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EFFECTS OF THE GLOBAL WAR ON TERROR ON MEDICAL SERVICE CORPS RETENTION RATES

by

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March 2007

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13. ABSTRACT (maximum 200 words)

This thesis analyzes the retention behavior of first term Medical Service Corps officers and examines the effect of the Global War on Terror (GWOT) on all communities within the Navy Medical Service Corps including Healthcare Administration (HCA), Healthcare Science (HCS) and Clinical Care Provider (CCS).

Data were collected from the Defense Manpower Data Center for MSC officers in entering cohort years 1998, 1999 and 2001. Four logistic regression models were estimated to capture the effects of different types of deployments on the retention of first term MSC officers. The models included both demographic and military experience explanatory variables. A difference-in-difference estimator was incorporated into each model to measure the effects of the deployment variables across the pre and post-GWOT periods. The post-GWOT period is defined as following the initiation of major combat operations in Iraq (March 2003).

Factors having positive effects on retention included age, having greater than two dependents, entering through the In-Service Procurement Program, and deployments including at least one hostile deployment during the first term. Negative influences on retention included serving in HCS or CCS when compared to HCA, entering through the Health Services Collegiate Program and commissioning in the 2001 cohort year. While serving a first term in the post-GWOT period has a negative effect on retention, the post-GWOT deployment indicators were inconclusive in this study.

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I. INTRODUCTION AND BACKGROUND

A. INTRODUCTION

Understanding retention characteristics of personnel is essential to the optimal management of any organization's human capital assets. The military is especially vulnerable to changes in retention trends due to the nature of being an all volunteer force. It is in the U.S. military's best interest to attract and retain the right people with the right skills and assign them to the right positions. In many cases the military must "grow their own" specialists, or fund the training and education of these specialists in civilian institutions. The continual reassessment of retention behavior helps organizations identify trends which can then be applied to policy in order to reduce turnover costs.

U.S. Navy healthcare professions are of particular interest as their skills and expertise are highly sought after in the civilian labor market. The U.S. Navy Medical Service Corps (MSC) is an instrumental component of the Navy Healthcare delivery system. The MSC is comprised of over 30 different specialties. The reduction of turnover costs is essential for the Navy to realize the greatest return on investment for training and education costs. Since the initiation of major combat operations in the Global War on Terror, the operational tempo of deployments of Navy MSC personnel to hostile areas such as Iraq have increased substantially. It is important to understand retention factors and the possible effects of the GWOT on MSC retention to as accurately as possible predict both short and long-term MSC human capital challenges.

B. BACKGROUND

1. United States Navy Medical Service Corps

The Navy Medical Service Corps (MSC) was started post World War II and was officially chartered by congress in 1947 by the Army-Navy Medical Service Corps Act (Navy Knowledge Online, MSC web page). A major strength of the MSC is its diversity of professionals. It is currently comprised of 32 different subspecialties in three different

categories. The three major categories are Healthcare Administration (HCA), Healthcare Sciences (HCS), and Clinical Care Providers (CCS). These three major components are crucial in the success of the Navy's healthcare mission. MSC officers do everything from managing the Navy healthcare system to providing direct patient care. The key component of the MSC mission is to support Navy Medicine's primary functions of readiness and providing healthcare benefits (Navy Medicine Online, Bureau of Medicine and Surgery web page).

According to the Bureau of Medicine and Surgery the main goals of the MSC are threefold; to create a cohesive team to support the mission of the Navy, to capitalize on synergy between the various specialties within the MSC and to promote job satisfaction and career development for MSC officers (Navy Medicine Online, Bureau of Medicine and Surgery web page).

HCA officers make up approximately 40% of all MSCs on active duty. HCA officers have historically concentrated in management and supply, but have expanded their scope significantly since the inception of the MSC, adding specialties such as finance, education and training, manpower analysis and medical intelligence. Overall, HCAs have 10 subspecialties.

Clinical Care Provider (CCS) officers are MSC officers trained to provide direct patient care and include specialties such as physician assistants and podiatrists. The Healthcare Sciences (HCS) officers provide expert allied health technology and knowledge. The HCS includes specialties such as environmental health and biochemistry. Table 1 lists the MSC subspecialties and number of personnel in each specialty as of September 2006.

The current population of the MSC is approximately 2,600 active duty officers (Navy Medicine Online web page). MSC officers serve in all of the Navy's hospitals and clinics world wide. They also have a strong operational presence and serve at sea on aircraft carriers and with the Marines in ground combat environments. Medical Service Corps officers also serve in joint commands and operations such as Central Command, and Northern Command.

Table 1. MSC Subspecialties, September 2006[1]

Health Care Admin		**Health Care Science**		**Clinical Care Provider**	
Subspecialty	*inventory%*	*Subspecialty*	*inventory %*	*Subspecialty*	*inventory%*
Health Care Admin.	53%	Biochemistry	6%	Clinical Psych	15%
Patient Admin	10%	Microbiology	7%	Audiology	3%
Mat'l Logist Mgt	8%	Radiation Health	12%	Social Work	4%
Info Systems	3%	Physiology	2%	Physical Therapy	10%
Med Construct Lia	2%	Aerospace Physio	15%	Occupation Therapy	3%
Plans/Ops/Med Int	10%	Aerosp Exper Psych	5%	Clinical Dietetics	5%
Financial Mgt	9%	Research Psych	3%	Optometry	17%
MPT&E	3%	Entomology	6%	Pharmacy, General	15%
Educ & Trng Mgt	1%	Environmental Hlth	13%	Podiatry	3%
Operation Research	1%	Industrial Hygiene	20%	Physician Assistant	27%
		Medical Technology	13%		
Totals #	987		627		774

There are several pathways to becoming a Medical Service Corps officer. The most common are the In-Service Procurement Program (IPP), The Health Services Collegiate Program (HSCP), The Health Professions Scholarship Program (HPSP) and direct commissioning. There are some other accession sources such as lateral transfers and inter-service transfer, but these make up a very small proportion of new MSC accessions. The IPP is a very popular program that provides a way for enlisted members to become MSC officers. They are eligible to serve in most of the different subspecialties depending on their level of education and degree program. If selected for the IPP, an enlisted member receives his or her full pay and military benefits through the educational program and retains eligibility for enlisted promotion. An IPP candidate must be at least an E-5 and can be from either the Navy or Marine Corps. All specific qualifications for the IPP can be found in OPNAVINST 1420.1A.

The HSCP is a way for individuals, with or without prior military service, to earn a commission in the MSC. This program also pays full salary and benefits to students who are pursuing an advanced degree that meets the needs of the MSC. Degree programs must meet certain accreditation criteria and be completed within a set time period, usually

[1] MSC report provided by LT Sonia Adams, MSC Personnel Planner, NM MPT&E.

24 months for a Master's program and 36 months for a PhD program. Earning a direct commission is another alternative for individuals who already have an advanced degree. The MSC uses HPSP primarily for developing Optometrists; those who complete their Optometry curriculum are commissioned as Lieutenants and serve for a minimum of three years. Direct commissions usually require the prospective member to be a graduate of an accredited program in his or her chosen field; for example, HCAs must have graduated from a program accredited by the Accrediting Commission on Education for Health Services Administration, and the American Assembly of Collegiate Schools of Business.

The initial rank for individuals commissioned through all the programs is dependent on the degree earned. Usually Master's degree holders enter as Lieutenant Junior Grade and PhD holders enter as Lieutenants. Enlisted members entering through the IPP who obtain a Bachelor's degree enter as Ensigns. The Navy makes a significant investment in individuals who use either the HSCP or the IPP. This investment is partially offset by setting minimum service obligations for participation in the programs. The standard payback tour for an HSCP Master's degree student is eight years upon commissioning date, three of those years being on active duty. Table 2 below provides breakdown of accession source percentages from this study's 2001 sample population.

Table 2. Source of Commission Percentages, 2001

Accession Source	**HCA/HCS/CCS %**
In-Service Procurement Program	30.36
Health Services Collegiate Program	22.27
Direct Commission	46.96

2. Personnel Tempo of Operations (PERSTEMPO)

The Navy developed a policy on personnel deployments in 1985 whose goal was to balance necessary deployments to support national security needs while maintaining a reasonable deployment schedule for Navy personnel. This policy is referred to as PERSTEMPO and is summarized in Chief of Naval Operations (OPNAV) Instruction 3000.13B. The focus of this instruction is to set limits on deployments to preserve Navy personnel quality of life (OPNAVINST 3000.13B). The main parameters of the program are to limit all deployments to a maximum of six months portal to portal, have a minimum 2:0:1 Turn Around Ratio (TAR) between deployments[2], and have a minimum of 50 percent time in homeport for a unit over a 5-year cycle (OPNAVINST 3000.13B). There are several instances where these parameters cannot be met and the instruction details the procedures for reporting when a unit or individual is in violation of the PERSTEMPO policy. Overall, the PERSTEMPO is meant to help with Navy personnel retention.

3. Global War on Terror (GWOT)/Operational Tempo (OPTEMPO)

Since the attacks of September 11, 2001, the global war on terror has been given extraordinary priority by the United States and our allies abroad. The military has been called upon to participate in several strategic operations including Operations Iraqi and Enduring Freedom. The Navy has had a very active role in the GWOT and will continue to do so in the future. The GWOT has presented several challenges in the form of asymmetrical warfare and the constant threat of terrorist attack. The military has reduced its end strength post cold war from 2.1 million to 1.4 million, while deployments have increased. This has made it more challenging to meet the PERSTEMPO guidance and caused more stress to service members and their families (Hosek, Kavanagh and Miller, 2006). The Navy and Navy Medicine have adapted and will continue to do so to meet these challenges to provide world class healthcare to our warriors. The MSC is an integral part of combat service support for the Marines when they deploy in harms way.

[2] TAR= days since last deployment/length of last deployment in days (OPNAVINST 3000.13B).

A recent Congressional Research Service (CRS) report to Congress stated that Navy Medicine will remain an invaluable part of the Navy's overall mission in supporting the GWOT to disrupt and eliminate terrorist networks (CRS Report to Congress, 2006). Navy Medicine deployable platforms such as fleet hospitals, expeditionary medical facilities and hospital ships are anticipated to be utilized in future years for the GWOT and humanitarian aid missions such as Hurricane Katrina and the tsunami crisis in Southeast Asia.

Operational Tempo has increased dramatically since the beginning of Operations Iraqi and Enduring Freedom. Wherever military forces are deployed there will be Navy Medicine Assets in the vicinity providing force health protection. Navy Medicine has personnel deployed globally supporting the GWOT (Arthur, 2005). The MSC is an integral part of the Navy healthcare team and deploys regularly, they have experienced increased OPTEMPO just as the rest of Navy Medicine. As of April 2004, over 7,300 reserve and active naval medical personnel were deployed. This constitutes one in six of deployable naval medicine personnel (Cowan, 2004). There has also been an increase in the number of Individual Augmentees (IA) assigned to fill deployed positions. MSC officers are commonly selected to fill crucial billets in hazardous duty locations such as Iraq and Afghanistan. These IA positions often must be filled in a time sensitive manner.

