary to assignment to a nuclear powered submarine. It is based solely on individual rank and time in service. Second, the Nuclear Officer Incentive Program (NOIP) provides special pay as a specific retention benefit for nuclear trained officers. Submarine officers who are qualified to supervise, operate and maintain naval nuclear propulsion plants can receive \$19,000 a year if they obligate for a period no less than 3, 4 or 5 years on active duty past their current service requirement (COPAY).

If an officer does not choose to obligate on active duty, he will still receive \$12,500 for every year served beyond his current military obligation (AIB). Finally, although not submarine specific, officers with dependents receive a family separation allowance of \$100.00 per month if their submarine is away from homeport for more than 30 continuous days. The purpose of this allowance is to pay a member for added housing expenses resulting from enforced separation from dependents.

Most retention-compensation research agrees that "pay does matter" to individuals contemplating retention in the armed services. This finding is especially true for economic research analyzing retention at the end of an individual's MSR (5 years of active service). Although the above is not a complete description of all pays and allowances available to a submarine officer, it provides the major pecuniary factors influencing his personal cost of leaving.

## **B. RELEVANT PAST STUDIES**

As stated previously, little research has been conducted that analyzes the retention behavior of military officers. Further, when retention research is conducted, little effort is made to explain the significance of non-pecuniary factors on an individual's stay/leave decision. Although few studies have sought this explanation, many have identified interesting differences in retention behavior with the use of these same non-pecuniary factors as control variables in economic retention models.

Michael Nakada and James Boyle performed one such study in 1996. Nakada and Boyle analyzed the effect of the NOIP program on nuclear officer retention, both surface and submarine, beyond the minimum service requirement. At the end of this minimum service requirement, a submarine officer may choose to: (1) stay in the Navy under

contractual obligation (COPAY); (2) stay in the Navy under no contractual obligation (AIB); or (3) leave the Navy. By analyzing submarine officers commissioned between fiscal year 1974 and 1989, the study showed that increases in NOIP positively influenced retention behavior of submarine officers at the end of their MSR. The study determined that although retention bonus elasticities were relatively small, their statistical significance indicated that increases in bonus amounts subsequently increased the probability of staying in the Navy beyond MSR. More pertinent to this study, however, it further identified significant differences in retention behavior among different demographic groups.

Of the year groups analyzed, most officers were single at the end of their MSR, and they had the lowest retention rate at 62 percent. If they stayed beyond MSR, single officers were much less likely to extend with obligation: 17 percent of all officers without dependents at MSR retained under contractual obligation, while 44 percent chose to remain under no obligation. On the other hand, 26 percent of those with one dependent, and 34 percent of those with more than one dependent chose to stay in the Navy under obligation. Further, 40 percent of the officers who were married at MSR, and 39 percent of those with more than one dependent chose to remain without incurring an additional obligation. Therefore, Nakada's study, as well as a 1981 NOIP study performed by the Center for Naval Analyses found that as the number of dependents increased, the likelihood the officer stayed increased, and if he stayed, the likelihood that he was obligated also increased. Again in 1996, Nakada conducted another study to analyze the effect of NOIP increases on retention each year beyond an officer's MSR.



(Nakada, et al., 1996) This second study found that both pay and demographic effects were consistent with the earlier research.

Additional studies have also identified differing retention behaviors among married and single officers. Mehay (1995) analyzed performance differences such as promotion, retention and fitness report evaluations between majority and minority Navy and Marine Corps officers. The study's data set was constructed from Promotion Board History Files for 1985-1990 and then merged with fitness report history files. Because many civilian studies have found that married workers and those with children to be more productive (measured by earnings) (Krieg, 2000), the study used marital status, as well as number of dependents as demographic control variables. Mehay found that married officers or those with dependents were more likely to remain in the Navy until the O-4 promotion board (approximately 10 years of service). Although marital status and number of dependents were used effectively as a control variable for performance, inferences regarding their impact on retention behavior should be made cautiously. The study fails to account for potential marital status and dependency status changes between the O-3 promotion board (approximately 4 years of service) and the O-4 promotion board (approximately 10 years of service). Therefore, the effect of these variables on actual retention behavior is difficult to quantify.

In a retention study of surface warfare officers, Bautista (1996) attempted to account for the bias that might arise from failing to account for marriage timing. His study determined that surface warfare officers who were married at the Lieutenant level (approximately 4 years of active service) were more likely to separate than those who were married at commissioning. Analyzing this relationship from a cost of leaving

perspective, he inferred that an officer who had been married for a longer period would more likely have more than one dependent at the end of his MSR. Therefore, his cost of leaving could be higher than the newly married Lieutenant because more emphasis is placed on the non-pecuniary benefits (commissary, health care and job stability) available for his family within the naval service.

This thesis attempts only to explain the significance of marital and dependency status on retention beyond a submarine officer's MSR regardless of the length of marriage. Therefore, the timing bias associated with marriage and family discussed in the Baustista and Mehay studies is not analyzed. Rather, the effect of marital and dependency status is analyzed specifically for the nuclear submarine officer community at a specific point in time

Contrary to the findings regarding marital and dependency status above, Bowman (1990) found that marital status actually had a negative effect on nuclear officer retention. The study utilized 1560 U S Naval Academy (USNA) graduates commissioned between 1976 and 1980. This subset of officers does not represent all USNA graduates during this time. Rather, it contains only those graduates who were selected into perceived technical warfare communities – surface and submarine warfare. Bowman found that married officers in the nuclear navy were far less likely than single officers to remain beyond their MSR. His study found that those with children were 27.8 percent less likely to remain and those without children were 35.6 percent less likely to remain beyond five years of active service (Bowman, 1990)

Bowman's results are contrary to most retention research incorporating marital and dependency status as control variables. This difference may be explained by the

nature of the data. Using only graduates from the Naval Academy, the data set may not be representative of the overall population of nuclear trained officers. Furthermore, the study utilized officers commissioned in the late 1970s. Differing studies, like those conducted by Nakada and Mehay, have analyzed both longer and more recent time periods. As a result, changes in social attitudes may also explain differences between the studies. Therefore, Bowman's conclusions regarding the relationship between marital status and retention should not be generalized to the wider population of officers. This thesis utilizes nearly the entire population of nuclear submarine officers commissioned between 1977 and 1991. Consequently, a more accurate analysis of the population will be possible.

Like the officer corps, enlisted second-term retention (6 to 10 years of active service) also decreased in the 1990's. In response to a significant drop in enlisted second-term retention between fiscal years 1992 and 1994, the Center for Naval Analyses was tasked to develop a predictive model that would relate Navy policy and personal characteristics of enlisted personnel to second-term retention. Moore et al. (1996) utilized various non-pecuniary factors such as civilian unemployment rate, marital and dependency status, race and gender in regression models to estimate the impact of each on enlisted retention. The study found that marital status was indeed a significant predictor of enlisted retention decisions. Married sailors were 28 percent less likely to leave after their first enlistment than their single counterparts. Furthermore, regardless of marital status, the probability of leaving after a first-term enlistment decreased with the number of children (Moore et al., 1996).

