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Retention of U.S. Navy Surface Warfare Officers Before and After the Global War on Terror (GWOT)

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THESIS

RETENTION OF U.S. NAVY SURFACE WARFARE OFFICERS BEFORE AND AFTER THE GLOBAL WAR ON TERROR (GWOT)

by

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March 2012

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This thesis analyzes the effect of the Global War on Terror (GWOT) on the retention of Navy Surface Warfare Officers. Multivariate probit models are used to estimate the effects of commissioning source and other demographic variables on retention. The data set used was based on archival data provided by the Navy via the Navy Econometric Modeling System (NEMS). The data set contained information on Navy Surface Warfare Officers in pay grades O2–O6. The archival data set included 73,348 records. In order to analyze the effect of the GWOT on officer retention, we created cohorts based on the entry years of the officers and analyzed retention to the sixth year in their careers. We used a probit model to estimate the partial effect of variables before and after the start of the Global War on Terror.

Our retention analysis shows that Naval Academy and ROTC/NROTC graduates are less likely to stay than OCS graduates during both the pre- and post-GWOT periods. Officers with advanced education are less likely to stay than officers with bachelor's degrees in the pre-GWOT period but, in the post-GWOT period, they are more likely to stay. We conclude that the GWOT was a significant factor affecting the retention decisions of Navy Surface Warfare Officers, as retention fell for officers making retention decisions in the post-GWOT period.

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RETENTION OF U.S. NAVY SURFACE WARFARE OFFICERS BEFORE AND AFTER THE GLOBAL WAR ON TERROR (GWOT)

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This thesis analyzes the effect of the Global War on Terror (GWOT) on the retention of Navy Surface Warfare Officers. Multivariate probit models are used to estimate the effects of commissioning source and other demographic variables on retention. The analysis data set was based on archival data provided by the Navy via the Navy Econometric Modeling System (NEMS). The data set contained information on Navy Surface Warfare Officers in pay grades O2–O6. The archival data set included 73,348 records. In order to analyze the effect of the GWOT on officer retention, we created entry cohorts and analyzed retention to the sixth year in their careers. We analyzed retention before and after the start of the Global War on Terror.

Our retention analysis shows that Naval Academy and NROTC graduates are less likely to stay than OCS graduates during both the pre- and post-GWOT periods. Officers with advanced education are less likely to stay than officers with bachelor's degrees in the pre-GWOT period but, in the post-GWOT period, those with advanced education are more likely to stay. We conclude that the GWOT was a significant factor affecting the retention decisions of Navy Surface Warfare Officers, as overall retention fell for officers making retention decisions in the post-GWOT period.

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LIST OF ACRONYMS AND ABBREVIATIONS

AIR	Aviation Information Resources
AOCS	Aviation Officer Candidate School
CMC	Commandant of the Marine Corps
DF	Degrees of Freedom
DMDC	Defense Manpower Data Center
FY	Fiscal Year
GPA	Grade Point Average
GWOT	Global War on Terror
LLR	Log Likelihood Ratio
MSO	Minimum Service Obligation
NEMS	Navy Econometric Modeling System
NROTC	Naval Reserve Officer Training Corps
OCS	Officer Candidate School
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OPTEMPO	Operational Tempo
OTS	Officer Training School
PERSTEMPO	Personnel Tempo
PLC	Platoon Leaders Course
SWO	Surface Warfare Officer
TFDW	Total Force Data Warehouse
USNA	United States Naval Academy

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I. INTRODUCTION

A. BACKGROUND

The U.S. Navy has implemented a variety of missions related to the Global War on Terrorism (GWOT) (O'Rourke, 2008). As Rear Admiral James Stavridis (2004) mentioned after the defeat of Saddam Hussein, conventional standing of the terrorist organizations changed. They eliminated their vulnerability by spreading themselves over the globe. They took advantage of marine transportation of their threats during this period. Unlike conventional war, the GWOT demanded more activities than usual, which also increased manning requirements. Since the GWOT is a continuous war, it pushed the U.S. Navy to the limit of its manpower resources. As of 2008, 11,300 Navy sailors were sent ashore to support ground forces in the U.S. Central Command region (including Iraq and Afghanistan) (O'Rourke, 2008). Also, the Navy became more concerned about officer continuation rates because of the increased operational tempo (OPTEMPO) due to the GWOT. Additionally, keeping officer quality high has been another concern for Navy decision makers.

There are three main commissioning sources providing a steady supply of officers to the Navy to accomplish its mission: The United States Naval Academy (USNA), Officer Candidate School (OCS), and Naval Reserve Officers Training Corps (NROTC). A small number of officers access from other sources, such as the U. S. Military Academy and U.S. Navy Integration Program. Each commissioning source provides a different level of training and exposure to military life, which results in differences in officer quality and propensity for retention.

Smith (2006) found that, after 2001, OCS graduates were more likely to stay in the Navy than USNA graduates. They were also more likely to stay than ROTC graduates. In contrast, Lehner (2008) found that USNA has the highest retention rate among all commissioning sources. These studies indicate that the retention decisions of officers show a conflicting pattern. Yet, it is of great importance to better understand the stay-or-leave decisions of officers so that future planning can help the Navy effectively perform its role in national security. For example, which commissioning programs provide officers with a stronger propensity for a long-term navy career?

B. THE PURPOSE OF THE STUDY AND RESEARCH QUESTIONS

The purpose of the study is to analyze the retention behavior of Surface Warfare Navy Officers before and after the initiation of the GWOT. U.S. military personnel have been deployed to Iraq and Afghanistan since 2002 but during the invasion of Iraq in 2003 the number of service members into the two war zones increased dramatically from 50,000 to nearly 300,000 per month (Hosek and Matorell, 2009). This sudden change in the number of deployments led us to choose 2003 as the threshold for the beginning of GWOT. The dataset used in this thesis contained information on officers who served in the Navy during the period 2002 through 2010. Our findings will provide information to decision makers to help the Navy maintain its mission without stumbling in the fast pace mandated by the GWOT. Attracting new officers and keeping accessions high is an important issue but retaining experienced and trained junior officers is also of great importance. Retaining officers will provide the Navy with both cost savings and higher experience levels. Therefore, understanding the retention behavior of junior officers is important for decision makers.

The primary questions addressed in the thesis are as follows: What factors affect the retention of SWOs? Does the impact of these factors differ before and after the start of the GWOT? A secondary question is as follows: Does commissioning source have an independent effect on the retention decision of SWOs?

C. OUTLINE OF THE STUDY

There are five chapters included in this study. Chapter I provides introductory material. Chapter II presents prior literature related to the effect of the GWOT on the retention decisions of officers. Chapter III covers information about the data set used in this study and provides a preliminary analysis of the variables used in the analysis. Chapter IV introduces the methodology used to understand the effect of the GWOT and the results of the multivariate regression models. In Chapter V, this study is summarized and recommendations for future research are offered.

II. LITERATURE REVIEW

Studies reviewed in this chapter provided us background on officer commissioning programs and on factors affecting officer retention before and after the GWOT. The prior studies also outlined alternative approaches for analyzing officer retention. As emphasized in a recent Navy advertisement, a one hundred percent continuous watch on seas is being applied by the Navy to provide national security in terms of both national defense and international trade safety. It can be argued that this continuous work tempo - which requires far more deployments away from home than other sources experience - may have become a routine for Surface Warfare Officers (SWOs) and they might be less affected by OPTEMPO of troubled times like the GWOT.

A. AN ANALYSIS OF THE EFFECT OF THE GLOBAL WAR ON TERROR ON THE RETENTION OF GRADUATES OF THE U.S. NAVAL ACADEMY (ALANKAYA AND KILIC, 2009)

Alankaya and Kilic (2009) analyzed the effect of the Global War on Terror (GWOT) on the retention behavior of United States Naval Academy (USNA) graduates one year after their minimum service obligation (MSO). The data used in this study was the Active Duty Personnel Cohort file of Navy and Marine Corps officers from the Defense Manpower Data Center (DMDC). The file is mostly constructed from Active Duty Personnel Extract files and includes the period from December 1987 to September 2007. The number of records for the Marine Corps file is 39,339, while the Navy file contains 129,692 records. The authors defined retention based on observing each officer one year beyond the MSO for each cohort.

In order to analyze the effect of increasing OPTEMPO due to the GWOT, they estimated three logistic regression models which focused on analyzing the effect of hostile deployments. In the study, hostile deployment was defined only for the GWOT-period deployments to Iraq or Afghanistan. The models included demographic, service-related and deployment variables. They used a difference-in-difference model to measure the effect of the GWOT. This model was used to analyze the difference between the effects of deployment for the control group and treatment group in the post-GWOT and pre-GWOT periods. Their control group included junior officers who graduated between 1990 and 1995, while the treatment group contained the junior officers

who graduated between 1996 and 2001 from the Naval Academy. The treatment group made retention decisions at MSO in 2001 through 2007.

For the deployment part of the study, Alankaya and Kilic (2009) found that there are three significant factors that affect the retention decisions of officers. They constructed a general deployment model to capture the effect of being deployed (regardless of type of deployment) or not being deployed, and they also added an interaction of the GWOT binary variable with being deployed to catch the treatment effect. Second, a general deployment frequency model was specified to understand the effect of the number of any deployments of any type. Third, a general deployment duration model was specified to capture the effect of the duration of deployments, regardless of deployment type.