4. Retention

There are numerous factors that can affect the retention of MSCs. Some of the key factors are job satisfaction, pay and benefits and permanent change of station moves (Shepherd, 2001). With the initiation of the GWOT and an increase in OPTEMPO it is possible that retention rates of MSCs could be declining as a result of increased deployments relative to the period before the initiation of GWOT and the start of sustained military presence both at sea and ashore. The MSC is a very diverse group and it is possible that some specialties experience shortfalls while others stay relatively stable. Current challenges in recruitment of MSC officers include military/civilian pay gaps, debt from self funded education and the impact of the current war (Brown, 2006). It is possible that these same challenges could be applicable to MSC first term retention.

It is important to acquire the full picture of retention trends and look at retention among all specialties within the MSC to obtain a holistic view of the entire community. An increase in voluntary separations of first term MSCs could be negatively affecting the cost effectiveness of some of the commissioning sources mentioned earlier.

C. PURPOSE OF THIS STUDY

This research analyzes and identifies key factors affecting the retention behavior of Medical Service Corps officers and measures the possible effects of the Global War on Terror on retention for Healthcare Administration, Healthcare Sciences, and Clinical Care Providers. The main objective is to identify significant characteristics that affect retention and identify important retention trends.

D. RESEARCH QUESTIONS

The primary research question of this thesis is: since the initiation of the Global War on Terrorism, has there been an effect on retention rates within the Medical Service Corps for junior officers? Secondary research questions are:

- Are there any differences in retention behavior among HCA, HSC and CCS officers?
- Does Medical Service Corps accession source have a significant effect on retention?

E. ORGANIZATION

Chapter II provides a comprehensive literature review of prior studies that cover the subjects of healthcare retention, increased operational tempo and retention and MSC retention behavior. Chapter III provides a description of the data that were utilized and provides summary statistics for the data. Chapter IV provides an overview of logistic regression, the difference-in-difference estimator and model specification. Chapter V presents the results of the statistical analysis including significant factors contributing to junior MSC retention. Chapter VI provides a conclusion and recommendations based on the findings of the analysis.

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II. LITERATURE REVIEW

A. INTRODUCTION

A thorough understanding of employee retention behavior is of paramount importance for every successful organization. Both civilian and military organizations are very concerned with tracking retention and focusing on keeping their best and brightest personnel. Losing highly trained individuals can be incredibly costly. Some estimate the replacement cost for one individual can be up to 200 percent of his or her total compensation package (Carbasho, 2002). There are also several other negative effects of poor retention that can stress an organization such as increased training costs, loss of productivity and low morale (Rodgers, 2006).

B. MILITARY RETENTION STUDIES: IDENTIFICATION OF RETENTION RISK FACTORS IN A NON-HEALTHCARE SETTING

The United States military has retention issues that are truly unique, due in large part to its reliance upon an all volunteer military force. This force is very sensitive to changes in the civilian economy that impact comparable civilian employment. In most cases the military must grow their own professionals. The military takes in an untrained individual and completely trains him or her to fill an existing need for a particular specialty. This presents two interesting issues. The first is the cost of the training in either an active duty military school, or a scholarship program in a civilian educational institution paid for by the military. The second is the lag time involved to produce a productive service member. These issues of cost and time make the military extremely vulnerable to organizational stress if retention is not fully understood and turnover mitigated when possible. Readiness of military units can also be adversely affected if retention is lower than expected.

Many studies completed by military organizations have attempted to gain a better understanding of retention behavior, specifically by identifying factors that influence military members to leave versus those that influence them to stay on active duty. Many

of these focus on first term members for both officers and enlisted, as the end of the first term is considered a critical decision point. The methodology used for a majority of the studies fall into three major categories; large scale surveys, econometric models and conceptual models (Weiss et al., 2003). Many of these studies have the same goal which is to predict retention based on internal factors such as policy changes i.e. bonuses, special pays, or external factors such as the economy and civilian job prospects.

Most retention studies use surveys or personnel data to develop models that focus on the decision to the stay or leave and investigate factors that affect that decision. One survey study conducted by The United States General Accounting Office, "Preliminary Results of DoD's 1999 Survey of Active Duty Members," looked at the significant factors leading to a stay or leave decision (Rabkin, 2000). This study was based on the DoD Active duty survey from 1999 which surveyed 66,000 service members, yielding 32,000 usable responses. Rabkin used a descriptive statistics approach to analyze the survey results.

Overall, the research found that satisfaction with military life is strongly linked to a service member staying. More of the survey respondents were satisfied with military life (50%), than were not satisfied (29%). Rabkin also found that, overall; officers are more satisfied with military life than enlisted members. He found that 73% of satisfied individuals plan to stay in the military while only 20% of the dissatisfied members plan on staying. The top five reasons for staying in the military were basic pay, job security, retirement pay, job enjoyment and family medical care. The top five reasons for leaving were dissatisfaction with basic pay, amount of family and personal time, quality of leadership, job enjoyment and number of deployments. Rabkin also noted that if a military member had a family, the family's satisfaction weighed heavily on the decision to stay.

Kocher and Thomas (2000) utilized a Marine Corps wide retention survey to determine major factors that influenced whether or not Marines stayed on active duty at major decision points in their career. Approximately 11,000 completed surveys were used in their analysis. The survey was comprehensive and asked questions regarding all

aspects of a Marine's satisfaction with his or her military experience, ranging from personal life to perceived civilian employment opportunities.

The respondents were categorized into major groups broken down by gender, enlisted versus officer, and career versus first termer. A careerist was defined as an individual in his or her second term for enlisted, or with a rank of 0-4 or above for an officer (Kocher, Thomas, 2000). Factor analysis was used to identify composite variables.

Kocher and Thomas found that the major reasons for the enlisted first termers to leave the Marine Corps were pay, personal freedom, civilian career opportunities, educational benefits, and incentive pay. The results for junior male officers differed slightly with the additions of retirement and medical benefits, time demands, equipment availabilities and unit morale (Kocher, Thomas, 2000). This study supports the Rabkin study in that military pay and benefits compared to civilian pay and benefits for a similar job were ranked as the biggest influencer to leave the military among all respondents.

Korkmaz (2005) performed a survival analysis using data from military personnel records to study the behavior of all United Stated Naval Officers who were commissioned between 1983 and 1990. The primary goal of his research was to identify the major factors leading to increased survival of naval officers and to determine whether or not accession source played a major role in the longevity of an officer's naval career. Survival analysis is one method of looking at retention behavior and is especially useful for observing differences across groups over time.

Korkmaz found that, among commissioning programs, one who attended the Naval Academy exhibited the highest chance of survival overall. Age at the time of commissioning and family status positively affected survival, while serving in the communities of Surface Warfare, Fleet Support, and Supply Corps negatively affected officer survival relative to all the other communities (Korkmaz, 2005).

Congressional Business Office (CBO), 2006 conducted a study focusing on accessions and continuation rates throughout all four services for enlisted personnel only. They used existing results of DoD's surveys of parents and other adults who influence

youth's decisions in 2005, which suggest that parents and youths are becoming less likely to consider the military as an option (CBO, 2006). They looked at overall end strength authorizations and compared how effective the services were at maintaining their respective end strengths.

CBO found that the Army missed their 2005 accessions by 6,400 personnel and expects this trend to continue for the next several years. In 2005 the Marine Corps met its recruiting targets and is anticipated to meet future end strength goals. The active duty Navy is also meeting accessions and end strength goals, however their biggest challenge is keeping skilled personnel and specialists while trying to provide incentives so that surplus individuals will leave (CBO, 2006). The active Air Force, like the Navy, is downsizing and is successfully meeting its accession and continuation goals.

C. MILITARY RETENTION STUDIES: IDENTIFICATION OF RETENTION RISK FACTORS IN A HEALTHCARE SETTING

There have been several healthcare related retention studies performed for the military healthcare system. Most of these studies focus on healthcare providers[3]. The Navy spends a lot of resources to recruit and retain its healthcare professionals. All Navy physicians and many nursing specialties are entitled to annual bonuses and special monthly pays. If a healthcare professional decides to leave the service at the end of his or her minimum obligated time, the Navy may not be getting its expected return on investment for that individual.

One such study titled "The Costs and Benefits of the Navy Nurse Corps Accession Sources" conducted by Maeder (1999), focused on Navy Nurse Corps commissioning programs. The nursing profession has recently experienced severe shortages in both the civilian community and the military. Maeder focused on the various accession sources for obtaining nurses and attempted to measure the cost effectiveness of each of the commissioning sources.

[3] A healthcare provider is traditionally a healthcare professional who is responsible for direct patient care such as a physician, Podiatrist, or Optometrist.

The data utilized for this study were all Navy nurses commissioned in the years 1992, 1993, 1994 and included demographic information and their respective accession sources. The goal of the study was to identify a "successful" candidate defined as someone who stayed beyond his or her initial obligation. Maeder utilized a multivariate logistic regression model to determine the probability that a nurse stays beyond his or her initial obligation.

Maeder's findings suggest that the accession sources that were positively significant for the retention of Navy nurses were the Medical Enlisted Commissioning Program, Nurse Commissioning Program, and direct commission with a bonus program. The partial effects of the logistic regression showed that males were more likely to stay than female nurses. Those who were married with children were more likely to stay beyond their initial period than a single person with no children and those with prior military experience were more likely to be retained.

Shepherd (2001) studied the MSC to determine what major factors led to MSC officers leaving or staying. This qualitative study focused on the ranks of 01-04. The rank of 04 is important because of the corporate knowledge they poses and potential for several more years for the Navy to realize a return on investment. Shepherd looked at the entire MSC community and organized her observations into the three major subgroups, HCA, HCS, and CCS. Her data consisted of interviews with 38 MSCs who were randomly selected according to their rank and specialty (Shepherd, 2001).The sample was stratified according to MSC officers on active duty and those that were recently retired. Of the 38 interviews, eight were recently retired and the remaining 30 were active duty.

Shepherd's findings reinforced previous junior officer retention studies. The study found that the major influencers to stay were satisfaction with pay and benefits, job satisfaction, family time, graduate education opportunities and military leadership (Shepherd, 2001). Among the three major MSC sub groups, the major influencers to stay were very much alike, with the only difference between HCAs and HCS/CCS being that CCS officers had a greater emphasis on graduate educational opportunities.