Other studies have also examined enlisted reenlistment behavior by utilizing models similar to those noted above. John T. Warner and Matthew S. Goldberg (1983) attempted to analyze the effects of non-pecuniary factors on enlisted pay elasticities. Using data describing all enlisted personnel who made an initial reenlistment decision between fiscal year 1974 and 1978, the study divided personnel into sixteen occupational groups to test the hypothesis that pay elasticities are inversely related to the non-pecuniary variable of sea duty. Again, marital status was simply a demographic control variable, yet it yielded some very interesting results. Warner and Goldberg found that married individuals reenlisted at higher rates than single persons across all occupation groups. Since their pay variable took account of pay differences arising from marital status, the retention differences must be due to factors other than the direct pay differential. Unfortunately, the study made little attempt to explain the difference other than to speculate that married personnel may place a greater value on the non-pecuniary benefits of military service such as health care for dependents.

At this point, it is clear that most retention research that includes marital and dependency status in its statistical modeling finds that it is a potential predictor of officer and enlisted retention. In a 1992 study regarding personnel tempo of operations and enlisted retention, Quester et al. offered two potential explanations.

Individuals who are married at the time of reenlistment may be expected to have higher reenlistment rates for two possible reasons. First, the decision to marry may be made jointly with the reenlistment decision. Individuals who choose to get married during their first-term of service may be signaling a relatively high degree of satisfaction with a Navy lifestyle. (The vast majority of individuals are single when they begin active duty.) Second, marriage often changes an individual's preferences for the attributes and benefits of Navy employment. In particular, the reservation wage may fall if an individual's desire for job security intensifies with marriage. In either case, married sailors are more likely to

reenlist, other things being equal. The relationship has also been found in past studies of reenlistment behavior both for sailors and personnel in other services (Quester et al., 1992).

Similarly, Moore et al. (1996) also suggested an explanation for this retention phenomenon. That study asserted that married personnel or those with additional dependents may be less likely to undertake disruptive career changes. It can be inferred then that they (married sailors) must also interpret a much higher cost of leaving than their single counterparts.

Very pertinent to this study, Cadigan (2000) analyzed the family status of enlisted personnel in the U. S. Navy. His study compared the number of enlisted members with families in the Navy with similar groups in the civilian sector. The study found that military personnel are more likely to be both married and have children than a similar group of civilians even when controlling for a variety of demographic factors. Cadigan offers two possible interpretations of this difference.

Alternatively, practices or policies enacted by the military may either make marriage more attractive to military personnel or lead those who are more likely to get married into military service. The structure of military compensation, with its focus on pay, allowances and the provisions of certain goods in kind, may make military service more attractive than jobs in the private sector for individuals with families. Also, policies for those already in the military may favor members with families. For example, military members with families are offered either family quarters or larger allowances than single members. Other benefits that differ according to dependent status (including transportation and travel allowances, separation pay, etc.) may encourage a greater percentage of enlisted personnel to marry (Cadigan, 2000).

Therefore, from a cost of leaving perspective, those sailors with families simply find it much harder to pursue civilian job opportunities than their single counterparts, and those without families either feel compelled to marry or leave the service.

Next, Cadigan (2000) attempted to determine if military members with dependents performed differently than those without. Unfortunately, the results were inconclusive. The study notes that prior performance research agrees that married soldiers and sailors have lower attrition rates, as well as proportionally fewer indiscipline and substance abuse charges. On the other hand, other military performance research shows higher promotion rates for single enlisted men and women within the competitive grades (E-5 to E-9), as well as fewer problems responding to short notice alerts and unit deployments. Although much of the civilian performance research indicates that marriage makes civilian men more productive as measured by earnings (marriage premium), it is inconclusive as to whether marriage has the same effect on those in the military.

On the other hand, the presence of the marriage premium in the civilian sector is very well documented. To distinguish the origins of the marriage premium, at least three separate hypotheses have been offered: (1) married men are more productive, (2) married men are evaluated more highly by their superiors, or (3) unobserved factors that cannot be separated from marital status positively influence civilian earnings. Krieg (2000) analyzed a large sample of first-term United States Marines to determine if a marriage premium existed in the military as it did in the civilian workforce. The study's results supported the second hypothesis noted above – married workers are evaluated more highly by their superiors. Although the study showed that married Marines were more highly evaluated by their superiors, it did not permit either of the remaining hypotheses to be rejected. Rather, higher evaluations can be consistent with a potential for higher productivity, as well as the possession of unobserved characteristics that are positively

correlated with both being married and productivity. As a result, the study offered several possible explanations for the presence of the marriage premium.

First, Krieg argues that the marriage premium may follow Becker's (1993) hypothesis that married workers are able to specialize in their personal labor activities because their spouse specializes in housework. This allows married Marines to perform better on the job because they are not burdened by excessive household responsibilities. As a result, they are rewarded with higher evaluations. Second, marriage may heighten individual awareness of the importance of job performance. In this case, acquiring dependents may cause workers to mature faster, as well as place greater value on job performance. Finally, the marriage premium may be related to the marital status of the evaluating officer. Senior officers, like civilian supervisors, are older and more likely to be married. As a result, senior officers may use higher evaluations as a reward for the increased responsibilities of their married subordinates. Although Krieg was able to show a marriage premium existed in the United States Marine Corps, other performance research, like that noted by Cadigan above, yields mixed results. As a result, family status has yet to be conclusively proven significantly related to military performance.

It is extremely difficult to definitively prove causality between demographic variables such as race, gender and marital status and outcomes such as performance or the decision to stay or leave. Mehay (1995), although analyzing the impact of racial/ethnic status on performance, conceded difficulty in drawing conclusions from his models as follows:

The multivariate models are purely *descriptive*, in that they attempt to statistically identify and compare the relative effects of different types of determinants on officer career outcomes. The search for causal

relationships is considerably more complicated and typically calls for speculative conclusions (Mehay, 1995).

It is legitimate to infer the same difficulties exist when analyzing the impact of marital status on nuclear submarine officer retention. However, it will be possible to draw inferences about *possible* causality between marital status and retention. The results may, of course, be consistent with alternative interpretations, which, in turn, will call for speculative conclusions. Consequently, further research may be needed to separate the alternative interpretations.

This thesis extends research on military officer retention, but more specifically analyzes marital and dependency status as predictors of retention rather than simply control variables. Historically, submarine officers have given family separation as a major reason for leaving the Navy. This study will determine if officer retention behavior in the submarine force follows the same trends as the studies described above when analyzed alone.



### **III. DATA AND METHODOLOGY**

This chapter describes the database and how it is used to estimate the statistical relationship between marital status and nuclear submarine officer retention beyond the minimum service requirement (MSR). The various logit model specifications are described, along with the dependent variable and the explanatory variables used in each model.