The general deployment model results showed that "female officers had 45 percent lower odds of retention at the end of their MSO than male officers," and if an officer was single, either with or without dependents, he/she was less likely to stay in the Navy. They found that retention among female officers was not affected by marital status.

The treatment variable (GWOT) had a statistically significant effect on retention. According to their results, "if an officer graduated from the Naval Academy between 1996 and 2001 and experienced a deployment, the odds of retention were 192 percent higher than for officers who graduated earlier and were not deployed" (Alankaya and Kilic, 2009, p. 58).

According to the general deployment frequency model, they found that both deployment categories (two or more deployments and one deployment) were insignificant in the post-GWOT period, which meant that after the GWOT, retention behavior was not affected by the number of general deployments. For the pre-GWOT period, the effect of one deployment was not significant but the effect of two or more deployments were significant and junior officers were more likely to stay.

But when they omitted the 1990, 1991, and 1992 cohorts due to the error in the coding of designators, they found that if an officer made his or her retention decision after the 9/11 attacks, he or she had 70 percent lower odds of retention than officers in the pre-GWOT cohorts. According to the results of their study, the hostile deployment variable had a very small coefficient. But the GWOT variable showed that living through 9/11 was strongly and positively associated with retention.

To summarize, after 2001, "the Navy enjoyed a ten-percentage point jump in the retention rate, presumably as a result of 9/11, until 2005" (Alankaya and Kilic, 2009, p. 69). And after 2005, the retention rate started to show a declining trend. They stated that deployment had a positive effect on the retention rate of junior officers. Female officers and single service members were less likely to remain in the military and age had a negative effect on retention. And last but not least increasing OPTEMPO caused retention rates to increase among naval junior officers (Alankaya and Kilic, 2009).

B. THE EFFECT OF THE GLOBAL WAR ON TERROR ON RETENTION OF MARINE CORPS AVIATORS (SMITH, 2006)

Smith (2006) examined the retention of Marine Corps aviators before and after 9/11. The data for the study came from the Marine Corps Total Force Data Warehouse (TFDW), the Department of Defense Manpower Data Center (DMDC) PERSTEMPO file, and Aviation Information Resources (AIR), Inc. Smith (2006) evaluated a ten-year period from 1995 through 2005. Since he studied the effect of the GWOT, he broke the data into two periods: The Pre-9/11 period contains FY1995 to FY2001, and the Post-9/11 (i.e., the GWOT) period includes FY2002 to FY2005. He defined retention as surviving at least six months after the expiration of active obligated service (the same as MSO in the Navy.)

Smith (2006) created three multivariate logistic regression models which estimated for three different samples: (a) Pooled; (b) the Pre-9/11 period; and (c) the GWOT period. He estimated a total deployment model, which estimated the effects of both hostile and non-hostile deployments, and a second model which analyzed the types of deployment independently.

According to his results, just a handful of variables were statistically significant for the Pre-9/11 period. Age at commissioning had a negative but diminishing effect on retention until the age of 32, when it became positive. In marital status category, he found that if an aviator was married with children, he was more likely to stay than an aviator who was single with no children in the Pre-9/11 period. The hostile variables (one hostile deployment and multiple hostile deployments) were jointly significant, and hostile deployments had a positive effect on retention decisions of Pre-9/11 aviators.

For the GWOT period, Smith (2006) obtained more statistically significant results. Again, age had a negative but diminishing effect to a certain age, after which the effect became

positive. Again, as in the Pre-9/11 model, he found that if an officer was married with children, he was more likely to stay than an officer who was single with no children. Smith (2006) also found that commissioning source affected the retention of Marine Corps aviators in the latter period. In the GWOT model, OCS graduates showed a significantly higher likelihood to stay than USNA graduates. He also found that the number of deployments negatively affected the retention behavior of aviators. Smith (2006) also indicated that the GWOT-period Marine Corps aviators had deployed more frequently and because of this, retention rates had decreased after GWOT. The increased OPTEMPO affected the retention behavior in a negative way.

To summarize, before 9/11, deployments had little effect on the retention behavior of Marine Corps aviators. But for the GWOT period, things changed dramatically. All deployment-type variables showed a negative effect on the retention rate.

C. MARINE CORPS DEPLOYMENT TEMPO AND RETENTION IN FY05 (QUESTER, HATTIANGADI, LEE AND SHUFORD, 2006)

With 2005 deployment and retention data, Quester et al, were able to analyze how deployments affected Marine Corps retention. In their study, 2005 retention decisions for first-, second-, and third-term Marines and officers were analyzed based on the length of individual deployments(in days) from October 2000 to 2005, the number of deployments, deployment to Iraq or Afghanistan, and dependent status. Quester, et al, used the Defense Manpower Data Center's crisis file.

For first-term enlisted Marines, they compared reenlistment rates between FY04 and FY05 based on the number of deployed days. They found that although very heavy deployers in 2004 were less likely to reenlist, very heavy deployers in 2005 were much more likely to reenlist. Additionally, first-term enlistees without any deployment experience were the least likely to reenlist in both years. The study also compared the reenlistment effects of having dependents to the effect of increased OPTEMPO. When the number of deployed days and deployment to crisis areas were controlled, results showed that Marines without dependents were negatively affected by increased OPTEMPO than enlistees with dependents. An interesting result from the 2005 first-term reenlistment study was that the reenlistment rate increased with very high OPTEMPO for Marines with dependents.

For the second and third-term reenlistment analyses, Quester et al, found similar increasing reenlistment rates for increased deployment days. They noted, "The lowest reenlistment rates were for Marines who did not deploy." They found that there was no apparent distaste for deployments to either Iraq or Afghanistan (Quester et al, 2006, p.12.)

In their retention analysis for Marine officers, Quester et al, analyzed retention rates of non-retirement eligible officers cross-tabulated with the number of deployment days. They found that retention rates were not adversely affected by increased OPTEMPO and the lowest officer retention probability was associated with no deployment experience. They also found that Black officers were more likely to stay in the service than other officers, retention tendencies for men and women were similar, and The Basic School (TBS) rank was positively related with officer retention.

D. HOW DEPLOYMENTS AFFECT SERVICE MEMBERS (HOSEK, KAVANAGH AND MILLER, 2006)

Because of the long military operations in Iraq and Afghanistan, the U.S. military has experienced extended and increased frequency of deployment and, especially due to the downsizing after the end of the Cold War; these deployments have affected military officers' decisions to stay. Hosek et al. (2006) focused on how more recent deployments have affected military personnel and have changed their propensity for military careers. They used data from the Status of Forces Surveys of Active Duty Personnel conducted by the Defense Manpower Data Center (DMDC) from March 2003 to July 2003. The demographic data was used for the statistical analysis of the effect of deployment.

They also conducted focus groups with enlisted personnel and with officers in each service in the first six months of 2004. Their analysis focused on stress and intention to stay based on self-reports. The two measures of stress were higher-than-usual work stress and higher-than-usual personal stress. Four measures of intention to stay were used: "intention to stay, intention to stay for a career of 20 years or more, whether desire to stay increased in the past years as a result of being away from permanent duty station, for those not away, as a result of not being away, and whether the respondent felt that his (or her) spouse wanted him (or her) to stay in the military" (Hosek, et al., 2006, p. xviii).

They estimated linear probability models of deployment and found that higher-than-usual work stress affected the intention to stay. The results of other measures such as intention to stay for a career of 20 years or more were mostly similar but showed weaker statistical relationships. Their results also showed that service members who experienced higher-than-usual stress had a higher intention to stay on active duty. They argued that officers who are well-matched to military service may have more intention to stay and be assigned or promoted to more stressful positions.

According to their regression results, involvement in OEF (Afghanistan) or OIF (Iraq) increased the stress among Army officers but decreased the stress among Marine Corps officers. On the other hand, involvement in OEF or OIF did not affect intention to stay for most military personnel, with the exception of Army officers, whose intention to stay decreased.

If personnel felt prepared both personally and as a team, their intention to stay was increased. But, higher-than-usual work stress decreased retention. Senior enlisted personnel were more likely to intend to stay, compared with junior enlisted personnel and senior officers, who were more likely to stay than junior officers. Marital status was irrelevant to higher-than-usual work stress, but being married had a positive effect on intention to stay in the military.

Some of the statistical findings supported what they heard from the focus groups. First, personnel in the groups had mixed feelings about reenlistment decisions because deployments had both positive and negative sides. For example, deployment brings uncertainty about the future, which increases stress levels. Family separation is another negative aspect of deployments, which created long work hours and high OPTEMPO. On the other hand, deployment pay helps to offset the difficulties of deployment, and they see deployment as an opportunity to use their training in the real world.

Finally, it must be kept in mind that the data set used in this study was drawn from a period early in OEF/OIF. But during 2004 and 2005, the insurgency in Iraq became more active and dangerous. Some personnel continued their duty even though they reached the expiration of their term of service and some faced their second or even third deployments. These changes may alter the results of subsequent studies.