Lane and Melody (1998) studied physician retention behavior using a multivariate approach. Navy physicians have a complex system of special and incentive pays. In theory these additional incentives are designed to level the pay gap that exits between military and civilian physicians. They found that Navy physicians are very difficult to retain because, despite the Navy's best efforts at offering these incentives, there still exists a large pay gap that attracts military physicians to the civilian market. This study attempted to identify characteristics of those who stayed versus those who left, concentrating on pay as a key variable.

The data utilized for this study were from two major sources: the Health Manpower Personnel Data File and data from the Hay group that includes civilian physician pay information by specialty. They developed a multivariate logistic regression model that included as an independent variable the military/civilian pay differential which was derived by calculating the differences between civilian and total military compensation by physician specialty. The dependent variable was a decision to stay or leave at a particular time in the study.

Lane and Melody found that after fixing the effects for physician specialty, the larger the civilian/military pay gap, the greater the chance a military physician will exit when reaching an un-obligated decision point. They also found that married physicians were more likely to leave. Physicians of higher rank were more likely to stay, however when they reached their 20 year mark they were more likely to leave active duty (Lane et al., 1998).

D. MILITARY RETENTION STUDIES: THE EFFECT OF OPERATIONAL TEMPO

Studies of military retention have recently begun to focus on the effects of the GWOT. Fricker (2002) completed a comprehensive retention study focusing on the effects of deployments on a service member's retention behavior. This study laid the ground work for determining how different kinds of deployments either increase or decrease retention. The study asked if increased deployments reduce retention and also if an increase in hostile deployments results in lower retention. All four services were

included in the study. Logistic regression was used to model the retention behavior of junior officers and survival analysis was used to model midgrade officers.

The study focused on officers in the ranks of 0-2 and 0-3 (junior officers) who were at approximately year four or five of service and on officers in the rank of 0-4 (midgrade officers) between their five to ten years of service (Fricker, 2002).

Fricker observed that increased non-hostile deployments actually decreased the odds of separation for all of the services. He reasoned that non-hostile deployments are often planned for and known about in advance therefore reducing stress for the individuals and their families. Hostile deployments had a "neutral" effect or "reduced the effect of the non-hostile deployments only slightly" (Fricker, 2002). The rate of separation was observed to be lower for hostile deployers than those who never deployed across the board (Fricker, 2002). Midgrade officers had very similar results to those for junior officers across all four services.

Hosek, Kavanagh and Miller (2006) conducted an analysis focusing on how deployments affect service members. They utilized the Status of Forces of Active Duty Personnel Survey, which was conducted by the Defense Manpower Data Center (DMDC) from March and July 2003 (Hosek, Kavanagh and Miller, 2006). They analyzed the survey data in two different ways. The first was the use of focus groups of both enlisted and officers in all four services. The second was the development of a linear probability model. The explanatory variables in the model were partially derived from the feedback they received from the focus groups. Their focus variables were job related stress and intent to stay which were both self reported. Deployment indicators were an element of the stress variables (Hosek, Kavanagh and Miller, 2006).

Hosek et al. found that deployments could have a positive effect on a service member's intent to stay which is in agreement with previous research. This is due to increased meaningfulness of their mission, increased pay and benefits and often reduced workload on deployment. The positive effects from a deployment could be reversed if the deployment is longer than expected, or duration is unknown. They also discovered that

the non-deployers in a unit left behind were more likely to leave due to increased stress due to long work days and increased stress without the benefits of a deployment.

Overall they found that individuals who were in jobs classified as having higher than usual stress were more likely to intend to stay, however they reasoned that this could be due to a self selection process that attracted service members who thrived in a military lifestyle that included stressful jobs. Another significant finding is that the intention to stay of individuals who deployed in OEF/OIF operations was not negatively affected, with the exception of Army personnel (Hosek, Kavanagh and Miller, 2006).

Bristol (2006) studied Navy physician retention and the possible effects of increased OPTEMPO due mostly to Operation Iraqi Freedom. He compared retention both pre and post 9/11 to determine if differences exist. A comprehensive analysis was performed to identify other important factors that influence retention such as demographics, physician subspecialty and duty location. The focus population were physicians who were at their first unobligated decision point[4].

The data were collected from three different sources from the Defense Manpower Data Center (DMDC). The Officer Master File was used for basic demographics, the Health Manpower Personnel Data System for physician specific information and the individual pay files were used to track individuals who deployed, hostile or non-hostile. Bristol selected cohorts of all Navy physicians on active duty in 1999 and 2002. The methodology used was a logistic regression to identify significant influences on physician retention. He also used a difference-in-difference estimator to determine if differences in retention result after a single event in time, pre and post 9/11.

Bristol found that separate models were needed for General Medical Officers (GMO) and specialists. The difference-in-difference estimators showed that the effects of increased OPTEMPO post 9/11 reduced GMO retention by 9.59% and specialist retention by 14.81%. Deployments that occurred before 9/11 had a small positive effect on deployment, but were not significant for GMOs. Race/ ethnicity and years of service

[4] It is thought that officers beyond the first decision point have "self selected" themselves and have a preference for a military lifestyle; therefore they need to be separated from the analysis of officers at their first decision points (Fricker).

were also significant in predicting the retention of GMOs. Specialists were far more likely to leave active duty than their primary care peers. A specialist stationed at Naval Medical Center San Diego was far more likely to stay than one stationed at the base case which was any other naval hospital besides National Naval Medical Center Bethesda, Naval Medical Center San Diego and Naval Medical Center Portsmouth (Bristol, 2006).

E. SUMMARY

Existing literature demonstrates that understanding retention is vitally important in both healthcare and non-healthcare settings. The identification of retention factors that motivate one to stay or leave the military helps to shape new policy, ensure military readiness and evaluate expected return on investment for training and accession costs. General themes across the studies showed that pay, family status, quality of life and source of entry are all significant factors. The Operational Tempo studies have had mixed findings, with earlier studies, suggesting that deployments could be positively related to retention, but, more recent studies indicate different results. The Medical Service Corps, in its entirety, has not been the subject of a quantitative retention study since 1989, and no study has analyzed the effects of GWOT on MSC retention. Considering the complexity of the MSC and the investment needed to ensure proper MSC end strength, it is important to have current information and understanding of MSC retention factors.

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III. DATA DESCRIPTION

A. DATA SOURCE

The data used for this thesis were collected and constructed by the Defense Manpower Data Center (DMDC) in Seaside California. The DMDC was established in the early 1970s. The primary mission for DMDC is to support the Office of the Assistant Secretary of Defense for Manpower and Reserve Affairs, however several other agencies are customers of DMDC as well (DMDC web page). Over the years DMDC has become the largest central collection point for Personnel and Financial data for the DoD (DMDC web page). Their personnel records include information such as accessions, separations, career specialties and retirement data. DMDC commonly provides data used by organizations such as the RAND Corporation, Congressional Budget Office and the Center for Naval Analysis for econometric retention studies.

The data requested from DMDC consisted of all MSC officers who served on active duty from 1997 through 2005, which included the designations of 2300 and 2305. The designation of 2300 denotes a regular USN MSC officer. A new MSC is assigned as a 2305 United States Navy Reserve officer and is typically transferred to a 2300 designator when promoted to the rank of Lieutenant. A snapshot of each year was taken on October 1st. Three different data files were used to construct a comprehensive data set. The first was the Officer Master File (OMF). This file included all basic demographic information for all officers. The Health Manpower Personnel Data System (HMPDS) was used for all healthcare-specific data such as specialty codes and education. The Individual Pay File was used to obtain information about special pays of all MSCs, which was used to determine who was deployed during a given year. These individual files were merged to create one file containing all of the different data elements.

1. Officer Master File

The OMF includes basic demographic and personnel information for all officers in the armed services. It is included as an element of DMDC's Active Duty Military

Personnel File, which tracks all active duty members going as far back as 1971 to the present day. The OMF has approximately 90 different data elements. This study restricted the data to all Medical Service Corps officers who served in the years 1997 through 2005. The OMF data elements selected for use in this study included service, designator, pay grade, unit identification code(UIC), duty unit location code, duty unit location code by US state, commissioning date, years of service (YOS), age, race, sex, marital status, number of dependents, educational level code, loss date and loss code. Prior retention studies have shown that demographic characteristics are often significant independent variables when predicting retention characteristics of a particular group. The YOS was important in identifying who is leaving and who is staying when constructing the dependent variable for the analyses.

2. Health Manpower Personnel Data System

The HMPDS file is medical-specific and provides comprehensive data on all medical personnel assets in the Army, Navy and Air Force, including active duty, reservists and retirees. Officer data for all services include physicians, nurses, and other healthcare professionals including the MSC. The data elements taken from this file consisted of source of commission, health profession begin date, procurement program and subspecialty. The subspecialty variable was key in identifying MSCs as either HCA, CCS, or HCS. This allowed the MSCs to be grouped into their various communities to determine if MSC subgroup has an effect on retention.

3. Active Duty Pay File

The active duty pay file provides a detailed account of compensation of every service member in the military, including basic pays, special pay and deployment pay. The data elements requested from this file reflect three different kinds of deployment pay. The first is Family Separation Pay (FSA). This pay is usually provided to service members if they have dependents and must be separated from them for 30 or more consecutive days. This pay was used to identify someone who may have been deployed in a non-hostile deployment. The second pay used was Hostile Fire pay (HFP). HFP is granted to someone who is serving in a combat zone. In this study it identified individuals

serving in hostile deployments. The third pay used was tax exclusion status. This pay captures individuals deployed in or around a combat zone, but not necessarily in a designated combat zone.

B. DATA RESTRICTIONS

This study focuses on MSC officers in the first term of their commissioned service. The HMPDS was vitally important in determining the exact year an officer started his or her obligated service time. The data element used for this purpose was the healthcare profession begin date. Use of the healthcare profession begin date ruled out the chance of including school or training time in the calculation of an officer's first term. This start date was used to divide the entire data set into specific cohorts. This was necessary because the initial data set included everyone who served in the MSC from 1997 through 2005. With the start date known, the first term decision to stay or leave could be determined for any cohort year.

The cohorts used were for fiscal years 1998, 1999 and 2001. These were chosen to identify changes in retention behavior between two distinct time periods. The first period includes data for the 1998[5] and 1999 entering cohorts. This combined cohort group had obligated service that expired before 2003. The second cohort had obligated service that expired in 2004 and were on obligated active duty during the spring of 2003. Past studies have focused on the effects of the 9/11 tragedy on retention rates. This study's primary focus is the effects of the beginning of major combat operations in the GWOT, which commenced in the spring of 2003. The 1998/1999 cohort is identified as the pre-GWOT group, while the 2001 cohort is identified as the post-GWOT group.

Officers in pay grades O-1 to O-3 were included in the sample due to the fact that, in most cases, the highest rank achievable in the first term of an MSC officer is a Lieutenant. The pooled data set was comprised of all MSC officers who started their healthcare profession in 1998, 1999 or 2001. The total number of observations was 608; numbers by cohort year are shown in Table 3.