#### **A. DESCRIPTION OF THE DATABASE**

The database used in this study comes from one that includes all of the newly commissioned nuclear submarine officers who entered the Navy between 1977 and 1991. The database tracks these entry cohorts through the end of their minimum service requirement. Dr. William Bowman of the United States Naval Academy provided the portion of the database describing submarine officers commissioned between 1977 and 1985. Dr. Bowman constructed the file by merging two administrative data files maintained on every naval officer by the Naval Bureau of Personnel, Washington, D. C. The two data files are the Navy History Promotion File and The Naval Officer Fitness Report Summary File. The Navy History Promotion File consists of various data elements taken from Officer Data Cards and the promotion outcomes from the promotion boards for each fiscal year. The Naval Officer Fitness Report Summary File records summary performance data for officers included in the data set. These two files were merged with the Officer Loss File, provided by the Defense Manpower Data Center (DMDC), which records both the timing of and the reason for separation. Dr. Bowman also provided the portion of the database describing nuclear submarine officers

commissioned between 1986 and 1991. When combined, the resulting database contains detailed information describing the demographic characteristics, pre-commissioning characteristics, performance history and promotion success for nearly all of the nuclear submarine officers commissioned between 1977 and 1991.

## **B. VARIABLE DEFINITIONS**

This section explains the variables utilized in specifications of the retention models. It provides an overview of all explanatory and dependent variables, explains why each variable belongs in the model and discusses their hypothesized effects. Descriptive statistics are provided in Tables 1 and 2.

### **1. Dependent Variables**

a. RETAIN. The dichotomous variable for retention, RETAIN, is set equal to 1 if a submarine officer remained on active service beyond his MSR (5 years of active service); otherwise RETAIN = 0. Officers who separate at, or prior to, or immediately following completion of their MSR are considered a loss, while those who remain a nominal one to two years past their MSR are considered retained.<sup>1</sup> Table 1 provides descriptive statistics on the dependent variable for retention and shows that 60 percent of the 4294 submarine officers who entered the Navy between 1977 and 1985 stayed at least one year past their MSR.

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<sup>1</sup> The typical career progression for a submarine officer allows for service in non-deployable (shore duty) billets during the two years immediately following the MSR. After this time, officers are required to return to operational submarine duty. Therefore, this study models retention as the decision to remain on active service past an individual's MSR even if he fails to return to sea duty after a tour ashore.

b. STAYER. The STAYER dichotomous variable models retention for submarine officers who were commissioned between 1977 and 1991. STAYER is set equal to 1 if a submarine officer remained on active service until the O-4 promotion board; otherwise STAYER = 0. Officers who separate prior to the O-4 promotion board are considered a loss, while those who remain until this time are considered retained. Table 1 provides descriptive statistics on the dependent variable STAYER for submarine officers commissioned between 1977 and 1985 and shows that 38 percent of the 4294 officers remained on active service until the O-4 promotion board. Table 2 provides descriptive statistics on the dependent variable STAYER for submarine officers commissioned between 1986 and 1991 and shows that 29 percent of the 2614 officers remained on active service until the O-4 promotion board.

**Table 1. 1977-1985 Variable Descriptive Statistics**

<b>VARIABLE</b>	<b>CASES</b>	<b>MEAN VALUE</b>	<b>STD DEVIATION</b>
<b>RETENTION VARIABLES</b>			
RETAIN	4294	.6067	.4885
STAYER	4294	.3810	.4857
<b>MARITAL STATUS VARIABLES</b>			
SINGLE	2255	.5252	.4994
MARRIED – NO CHILDREN	1439	.3351	.4721
MARRIED – ONE OR MORE CHILDREN	600	.1394	.3467
<b>COMMISSIONING SOURCE VARIABLES</b>			
USNA	1496	.3484	.4765
ROTC	1201	.2797	.4489
OCS	1470	.3423	.4745
ENLISTED/OTHER	127	.0296	.1694
<b>UNDERGRADUATE MAJOR VARIABLES</b>			
BIOLOGY/ PHYSICAL SCI	827	.1926	.3944
MATH/ COMPUTER SCI	371	.0864	.2810
ENGINEER	2535	.5904	.4918
SOCIAL SCIENCE	126	.0293	.1688
BUSINESS/ ECONOMICS	112	.0261	.1596
HUMANITIES	323	.0752	.2638
<b>AGE VARIABLE</b>			
AGE	4284	22.36	1.71
<b>EARLY PERFORMANCE EVALUATIONS VARIABLES</b>			
PRAP1	3590	.0895	.2833
PRAP2	3577	.4706	.4592

**Table 2. 1986-1991 Variable Descriptive Statistics**

<b>VARIABLE</b>	<b>CASES</b>	<b>MEAN VALUE</b>	<b>STD DEVIATION</b>
<b>RETENTION VARIABLE</b>			
STAYER	2614	.2919	.4547
<b>MARITAL STATUS VARIABLES</b>			
SINGLE	1297	.4962	.5001
MARRIED – NO CHILDREN	899	.3439	.4751
MARRIED – ONE OR MORE CHILDREN	406	.1553	.3623
<b>COMMISSIONING SOURCE VARIABLES</b>			
USNA	735	.2812	.4497
NROTC	789	.3018	.4591
OCS	915	.3500	.4771
ENLISTED/ OTHER	174	.0665	.2493
<b>UNDERGRADUATE MAJOR VARIABLES</b>			
BIOLOGY/ PHYSICAL SCI/ MATH	618	.2364	.4250
ENGINEER	1715	.6561	.4751
SOCIAL SCIENCE	64	.0244	.1546
BUSINESS/ ECONOMICS	40	.0153	.1228
HUMANITIES	34	.0130	.1133
<b>AGE VARIABLE</b>			
AGECOMM	2614	22.46	1.58

## 2. Explanatory Variables

The baseline variables used in the model to predict retention are marital and dependency status, commissioning source, undergraduate major, age at commissioning and results of early performance evaluations. These variables are described below.

a. Marital and dependency status. Marital and dependency status as noted at the O-3 promotion board is divided into two separate categories: single and married. It is included to investigate the relationship between marriage and submarine officer retention. Then, a second analysis is conducted to determine the independent effects of marital status and the presence of dependent children. Since nearly all of the research cited in the previous chapter has found a positive relationship between both marital and dependency status and retention, having either a spouse or a spouse with children can be expected to increase the likelihood of retention beyond MSR within the submarine community as well.

Table 1 provides descriptive statistics on the marital and dependency status at O-3 of all officers commissioned between 1977 and 1985 included in the data set.