In this chapter, we have reviewed and analyzed previous studies related to our topic. Since our interest is on the effect of the GWOT on the retention behavior of officers, these studies provided us with an understanding of the subject along with results on other predictors of retention. Note that, unlike previous studies, our threshold for the GWOT is year 2003 and we were not able to factor in deployment in our model due to lack of data. Also, it is important to note that our technique for analyzing the effect of GWOT is different from the previous studies. We created two multivariate models for periods and then compared the results.

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III. PRELIMINARY DATA ANALYSIS

A. DATA SOURCE

The data set used in this study is based on archival data provided by the Navy via the Navy Econometric Modeling System (NEMS). The NEMS data includes information on SWOs between pay grades O2 and O6 during the period from 2000 through 2011. The data set contains information about the educational level attained by the officers, accession source, marital status, ethnicity, race and prior enlisted service. The archival data set contains a total of 73,348 records.

We created 10 cohorts in the data set between 2000 and 2010. We defined retention based on staying one year beyond the MSO. For USNA graduates, the MSO is five years, which means that after five years of service, a USNA graduate can leave the Navy. ROTC and OCS graduates have an MSO of four years. In our study, we looked at officers who were at their sixth year of service so that we could cover the retention decisions of all of the commissioning sources. To give an example, if an officer graduated from the Naval Academy in 2000, we examine the stay-or-leave decision in 2006, six years after commissioning. Since our data set includes information from 2000 through 2011, we could not look at the retention decisions of officers who graduated after 2005 because their MSO had not yet expired. Also, since there was some missing information for the year 2011, we had to exclude the whole year from our data set, which left us with data on retention in the years 2000 through 2010.

Figure 1 shows the logic used to set up the retention analysis. It demonstrates why 2006 graduates are beyond the scope of this study because our data set ends at year 2011, and 2005 graduates were excluded because of incomplete information in 2011.

Figure 1. Set up of Retention Model

B. DATA RESTRICTIONS AND LIMITATIONS

As mentioned, the data set used in this study includes information only about SWOs. Aviators, nuclear officers, and other officer communities were excluded. Also, we did not have any information about deployments to war zones; for this reason, we omitted this factor from our model even though the prior literature has found that deployments to war zones affect retention. On the other hand, the Navy is an expeditionary force routinely which deploys in both peacetime as well as in war time. The surface Navy is the heart of the expeditionary force, so GWOT-related deployment would affect retention only if deployments became more frequent or longer in duration. We define a binary variable to capture the effect of the post-GWOT period and as a proxy for any increases in deployment activity.

One goal of the study was to compare retention decisions in pre- and post-GWOT periods. We accepted 2003 as the threshold for the GWOT period because of the increased deployments during the invasion of Iraq in 2003. Cohorts from 1996 to 1997 comprised the pre-GWOT period, and provided a sample size of 1,236. Cohorts from 1998 to 2004 formed the post-GWOT period, and provided a sample size of 5,342.

C. VARIABLES

Table 1 shows the definitions of the variables used in our models. As Table 1 shows, all of the variables are binary. Table 2 shows the descriptive statistics for the variables we include in the multivariate models, including the dependent variable “stay” which is a binary variable that equals one if the officer was still in the Navy six years after commissioning and equals zero otherwise. The descriptive statistics are presented by cohort (1996–2004). Table 2 shows that sample sizes for each cohort varied from 588 for the cohort 1996 to 896 for the cohort 2000. As

seen from Table 2 post-GWOT cohorts are generally larger in size, with cohort size peaking with the 2000 cohort (a post-GWOT cohort).

Variable	Desciption
Dependent variable	
Stay	=1 if stayed in the 6th year; 0 otherwise
Explanatory variables	
Commissioning Source	
USNA	=1 if USNA graduate; 0 otherwise
OCS	=1 if OCS, or AOCS, or OTS, or PLC source; 0 otherwise
ROTC	=1 if ROTC/NROTC scholarship or non-scholarship program; 0 otherwise
Other_comm	=1 if Military Academy, or Air Force Academy, or USN Integration Program source; 0 otherwise
Educational Level	
Bachelor's Deg.	=1 if attained a Baccalaureate degree; 0 otherwise
Advanced Education	=1 if attained a Doctorate Degree, or a First Professional Degree, or a Master's Degree; 0 otherwise
Other	=1 if attained an Associate Degree, or a High School Diploma, or an Occupational Program Certificate, or completed one semester of college; 0 otherwise
Unknown	=1 if attained Educational Level is not known; 0 otherwise
Race	
White	=1 if white; 0 otherwise
Black	=1 if black; 0 otherwise
Other	=1 if race is American Indian/Alaska Native, or Asian, or Native Hawaiian/Other Pacific Islander; 0 otherwise
Gender	
Female	=1 if female; 0 otherwise
Male	=1 if male; 0 otherwise
Marital Status	
Married	=1 if married; 0 otherwise
Not married	=1 if not married; 0 otherwise
Dependency Status	
With Dependents	=1 if with dependent; 0 otherwise
No Dependents	=1 if no dependent; 0 otherwise
Prior Enlisted Service	
Prior Enlisted	=1 if had prior service; 0 otherwise
Not Prior Enlisted	=1 if had no prior service; 0 otherwise
Cohorts	
Cohort 1996	=1 if commissioning year is 1996; 0 otherwise
Cohort 1997	=1 if commissioning year is 1997; 0 otherwise
Cohort 1998	=1 if commissioning year is 1998; 0 otherwise
Cohort 1999	=1 if commissioning year is 1999; 0 otherwise
Cohort 2000	=1 if commissioning year is 2000; 0 otherwise
Cohort 2001	=1 if commissioning year is 2001; 0 otherwise
Cohort 2002	=1 if commissioning year is 2002; 0 otherwise
Cohort 2003	=1 if commissioning year is 2003; 0 otherwise
Cohort 2004	=1 if commissioning year is 2004; 0 otherwise

Table 1. Variable Descriptions

	Cohort 1996		Cohort 1997		Cohort 1998		Cohort 1999		Cohort 2000		Cohort 2001		Cohort 2002		Cohort 2003		Cohort 2004		All Cohorts	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Stay	0.816	0.387	0.742	0.437	0.721	0.448	0.665	0.471	0.635	0.481	0.583	0.493	0.583	0.493	0.577	0.494	0.645	0.478	0.657	0.474
USNA	0.372	0.483	0.362	0.481	0.314	0.464	0.268	0.443	0.256	0.437	0.27	0.444	0.316	0.465	0.312	0.463	0.354	0.478	0.309	0.462
OCS	0.204	0.403	0.236	0.425	0.327	0.469	0.295	0.456	0.323	0.468	0.298	0.457	0.205	0.404	0.164	0.371	0.101	0.302	0.246	0.43
ROTC	0.348	0.476	0.33	0.47	0.31	0.463	0.405	0.491	0.385	0.486	0.401	0.49	0.436	0.496	0.474	0.499	0.48	0.5	0.397	0.489
Other commissioning source	0.074	0.263	0.071	0.257	0.047	0.212	0.031	0.171	0.034	0.182	0.028	0.167	0.041	0.199	0.048	0.215	0.063	0.243	0.046	0.211
Bachelor's Degree.	0.864	0.343	0.81	0.392	0.792	0.405	0.668	0.471	0.627	0.483	0.665	0.472	0.755	0.43	0.789	0.408	0.824	0.381	0.745	0.435
Advanced education	0.039	0.194	0.058	0.235	0.045	0.209	0.069	0.253	0.101	0.302	0.089	0.285	0.066	0.249	0.08	0.272	0.074	0.262	0.071	0.257
Other education	0.064	0.246	0.101	0.301	0.089	0.285	0.084	0.277	0.054	0.227	0.042	0.202	0.051	0.22	0.047	0.212	0.006	0.079	0.06	0.237
Unknown education	0.032	0.177	0.031	0.173	0.072	0.259	0.178	0.383	0.216	0.412	0.205	0.402	0.126	0.332	0.082	0.274	0.095	0.293	0.123	0.328
White	0.79	0.407	0.755	0.43	0.795	0.403	0.811	0.391	0.787	0.408	0.785	0.41	0.773	0.418	0.785	0.41	0.839	0.366	0.791	0.406
Black	0.081	0.274	0.132	0.339	0.091	0.289	0.097	0.297	0.119	0.324	0.101	0.302	0.104	0.305	0.105	0.308	0.064	0.246	0.101	0.301
Other race	0.127	0.333	0.112	0.316	0.112	0.316	0.09	0.287	0.092	0.29	0.112	0.315	0.122	0.327	0.108	0.311	0.095	0.293	0.107	0.309
Female	0.158	0.365	0.125	0.33	0.161	0.368	0.212	0.409	0.234	0.423	0.238	0.426	0.244	0.43	0.232	0.422	0.245	0.43	0.208	0.406
Male	0.841	0.365	0.875	0.33	0.838	0.368	0.787	0.409	0.765	0.423	0.761	0.426	0.755	0.43	0.767	0.422	0.754	0.43	0.791	0.406
Married	0.491	0.5	0.464	0.499	0.442	0.497	0.418	0.493	0.486	0.5	0.5	0.5	0.49	0.5	0.518	0.499	0.54	0.498	0.482	0.499
Not married	0.508	0.5	0.535	0.499	0.557	0.497	0.581	0.493	0.513	0.5	0.5	0.5	0.509	0.5	0.481	0.499	0.459	0.498	0.517	0.499
With dependents	0.472	0.499	0.461	0.298	0.504	0.5	0.528	0.499	0.556	0.497	0.543	0.498	0.5	0.5	0.531	0.499	0.524	0.499	0.517	0.499
No dependent	0.527	0.499	0.538	0.498	0.495	0.5	0.471	0.499	0.443	0.497	0.456	0.498	0.5	0.5	0.468	0.499	0.475	0.499	0.482	0.499
Prior service	0.428	0.495	0.425	0.494	0.387	0.487	0.34	0.474	0.392	0.488	0.472	0.499	0.901	0.298	0.549	0.497	0.339	0.473	0.47	0.499
Sample Size	588		648		718		796		896		864		720		717		631		6,578	
	Pre-GWOT=1,236				Post-GWOT=5,342															
	TOTAL=6,578																			