[5] Source of commission data was missing for cohort year 1998; all accession source analysis for the pre-GWOT group consists of 1999 source of commission data.

Table 3. MSC Pooled Sample Size 1998-1999, 2001

	1998-1999	2001	Total
MSC Sample	361	247	608

C. PRELIMINARY DATA ANALYSIS

1. Dependent and Explanatory Variables

The dependent variable STAY is binary and indicates if an MSC officer stayed beyond his or her first obligated term. Most MSC officers have a minimum obligation of three years upon entering the service. This criterion was used to determine if someone stayed to a second term. If an officer was classified as a stayer he or she received a value of 1, if not he or she was assigned a value of 0 and classified as a leaver.

The Explanatory variables include demographic information: age, gender, race, and marital status. Education level was not included because a majority of those entering the service without a Master's degree come into the MSC through the In-Service Procurement Program (IPP) source of commission, which is already captured as an explanatory variable in the model. The military experience explanatory variables include: rank, MSC subgroup, accession source, and several variables indicating deployment history (deployed, hostile deployment, multiple deployment and hostile months deployed).

2. Data Description by Cohort

Table 4 provides statistics about the pooled sample as well as the two individual cohort groups. Frequency tables show the distributions of the dependent variable and the explanatory variables for the entire sample as well as for individual cohort year groups.

Table 4. Characteristics of MSC Officers Pooled 1998-1999, 2001

Characteristics	**1998-1999 Pre-GWOT N=361**	**2001 Post-GWOT N=247**	**Pooled Sample N=608**
Retention%			
Stay***	84.49	72.47	79.61
Gender%			
Male	70.64	64.78	68.26
Female	29.36	35.22	31.74
Race/Ethnic%			
White	70.67	68.83	69.90
Black	14.68	17.41	15.79
Other Race	8.03	9.72	8.72
Marital Status %			
Married	48.88	44.77	47.24
Single	51.12	55.23	52.76
Dependents %			
Dependents *	44.41	51.46	47.24
No Dependents	67.04	69.64	68.09
Age			
Average Age (Mean in Years) +++	31.90	33.39	32.50
Rank%			
LT	64.54	59.11	62.34
ENS-LTJG	34.07	37.65	35.53
MSC Subgroup			
Healthcare Administration (HCA)	40.44	38.06	39.47
Clinical Care Provider(CCS)	33.52	38.46	35.53
Healthcare Science (HCS)	19.67	21.86	20.56
Accession Source			
IPP (Former enlisted)	28.44	30.36	29.45

Characteristics	**1998-1999 Pre-GWOT N=361**	**2001 Post-GWOT N=247**	**Pooled Sample N=608**
HSCP (SOCHSCP)	19.56	22.27	20.97
Direct Commission (SOCDC)	48.89	46.96	47.88
Deployments%			
Deployments	32.96	30.36	31.91
No Deployments	67.04	69.64	68.09
Deployments (Hostile) %			
Hostile Deployments **	11.91	19.43	14.97
No Hostile Deployments	88.09	80.57	85.03
Deployments (Non-Hostile)%			
Non-Hostile Deployments **	21.05	10.93	16.94
No Non-Hostile Deployments	78.95	89.07	83.06
Multiple Deployments %			
Multiple Deployments	11.91	8.50	10.53
No Multiple Deployments	88.09	91.50	89.47
Hostile Months Deployed			
Hostile Months (mean in months) ++	.46	.86	.62

******* Chisq statistic significant at .01 level
****** Chisq statistic significant at .05 level
***** Chisq statistic significant at .10 level
+++ T-statistic for difference in means significant at .01 level
++ T-statistic for difference in means significant at .05 level

The preliminary analysis in Table 4 provides insight into the characteristics of MSC officers and how they differ over the two time periods. Overall 68.26% of the sample is male. The pre-GWOT group is 70.64% male while the post-GWOT group is 64.78% male, showing an increase in female MSC officers of 5.86 percentage points. With respect to race, 69.90% of the overall sample is white, 15.79% is black and 8.72% is classified as other race. Black MSC officers increased slightly from 14.68% in the pre-GWOT group to 17.41% in the post-GWOT group. Regarding the other demographic

variables, the number of dependents changed significantly over the time periods with an increase in MSC officers with 2 or more dependents increasing from 44.41% in the pre-GWOT group to 51.46% in the post-GWOT group. The average age of the entire sample is 32.50 years, which also showed a significant change over time from 31.90 years old in the pre-GWOT group to 33.39 years old in the post-GWOT group. Overall, there are more single than married MSCs with 47.24% married, decreasing slightly from 48.88% in the pre-GWOT group to 44.77% in the post-GWOT group. Most of the sample, 62.34%, are Lieutenants at the end of their first term. This decreases slightly in the post-GWOT group, possibly indicating more MSC officers starting as Ensigns in the later period. By subspecialty, HCAs make up the largest proportion of the sample with 39.47%, CCS officers are 35.53% of the sample and HCS officers comprise 20.56% of the sample. The only notable change is an increase in CCS officers from 33.52% in the pre-GWOT group to 38.46 % in the post-GWOT group. There are no major differences in accession source. Overall, the largest group of new accessions enters under a direct commission, 47.88%, with the IPP and HSCP programs comprising 29.45% and 20.97%, respectively.

The deployment results show no major difference in overall deployments between the two groups with 68.09% of the pooled sample not deploying and approximately 32% deploying at least once during their first term. There is a significant increase in hostile deployment results between the groups, changing from 11.91% in the pre-GWOT group to 19.43% in the post-GWOT group. In contrast there was a decrease in the occurrence of multiple deployments with a change from 11.91% in the pre-GWOT group to 8.50% in the post-GWOT group. There was also a significant change in the number of non-hostile deployments between the two time periods from 21.05% in the pre-GWOT group to 10.93% in the post-GWOT group having at least one non-hostile deployment. This could indicate that medical assets were being directed towards missions that were more hostile in nature during the post-GWOT time period. The mean number of hostile months deployed experienced a significant change almost doubling over the period, increasing from .46 months for the pre-GWOT group to .86 months for the post-GWOT group.

The retention of MSC officers over this time period decreased. The percentage of stayers in the pre-GWOT group is 84.49%, while the percentage of stayers in the post-GWOT group is 72.47%, indicating that retention has decreased by approximately 11 percentage points. This reduction could be a response to increased hostile OPTEMPO or some other reason such as deployment uncertainty or increased civilian job opportunities.

In summary, there are major differences between the two groups in both demographics and military experience. MSC officers in the post-GWOT group are much more likely to have dependents and be older by approximately two years over their pre-GWOT peers. They are also much more likely to have had one or more hostile deployments and less likely to have had one or more non-hostile deployments. If they had a hostile deployment it is likely to have been for a longer period than a hostile deployment experienced in the pre-GWOT group. Overall, MSCs in the post-GWOT group are less likely to stay after completing their service obligation, which may be attributed to an increase in hostile deployments or other factors.

3. Data Description by Cohort and Retention Status

Table 5 provides a more detailed look at the characteristics of the MSC officers who made the decision to stay into a second term. This data, combined with the information from Table 4, provides interesting information that helps to identify differences between stayers and leavers over the period studied.

Table 5. Characteristics of MSC Officers By Retention Status Pooled (Percent STAY)

Characteristics	**1998-1999 N=361**	**2001 N=247**	**Combined N=608**
Gender * (post-GWOT)			
Male	84.71	76.25	81.45
Female	83.96	65.52	75.65
Race/Ethnic			
White	84.31	72.94	79.76
Black	90.57	72.09	82.29

Characteristics	**1998-1999 N=361**	**2001 N=247**	**Combined N=608**
Other Race	89.66	66.67	79.25
Marital Status ** (pre-GWOT)			
Married	80.57	78.50	79.79
Single	89.62	71.97	82.22
Dependents *** (post-GWOT)			
Dependents	85.08	82.19	83.79
No Dependents	81.40	68.60	76.09
Age + (pre/post GWOT)			
Average Age (Mean in Years) Stayers	33.17	33.39	33.41
Average Age (Mean in Years) Leavers	25	32.22	28.95
Rank * (pre-GWOT), ** (post-GWOT)			
LT	81.97	67.81	76.52
ENS-LTJG	91.06	86.02	88.89
MSC Subgroup ** (pre-GWOT), ***(post-GWOT)			
Healthcare Administration (HCA)	89.73	84.04	87.50
Clinical Care Provider (CCS)	80.99	61.05	72.22
Healthcare Science (HCS)	74.65	70.37	72.80
Accession Source ***(pre/post-GWOT)			
IPP (Former enlisted-SOCFMENL)	95.31	89.33	92.09
HSCP (SOCHSCP)	75.00	43.64	57.58
Direct Commission (SOCDC)	78.18	75.00	76.55
Deployments ** (pre/post-GWOT)			
Deployments	90.76	81.33	87.11
No Deployments	81.40	68.60	65.08

Characteristics	**1998-1999 N=361**	**2001 N=247**	**Combined N=608**
Deployments (Hostile) ** (pre-GWOT), * (post-GWOT)			
Hostile Deployments	95.35	83.33	89.01
No Hostile Deployments	83.02	69.85	77.95
Deployments (Non-Hostile)			
Non-Hostile Deployments	88.16	77.78	85.44
No Non-Hostile Deployments	83.51	71.82	78.42
Multiple Deployments *(pre-GWOT**)**			
Multiple Deployments	93.02	80.95	89.06
No Multiple Deployments	83.33	71.68	78.49
Hostile Months Deployed ++ (pre/post-GWOT)			
Hostile Months (mean in months) Stayers	.50	.96	.67
Hostile Months (mean in months) Leavers	.21	.61	.43

******* Chisq statistic significant at .01 level
****** Chisq statistic significant at .05 level
***** Chisq statistic significant at .10 level
+ + T-statistic for difference in means significant at .05 level
+ T-statistic for difference in means significant at .10 level

Of the demographic variables gender, marital status and dependents all had significant associations with the rate of retention. In the pre-GWOT group, men and women stayed at similar rates, 84.71% and 83.96% respectively, while the difference between the percent of men who stayed and the percent of women who stayed in the post-GWOT period was larger, 76.25% versus 65.52% and the 11% difference was significant at the .10 level. Although both males and females experienced declining retention, the decrease for females who started in the post-GWOT group was much more pronounced than for males starting in the same period. For the race variables, there were differences in retention among the race groups in the pre-GWOT period, however none of these

differences were significant. In the post-GWOT period the retention rates were even more similar for white, black and other race, 72.94%, 72.09% and 66.67% respectively. Retention for all the race groups decreased between the two time periods with a fall in retention for whites of 11%, 18%for blacks and 23% for other race.