Approximately 53 percent of submarine officers at the O-3 promotion board are single, 34 percent are married without children and 14 percent are married with children. Table 2 provides descriptive statistics on the marital and dependency status at O-3 of all officers commissioned between 1986 and 1991. Approximately 50 percent of submarine officers at the O-3 promotion board are single, 34 percent are married without children and 16 percent are married with children.

b. Commissioning Source. The commissioning source variable is divided into four separate categories: U. S. Naval Academy (USNA), Reserve Officers Training Corps (ROTC), Officer Candidate School (OCS) and Enlisted Commissioning Programs or Other. Commissioning source is included to control for retention differences between the various accession programs. The significant military training received at the Naval Academy has traditionally resulted in higher officer retention rates than the other commissioning programs. Therefore, potential retention differences between officers accessing from different sources must be accounted for before accurate analysis of the impact of marital status may occur. Table 1 shows the descriptive statistics associated with commissioning source for submarine officers commissioned between 1977 and 1985, and Table 2 shows the descriptive statistics for submarine officers commissioned between 1986 and 1991. During the years between 1977 and 1985, about 34 percent of submarine officers were commissioned via USNA and OCS each, and 28 percent were commissioned via ROTC. During the years between 1986 and 1991, 28 percent of submarine officers were commissioned via USNA, 30 percent via ROTC and 35 percent via OCS.

c. Undergraduate Major. For the portion of the data set describing submarine officers commissioned between 1977 and 1985, undergraduate major is introduced as a series of dichotomous variables divided into six categories: Biology/Physical Science, Math/Computer Science, Social Science, Business/Economics, Humanities and Engineering. For the remaining data (1986-1991), undergraduate major is introduced as a series of dichotomous variables divided into five categories: Biology/Physical Science/Math, Social Science, Business/Economics, Humanities and

Engineering.<sup>2</sup> This variable is included to control for potential retention differences resulting from educational background. Duffy (2000) found that surface warfare officers with an undergraduate major in engineering exhibited lower retention rates than officers with other college majors. Duffy speculated that this retention difference was the result of the higher civilian marketability of an officer with an engineering degree. It is legitimate to infer that the same phenomenon would be evident in the highly technical submarine service. As a result, the model investigates the retention effect of college major. Table 1 shows that 59 percent of submarine officers commissioned between 1977 and 1985 have an engineering degree and 27 percent have a science or math degree. Table 2 shows that approximately 66 percent of submarine officers commissioned between 1986 and 1991 have an engineering degree and 24 percent have a science or math degree.

d. Age. The age variable is based on an officer's age at commissioning. Ehrenberg and Smith (1993) noted that age is negatively correlated with mobility in the civilian labor market. As a result, it can be hypothesized that those who are older at commissioning may not only be more likely to have prior enlisted service, but also exhibit an increased likelihood of retention. Table 1 and 2 show the mean age at commissioning of officers commissioned between 1977 and 1985 is 22.36 with a standard deviation of 1.71, while the mean age for the rest is 22.46 with a standard deviation of 1.58.<sup>3</sup>

e. Early Performance Evaluations (PRAP1/PRAP2). The PRAP1 and PRAP2 variables are the ratios of officer fitness reports in grades O-1 and O-2 that were

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<sup>2</sup> 143 cases were excluded between 1986 and 1991 due to missing information.

<sup>3</sup> 10 cases were excluded due to missing information.



scored with a recommendation for accelerated promotion (RAP) to the total number of valid fitness reports in those grades. For several reasons, early performance evaluations are a potentially important predictor of retention behavior. Officers who receive a significant number of RAP's may not only be exhibiting exceptional job performance, but also a greater taste for naval service. An alternative explanation for any differential in performance between married and unmarried officers is that superiors might simply evaluate married subordinates higher than their single counterparts. (Krieg, 2000) Table 1 shows the descriptive statistics associated with PRAP1 and PRAP2.<sup>4</sup> While only 9 percent of O-1 fitness reports received a RAP, 47 percent of O-2 reports were RAP'ed.

f. Commissioning Year Group. The logit retention models also include a series of dummy variables for commissioning year with FY 1980 as the omitted year group for the portion of the data set describing officers commissioned between 1977 and 1985. (FY 1989 is the omitted year group for the portion describing 1986 through 1991) This variable controls for differences in retention behavior between different entry cohorts.

### **C. METHODOLOGY**

The purpose of this analysis is to determine the difference in retention behavior, if any, between submarine officers who are currently married at the O-3 promotion board and those who are single. In the second model, marital status is interacted with dependent children to create three separate marital/dependent status categories.

Retention was modeled using binary logit analysis because the dependent variables

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<sup>4</sup> 704 cases were excluded from PRAP1 and 717 cases were excluded from PRAP2 due to missing information.

describing retention are dichotomous. Four models were constructed to determine the effect of marital status (single versus married) and/or dependency status (married with children versus married with no children) on nuclear submarine officer retention, holding other retention predictors constant. Table 3 outlines the specifications of the four logit models.

Model A includes the basic background characteristics (Commissioning Source, Undergraduate Major, Age and Early Performance) and a single dummy variable for married officers with single as the omitted category. Model B adds the interactions between marital status and dependents to test for the differential effect of the presence of dependent children. Models C and D use similar methodology to determine differences in retention behavior through the O-4 promotion board. MSR retention and the effect of early performance evaluations as a predictor of retention cannot be determined for officers commissioned between 1986 and 1991 due to limitations of the data set. As a result, models C and D analyze retention through the O-4 promotion board for both the 1977-1985 and 1986-1991 cohorts.<sup>5</sup>

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<sup>5</sup> There is a six –year differential between marital and dependency status as measured at the O-3 promotion board and retention as measured at the O-4 promotion board. As a result, comparisons of MSR retention and O-4 promotion board retention for the 1977-1985 cohorts will allow retention behavior results for the later cohorts to be inferred.

**Table 3. Nuclear Submarine Officer Retention Modeling Methodology**

**A. Logit MSR Retention Model Based on Marital Status (Cohorts = 1977-1985):**

RETAIN = f(Married, Commissioning Source, Undergraduate Major, Commissioning Year Group, Age, Performance Evaluations)

**B. Logit MSR Retention Model Based on Marital Status With Dependents (Cohorts = 1977-1985):**

RETAIN = f(Married with dependents, Married no dependents, Commissioning Source, Undergraduate Major, Commissioning Year Group, Age, Performance Evaluations)

**C. Logit Retention (O-4 Promotion Board) Model Based on Marital Status (Cohorts = 1977-1991):**

STAYER = f(Married, Commissioning Source, Undergraduate Major, Commissioning Year Group, Age)

**D. Logit Retention (O-4 Promotion Board) Model Based on Marital Status with Dependents (Cohorts = 1977-1991):**

STAYER = f(Married with dependents, Married no dependents, Commissioning Source, Undergraduate Major, Commissioning Year Group, Age)

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## IV. DATA ANALYSIS

This chapter reports the results of the multivariate logit models used to analyze the effect of marital and dependency status on nuclear submarine officer retention beyond the MSR, while controlling for other important retention factors such as commissioning source, undergraduate major and early performance evaluations. First, the probability of retention beyond the MSR for submarine officers commissioned between 1977 and 1985 is predicted by including marital status with the explanatory variables in the baseline model. Next, after including an explanatory variable describing the dependency status of these same cohorts, a second probability of retention past the MSR is estimated. A second set of analyses predicts the probability of retention through the O-4 promotion board for cohorts commissioned between 1977 and 1991 by using the same models.

Logit estimates for each model are provided in tables throughout this chapter. Because the logit coefficients fail to indicate the effects of changes in each explanatory variable on retention, marginal effects are calculated so that the reader can easily see the effects of these changes on the overall probability of retention beyond the MSR. Results of each model are discussed in the corresponding section.