Table 2. Descriptive Statistics by Cohort

Table 3 displays descriptive statistics of the analysis variables for the pre-GWOT and post-GWOT samples and for the full sample. Column 1 shows the means for each variable in the pre-GWOT period, and Column 2 shows the means for the post-GWOT period. Column 5 shows means for the whole sample. Additionally, we computed t-statistics for each variable to determine whether the variables differed significantly between the pre- and post-GWOT periods. Column 3 displays the t-statistic for the test of differences in group means and Column 4 displays the level of significance.

Characteristics	Pre-GWOT Sample (Cohorts 1996-1997)	Post-GWOT Sample (Cohorts 1998-2004)	T-Test	Significance	Full Sample (2002-2010)
Stay (%)	**77.75**	**62.93**	**-9.96**	**0.01*** **	**65.72**
Race (%)					
White	**77.18**	**79.60**	**1.88**	**0.10***	**79.14**
Black	**10.84**	**9.94**	**-0.95**		**10.11**
Other race	**8.33**	**5.47**	**-1.54**		**6.00**
Gender (%)					
Female	**14.08**	**22.44**	**6.54**	**0.01*** **	**20.87**
Commissioning Source (%)					
USNA	**36.73**	**29.58**	**-4.91**	**0.01*** **	**30.92**
ROTC	**33.90**	**41.09**	**4.66**	**0.01*** **	**39.74**
OCS	**22.09**	**25.23**	**2.31**	**0.05** **	**24.64**
Other	**7.28**	**4.10**			**4.70**
Educational Level (%)					
Bachelor's Degree	**83.58**	**72.41**	**-8.16**	**0.01*** **	**74.11**
Advance education	**4.94**	**7.66**	**3.35**	**0.01*** **	**7.15**
Unknown education	**3.16**	**14.47**	**11.00**	**0.01*** **	**12.34**
Other education	**8.33**	**5.47**	**-3.83**	**0.01*** **	**6.00**
Marital status (%)					
Married	**47.73**	**48.39**	**0.42**		**48.27**
Has dependents (%)					
No dependent	**53.32**	**47.14**	**-3.92**	**0.01*** **	**48.30**
Prior Service (%)					
Yes	**42.72**	**48.03**	**3.38**	**0.01*** **	**47.04**
Sample Size	**1,632**	**5,342**			**6,578**

***p<0.01, **p<0.05, *p<0.1
(The t-statistic shows that whether the difference between the two periods result from a random sampling or originates from a true difference)

Table 3. T-Test of Differences in Group Means of Analysis Variables

When we look at the t-stats of the variables, we see that the differences in the means between two periods are significant for most of the variables. The t-stats of the

stay variable show that means of pre-GWOT and post-GWOT samples differ significantly from each other. In the post-GWOT period retention rate decreased to 62.93 percent compared to 77.75 percent in the pre-GWOT period. Gender, commissioning source, educational level, dependency status, and prior enlistment variables show that the difference in means between two periods is statistically significant. This means the difference did not occur by chance.

1. Stay

For the retention model, we created "stay" as the dependent variable. If an officer was still in Navy at the sixth year, he or she was coded as "1" and was coded as a "0" otherwise. Table 4 shows the retention rates of Navy SWOs by commissioning source. Our retention rate analysis for each cohort was based on taking a snapshot picture of each officer's status after six years of service. For example, the 1996 cohort included all SWOs who were commissioned in 1996. We calculated respective retention rates by the commissioning source of each cohort as the ratio of stayers to new cohort entrants.

As seen from Table 4, OCS graduates' six-year retention rate was above 92 percent in the pre-GWOT period but decreased in the post-GWOT period and was only 69.5 percent for the 2003 cohort. ROTC graduates showed a similar pattern to OCS graduates. For cohort 1996, the retention rate of ROTC graduates was 79 percent but after the GWOT, the number decreased gradually and for cohort 2001 fell below 45 percent. And, finally, we see the same decreasing retention pattern for USNA graduates. In 2002, the retention rate for cohort 1996 was 74.8 percent but after GWOT, the rate fell to 50.4 percent in 2009 (for cohort 2003). Based on our retention rate analysis, it appears that SWO retention decisions were adversely affected by the GWOT.

Commissioning Source	RETENTION BY COHORT (%)								
	1996	1997	1998	1999	2000	2001	2002	2003	2004
OCS	92.5	92.1	85.9	85.9	81.7	77.9	75.6	69.5	73.4
Other	97.7	95.6	88.2	83.3	70.9	76.0	80.0	91.4	90.0
ROTC	79.0	63.6	59.2	56.0	51.3	44.4	48.7	55.0	59.4
USNA	74.8	68.1	68.1	59.3	57.8	55.5	57.4	50.4	64.3

Table 4. Retention Rates by Commissioning Source and Cohort

2. Race

Race is broken down into three different categories: white, Black, and other race. When we compare the percentages of officers by race in Table 3, we do not see much difference between the pre-GWOT and post-GWOT period and t-stats show us that the difference in mean values are not significant, except for the white variable, which is significant at 10% level. The rate of white officers increased to 79.60 percent in the post-GWOT period. We thought that race would be an important factor in the retention decisions of officers. However, both Alankaya and Kilic (2006) and Celik and Karakaya (2011) found that race was not significantly associated with officer retention.

3. Gender

Based on literature review, gender could be another factor affecting the retention decisions of officers. In their general deployment model, Alankaya and Kilic (2009) found that female officers are less likely to stay at the end of their MSO when compared to male officers. When we compare the percentages in Table 3, we see a drastic difference between representations of female officers. Before the GWOT, the female representation was 14 percent but after the GWOT, the percentage jumped to nearly 23 percent and this difference is statistically significant. Figure 2 also shows the increase in gender representation over time.

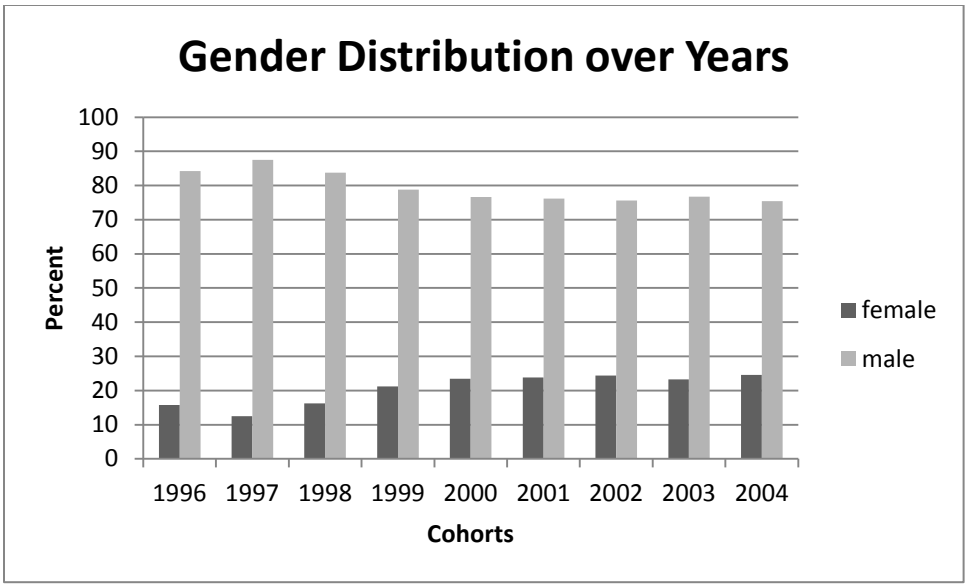

Figure 2. Gender Distribution by Cohort

4. Commissioning Source

Commissioning source is divided into four categories: USNA, ROTC, OCS, and "other commissioning source." ROTC includes officers from both ROTC scholarship and non-scholarship programs. OCS captures officers from Officer Candidate School, Aviation Officer Candidate School (AOCS), Officer Training School (OTS), and Platoon Leaders Course (PLC). The last variable, "other commissioning source," contains information on graduates who were directly commissioned from the U.S. Air Force Academy, U.S. Military Academy, or the U.S. Navy Integration Program. Since each commissioning program requires different levels of training and exposure to military life, prior studies suggest that this can impact retention decisions of officers.