For the marital status variable, the proportion of married MSCs who stayed was significantly different than for singles in the pre-GWOT period with retention rates of 80.57% and 89.62% respectively, which were significantly different at the .05 level, indicating that married MSCs opted to leave more frequently than single MSCs in the pre-GWOT period. Although this remains true in the post-GWOT period, the difference is not significant. MSC officers with more than two dependents and those with one or fewer dependents had very similar retention rates in the pre-GWOT period, 85.08% and 81.40% respectively. This difference became much more significant in the post-GWOT period with rates of staying of 82.19% for those with multiple dependents and 68.60% for those with one dependent or less. This major difference was significant at the .01 level. The large change in retention rates of those with one or fewer dependents could indicate that married MSCs with two or more dependents may be opting for more job security despite an overall drop in retention rates between the two periods.

There were significant differences in the age of retained MSC officers versus those who left with an average age for stayers of 32.50 years and an average age of leavers of 25 years in the pre-GWOT group, which was significant at the .10 level. This difference narrowed in the post-GWOT group to 33.39 years and 32.22 years respectively, however, the difference stayed significant. The reason the mean age of leavers increased could be due to an overall sharp decline in retention among all MSC officers between the two periods.

There were also significant differences in retention rates for the military experience explanatory variables. Difference in retention rates in the pre-GWOT group for Lieutenants (LT) versus Ensign/Lieutenant Junior Grade (ENSJG) was significant at the .10 level with 81.97% for LT and 91.06% for ENSJG. This finding is not unexpected as the later group constitutes a large percentage of prior enlisted individuals who have already made a large time investment in military service. This difference became much

more pronounced in the post-GWOT group with rates of 67.81% and 86.02% for LT and Ensign, respectively, significant at the .05 level. The large drop in retention rates of LTs could be due in part to accession sources starting MSC officers at the accelerated rank of Lieutenant Junior Grade, ensuring these officers attain LT before their retention decision point.

The differences in retention rates among the MSC subgroups were significant at the .05 level in the pre-GWOT period with rates for HCA, HCS and CCS of 89.73%, 80.99% and 74.65% respectively. These differences became even larger and more significant in the post-GWOT group with rates of 84.04%, 61.05% and 70.37% respectively. Although all subgroups experienced decreasing retention, the decrease for CCS officers outpaced the other groups.

The sources of commission variables were associated with differences in retention rates that were very significant in the pre-GWOT period. The rates for MSCs entering under the IPP were 95.31% versus those for the Health Services Collegiate Program and Direct Commissioning Program of 75% and 78.18% respectively. These differences stayed significant at the .01 level in the post-GWOT period, particularly for those from the HSCP who dropped from 75% to 43.64%. This severe drop may indicate that retention for the HSCP was severely negatively affected by the post-GWOT period.

There were significant differences in retention for those who deployed verses those who did not, 90.76% and 81.40% respectively in the pre-GWOT period, significant at the .05 level for both time periods. This difference became more pronounced in the post-GWOT period with retention rates of 81.33% for deployers versus 68.60% for those who did not deploy. This may indicate that those who did not deploy are more likely to get out after their initial term. This pattern continues with very similar results for those who had at least one hostile deployment during their first term with 95.35% retention for hostile deployers and 83.02% for those with no hostile deployments in the pre-GWOT group. The post-GWOT group had similar differences with 83.33% and 69.85% respectively. These differences were significant at the .05 level in the pre-GWOT and the .10 level in the post-GWOT period, indicating higher retention for those who have at least one hostile deployment during their first term.

The differences in retention rates for those with a non-hostile deployment and those without during their first term were not significantly different, varying by only 5-6% in both the pre and post-GWOT periods. Conversely those who had multiple deployments versus those who did not had a significant difference in retention during the pre-GWOT period of 93.02% and 83.33% respectively, however this difference became insignificant in the post-GWOT period. The differences in mean number of hostile months deployed also showed significant differences between stayers and leavers. The mean number of months in the pre-GWOT period was .50 for stayers versus .21 for leavers. These numbers increased substantially in the post-GWOT period to .96 and .61 respectively. This change is not unexpected as hostile deployments increased during the post-GWOT period

In summary, significant differences in continuation behavior were noted for the demographic variables of gender, marital status, number of dependents and age. This indicates that MSC officers who are male, married, and have multiple dependents are more likely to continue beyond their first term of service. Although there is a major age difference between stayers and leavers, the age of the leavers is creeping upwards in the post-GWOT group. Those who enter with an accelerated rank experienced a severe drop in retention as is the case with the HSCP program and those in the CCS subgroup. Even though retention rates have decreased across the board for the deployment variables, the decrease in continuation for those without the deployment indicators have outpaced those with the deployment indicators in most cases, indicating the possibility that deployments may not have a negative effect on MSC retention.

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IV. ANALYTICAL METHOD/VARIABLE DEFINITIONS

A. ANALYTICAL METHOD

1. Theoretical Model

Multiple logistic regressions are used for this analysis. This approach is the preferred method when estimating a model that has a discreet dependent variable i.e. the dependent variable is dichotomous and bounded between zero and one. The logistic regression calculates the log of the odds which ensures the upper and lower bounds of the dependent variable are not violated. The theoretical model is:

$$L_i = \ln [P_i/(1- P_i)] = \alpha + \beta x_i$$

where:

L_i= The log of the odds ratio

P_i=The probability an individual stays given personal attributes x_i

α= The intercept parameter

β= The direction (vector) of the slope of explanatory variable coefficients

x_i= Values of explanatory variables in the model

Each of the logistic models in this study incorporates a difference-in-difference estimator. The difference-in-difference estimator is a measure of the changes in average outcome given a treatment and a control group over a given time period. This estimator helps to determine whether or not there was an increased effect of a variable in one particular time period relative to that of another. The difference-in-difference estimator works by calculating the average outcome of the treatment group and subtracting the average outcome of the control group over the same period, thus separating a general trend from the possible increased effect of a treatment. This addition to the model will help to determine whether or not deployments during a specific time frame had a greater effect on the treatment group. In these models the time frames are the pre and post-

GWOT time periods. The treatment groups will be the various deployment variables. The control group will be those who did not meet the criteria for a treatment group, namely they were not deployed.

Overall, the effect being measured by the difference-in-difference estimator is whether or not there was an effect from an increase in OPTEMPO between the two time periods. The deployed variables measure if there was an overall effect in the pooled sample. The addition of the FY01 variable will control for a common time frame, which is post-GWOT. The variable actually measuring the difference is the interaction term FY01_Deployed which tells us whether or not the effect of the deployments was influenced by the time frame being post-GWOT or not.

The signs of the individual coefficients indicate whether or not an explanatory variable is associated with either increasing or decreasing the probability of an MSC officer making a decision to stay. A positive sign for a parameter estimate indicates an increased probability of staying and a negative sign indicates a decreased probability of staying into a second term. The Wald Chi-square statistic is used to determine if a parameter estimate is significant at the standard levels of statistical significance. The Wald Chi-square is derived by dividing the parameter estimate by its standard error and squaring the result.

The partial effects of the models are interpreted using the notional person approach. Characteristics of the typical person are those of the base case for all dummy variables and the average value for all continuous variables. The partial effect of each explanatory variable is calculated by predicting the probability of staying for an individual who differs from the typical person only on that variable and comparing it with the predicted probability that the typical person is a stayer. All interpretation is therefore based on a comparison with the notional individual.

2. Model Specification

Listed below are the models used in the analysis with the addition of the difference-in-difference estimation variables. A full description of variables and their expected effects is presented in Section B of this chapter.

a. Logit Model Including Deployment Variable

$$L_i = \ln [P_i/(1- P_i)] = \beta_0 + \beta_1(\text{FEMALE}) + \beta_2(\text{BLACK}) + \beta_3(\text{OTHER RACE}) + \beta_4(\text{AGE}) + \beta_5(\text{MARRIED}) + \beta_6(\text{DEPENDENTS}) + \beta_7(\text{ENSJG}) + \beta_8(\text{HCS}) + \beta_9(\text{CCS}) + \beta_{10}(\text{SOCFMENL}) + \beta_{11}(\text{SOCHSCP}) + \beta_{12}(\text{DEPLOYED}) + \beta_{13}(\text{FY01}) + \beta_{14}(\text{FY01\_DEPLOYED})$$

where:

FEMALE = being Female

BLACK= being African American

OTHER RACE = being any race other than White or African American

AGE = average age

MARRIED = being married

DEPENDENTS = having greater than two dependents

ENSJG = being either an Ensign or Lieutenant Junior Grade

HCS = being a Healthcare Science MSC officer

CCS = being a Clinical Care Provider MSC officer

SOCFMENL = having a former enlisted source of commission

SOCHSCP = having a Health Services Collegiate Program source of commission

DEPLOYED = being deployed prior to making a retention decision

FY01 = time trend common to control and treatment groups

FY01_DEPLOYED = the effect of treatment (Post-GWOT)

b. Logit Model Including Hostile and Non-Hostile Deployment Variable

$$L_i = \ln [P_i/(1- P_i)] = \beta_0 + \beta_1(\text{FEMALE}) + \beta_2(\text{BLACK}) + \beta_3(\text{OTHER RACE}) + \beta_4(\text{AGE}) + \beta_5(\text{MARRIED}) + \beta_6(\text{DEPENDENTS}) + \beta_7(\text{ENSJG}) + \beta_8(\text{HCS}) + \beta_9(\text{CCS}) + \beta_{10}(\text{SOCFMENL}) + \beta_{11}(\text{SOCHSCP}) + \beta_{12}(\text{DEPHOST}) + \beta_{13}(\text{NONHOST})$$

$$+ \beta_{14}(\text{FY01}) + \beta_{15}(\text{FY01\_DEPHOST}) + \beta_{16}(\text{FY01\_NONHOST})$$

where:

DEPHOST = having at least one hostile deployment prior to retention decision

NONHOST = having at least one non-hostile deployment prior to retention decision

FY01_DEPHOST = the effect of treatment (Post-GWOT)

FY01_NONHOST = the effect of treatment (Post-GWOT)

c. Logit Model Including Multiple Deployments Variable

$$L_i = \ln [P_i/(1- P_i)] = \beta_0 + \beta_1(\text{FEMALE}) + \beta_2(\text{BLACK}) + \beta_3(\text{OTHER RACE}) + \beta_4(\text{AGE}) + \beta_5(\text{MARRIED}) + \beta_6(\text{DEPENDENTS}) + \beta_7(\text{ENSJG}) + \beta_8(\text{HCS}) + \beta_9(\text{CCS}) + \beta_{10}(\text{SOCFMENL}) + \beta_{11}(\text{SOCHSCP}) + \beta_{12}(\text{MULTDEPLOY}) + \beta_{13}(\text{FY01}) + \beta_{14}(\text{FY01\_MULTDEP})$$

where:

MULTDEP = having multiple deployments prior to retention decision

FY01_MULTDEP = the effect of treatment (Post-GWOT)

d. Logit Model Including Months of Hostile Deployments Variable

$$L_i = \ln [P_i/(1- P_i)] = \beta_0 + \beta_1(\text{FEMALE}) + \beta_2(\text{BLACK}) + \beta_3(\text{OTHER RACE}) + \beta_4(\text{AGE}) + \beta_5(\text{MARRIED}) + \beta_6(\text{DEPENDENTS}) + \beta_7(\text{ENSJG}) + \beta_8(\text{HCS}) + \beta_9(\text{CCS}) + \beta_{10}(\text{SOCFMENL}) + \beta_{11}(\text{SOCHSCP}) + \beta_{12}(\text{MONTHS\_HOST}) + \beta_{13}(\text{FY01}) + \beta_{14}(\text{FY01\_MONTHS\_HOST})$$

where:

MONTHS_HOST = number of months in a hostile deployment

FY01_MONTHS_HOST = the effect of treatment (Post-GWOT)

B. VARIABLE DEFINITIONS

1. Explanatory Variables Defined

a. Demographic Variables

(1) Gender (MALE, FEMALE). The gender variable is a dichotomous variable and has two categories, male and female. The base case are males as they make up a majority of the MSC. Females are represented in all of the MSC subgroups. Female MSCs commonly deployed (both non-hostile and hostile deployments) in both the pre and post-GWOT time periods. Despite the fact that numerous female MSCs stay beyond a first term to have successful military careers, it is expected that females will have a negative effect on first term retention compared to their male peers. In the last several years many more positions have been opened to females in the military. Family support services have also been developed to help with the burdens on the family from military life such as deployments. Although several improvements have been made to military life for females, the effect is expected to be negative when compared to males because females still form the foundation of the family unit when children are involved and as a result, they could be more negatively affected by deployments or risk of deploying than their male peers (Bristol, 2006).

(2) Race Group (WHITE, BLACK, OTHER_RACE). Race group is described by three different categories: WHITE, BLACK, and OTHER RACE. Each category is a dichotomous variable. The base case is white since white MSCs make up a majority of the population. Overall, the military is perceived to have equitable professional and advancement opportunities across all race groups when compared to the civilian sector. As a result, MSC officers who are African American or classified as other race may feel their chances for a successful career are greater in the military and they may decide to stay at higher rates than their white peers. For this reason the effects of the black and other race variables are expected to be positive.

(3) Age (AGE). The Age variable is the average age of an individual during his or her first term. This variable is continuous and is measured in

years. Older MSC officers are expected to be more likely to stay for several reasons. Older MSCs have a greater chance of having a family and therefore desire a job with stable income and health benefits. They may also value retirement benefits more than their younger peers. Among prior enlisted officers, older individuals will have more years of completed service and thus earn a higher income than their peers. For these reasons the AGE variable is expected to have a positive effect.

(4) Marital Status (MARRIED). The marital status variable defines two groups, married and single. For this dichotomous variable, single is the base case because single officers make up a majority of the sample. Married individuals often have dependents and may have concerns with the satisfaction of a spouse. They also are likely to value job stability if they have a family. It may be easier for a single person to switch careers or transition to the civilian market. Deployments may have a more negative effect on married individuals than on singles due to family separations. Overall, the expected effect of MARRIED on retention is positive.

(5) Dependents (DEPENDENTS). The dependents variable is dichotomous and consists of two groups, those with greater than two dependents (DEPENDENTS=1) and those with one or less (DEPENDENTS=0). The base case is less than two dependents. Those with two or more dependents have a greater familial responsibility, whether married or not, than those with one or less. Deployments cause family separation, having a possible negative effect; conversely, someone with many dependents may want the added job security the military has to offer. Overall the expected sign of DEPENDENTS is positive.

b. Military Experience Variables

(1) Rank (ENSJG). Rank is described by two categories LT and ENSJG. The base case is LT. This variable is dichotomous with someone assigned as LT in the pay grade of O-3 and someone assigned as ENSJG in the pay grade of O-1 to O-2 in the year before a decision point. Most MSCs entering with an advanced degree usually start as an O-2 and are promoted to O-3 before a decision point is reached. However, if an MSC enters into service with a Bachelor's degree, he or she starts as an

O-1. Many individuals commissioned through a prior enlisted program enter as Ensigns. For the most part, MSCs who enter as O-1s are from the In-Service Procurement Program and thus are prior enlisted officers. These officers already have established a taste for military life and made a significant time investment in the military. As a result, the expected sign of the rank variable ENSJG is positive

(2) MSC Subgroup (HCS, CCS). The Medical Service Corps subgroups were divided into three different categories, Healthcare Administrator (HCA), Healthcare Science (HCS) and Clinical Care Provider (CCS). The base case were Healthcare Administrators (HCA). Some HCS/CCS officers qualify for special and incentive pays depending on their medical profession and this provides an incentive for them to stay on active duty. In many cases both HCS and CCS officers have very specific technical skills and therefore may find it very easy to find work in the civilian market, especially if there is a shortage for their skill set. As a result, the effect on retention for both HCS and CCS officers is expected to be negative, compared with HCA officers who are not eligible for the same incentive pays, or may not have as many civilian job opportunities.

(3) Source of Commission (SOCFMENL, SOCHSCP,). Source of commission is defined by three different categories: Former enlisted commissioning, also known as IPP (SOCFMENL); Health Services Collegiate Program (SOCHSCP); and Direct Commissioning (SOCDC). The variables are dichotomous, with SOCDC as the base case. It is anticipated that SOCFMENL program will have a positive effect on retention compared with SOCDC, as these individuals are all prior enlisted. Someone who is prior enlisted has already invested years in the military and has demonstrated that he or she has a taste for a military lifestyle. Officers entering under the HSCP have received substantial monetary support from the Navy and may feel a sense of loyalty to stay beyond their first term, while officers from a direct commission did not receive support in most cases. Officers that enter under a direct commission have work experience and may be older and more career focused compared with those entering under the HSCP, therefore the effect of SOCHSCP is expected to be either positive or negative compared with SOCDC.

(4) Deployments (DEPLOYED, DEPHOST, NONHOST, MULTDEP, and MONTHS_HOST). The deployment variables divide the sample into six different categories: No deployments during the first term; at least one deployment during the first term (DEPLOYED); at least one hostile deployment during the first term (DEPHOST); at least one non-hostile deployment during the first term (NONHOST); more than two deployments during the first term (MULTDEP); and number of hostile months deployed during the first term (MONTHS_HOST). All deployment variables are dichotomous with the exception of MONTHS_HOST, which is continuous.

Prior literature shows there can be positive or neutral effects from deployments. Fricker (2002) found that, across the board, both non-hostile and hostile deployments reduced the odds of separation. They reasoned that individuals who deployed were able to use their training in a real combat situation and received monetary rewards for deploying, both leading to increased job satisfaction. Hosek, Kavanagh and Miller (2006) found similar results showing that military personnel, except Army, who deployed with OIF/OEF did not experience increased odds of separation. Conversely, Bristol (2006) found that Physician deployments occurring after September 11, 2001 did negatively affect physician retention. His explanation was that the increased OPTEMO during Operations Iraqi and Enduring Freedom had a negative effect on physician retention. Based on these prior studies the deployment dummy variables, DEPLOYED, NONHOST and DEPHOST, are expected to have an overall positive impact on retention compared to the base cases of no deploy, no non-hostile deployment and no hostile deployment.

In contrast, the expected sign for MULTDEP is negative, as two or more deployments in a three year period would be very difficult for individuals with families or those with no prior military experience compared to those deploying once or less. The variable MONTHS_HOST is a continuous variable and expected to have a negative sign due to the austere conditions of a hostile deployment combined with prolonged absences from family or significant others.

The expected sign of the difference-in-difference estimators are all negative. They occur after the initiation of the GWOT in the post-GWOT period. The

post-GWOT period has an increased OPTEMPO with respect to hostile deployments and may be adversely affecting retention as earlier studies suggest (Bristol, 2006). The common time trend variable, FY01, is also expected to be negative as retention trends have sharply decreased between the pre and post-GWOT periods.

2. Dependent Variable (STAY)

The dependent variable STAY is dichotomous. If an MSC officer stayed beyond his or her initial term he or she is assigned a value of 1 and classified as a stayer. If he or she separated from active duty during, or at the end of his or her initial term he or she was assigned a value of 0 and classified as a leaver. Individuals in the pre-GWOT group had their first term expire in 2001 if they started in 1998 and 2002 if they started commissioned service in 1999. The post-GWOT group had their first term expire in 2004. To be classified as a stayer they had to have stayed into a fourth year beyond their initial three year obligation.

Table 6 provides a summary of all explanatory variables and their expected effects on the dependent variable (STAY).

Table 6. Explanatory Variables with Expected Sign

Variable Name	Variable Type	Expected Sign
Demographic		
Gender	Dichotomous	
MALE		Base Case
FEMALE		-
Race/Ethnic	Dichotomous	
WHITE		Base Case
BLACK		+
OTHER_RACE		+
Current Age	Continuous	
AGE		+

Variable Name	Variable Type	Expected Sign
Marital Status	Dichotomous	
MARRIED		+
SINGLE		Base Case
Dependents	Dichotomous	
DEPENDENTS		+
NO DEPENDENTS		Base Case
Military Experience Variables		
Rank	Dichotomous	
LT		Base Case
ENSJG		+
MSC Subgroup	Dichotomous	
HCA		Base Case
HCS		-
CCS		-
Source of Commission	Dichotomous	
SOCDC		Base Case
SOCHSCP		+/-
SOCFMENL		+
Deployment Variables	Dichotomous	
NO DEPLOY		Base Case
DEPLOY		+
DEPHOST		+
NONHOST		+
MULTDEP		-
MONTHS_HOST	Continuous	-

V. RESULTS OF THE ANALYSIS

A. OVERVIEW

The Logistic (Logit) regression model incorporated both demographic and military experience variables. The purpose of the model was to measure MSC retention behavior and the effects of deployments in general and during the post-GWOT period. Initially one logistic model was created for the pooled sample of all three cohorts from 1998, 1999 and 2001. The cohorts were pooled throughout the analysis to preserve the maximum number of observations, thereby increasing the likelihood of determining significant retention characteristics. The outcome of a single model that included several measures of deployment history indicated that multicollinearity existed among several of the candidate deployment variables. This made it difficult to determine whether or not the deployment variables had a significant effect on first term retention. In order to ensure that the deployment variables were mutually exclusive and independent in the models, a total of four models were estimated so that the effects of the deployment measures could be separated.

The four models included the same demographic and military experience variables, differing only by deployment variable type.