### **A. MSR RETENTION MODEL INCLUDING MARITAL STATUS (1977-1985 COHORTS)**

Table 4 displays the maximum likelihood estimates of the MSR retention logit model (based on marital status alone) for cohorts commissioned between 1977 and 1985. In this model, five explanatory variables are significant at the .05 level or better, and two more variables are significant at the .10 level. Being married at the O-3 promotion board, majoring in biology or the physical sciences during undergraduate studies, being older at

commissioning and obtaining a commission via an enlisted commissioning program are all positively associated with retention beyond the MSR. Based on the computed marginal effects, the explanatory variables noted above increase the probability of retention beyond the MSR by .02, .03, .02 and .15 respectively.<sup>6</sup> Additionally, the more times an officer is recommended for accelerated promotion as a Lieutenant (j.g.) the higher his probability of retention beyond the MSR. The computed marginal effect for the PRAP2 variable indicates that recommendations for accelerated promotion as an O-2 increases MSR retention probability by .10.

Only two statistically significant explanatory variables are negatively associated with MSR retention; submarine officers commissioned via ROTC and OCS exhibit a lower retention probability when compared to the USNA reference group (.05 and .19 lower, respectively).

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<sup>6</sup> The majority of the submarine officers in the data sets were engineering majors. Relative to that group, officers who majored in science are significantly more likely to retain past the MSR; other majors do not show a significant retention difference.

**Table 4. Logit Retention (MSR) Model (1977-1985) Results Using Marital Status**

VARIABLE	LOGIT COEFFICIENT	STANDARD DEVIATION	SIGNIFICANCE	MARGINAL EFFECT
<b>FOR MARITAL STATUS: SINGLE = REFERENCE CATEGORY</b>				
MARRIED	.138	.076	.069	.0249
<b>FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY</b>				
ROTC	-.300	.098	.002	-.0541
OCS	-1.070	.098	.000	-.1929
ENLISTED/ OTHER	.835	.425	.050	.1505
<b>FOR UNDERGRADUATE MAJOR: ENGINEERING = REFERENCE CATEGORY</b>				
BIOLOGY/ PHYSICAL SCIENCE	.193	.102	.059	.0348
MATH/ COMPUTER SCIENCE	-.047	.136	.731	-.0085
SOCIAL SCIENCE	-.183	.226	.419	-.0329
BUSINESS/ ECONOMICS	-.080	.234	.733	-.0144
HUMANITIES	.015	.144	.915	.0027
AGE	.115	.029	.000	.0207
PRAP1	.199	.146	.172	.0359
PRAP2	.588	.089	.000	.1059
CONSTANT	-2.048	.633	.001	
<b>CHI SQUARE:</b>	291.827	<b>-2 LOG LIKELIHOOD:</b>	4204.286	<b>SAMPLE SIZE:</b> 3570

## **B. MSR RETENTION MODEL INCLUDING DEPENDENCY STATUS (1977-1985 COHORTS)**

Table 4 found that being married was marginally important in explaining nuclear submarine officer retention beyond the MSR. Table 5 displays the maximum likelihood estimates of the MSR retention logit model based on the independent effect of dependent children for cohorts commissioned between 1977 and 1985. Again, five explanatory variables are significant at the .05 level or better, and two more are significant at the .10 level. Being married with one or more children at the O-3 promotion board is statistically significant at the .01 level and increases the MSR retention probability by .07. Being married with children is one of the strongest retention predictors in the model. On the other hand, being married but having no children is an insignificant predictor of the retention probability. The computed marginal effects show that increased age at commissioning increases retention probability by .02. Being commissioned via an enlisted commissioning program still exerts a significant positive effect on the retention probability with a .13 increase for obtaining a commission in this manner. Additionally, majoring in biology or the physical sciences during undergraduate studies, as well as obtaining recommendations for accelerated promotion as a Lieutenant (j.g.) increase MSR retention probability by .03 and .11, respectively. As with the previous model, officers commissioned via ROTC and OCS exhibit a lower retention probability.

(Approximately .05 and .19 lower for each)



**Table 5. Logit Retention (MSR) Model (1977-1985) Results Using Dependents**

VARIABLE	LOGIT COEFFICIENT	STANDARD DEVIATION	SIGNIFICANCE	MARGINAL EFFECT
<b>FOR MARITAL STATUS: SINGLE = REFERENCE CATEGORY</b>				
MARRIED/ NO CHILD	.052	.082	.528	.0094
MARRIED/ ONE OR MORE CHILD	.403	.126	.001	.0726
<b>FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY</b>				
ROTC	-.305	.098	.002	-.0549
OCS	-1.076	.098	.000	-.1939
ENLISTED/ OTHER	.741	.427	.083	.1336
<b>FOR UNDERGRADUATE MAJOR: ENGINEERING = REFERENCE CATEGORY</b>				
BIOLOGY/ PHYSICAL SCIENCE	.193	.102	.060	.0348
MATH/ COMPUTER SCIENCE	-.052	.136	.700	-.0094
SOCIAL SCIENCE	-.187	.226	.410	-.0337
BUSINESS/ ECONOMICS	-.108	.235	.645	-.0195
HUMANITIES	.007	.144	.962	.0013
AGE	.098	.029	.001	.0177
PRAP1	.193	.146	.187	.0348
PRAP2	.598	.089	.000	.1078
CONSTANT	-1.662	.650	.011	
<b>CHI SQUARE:</b>	299.087	<b>-2 LOG LIKELIHOOD:</b>	4197.026	<b>SAMPLE SIZE: 3570</b>

### **C. MODEL OF RETENTION TO THE O-4 PROMOTION BOARD INCLUDING MARITAL STATUS (1977-1991 COHORTS)**

Table 6 displays the maximum likelihood estimates of the logit retention (O-4 promotion board) model based on marital status alone for cohorts commissioned between 1977 and 1985. In this model, eight explanatory variables are statistically significant predictors of retention to the O-4 promotion board (five are significant at the .05 level or better, and three are significant at the .10 level). Being married at the O-3 promotion board increases the probability of retention to the O-4 promotion board by .03, and the variable is significant at the .05 level. Unlike the previous MSR retention models, majoring in biology or physical science does not predict a higher retention probability. Rather, officers with undergraduate degrees in the humanities exhibit a .04 higher retention probability, while those who majored in math/computer science, and business/economics show lower retention probability; -.04 and -.07, respectively. As with the previous models, increased age at commissioning and obtaining a commission via an enlisted commissioning program positively affect the retention probability to the O-4 promotion board, while being commissioned via ROTC and OCS negatively affect retention.

Table 7 displays the results for cohorts commissioned between 1986 and 1991. For these later cohorts, being married at the O-3 promotion board results in a .06 higher probability of retention to the O-4 promotion board and is significant at the .01 level. The only explanatory variable that differs from the 1977 through 1985 cohorts in its effect on retention is being a humanities major during undergraduate studies. For the 1986 through 1991 cohorts, being a humanities major is no longer a significant predictor of retention probability to the O-4 promotion board.