Since our goal is to find the effect of the GWOT on the retention of SWOs, we created two different groups. The pre-GWOT group included graduates from cohorts 1996 and 1997, and the post-GWOT group included cohorts 1998 thru 2004. Table 5 shows differences in the number of officers by commissioning source for these two periods.

	Full Sample (2002-2010)	Pre-GWOT (2002-2003)	Post-GWOT (2004-2010)
OCS	1,621	273	1,348
Other	309	90	219
ROTC	2,614	419	2,195
U. S. Naval Academy	2,034	454	1,580
Total	6,578	1,236	5,342

Table 5. Sample of SWOs by Commissioning Sources in the Pre- and Post-GWOT Periods.

As seen in Table 3 the proportion of graduates from each commissioning program differed significantly between the pre- and post-GWOT periods. When we compare the distribution of SWOs at six years of service in Table 3, it is seen that USNA graduates represent 36.73 percent of new entrants in the pre-GWOT period but in the post-GWOT period, their representation decreased to 29.58 percent. Conversely, in the pre-GWOT period, the percentage of ROTC graduates is 33.90 percent but in the post-GWOT period, the percentage climbed to 41.09 percent, revealing a more than 7 percentage point increase. Additionally, OCS graduates represent 22.09 percent in the pre-GWOT period and 25.23 percent in the post-GWOT period.

5. Educational Level

Educational level should capture unobservable characteristics of officers, such as their ability and cognitive skills. We divided educational level into four categories: “bachelor’s degree,” “advanced education,” “unknown education,” and “other education.” Advanced education consists of doctorate degrees, first professional degrees, and master’s degrees. Officers who have associate degrees, high school diplomas, and occupational program certificates or have completed one semester of college are grouped in the “other education” category. Officers without educational level information were included in the “unknown education” variable.

When we look at the distribution of officers by education in Table 6, there is a prominent decrease in officers who have bachelor's degrees in the GWOT period. In the 1996 cohort, the percentage of officers who had a bachelor's degree was 86.39 percent but in the post-GWOT period, especially for the 2000 cohort, the percentage plummeted to 62.72 percent. On the other hand, Table 3shows a dramatic increase in the percentage of officers who did not report their educational level. In the pre-GWOT period, the percentage was 3.16 while during the post-GWOT period, the percentage is 14.47. This increase in the "unknown education" category appears to explain why the percentage of bachelor's degrees decreased. Also, as seen in Table 3, the percentage of officers with "advanced education" increased to 7.66 percent in the post-GWOT period compared to 4.94 percent in the pre-GWOT period.

Educational Level attained	Distribution of Education over Years by Cohort (%)								
	1996	1997	1998	1999	2000	2001	2002	2003	2004
Bachelor's deg.	86.39	81.02	79.25	66.83	62.72	66.55	75.56	78.94	82.41
Advanced education	3.91	5.86	4.6	6.91	10.16	8.91	6.67	8.09	7.45
Unknown	3.23	3.09	7.24	17.84	21.65	20.25	12.64	8.23	9.51
Other	6.46	10.03	8.91	8.42	5.47	4.28	5.14	4.74	0.63

Table 6. Distribution of Education over Years by Cohort (%)

6. Marital Status

Marital status is measured at the sixth year career point of the officers and divided into two groups: "married" and "not married." When we compare the rates in Table 3, we can assume that the GWOT did not affect the tendencies of Navy SWOs to get married or stay single because the percentage of married officers was 47.73 percent in the pre-GWOT period and 48.39 percent in the post-GWOT period; this difference is not significant. The marital status distribution over time is also displayed in Figure 3.

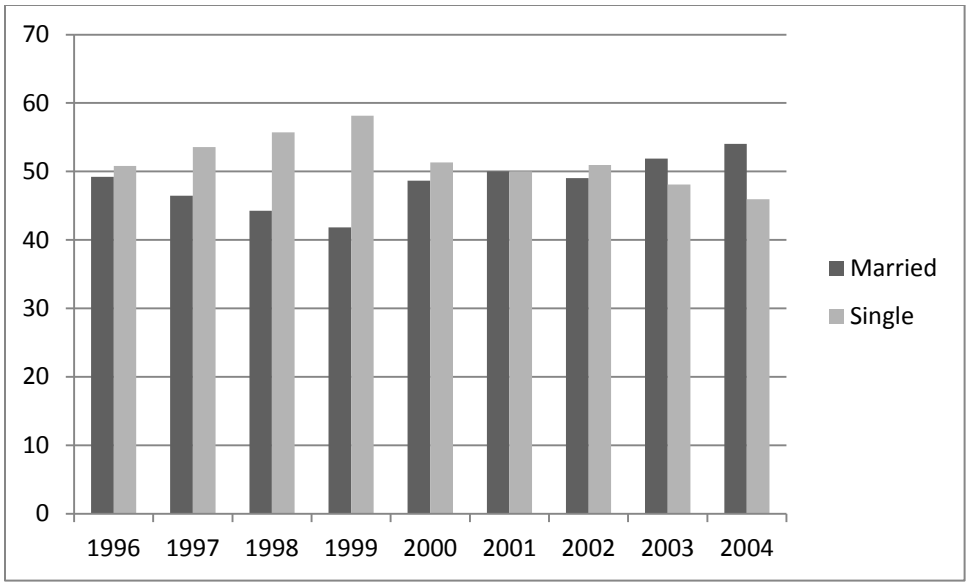

Figure 3. Marital Status Distribution by Cohort

7. Dependency Status

We hypothesized that dependency status could be an important factor in the retention decision of an officer based on the previous literature. Dependency status is also measured at the sixth year career point of the officers and is grouped in two categories: "with dependent," and "no dependent." When we look at dependency rates in Table 3, we observe a 6 percentage points decrease in the "no dependent" status in the post-GWOT period. Smith (2006) and Quester et al, (2006) point out that military personnel who have dependents are more likely to stay.

8. Prior Enlisted Service

Being prior enlisted is a factor that may affect the retention decisions of officers. The assumption is prior enlisted have longer military careers and are more accustomed to military life. Thus, they may be more likely to stay in the military for a career than their peers who were not prior enlisted. When we look at Table 3, the prior enlisted personnel ratio increased from 42.72 percent to 48.03 percent between the pre-GWOT and the post-GWOT periods. This represents a 6 percentage point increase and this difference is statistically significant at 1% level.

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IV. METHODOLOGY AND RESULTS

In this chapter we explain the methodology used to estimate the partial effect of variables that affect the stay-or-leave decisions of SWOs before and after the GWOT. The results of the multivariate models are presented along with likelihood ratio tests of differences in the estimated coefficients between the pre-GWOT and post-GWOT periods.

A. METHODOLOGY

We used a probit model for the analysis of retention because it allows the relationship between the dependent and independent variables to be non-linear. We formed a probit model for the pre-GWOT period to estimate partial correlations between explanatory variables and retention. We used the same model for the post-GWOT period and then jointly compared the partial effects between the two periods via a log-likelihood ratio test.

The probit model is utilized in this study because this model is designed for binary dependent variables which are bounded between zero and one. The theoretical model used in this study is displayed below (Wooldridge, 2009, p. 575):

$$P(y=1|x) = P(y=1|x_1, x_2\ldots, x_k)$$

Where **x** indicates the explanatory variables included in the model. Since we are looking at the effect of the GWOT on the retention decision of Navy SWOs, we have created two different models to capture the effects of the explanatory variables in the pre- and post-GWOT periods.

1. Pre-GWOT Model

In our model, "stay" is the binary dependent variable which takes the value of "1" for those who stay for six years and "0" otherwise. The independent variables in the model include education level, commissioning sources, gender, race, marital status, dependency status, and prior enlisted service.

The pre-GWOT sample includes cohorts from 1996 and 1997 who made retention decisions in 2002 and 2003. The model specification is as follows:

$$(STAY) = \beta_0 + \beta_1(advance\_educ)_i + \beta_2(other)_i + \beta_3(unknown)_i + \beta_4(black)_i + \beta_5(other\_race)_i + \beta_6(female)_i + \beta_7(USNA)_i + \beta_8(ROTC)_i + \beta_9(other\_comm)_i + \beta_{10}(married)_i + \beta_{11}(no\_dep)_i + \beta_{12}(prior\_serv)_i + \varepsilon_i \quad (1)$$

Where, the variables are defined as in Table 1, and ε is an error term.

2. Post-GWOT Model

The post-GWOT model included the same explanatory variables as in equation (1). The only difference from the previous model is the sample for the post-GWOT model includes entry cohorts from 1998 to 2004 who made retention decisions from 2004 through 2010.

B. RESULTS

Table 7 shows the results of our probit analysis for the pre-GWOT and post-GWOT samples in columns 1–2 and 3–4. For the pre-GWOT period, the sample size was 1,236 and for the post-GWOT period, the sample size was 5,342. Columns 5–6 include results for the combined sample (N=6,579).