- Model (1) included whether or not an MSC officer deployed during his or her first term. This deployment could have been either hostile or non-hostile.
- Model (2) included whether or not an MSC officer had one or more hostile deployments, or one or more non-hostile deployments during his or her first term.
- Model (3) included whether or not an MSC officer had multiple deployments during his or her first term.
- Model (4) included the months of hostile deployments during the first term, which was the only continuous deployment variable.

All four of the models included the difference-in-difference estimators to measure the effect of a deployment variable in the post-GWOT period relative to the effect of the deployment variable in the pre-GWOT period. The purpose was to determine the effects

of increased OPTEMPO after the initiation of major combat operations in the post-GWOT period. In addition to the four Logit models, partial effects were calculated for each independent variable in each of the models. Several techniques for evaluating goodness of fit were employed to verify accuracy and statistical significance of each of the models.

B. MSC RETENTION MODELS

1. Goodness of Fit

a. Global Null Hypothesis

The Global Null Hypothesis tests whether or not any of the explanatory variables in the model explains the variation observed in the dependent variable "Stay". The Null Hypothesis tests the hypothesis that all of the coefficients are zero and have no effect on the dependent variable. The Alternative Hypothesis states that at least one of the independent variables explains variation observed in the dependent variable.

The technique used for a Logit multiple regression utilizes the Wald statistic and likelihood ratio statistic to determine the relative explanatory power of the model as a whole. The resulting Pr>Chisq distribution can be analyzed in a similar fashion to the OLS regression global F-test. Table 7 shows that models (1) through (4) have a likelihood ratio statistic significant at the .01 level. Based on this we can reject the Null Hypothesis and conclude that at least one of the independent variables in each of the models helps to explain the variation in the dependent variable "Stay".

Table 7. Global Null Hypothesis Test for Logit models

Model	Likelihood Ratio	Chi-Squared	DF	Pr>Chisq
(1)	472.385	106.9160	15	<.0001
(2)	471.117	108.1845	17	<.0001
(3)	475.275	104.0258	15	<.0001
(4)	475.213	104.0880	15	<.0001

b. R-Square

The second method used to measure model goodness of fit is based on the R-squared value. The basic R-Squared statistic measures the percent of the variation in the dependent variable that is explained by the explanatory variables. In a Logistic regression the basic R-squared (sometimes called pseudo R-squared) does not accurately depict the overall relationship between the dependent and explanatory variables. Logit regression by definition has a binary response variable and the upper bound of the R-square value cannot equal one. The Max–rescaled R-square value is adjusted so that its upper bound does equal one.

The basic R-squared and Max-rescaled R-square values are shown below in Table 8. All four models have a basic R-square value of approximately 16% and a more accurate Max-rescaled R-square value of approximately 26%. This indicates that the explanatory variables in the model explain roughly 26% of the variation observed in the dependent variable "Stay". A relatively low R-Square is common for a Logit regression model.

Table 8. Basic and Max-rescaled R-square for Logit models

Model	Basic R-Square	Max-rescaled R-Square
(1)	.1640	.2640
(2)	.1657	.2669
(3)	.1599	.2575
(4)	.1600	.2576

c. Classification Table

The third measure commonly used to assess Logit model goodness of fit is the classification table. This table gives a bias adjusted account of the number of cases accurately predicted by the model and reports them as a percentage. This percentage is referred to as the percent correctly predicted. It is a measure of the number of correct predictions divided by the number of total events. The classification table also provides a

specificity percentage, which measures false positive and false negative predictions. The probability level in the table is used to determine the percent correctly predicted in the model. It is common to use a probability of .5 that the dependent variable was equal to one to determine the percent correctly classified. A more accurate method is to use the actual number of successes in the model. In this case it is the number of observations for which "Stay"=1 as a proportion of the total number of observations per model, which is the actual proportion of events.

The actual proportion of events in each of the models was .810, which was used as the criterion for determining the percent correctly predicted. Table 9 provides a summary of the percent correctly predicted for each of the models. The classification table shows that the models correctly predict retention status for approximately 65% to 67% of the MSC officers. This percentage shows that the model is a useful tool for determining retention behavior in the MSC sample.

Table 9. Classification Table for Logit Models

		Correct		Incorrect		Percentages				
Model	**Prob level**	**Event**	**Non-Event**	**Event**	**Non-Event**	**Correct**	**Sensi-tivity**	**Speci-ficity**	**False POS**	**False NEG**
One	.810	328	66	48	156	65.87	67	58	12.6	70
Two	.810	323	67	47	161	65	66	58.8	12.6	70.3
Three	.810	332	66	48	152	66	68	58.1	12.5	70.4
Four	.810	334	65	49	150	67.55	69.1	57.7	12.5	70

2. Interpretation and Evaluation of Coefficients

There were a total of 22 independent variables among the four different Logit models. Of the seven demographic independent variables, two were found to be statistically significant. Of the 15 military experience variables, seven were found to be statistically significant. Parameter estimates and significance levels are shown in Table 10. Relevant deployment variables are listed only for those models in which they were included. Table 10 represents significance levels for two-tailed tests.

Table 10. Logit Regression Results All Models (N=597)

Models	**(1) (Any deployment)**		**(2) (Hostile vs. Non-hostile Deploy)**		**(3) (Multiple Deployment categories)**		**(4) (Hostile Months Deploy)**	
Variables	**Estimate**	**Pr>Chisq**	**Estimate**	**Pr>Chisq**	**Estimate**	**Pr>Chisq**	**Estimate**	**Pr>Chisq**
AGE	.0882	.0001***	.0860	.0001***	.0874	.0001***	.0859	.0001***
FEMALE	-.0876	.7290	-.0838	.7409	-.1154	.6471	-.1104	.6617
ENSJG	.2833	.3424	.3005	.3163	.3140	.2931	.3242	.2748
BLACK	-.3656	.3204	-.3759	.3083	-.3419	.3517	-.3296	.3675
OTHER_ RACE	-.3532	.3797	-.3847	.3408	-.3868	.3324	-.3844	.3348
MARRIED	-.2986	.2182	-.2835	.2443	-.2808	.2439	-.2793	.2474
DEPS (Dependents)	.4783	.0593**	.4854	.0562**	.5189	.0402**	.5059	.0453**
HCS	-.6480	.0504**	-.6698	.0442**	-.6075	.0649**	-.6283	.0561**
CCS	-.4447	.1267*	-.4359	.1349*	-.4632	.1110*	-.4540	.1187*
SOC-FMENL	.8278	.0924**	.8599	.0812**	.9283	.0589**	.9371	.0562**
SOC-HSCP	-1.016	.0007***	-.9985	.0009**	-.9479	.0012***	-.9451	.0012***
FY01 (post-GWOT)	-.7100	.0180***	-.7048	.0187***	-.7535	.0059***	-.7527	.0066***
DEPLOY	.6836	.1091*						
FY01_ DEPLOY	-.3629	.5295						
HOSTILE			1.2528	.1064*				
FY01_ DEPHOST			-.8021	.3757				
NON-HOSTILE			.4020	.4145				
FY01_ NON-HOST			-.3167	.6779				
MULTDEP					.3815	.5702		
FY01_ MULTDEP					-.6981	.4446		
MONTHS HOSTILE							.1070	.4713

Models	(1) (Any deployment)		(2) (Hostile vs. Non-hostile Deploy)		(3) (Multiple Deployment categories)		(4) (Hostile Months Deploy)	
Variables	**Estimate**	**Pr>Chisq**	**Estimate**	**Pr>Chisq**	**Estimate**	**Pr>Chisq**	**Estimate**	**Pr>Chisq**
DEPLOY								
FY01_ MONTHS-HOST							-.1160	.4893

Significance levels for one-tailed tests except HSCP.
Null hypothesis tested that coefficients are zero.
******* Chisq statistic significant at .01 level
****** Chisq statistic significant at .05 level
***** Chisq statistic significant at .10 level

a. Key Policy Variables (Deployment and FY01)

The strategy for the deployment indicators in the four models was to begin by testing the general deployment indicator and then further divide the overall deployment indicator into specific types of deployments. Model (1) included only the general deployment indicator variable. The variable DEPLOYED in model (1) was found to be significant at the .10 level for a one-tailed test. The expected sign of the parameter estimate was positive. Deployed had a positive parameter estimate indicating that those who deploy are more likely to stay to a second term versus those who did not deploy during their first term. This supports earlier research, which also found positive relationships between deployment and retention (Hosek&Totten, 2002, Fricker, 2002, Pierre, 2005).

The interaction variable FY01_DEPLOYED indicates whether or not deployments that occurred in the post-GWOT period had a greater effect on retention relative to the pre-GWOT period. FY01_DEPLOYED had a negative parameter estimate as expected; however, it was not significant at any of the usual levels. This indicates that overall, deployments occurring in the post-GWOT period are not having a significantly different effect on the decision of first term MSC officers to stay to a second term relative to their deploying peers who started commissioned service in the pre-GWOT period.

Model (2) included variables that further broke deployments into hostile and non-hostile deployments. The deployment variable in model (2) with significance was the variable HOSTILE, which was significant at the .10 level for a one-tailed test. The expected sign for HOSTILE was positive. The parameter estimate was positive, indicating that someone with a hostile deployment relative to one without has a greater chance of staying to a second term, which supports earlier research showing that hostile deployments do not increase the odds of separation (Fricker, 2002). The variable NONHOST was not statistically significant and had a positive parameter estimate as well. Both of the interaction terms for the difference-in-difference estimation for hostile and non-hostile deployments were insignificant with negative signs. The negative signs indicate that if they had been significant then both hostile and non-hostile deployments occurring in the post-GWOT period have a negative effect relative to the pre-GWOT period, however, since they were insignificant, we cannot conclude they have a significantly different post-GWOT effect.

Model (3) included the variable MULTDEP, which was not significant at any of the usual levels. This finding indicates that multiple deployments do not have a substantial impact on retention decisions for either time period in the study. Likewise in Model (4), the MONTHS_HOSTILE_DEPLOYEMNT variable was insignificant and had a positive parameter estimate and the difference-in-difference interaction term was insignificant with a negative parameter estimate.

b. Control Variables

This section discusses the signs and significance of each predictor. Discussion of the magnitudes of effects is deferred to the next section when partial effects are addressed. The Age variable is statistically significant in all four models at the .01 level of significance. The parameter estimates in all models were positive, which was the expected result. We can conclude that an increase in age has a positive effect on first term retention for MSC officers. It could be that older MSC officers already have other work experience and many of them have been prior enlisted with several years of military

service. They may also be more likely to have families and prefer job stability and may be less likely to want a career change after serving for a first term.

For the gender variable, male was the base case while FEMALE was included in the models. In all models the parameter estimate for females was negative as expected; however, the FEMALE variable was not significant at any of the usual levels. We can conclude that male and female MSC officers do not vary enough in their retention behavior to make a significant difference in their decision to stay into a second term of service.