**Table 6. Logit Retention (O-4 Promotion Board) Model (1977-1985) Results Using Marital Status**

VARIABLE	LOGIT COEFFICIENT	STANDARD DEVIATION	SIGNIFICANCE	MARGINAL EFFECT
<b>FOR MARITAL STATUS: SINGLE = REFERENCE CATEGORY</b>				
MARRIED	.151	.067	.024	.0272
<b>FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY</b>				
ROTC	-.349	.082	.000	-.0629
OCS	-.994	.090	.000	-.1792
ENLISTED/ OTHER	.701	.278	.012	.1264
<b>FOR UNDERGRADUATE MAJOR: ENGINEERING = REFERENCE CATEGORY</b>				
BIOLOGY/ PHYSICAL SCIENCE	.102	.087	.244	.0184
MATH/ COMPUTER SCIENCE	-.224	.123	.068	-.0404
SOCIAL SCIENCE	.053	.192	.783	.0095
BUSINESS/ ECONOMICS	-.392	.212	.064	-.0707
HUMANITIES	.228	.128	.076	.0411
AGE	.194	.025	.000	.0349
CONSTANT	-4.653	.551	.000	
<b>CHI SQUARE:</b>	350.073	<b>-2 LOG LIKELIHOOD:</b>	5344.577	<b>SAMPLE SIZE:</b> 4284

**Table 7. Logit Retention (O-4 Promotion Board) Model (1986-1991) Results Using Marital Status**

<b>VARIABLE</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD DEVIATION</b>	<b>SIGNIFICANCE</b>	<b>MARGINAL EFFECT</b>
<b>FOR MARITAL STATUS: SINGLE = REFERENCE CATEGORY</b>				
MARRIED	.343	.093	.000	.0618
<b>FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY</b>				
ROTC	-.329	.117	.005	-.0593
OCS	-.522	.119	.000	-.0941
ENLISTED/ OTHER	.928	.223	.000	.1673
<b>FOR UNDERGRADUATE MAJOR: ENGINEERING = REFERENCE CATEGORY</b>				
BIOLOGY/ PHYSICI/ MATH	.210	.105	.046	.0379
SOCIAL SCIENCE	.273	.283	.336	.0492
BUSINESS/ ECONOMICS	-1.012	.477	.034	-.1824
HUMANITIES	.067	.389	.863	.0121
AGE	.181	.035	.000	.0326
CONSTANT	-4.968	.774	.000	
<b>CHI SQUARE:</b>	<b>214.487</b>	<b>-2 LOG LIKELIHOOD:</b>	<b>2942.363</b>	<b>SAMPLE SIZE: 2614</b>

#### **D. MODEL OF RETENTION TO THE O-4 PROMOTION BOARD INCLUDING DEPENDENCY STATUS (1977-1991 COHORTS)**

Table 8 displays the maximum likelihood estimates of the logit retention (O-4 promotion board) model, using the marriage and dependent interaction variables, for cohorts commissioned between 1977 and 1985. In this model, like the previous models describing these same cohorts, marriage alone is not a significant predictor of retention behavior to the O-4 promotion board. However, being married with one or more children is associated with a .07 higher probability of retention, which is significant at the .01 level. Additionally, age at commissioning, accession from enlisted commissioning programs and majoring in humanities remain positive influences on retention probability, while majoring in math/computer science or business/economics, as well as being commissioned via ROTC and OCS remain negative influences on the probability of retention to the O-4 promotion board.

Table 9 displays the model results for the cohorts commissioned between 1986 and 1991. The results indicate a shift in the effect of marital status (without the presence of dependent children) on retention to the O-4 promotion board. For these cohorts, being married without children now becomes a positive predictor of retention (significant at the .05 level). Being married with no children at the O-3 promotion board increases the probability of retention to the O-4 promotion board by .04, while being married with one or more children at the same point increases the probability of retention by .12 and is significant at the .01 level. As seen in the previous retention models, being older at commissioning and obtaining a commission via an enlisted commissioning program positively influence retention behavior, while being commissioned via ROTC and OCS negatively influence retention to the O-4 promotion board. Being older at commissioning

and accession from an enlisted commissioning program increase the probability of retention by .03 and .15, respectively. Accession from ROTC lowers the probability of retention to the O-4 promotion board by .06, and obtaining a commission via OCS reduces the probability by .15.

The results of all multivariate logit models show that simply being married at the O-3 promotion board is weakly correlated with nuclear submarine officer retention beyond the MSR. When marriage alone is interacted with the presence of dependent children, being married without children remains a statistically significant predictor of retention for the 1986 through 1991 cohorts only. On the other hand, being married with one or more children at the O-3 promotion board is strongly correlated with retention beyond the MSR, and is statistically significant at the .05 level or better in all models.

**Table 8. Logit Retention (O-4 Promotion Board) Model (1977-1985) Results Using Dependents**

VARIABLE	LOGIT COEFFICIENT	STANDARD DEVIATION	SIGNIFICANCE	MARGINAL EFFECT
<b>FOR MARITAL STATUS: SINGLE = REFERENCE CATEGORY</b>				
MARRIED/ NO CHILD	.075	.073	.304	.0135
MARRIED/ ONE OR MORE CHILD	.385	.107	.000	.0694
<b>FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY</b>				
ROTC	-.351	.082	.000	-.0633
OCS	-.999	.090	.000	-.1801
ENLISTED/ OTHER	.620	.280	.027	.1118
<b>FOR UNDERGRADUATE MAJOR: ENGINEERING = REFERENCE CATEGORY</b>				
BIOLOGY/ PHYSICAL SCIENCE	.104	.087	.232	.0187
MATH/ COMPUTER SCIENCE	-.228	.123	.063	-.0411
SOCIAL SCIENCE	.055	.192	.773	.0099
BUSINESS/ ECONOMICS	-.413	.212	.052	-.0744
HUMANITIES	.219	.129	.089	.0395
AGE	.179	.026	.000	.0322
CONSTANT	-4.316	.564	.000	
<b>CHI SQUARE:</b>	357.839	<b>-2 LOG LIKELIHOOD:</b>	5336.811	<b>SAMPLE SIZE:</b> 4284

**Table 9. Logit Retention (O-4 Promotion Board) Model (1986-1991) Results Using Dependents**

<b>VARIABLE</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD DEVIATION</b>	<b>SIGNIFICANCE</b>	<b>MARGINAL EFFECT</b>
<b>FOR MARITAL STATUS: SINGLE = REFERENCE CATEGORY</b>				
MARRIED/ NO CHILD	.210	.101	.038	.0379
MARRIED/ ONE OR MORE CHILD	.692	.135	.000	.1247
<b>FOR COMMISSIONING SOURCE: USNA = REFERENCE CATEGORY</b>				
ROTC	-.333	.117	.004	-.0600
OCS	-.549	.120	.000	-.0989
ENLISTED/ OTHER	.825	.226	.000	.1487
<b>FOR UNDERGRADUATE MAJOR: ENGINEERING = REFERENCE CATEGORY</b>				
BIOLOGY/ PHYSICI/ MATH	.207	.105	.049	.0373
SOCIAL SCIENCE	.284	.283	.316	.0511
BUSINESS/ ECONOMICS	-1.028	.481	.033	-.1853
HUMANITIES	.119	.389	.760	.0214
AGE	.160	.036	.000	.0288
CONSTANT	-4.483	.788	.000	
<b>CHI SQUARE:</b>	226.704	<b>-2 LOG LIKELIHOOD:</b>	2930.146	<b>SAMPLE SIZE:</b> 2614



## **V. CONCLUSIONS AND RECOMMENDATIONS**

This study focused on determining the impact of marital status on nuclear submarine officer retention beyond the minimum service requirement (MSR). The ultimate goals of this study were to identify some of the significant factors affecting submarine officer retention, as well as to provide policy-makers with useful information regarding policies that may increase junior officer retention rates in the submarine force. The significant retention factors identified in this study (including marital and dependency status) are explained below. This chapter concludes with recommendations for policy changes and for further research.