The categories of education are "advanced education," which comprises master's degree, doctorate degree, and first professional degree; "other education," which comprises associate degree, high school diploma, occupational program certificate, and completed one semester of college; "bachelor's degree;" and "unknown education." The reference category for educational level is bachelor's degree. For the commissioning source variable, we created four variables: USNA; OCS, which includes graduates from OCS, AOCS, OTS, and PLC; ROTC, which comprises officers from NROTC scholarship and NROTC non-scholarship programs; and "other commissioning source," which includes officers from the U.S. Air Force Academy, U.S. Military Academy, or U.S.

Navy Integration Program. OCS is the reference category for commissioning source. In the race category, “white” is selected as the reference category; the other variables included in the models are “Black” and “other race.” Male is the reference category in the gender category. Prior enlisted service members were coded as “1” and formed the variable “prior service.” The reference category for this variable is officers without prior enlisted service. For marital status we created “married” and “not married” variables. “Not married” is selected as the reference category. For the dependency status category, we created a binary variable “with dependents”, and a binary variable for “no dependent” (=1 if an officer has no dependent, =0 otherwise). “With dependents” was selected as the base variable.

Table 7 shows the probit results of our three retention models, including for the full sample. Note that descriptive statistics and definitions of variables are presented in Table 1 and Table 2 in Chapter III.

	Pre-GWOT		Post-GWOT		Full Sample	
	coefficient (std. error)	**marginal effect (std. error)**	coefficient (std. error)	**marginal effect (std. error)**	coefficient (std. error)	**marginal effect (std. error)**
Advance education	-0.5912 (0.2375)**	**-0.1925 (0.0880)****	0.2570 (0.0846)***	**0.0901 (0.0279)*****	0.1348 (0.0790)*	**0.0467 (0.0265)***
Other education	-0.4184 (0.2120)*	**-0.1288 (0.0726)***	0.6383 (0.1273)***	**0.2003 (0.0315)*****	0.4302 (0.1063)***	**0.1371 (0.0292)*****
Unknown education	-0.4580 (0.2678)	**-0.1448 (0.0957)**	-0.5464 (0.0607)***	**-0.2111 (0.0237)*****	-0.6345 (0.0576)***	**-0.2424 (0.0225)*****
Black	-0.1203 (0.1443)	**-0.0336 (0.0419)**	0.3059 (0.0675)***	**0.1064 (0.0218)*****	0.2536 (0.0606)***	**0.0856 (0.0192)*****
Other race	-0.1028 (0.1290)	**-0.0285 (0.0370)**	0.1421 (0.0603)**	**0.0511 (0.0211)****	0.1128 (0.0543)**	**0.0393 (0.0185)****
Female	-0.3152 (0.1134)**	**-0.0928 (0.0362)****	-0.2271 (0.0443)***	**-0.0855 (0.0169)*****	-0.2722 (0.0407)***	**-0.1002 (0.0154)*****
USNA	-0.7361 (0.1523)***	**-0.2128 (0.0455)*****	-0.6252 (0.0644)***	**-0.2371 (0.0244)*****	-0.6630 (0.0584)***	**-0.2450 (0.0217)*****
ROTC	-0.8312 (0.1544)***	**-0.2461 (0.0477)*****	-0.7477 (0.0602)***	**-0.2769 (0.0217)*****	-0.7885 (0.0553)***	**-0.2849 (0.0196)*****
Other commissioning source	0.5517 (0.2896)***	**0.1172 (0.0454)*****	0.1809 (0.1180)	**0.0643 (0.0402)**	0.2531 (0.1068)**	**0.0847 (0.0332)****
Married	-0.2352 (0.1886)	**-0.0634 (0.0511)**	0.3653 (0.0509)***	**0.1338 (0.0184)*****	0.3434 (0.0485)***	**0.1216 (0.0170)*****
No dependent	-0.6715 (0.1966)***	**-0.1762 (0.0501)*****	-0.0346 (0.0522)	**-0.0127 (0.0192)**	-0.0369 (0.0495)	**-0.0132 (0.0177)**
Prior service	0.2314 (0.1067)**	**0.0612 (0.0277)****	0.0597 (0.0410)	**0.0220 (0.0151)**	0.0549 (0.0378)	**0.0196 (0.0135)**
Mean Retention Rate	0.77		0.62		0.65	
LR/chisq	145.14		730.91		862.96	
p-value	0.00		0.00		0.00	
Observation	1,236		5,342		6,578	
Statistical Significance Levels : *** = 0.01, ** = 0.05, * = 0.10						

Table 7. Probit Results of Retention Models by Sample

When we look at the full sample results in Columns 5 and 6, it is seen that an officer with advanced education is four percentage points more likely to stay than an

officer with only a bachelor's degree. Likewise, an officer in the "other education" category is 13 percentage points more likely to stay than an officer with only a bachelor's degree. However, officers in the "unknown education" category are 24 percentage points less likely to stay than officers with a bachelor's degree. In the race category, Black officers and "other race" officers are 8 and 3 percentage points more likely to stay, respectively, than white officers. Our results indicate that female officers are 10 percentage points less likely to stay than their male peers.

We found significant retention effects for graduates of the various commissioning programs. For example, USNA and ROTC graduates are 24 and 28 percentage points, respectively, less likely to stay in the Navy than OCS graduates. Thus, for these two groups, the retention rate is about 35 percent lower than for OCS graduates. On the other hand, officers in the "other commissioning source" category are 8 percentage points (or 12 percent) more likely to stay than OCS graduates. Marital status is another category that affects the retention decisions of officers in the full sample. Married officers are 12 percentage points (or about 20 percent) more likely to stay than their single peers and this result is significant at the 1% level. The coefficients for dependency status and prior service are not statistically significant.

The results for the full sample in columns 5–6 are a weighted average of the effects of each independent variable over all of the cohorts 1996–2004. To identify any differences in the effects of the explanatory variables by period, we estimated separate models for the pre-GWOT and post-GWOT periods. Columns 1 and 2 provide the pre-GWOT results, while Columns 3 and 4 present the post-GWOT results.

In Table 7, when we look at the coefficients of educational level in the pre-GWOT period, we see that advanced education is a significant factor predicting retention. Marginal effects show that an officer who has advanced education is 19 percentage points less likely to stay in the military than an officer with only a bachelor's degree. However, in contrast, in the post-GWOT period, an officer with advanced education is 9 percentage points more likely to stay than an officer with only a bachelor's degree. These results suggest that opening additional advanced education opportunities to SWOs during wartime may be a remedy to anticipated decreases in officer retention during these times.

We observe the same pattern for officers who are in the "other education" category as for those with advanced degrees. For the pre-GWOT period, officers who are in the "other education" category were 12 percentage points less likely to stay but, in the post-GWOT period, they are 20 percentage points more likely to stay than officers who have a bachelor's degree only. In the pre-GWOT period, the effect of "unknown education" is not significant whereas in the latter period, officers with unknown education were 21 percentage points less likely to stay than officers with a bachelor's degree. The difference in the effect of an advanced degree may stem from the differences in the number of cohorts in each model. The pre-GWOT model contains only two cohorts and a much smaller sample than that of the post-GWOT period.

The effects of race in the pre-GWOT period are statistically insignificant, which supports the findings of Alankaya and Kilic (2009). But for the post-GWOT period, we found positive and significant results showing that Black officers are 10 percentage points more likely to stay than white officers, and officers who are in the "other race" category are 5 percentage points more likely to stay than white officers.

Gender is a statistically significant factor in both periods. For the pre-GWOT period, female officers are 9 percentage points less likely to stay than male officers and, in the latter period, they are 8 percentage points less likely to stay. Our results support the findings of Celik and Karakaya (2011) and Alankaya and Kilic (2009).

For the commissioning source variables, we found significant results (at the 1% level) for all coefficients in the pre-GWOT period. In the post-GWOT period, the coefficient of the "other commissioning source" variable is insignificant. Before the GWOT, USNA graduates were 21 percentage points less likely to stay than OCS graduates, whereas in the latter period they are 23 percentage points less likely to stay. These results are consistent with the findings of Celik and Karakaya (2011). The retention of NROTC graduates followed the same pattern as USNA graduates: in the pre-GWOT period, they were 24 percentage points less likely to stay in the service than OCS graduates, but in the post-GWOT period they were 27 percentage points less likely to stay than OCS graduates. Officers from "other commissioning source" have higher retention: They were 11 percentage points more likely to stay in the Navy than OCS

graduates in the pre-GWOT period. In the post-GWOT period, this marginal effect was only a 6 percentage point difference. Note that OCS graduates are comprised of officers from Officer Candidate School, AOCS (Aviation Officer Candidate School), OTS (Officer Training School) and PLC (Platoon Leaders Course); officers coming from other commissioning sources are comprised of U.S. Air Force Academy, U.S. Military Academy, or the U.S. Navy Integration Program.

Being married has an insignificant effect on retention in the pre-GWOT period, but in the post-GWOT period, married officers are 13 percentage points more likely to stay in the military than their single peers, and the effect is statistically significant. This result supports the findings of Alankaya and Kilic (2009) and Fricker (2002). Dependency status is not statistically significant in the post-GWOT period. However, in the pre-GWOT period, officers without dependents are 17 percentage points more likely to leave the military compared to officers who have dependents. Quester et al, (2006) also found similar results that the retention probability of military personnel without dependents decreased due to the increased OPTEMPO associated with the GWOT. Parallel with the results of prior studies, our findings allowed us to conclude that being married may have helped SWOs to cope with the related stress of the increased GWOT OPTEMPO. Furthermore, the spouse's tangible or intangible support may have been an important factor in binding SWOs to service.

Prior enlisted service members are more likely to stay in the Navy, as hypothesized. For the pre-GWOT period, they are 6 percentage points more likely to stay in the military, whereas in the post-GWOT period, prior enlisted status did not affect retention. Our pre-GWOT result supports the findings of Smith (2006) on the retention of prior enlisted personnel.

C. JOINT-HYPOTHESIS TEST

The log likelihood ratio (LLR) test is used to determine differences in the coefficients of the statistical models between the two periods (Stata Base Reference Manual, 2007). This test "provides the means for comparing the likelihood of the data under one hypothesis (usually called the alternate hypothesis) against the likelihood of

the data under another, more restricted hypothesis (usually called the null hypothesis), (Purcell, 2007).” The procedure is to run the model separately for the pre-GWOT sample and the post-GWOT sample (which comprises the unrestricted model) and compare the log-likelihood value to the full sample (which is the restricted model). The last row of Table 8 displays the chi-square value for the likelihood ratio test of 116.61, which has a p-value of 0.000. Thus, we can reject the null hypothesis that the parameter estimates were identical between two periods.

Model	LR Chi2	DF	Pr>Chisq
Full Sample (N = 6,578)	862.96	12	0.0000
Pre-GWOT Sample (N = 1,236)	145.14	12	0.0000
Post-GWOT Sample (N = 5,342)	730.91	12	0.0000
Full, Nested in Pre-GWOT and Post-GWOT	116.61	13	0.0000

Table 8. Log likelihood Ratio Test

D. TEST OF DIFFERENCES BETWEEN PERIODS

The LLR only tests whether all of the coefficients are the same in the models for both periods (the null hypothesis). We also wanted to test which specific parameter estimates significantly differed between the two periods. We used a fully interacted model for this purpose. This technique involves using the full sample and analyzing interaction terms for each covariate. To be more specific, in the interaction model, we created a binary “post” variable which equaled “1” for officers who made retention decisions during the post-GWOT period (1998–2004 cohorts), and equaled “0” otherwise. By doing so we were able to differentiate between the pre-GWOT and post-GWOT periods in the full data sample. Then, we created interaction terms for each one of the explanatory variables included in the model by multiplying “post” by the value of the specific variable. We estimate the model via probit technique on the full sample and include the interaction variables as well as the full set of explanatory variables. The t-statistics on the interaction variables test whether the parameter estimates differ significantly between the two periods. The fully interacted model is specified below:

$$Y = \beta_0 + \beta_1(post)_i + \beta_2(post*advance\_educ)_i + \beta_3(advance\_educ)_i + \beta_4(post*other)_i + \beta_5(other)_i + \beta_6(post*unknown)_i + \beta_7(unknown)_i + \beta_8(post*black)_i + \beta_9(black)_i + \beta_{10}(post*other\_race)_i + \beta_{11}(other\_race)_i + \beta_{12}(post*female)_i + \beta_{13}(female)_i + \beta_{14}(post*USNA)_i + \beta_{15}(USNA)_i + \beta_{16}(post*ROTC)_i + \beta_{17}(ROTC)_i + \beta_{18}(post*other\_comm)_i + \beta_{19}(other\_comm)_i + \beta_{20}(post*married)_i + \beta_{21}(married)_i + \beta_{22}(post*no\_dep)_i + \beta_{23}(no\_dep)_i + \beta_{24}(post*prior\_serv)_i + \beta_{25}(prior\_serv)_i + \varepsilon_i \quad (2)$$

Table 9 displays the results for the interacted model. As seen in Table 9, the output helps us to assess the significance of differences between parameter estimates in the two periods. Coefficients of interaction variables which are marked by asterisks indicate the variables that differ significantly between the pre-GWOT and the post-GWOT periods.

Because Navy officers have civilian employment options, officer retention tends to fluctuate at the end of the initial service obligation periods. Additionally, the GWOT period, with its increased work tempo and related stress levels, also has affected junior officer retention. In Table 9, the "post" variable indicates that officers in the post-GWOT period are 32 percentage points more likely to leave service than officers in the pre-GWOT. As Hosek et al. (2006) points out, uncertainty and family separation aspects of frequent and back-to-back deployments in the GWOT period could explain this 32 percentage point difference.

The results in Table 9 shows that the coefficient on the interaction between post-GWOT and advanced education is statistically significant (t=3.36, p=0.001) indicating that the effect of advanced education on the stay decision differs significantly between the two periods. The t-statistic shows us that the difference between the two periods doesn't result from a random sampling but originates from a true difference. Additionally, we can see that the effect of advanced education (compared to a bachelor's degree) on the stay decision has significantly increased in the post-GWOT period as compared to the pre-GWOT period. The difference in "other education" between periods also is statistically significant (t=4.27, p-value=0.000). When we look at the direction of

the effect of "other education" on retention, it is seen that there is a significant change from negative to positive, which means officers in the pre-GWOT period were more likely to leave, whereas in the post-GWOT period, they were more likely to stay (compared to officers who have only bachelor's degrees).

Among our commissioning source variables none of the t-statistics for the interaction terms are statistically significant. Similarly, the effect of being female on retention between periods is not significantly different. The coefficients on the interaction between post-GWOT and Black, and post-GWOT and other race are statistically significant (t=2.67, p-value=0.007; t=1.72, p-value=0.086, respectively). These values again indicate that the differences between periods are not a random sampling but on the GWOT period. Marital status results indicate that the differences between the periods in the retention decision of Navy SWOs are statistically significant at the 1% level (t=3.07, p-value=0.002). For the dependency status, it is seen that there is a significant change in the retention behavior of officers without dependents (t=3.13, p-value=0.002). In the pre-GWOT period, they were less likely to stay but in the post-GWOT period, they were more likely to stay than officers with dependents.

	Full Sample		
	Coefficient (t-stat)	**marginal effect (t-stat)**	**p-value**
post	-1.2007 (-4.79)***	**-0.3249 (-4.79)*** **	**0.000**
post*advance_educ	0.8482 (3.36)***	**0.2321 (3.36)*** **	**0.001**
advance_educ	-0.5912 (-2.49)***	**-0.2264 (-2.49)** **	**0.013**
post*other	1.0568 (4.27)***	**0.2626 (4.27)*** **	**0.000**
other	-0.4184 (-1.97)*	**-0.1584 (-1.97)* **	**0.048**
post*unknown	-0.0883 (-0.32)	**-0.0318 (-0.32)**	**0.748**
unknown	-0.4580 (-1.71)*	**-0.1725 (-1.71)* **	**0.087**
post*black	0.4262 (2.67)***	**0.1356 (2.67)*** **	**0.007**
black	-0.1203 (-0.83)	**-0.0436 (-0.83)**	**0.405**
post*other_race	0.2449 (1.72)*	**0.0820 (1.72)* **	**0.086**

other_race	-0.1028 (-0.80)	**-0.0371** **(-0.80)**	**0.426**
post*female	0.0880 (0.72)	**0.0308** **(0.72)**	**0.470**
female	-0.3152 (-2.78)***	**-0.1159** **(-2.78)***	**0.005**
post*USNA	0.1108 (0.67)	**0.0387** **(0.67)**	**0.503**
USNA	-0.7361 (-4.83)***	**-0.2711** **(-4.83)***	**0.000**
post*ROTC	0.0835 (0.50)	**0.0294** **(0.50)**	**0.614**
ROTC	-0.8312 (-5.38)***	**-0.2986** **(-5.38)***	**0.000**
post*other_comm	-0.3707 (-1.19)	**-0.1400** **(-1.19)**	**0.236**
other_comm	0.5517 (1.90)**	**0.1667** **(1.90)**	**0.057**
post*married	0.6005 (3.07)***	**0.2036** **(3.07)***	**0.002**
married	-0.2352 (-1.25)	**-0.0833** **(-1.25)**	**0.213**
post*no_dep	0.6369 (3.13)***	**0.2145** **(3.13)***	**0.002**
no_dep	-0.6715 (-3.42)***	**-0.2358** **(-3.42)***	**0.001**
post*prior_service	-0.1716 (-1.50)	**-0.0613** **(-1.50)**	**0.134**
prior_service	0.2314 (2.17)**	**0.0816** **(2.17)**	**0.030**
LR chi2	979.57		
p-value	0.00		
Observations	6,578		
***p<0.01, **p<0.05, *p<0.1			

Table 9. Probit Results of Retention Model with Interaction Terms

E. SUMMARY

This chapter includes the methodology used in this study and the results of the estimations of the probit models. The LLR test analyzed whether the coefficients of the statistical models differed between periods. Additionally, we presented a fully interacted model with which we analyzed whether the difference between the two periods is significant.