### **A. CONCLUSIONS**

The conclusions of this study are organized into two parts and are discussed below. The first part discusses the conclusions reached regarding the impact of marital status and the independent effect of dependent children on nuclear submarine officer retention beyond the MSR. The second part discusses conclusions reached regarding the effects of various control variables that were found to be significantly related to officer retention during the analysis.

1. A nuclear submarine officer who is married with dependent children by the O-3 promotion board is more likely to continue on active duty beyond the MSR than single officers or those who are married with no children. Previous retention studies have utilized marital and dependency status as simple control variables rather than analyzing their specific effect on retention behavior. The results of this analysis indicate that there are very specific differences in the retention behavior between these groups.

The most interesting finding of this study is that marital status by itself is not significantly related to submarine officer retention beyond the MSR. Rather, as discussed in the previous chapter, when the variable describing dependent children is included in the statistical models, marital status itself becomes an insignificant predictor of officer retention.<sup>7</sup> There are multiple explanations for these differences.

First, the cost associated with leaving the military significantly increases when a submarine officer has children. The military pay structure increases the rate of compensation only when an officer gains his first dependent (i.e., marriage). However, the value of non-pecuniary compensation such as commissary and exchange privileges, medical coverage and housing allowances continue to increase as an officer gains additional dependents. For example, goods purchased at the commissary and exchange are tax-free, and are significantly less expensive than those offered in the civilian market. As a result, a submarine officer can provide his family with a higher standard of living while in the military than if he was a civilian who made a comparable yearly salary but was forced to obtain goods in the civilian market. Although housing allowances increase only when an officer gains his first dependent, the size of government quarters provided to the service member increases with additional dependents. Therefore, an officer can again provide a higher standard of living for his family in the military. Finally, the value of military medical coverage also continues to increase as an officer gains additional dependents. Medical evaluations and treatments can be scheduled as often as deemed necessary by the service member. Further, specialized treatments, as well as prescription

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<sup>7</sup> There is a weak positive relationship between marital status and retention to the O-4 promotion board for the 1986-1991 cohorts.

drugs are provided to the family at no cost to the service member. Again, this allows the officer to use money, which would normally be used to defray these costs in the civilian market, to provide a higher standard of living for his family. Consequently, when combined, the value of these non-pecuniary benefits translate to a significantly higher cost of leaving for a submarine officer who is married with dependent children.

It can be argued that submarine officers who are married without dependent children also experience the same increased cost of leaving described above. They, like their counterparts with dependent children, receive the same increase in monetary compensation, as well as the commissary, exchange and medical benefits available for the spouse. However, various lifestyle aspects associated with a naval career may counterbalance the increased value of both pecuniary and non-pecuniary benefits. Most retention research discusses the negative influence of family separation, erratic work hours and frequent relocation on individual retention behavior. Certainly, these aspects of the military lifestyle are difficult on a spouse regardless of the presence of dependent children. Family separation and erratic work hours strain the relationship between the service member and his spouse, while frequent relocations make it exceedingly difficult for a spouse to become established in a community, as well as limiting her civilian employment opportunities. The results of this study indicate that the positive increase in the military benefits associated with being married and the negative aspects of the military lifestyle may balance indicating no significant retention difference between single submarine officers and those who are married without dependent children. However, when there are children in a military family, the military compensation

structure does significantly increase the cost of leaving resulting in an increased probability that a nuclear submarine officer will retain beyond the MSR.

Another explanation for differences in retention behavior between these groups may be the stability associated with military employment. Officers who are married with dependent children may be less likely to make a significant career change. Officers who separate from the naval service can usually expect a decrease in basic salary during the first few years of civilian employment. This pay decrease coupled with the loss of benefits such as tax-free goods and family healthcare attaches an even greater cost of leaving the Navy as an officer acquires dependent children. As discussed previously, family separation has traditionally been a significant negative influence on retention behavior. However, a submarine officer, as well as his family, may be more likely to accept this separation in exchange for the financial stability and comfort offered by the Navy.

2. Several conclusions can be made regarding effect of various control variables utilized in this study. First, the older a submarine officer is at commissioning, the more likely he is to remain on active duty beyond his MSR. Two explanations may be given for this difference. First, officers who are older at commissioning may have served as enlisted sailors in the Navy prior to obtaining a commission. Therefore, their decision to pursue a commission may indicate a greater taste for military service. Second, officers who are older at commissioning may have held a job in the civilian sector prior to joining the Navy. As a result, these officers may be more likely to place a greater value on the pecuniary and non-pecuniary benefits offered by the military than officers who have only worked within the military.

Second, submarine officers commissioned via enlisted commissioning programs are more likely to remain on active duty beyond the MSR. Like the effect of age at commissioning, officers with prior enlisted service have indicated a greater taste for the military lifestyle. Further, these officers have likely compiled more years of service upon commissioning. Thus, the present value of retirement benefits is greater, as they have fewer years of service as an officer required before becoming eligible for military retirement.

Third, the more times that an officer is recommended for accelerated promotion as a Lieutenant (j.g.) the more likely he is to remain on active duty beyond his MSR. Nearly 50 percent of the submarine officers commissioned between 1977 and 1985 were recommended for early promotion at least once. Although performance data were not available for officers commissioned between 1986 and 1991, it can be inferred that they would be evaluated similarly. These evaluations do little to affect long-term promotion potential. However, positive feedback (i.e., higher quality fitness reports) early in a submarine officer's career does have a distinct bearing on retention behavior beyond the MSR. Unfortunately, the Navy determined in 1999 that Ensign and Lieutenant (j.g.)'s would no longer receive recommendations for accelerated promotion when evaluated by their superiors. Rather, all O-1's and O-2's are given a promotable grade regardless of their performance in relation to their peers. This new policy is designed to encourage greater overall performance by all officers rather than to discourage the performance and retention of the 50 percent of submarine officers who never receive a recommendation for early promotion. Regardless, an important predictor of retention beyond the MSR has been lost.

Finally, being commissioned via the Reserve Officer's Training Corps (ROTC) and the Officer's Candidate School (OCS) are indicators that a submarine officer is less likely to remain on active duty beyond his MSR compared to being commissioned via the Naval Academy. As noted in previous studies, this result may be explained by the exposure to the Navy an officer receives prior to commissioning. A Naval Academy graduate has received four years of intense military indoctrination while obtaining his undergraduate degree. On the other hand, ROTC graduates receive a limited indoctrination during their four years of schooling, and OCS graduates have no indoctrination prior to attending a 13-week course at OCS immediately prior to their commission. As a result, ROTC and OCS graduates have had significantly less time than Naval Academy graduates to develop a taste for the Navy lifestyle and this difference appears to negatively influence retention behavior beyond the MSR. Although self-selection into USNA of individuals with a greater taste for military service explains a significant portion of the retention difference between these groups, pre-commissioning military exposure must also influence retention behavior.