We found that OCS graduates were more inclined to stay than USNA and ROTC graduates at the end of their initial service obligation. Both USNA and ROTC graduates

performed worse than OCS graduates in the pre- and post-GWOT periods in terms of officer continuation. OCS graduates' performance difference could be explained by less military training compared to USNA and ROTC acculturation processes. It could be that, after commissioning, OCS graduates experience the enthusiasm of working during their initial obligation, whereas USNA graduates and ROTC graduates have already exhausted the enthusiasm that had bonded them to service.

V. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

Naval forces play vital roles in sustaining national security from both short- and long-run external threats. Needless to say, these efforts are much more intensive during wartime periods. As an important component of the force structure, officer retention rates and productivity are a focal point for decision makers. The goal of this thesis is to analyze changes in the retention decisions of SWO officers due to the initiation of the Global War on Terror (GWOT). The GWOT period has been accompanied by increases in deployment frequency and intensity (Hosek et al., 2006). Since we had more recent data, we were able to contribute explaining retention behavior of SWOs when GWOT effects on retention matured and stabled. Our study provides decision makers an insight for future planning regarding manpower issues with the SWO community in the Navy. Although more recent data puts additional value to our work, lack of deployment information could have lessened explanatory power of our results.

This study analyzes the effect of the GWOT on the retention decisions of Navy SWOs. The data set used in this study was provided by the Navy via The Navy Econometric Modeling System, which included information on officers from 2000 through 2011. To analyze the effect of the GWOT, we identified the year 2003 as the beginning of the GWOT. Thus, we defined the pre-GWOT period as 2000–2003 and the post-GWOT period as 2004–2011. Because of the missing stay-or-leave information before 2002 and in 2011, we revised our periods as pre-GWOT 2002–2003 and post-GWOT as 2004–2010. After this correction, we had 1,236 observations in the Pre-GWOT period and 5,342 observations in the latter, or a total sample size of 6,578.

Table 10 shows retention rate by year. As noted in Chapter III, prior to the GWOT the overall retention rate of officers was 77 percent but after 2003 the retention rate fell to 63 percent. This supports the view that the GWOT negatively affected the retention decisions of officers.

On the other hand, as seen in Table 10, although the retention rate decreased until 2001, it stays stable for three years, after which there is a slight upturn.

In order to evaluate the factors that affect the retention decision of officers, we specified and estimated multivariate regression models. To understand the effect of the GWOT, we estimated the models separately for the pre- and post-GWOT periods and compared the estimated effects of the independent variables in the models. We also estimated a fully interacted model to determine which factors differed significantly in the two periods.

In accordance with the literature, OCS graduates were more likely to stay in the military compared to USNA and ROTC graduates for both periods, females were less likely to remain in the Navy, and married personnel were more likely to stay in the service. Educational variables showed having advance education contributed to higher retention in the post-GWOT period, but in the pre-GWOT period those with graduate degrees were more likely to leave the military. In the race category, our findings showed that being black contributed to higher retention rates in the post-GWOT period. The effect of prior enlisted service was the same in both periods. Officers who were not prior enlisted were more likely to attrite, which is also parallel with findings in prior literature. Contrary to findings in the prior literature, coming from “other commissioning source” contributed to higher retention.

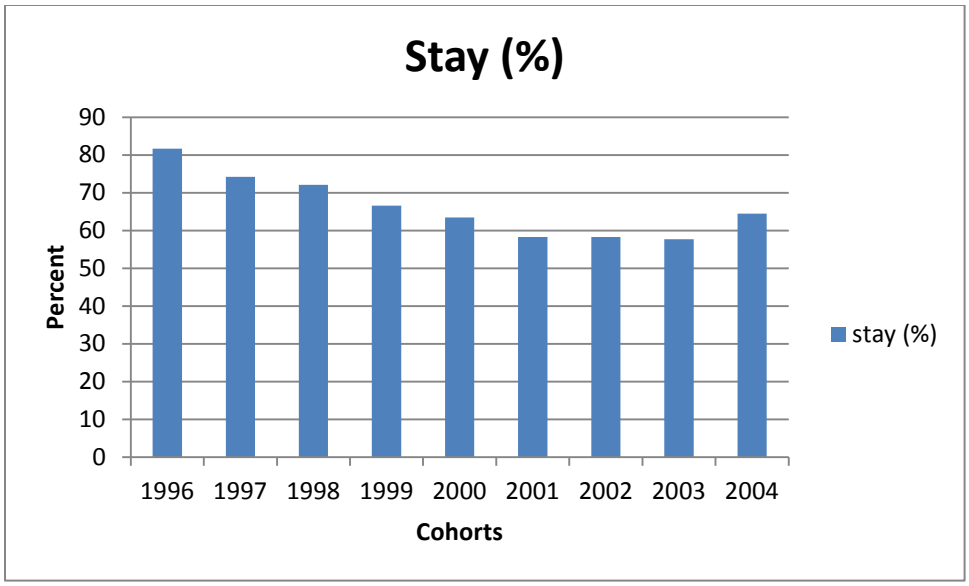

Table 10. Retention Rate by Year

Table 11 compares the results of our study and previous studies regarding to the retention effect of high OPTEMPO due to the GWOT. When we compare our retention results with the prior studies included in the literature, we see similar results as those of Alankaya and Kilic (2009) who had deployment information in their study. Since their model included only Naval Academy graduates, which consisted of many SWOs, we observe similar retention results between their study and ours. Additionally, Smith (2006) obtained a negative effect of the increased operational tempo of GWOT on Marine Corps aviator retention. However, Quester et. al (2006) found that increased OPTEMPO positively affected the retention decisions of Marine Corps officers. Contrary to our results, this latter positive effect can be explained by sample selection since Marine officers may be more committed to their service and are not affected by increased OPTEMPO of the GWOT. Hosek and Matorell (2009) did not find an effect of the GWOT on Naval first-term enlistees. However, for second-term enlistees the effect was positive but decreasing in the beginning of the GWOT, and after 2004 the effect turned upwards and remained positive.

In 2003 during the invasion of Iraq the number of deployments increased substantially (Hosek and Matorell, 2009). Because of this change we accepted 2003 as

the threshold for the beginning of the GWOT. On the other hand since we did not have any deployment frequency or deployment duration information, we could not factor this prominent effect in our model. Having information on deployment status of officers could have helped our results to be more revealing and justified.

	Time period	Threshold for GWOT period	Population	Retention effects of high OPTEMPO due to the GWOT
Ongun and Bayram (2012)	2002–2010	2003	Navy SWO	NEGATIVE
Alankaya and Kilic (2009)	1996–2007	2001	Naval Academy Graduates	POSITIVE
Alankaya and Kilic (2009)	1999–2007	2001	Naval Academy Graduates	NEGATIVE
Hosek and Matorell (2009)	1996–2007	2002	Naval Second-Term Enlistees	POSITIVE
Smith (2006)	1995–2005	2001	Marine Corps Aviators	NEGATIVE
Quester, Haatiangadi, Shuford and Lee (2006)	2004–2005	-	Marine Corps Officers	POSITIVE
Presented results of the prior studies are all statistically significant				

Table 11. Comparison of Retention Results

B. RECOMMENDATIONS

According to the results of this thesis, officers with advanced education were more likely to stay after 2003. While this suggests that the Navy should consider opening additional advanced education opportunities during war time, we note above that the result could be due to the differences in the number of cohorts and sample size of the two models, specifically the much smaller sample size for pre-GWOT period. In terms of commissioning source, we could not find significant differences between the various officer commissioning programs between the pre- and the post-GWOT periods.

Consistent with previous studies, in their initial stay-or-leave decisions USNA and ROTC graduates were less likely to stay than OCS graduates. According to this result, in order to keep junior officer retention stable during war time, the Navy should consider keeping OCS accessions stable.

C. FUTURE RESEARCH

There are several possible directions for future research on officer retention. For the purpose of our study, we accepted the threshold for the GWOT as the year 2003. But missing information before 2002 allowed us to include only two entry cohorts for the pre-GWOT period in our data set. On the other hand, our post-GWOT period consists of seven entry cohorts. If we could capture more years in the pre-GWOT period, we would have more observations and better statistical reliability in comparing the two periods.

Also, no measures of officer quality were available for our study. The only proxy for quality was the education level of officers. A data set which includes undergraduate grade point average (GPA) or other test scores could improve the robustness of our study. Another issue is that information on deployment to a war zone was not included in the data set. But it is likely that being deployed to a war zone would affect the career plans of an officer. Also, our retention model did not contain a variable reflecting employment conditions in the civilian labor market. If we had information on civilian job opportunities we could have a better understanding of Navy SWOs' retention decisions.

Our data set included information about Navy SWOs, which restricts our results to the SWO community. A thorough study including officers from all Navy communities would give information on the retention intentions of other communities.

Deployment information of officers to war zone is not included in our study. But based on prior literature, deployment frequency and deployment duration were two important factors that affect the retention decision of officers. If we had data on deployment status we could analyze stay-or-leave decisions of officers in a better way.

Finally, this study looked at retention only at the sixth year point in the career of a commissioned officer. However, the retention decision of officers may change from year-

to-year. Further studies should capture retention at the seventh, eighth, or even ninth year of an officer's career via using a Hazard model, in order to have a better understanding of SWO career plans in the Navy.

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