## **B. RECOMMENDATIONS**

The results of this study indicate that dependency status, as well as various performance and demographic factors do affect nuclear submarine officer retention beyond the MSR. Accordingly, several issues are raised that warrant further investigation.

- Will retention differences persist between these groups when MSR retention is more accurately defined for submarine officers commissioned after 1985?
- Why does there appear to be a shift after 1985 in the retention behavior of submarine officers who are married with no dependent children?

- Is it more cost effective for the Navy to increase the cost of leaving even more for submarine officers who are married, both with and without dependent children, rather than conduct policy changes targeted at improving single officer retention?
- How has the Navy's current policy of not allowing junior officers to be recommended for accelerated promotion during their performance evaluations affected retention beyond the MSR?
- Is there a way to increase the retention of ROTC and OCS graduates within the nuclear submarine community?

Many possibilities exist for future research on the subject of officer retention in the nuclear submarine community. For example, this study relied on retention to the O-4 promotion board as a proxy for MSR retention when analyzing officers commissioned between 1986 and 1991. Consequently, applying a strict MSR retention model, like that used for officers commissioned between 1977 and 1985 in this study, would more accurately assess the implications of marital and dependency status on submarine officer retention behavior for the cohorts commissioned after 1985. Further, use of junior officer exit surveys and personal interview data obtained from officers who leave the submarine service may help to explain the apparent shift in retention behavior of submarine officers who are married but have no dependent children. Since this study only utilized data compiled for officers commissioned between 1977 and 1991, application of this model to year groups commissioned after the force reductions of the early 1990's would also positively contribute to the understanding of this issue in both the force reduction and post force reduction environment.

Undoubtedly, future research should also investigate the impact of the Navy's policy to not assign a recommendation for accelerated promotion on Ensign and Lieutenant (j.g.) performance evaluations on MSR retention of the year groups involved.

Due to this policy change, one of the most significant predictors of submarine officer retention beyond the MSR is no longer being used to provide positive feedback to officers early in their career. Consequently, the effect of this change on retention behavior should be analyzed.

As the Navy has tailored its system of pay and benefits to offset the stress of family separation, married submarine officers with dependent children experience an ever-increasing cost of leaving the naval service. With these pro-marriage policies in place, how then do we increase the cost of leaving of the single nuclear submarine officer? Clearly, we cannot change a single officer's perceptions of the non-pecuniary benefits offered by the military. However, as noted by Nakada (1996), "pay does matter" with regard to officer retention regardless of marital or dependency status. Therefore, increases in the Nuclear Officer Incentive Program bonus levels may not only increase the yearly salary of a single submarine officer, but also raise his personal cost of leaving. Further, other policy changes that can be made include raising the housing allowance for single officers, as well as offering government quarters rather than forcing single officers to buy or rent non-military housing. Finally, single officers could be offered a deployment allowance on par with the family separation allowance received by married officers. These monetary policy changes may not only raise a single officer's cost of leaving the naval service, but also promote perceptions of equity between the groups.

Within the constraints of the current Department of Defense budget, the Navy may only change the most cost-effective policies in its effort to improve submarine officer retention. As a result, changing policies that increase the cost of leaving for single officers may be too expensive for the increased retention they achieve. Perhaps the most



cost-effective approach is to further increase the cost of leaving for married officers both with and without children (i.e. targeted pay raises, improved government housing, etc.). Changing policies that improve the retention of these two groups may both offset the losses of single submarine officers, as well as improve retention rates for a significantly lower cost. Unfortunately, this study only identified some significant factors affecting nuclear submarine officer retention. Future research will have to be conducted to determine the retention elasticities of specific policy changes for each group. Only then can concrete policy recommendation be made about how to improve nuclear submarine officer retention.

Retention of highly skilled nuclear submarine officers is critical to the readiness of the nuclear submarine force. No single policy change will completely solve the current retention difficulties. However, an understanding of the issues raised in this and similar studies, as well as a willingness to address each will ensure that we continue to man our submarines with the highest caliber officers available.

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## LIST OF REFERENCES

1. Bautista, G. E. "Surface Warfare Junior Officer Separation: Does Ship Type Make a Difference?". Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1996.
2. Becker, Gary S. *Human Capital*. 3<sup>rd</sup> edition. The University of Chicago Press, 1991.
3. Bowman, William R., 1990. "Do Engineers Make Better Naval Officers?" *Armed Forces and Society*, 16 (2), 271-286.
4. Cadigan, John. "Family Status of Enlisted Personnel". Congressional Budget Office, Washington, D. C., August, 2000.
5. Duffy, Johnathan C. "A Statistical Analysis of Retention in the Surface Warfare Community". Master's Thesis, Naval Postgraduate School, June, 2000.
6. Ehrenberg, R. G., and Smith, R. S., *Modern Labor Economics: Theory and Public Policy*. Harper Collins College, New York City, NY, 1993.
7. Hogan, P. F., "Family Annualized Cost of Leaving: The Household as the Decision Unit in Military Retention". U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, 1990.
8. Howell, J.R., "Why Mid-Grade Surface Warfare Officers are Resigning from the Naval Service". Master's Thesis, Naval Postgraduate School, Monterey, CA, December 1980.
9. Krieg, John M. and David Anderson. "The Marriage Premium and the Marine Corps". United States Naval Academy, Annapolis, MD, 2000.
10. Mackin, P.C. and Hogan, P.F. and Mairs, L.S., "Estimation of Retention Parameters for the Prototype Officer Personnel Inventory, Cost and Compensation (OPICC) Model: Final Report". U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA, January 1995.
11. Mehay, S.L., "Analysis of Performance Data for Junior Navy and Marine Corps Officers". Naval Postgraduate School, Monterey, CA, October 1995.
12. MILPERSMAN. U.S. Government Printing Office, 1995.
13. Moore, Carol S. and Griffis, Henry S. and Cavalluzzo, Linda C. "A Predictive Model of Navy Second-Term Retention". Center for Naval Analyses, Alexandria, VA, April, 1996.

14. Nakada, Michael K. and Mackin, Patrick C. and Mackie, Christopher D. "Nuclear Officer Retention: MSR and Beyond", (TR-97-1). Navy Personnel Research and Development Center, San Diego, CA, October, 1996.
15. Nakada, Michael K. and James P. Boyle. "Nuclear Officer Retention: An Economic Model". Navy Personnel Research and Development Center, San Diego, CA, March, 1996.
16. Quester, Aline O. and Cooke, Timothy W. and Marcus, Alan J. "Personnel Tempo of Operations and Navy Enlisted Retention". Center for Naval Analyses, Alexandria, VA, February, 1992.
17. Warner, J.T. and Goldberg, M.S., "The Influence of Non Pecuniary Factors on Labor Supply: The Case of Enlisted Personnel". *Review of Economics and Statistics*. Vol. 66, 1984.
18. Woelper, Eric P. " The Impacts of Academic Background on Submariner Performance, Retention, and Promotion". Master's Thesis, Naval Postgraduate School, Monterey, CA, March, 1998.

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