For the Rank variable, LT was the base case and ENSJG (Lieutenant Junior Grade or Ensign) was the rank category included in the models. ENSJG was not found to be statistically significant in any of the models. It did have a positive parameter estimate, which was expected. Many of the MSCs who are Lieutenant Junior Grade or Ensign at their first term retention decision point are prior enlisted. One reason why this variable may have not been significant is possible collinearity between ENSJG and the SOCFMENL variable, which is an indicator that an MSC entered through a prior enlisted source of commission.

For the race variables neither black nor other race were statistically significant. Both variables had negative parameter estimates in all of the models. The expected sign was positive for this variable so this finding is surprising, however because they were insignificant we can conclude that race does not play a major role in the first term retention decision of MSC officers. A test for joint significance was performed to see if together black and other race were significant in the model. The result of the joint significance test was also not significant at any of the usual levels.

For the marital status variable, MARRIED was included in the four models and not married was the base case. The expected sign for the MARRIED variable was positive. The parameter estimates for MARRIED were negative in all of the models, however the estimates were not significant at the usual levels. This indicates that being married does not have a significant effect on the retention decision when compared to that of a single MSC officer.

The variable DEPENDENTS was found to be significant in all of the models. It was significant at the .05 level in models (1) through (4). In all models the parameter estimate was positive as expected. This indicates that MSC officers with two or more dependents are more likely to stay into a second term of service when compared to their peers with one or fewer dependents. It may be that MSCs with more dependents prefer greater job stability and are less likely to embark on a career change outside of military service.

Both subgroup variables, HCS and CCS, were significant in the models. The HCS variable was significant at the .05 level in all models. In all of the models HCS had a negative sign, as was expected . The CCS variable was significant at the .10 level for a one-tailed test for all models. The parameter estimate for CCS was also negative in all cases, as anticipated. This indicates that MSC officers who are in Clinical Care Provider or Healthcare Science are less likely to stay to a second term when compared to the base case HCA. One possible reason is better civilian job opportunities for HSC and CCS officers compared to the base case.

For the sources of commission variables both SOCFMENL and SOCHSCP were found to be statistically significant. The SOCFMENL variable was an indicator for those who were commissioned under a former enlisted program. The anticipated sign for the parameter estimate was positive; since these individuals all had prior enlisted service and had invested several years towards retirement. In all cases the SOCFMENL parameter estimate was positive as expected. It was significant at the .05 level for all four models. This indicates that MSC officers who were prior enlisted entering under the IPP are more likely to stay beyond their first term than someone who was directly commissioned. The SOCHSCP variable was an indicator for one entering service under the Health Services Collegiate Program. The SOCHSCP variable was found to have a negative effect significant at the .01 level for a two-tailed test for all models. This indicates that individuals accessed under this program have a reduced probability of staying compared to someone entering under a direct commission.

For all models the variable FY01 was incorporated to identify officers who were making a retention decision in the post-GWOT time period. For all of the

models the time period FY01 was significant at the .01 level. In all cases the parameter estimate was negative. This indicates that, all else being equal, MSC officers who started their first term in 2001 are less likely to stay to a second term compared to their peers who started service in 1998 or 1999. This finding is interesting and warrants further investigation. It could be that there is a fear of deploying or deployment uncertainly even among non-deployers that is causing MSC officers to leave at a greater rate in the later time period as compared to those who entered in the earlier period.

3. Partial Effects of Significant Variables

a. Notional Person

The partial effects of the significant variables in the models are determined by using the notional person approach, otherwise known as the base case person. The notional person is one who has characteristics that identify the base case for all of the dummy variables in the model. If an independent variable was continuous the notional person was assigned the mean value. This allows us to observe the probability of staying beyond the first term when an individual differs from the notional person on an individual explanatory variable. Only those independent variables that had statistical significance will be discussed.

The notional person is a white male who is 32.5 years old. He is a Lieutenant, Healthcare Administrator who is not married and has one or fewer dependents. The notional person was accessed into the MSC with a direct commission from 1998-1999. For Model (1) the notional person was a non-deployer. For model (2) the notional person did not have a hostile deployment when observing the partial effect for hostile deployments and did not have a non-hostile deployment when observing the effects for non-hostile deployments. For models (3) and (4) the notional person did not have multiple deployments and has .62 months of hostile deployments respectively.

b. Partial Effects

Table 11 shows the partial effects for the independent variables that were statistically significant for models (1) through (4). For models (1) through (4) the notional person has a probability of staying beyond their first term of 89%, 88.8%, 90% and 90.3% respectively. For age, the probability of staying increases by .8% for model (1), .82% for model (2), .765% for model (3) and .72% for model (4) for each additional year in age, all else being held constant. An MSC with the same characteristics as the notional person, having two or more dependents increases the likelihood to stay by 3.8%, 4.0%, 3.8%, and 3.6% for models (1) through (4).

For an MSC similar to the notional person except he entered under an enlisted commissioning program, the likelihood to stay increases by 5.8%, 6.1%, 5.83% and 5.6% for models (1) through (4). Conversely, that same individual entering under the HSCP program has a decreased probability of staying by 14.3% for models (1) and (2), 12.3% for model (3) and 12% for model (4). An MSC similar to the notional person except his MSC subgroup was HCS has a diminished likelihood of staying of 8.0% for model (1), 5.1% for model (2), and 7% for models (3) and (4), and likewise that same individual who is a CCS officer has a decreased chance of staying of 5.1%, 8.5%, 5.0, and 4.7% respectively in models (1) through (4).

An MSC similar to the notional person except for a begin date in 2001 rather than 1998 or 1999 has a decreased probability of staying by 9.0% for model (1), 9.1% for model (2) and (3) and 8.8% for model (4). If an MSC deployed, with all else equal to the notional person, the likelihood of staying increases by 5.1% for model (1). If an MSC has at least one hostile deployment during his first term, with all else being equal to the notional person, his probability of staying increases by 7.7%.

Table 11. Partial Effects of Significant Variables

Models	**(1)**	**(2)**	**(3)**	**(4)**
Variables	Partial Effect	Partial Effect	Partial Effect	Partial Effect
AGE	+.0083***	+.0082***	+.0077***	+.0072***
DEPENDENTS	+.0386**	+.0399**	+.0382**	+.0360**
HCS	-.0801**	-.0511**	-.0698**	-.0703**
CCS	-.0513*	-.0855*	-.0504*	-.0475*
SOCFMENL	+.0584**	+.0611**	+.0583**	+.0563**
HSCP	-.1438***	-.1427***	-.1235***	-.1191***
FY01	-.0904***	-.0911***	-.0914***	-.0883***
DEPLOYMENT	+.0509*			
HOSTILE DEPLOYMENT		+.0770*		

******* Chisq statistic significant at .01 level
****** Chisq statistic significant at .05 level
***** Chisq statistic significant at .10 level
Probability of notional person staying: Model 1 (89%), Model 2 (88.8%), Model 3 (90%), Model 4 (90.3%).

4. Potential Problems with Models

One of the potential problems with a regression model is omitted variable bias. This occurs when important independent variables are left out of the model. This can occur for several reasons; commonly, the variables left out are simply not available. An omitted variable bias can result in either a positive or negative bias, which may affect all of the independent variables in the model. Logit regressions commonly have low Max-rescaled R-squared values and models (1) through (4) had R-squared values of approximately 26% indicating that other variables that were not included could have been useful in predicting retention behavior. Other variables such as satisfaction with military lifestyle, civilian healthcare job opportunity, or satisfaction with pay and benefits are important factors in a stay or leave decision (Shepherd, 2001).

Another potential problem in regression analysis is multicollinearity. This occurs when two or more independent variables in the model are measuring the same thing. This

can affect the regression results by making one or both of the variables that are correlated not significant, when in reality they are statistically significant in the model. The problem of multicollinearity can be overcome by simply taking out variables that are measuring the same thing, or by performing joint significant tests for a group of variables that are not significant, but highly correlated with each other. Multicollinearity can also be ignored when it does not cause serious problems.

The models in this study were checked for multicollinearity using variance inflation factors (VIFs), which show if multicollinearity has increased the instability of a coefficient estimate. Variance inflation factors that are >5 are usually deemed symptomatic of multicollinearity. The sample size for this study was relatively low; as a result, the model VIF was compared to the individual VIFs to diagnose multicollinearity. The model VIF was calculated using the equation $1/(1-R^2)$, where R^2 is the coefficient of determination for the comparable ordinary least squares model. If an individual VIF was larger than the model VIF then multicollinearity may be an issue. All variables that had VIFs greater than the model VIF were identified and double-checked with a correlation table. The variable ENSJG and SOCFMENL were found to have a correlation coefficient of .49, higher than any other correlations between the independent variables, which may be rendering ENSJG statistically insignificant. However, SOCFMENL, one of the focus variables for the study, was significant in all the models and so adjustments for collinearity were not pursued.

C. SUMMARY

The logistic regression models were successful in determining several key factors that influence retention behavior of first term MSC officers. The four- model approach was successful in identifying the significance of two of the key deployment variables. Both deployments and hostile deployments of first term MSC officers were found to have a positive effect on retention rates of 5.09% and 7.7% respectively. The results for the difference-in-difference estimators were inconclusive. While they had negative signs indicating a possible negative effect on retention, their significance levels were too low to draw any conclusions about them. We cannot conclude if the change in OPTEMPO

characterized by more hostile deployments, post-GWOT, is having an effect on retention. A much larger sample size may be needed to definitively conclude the presence of a post-GWOT deployment effect.

One interesting finding is that the time trend variable FY01 is influential. Starting commissioned service in 2001, post-GWOT, reduced the probability of staying for MSC officers by approximately 9%.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

A thorough understanding of retention behavior is a key component of effective human capital management. Knowledge of MSC retention characteristics can potentially help with assessing policy decisions such as military to civilian conversion programs. Not only can retention studies assist in meeting desired end strength manpower requirements, but they can also help with identifying cost containment strategies such as determining the most cost effective and efficient MSC accession programs. Although this study is narrow in scope, several key indicators of MSC retention are identified. This study also attempted to measure the possible effects of the Global War on Terror on MSC retention due to increased OPTEMPO.

1. Primary Research Question

The primary research question of this retention study was to determine if there has been an effect on retention rates within the Medical Service Corps for junior officers since the initiation of the Global War on Terrorism and, if so, to attempt to determine possible sources. The primary question was addressed by incorporating the difference-in-difference estimation technique to compare retention rates in two samples of MSC cohorts: a sample of the cohort of MSC officers who served and had to make their first retention decision before the initiation of GWOT (control group), and a sample of the cohort of MSC officers who served and had to make first retention decision after the initiation of the GWOT. It was found that there is a significant negative effect on retention for officers who served in the 2001 cohort relative to those serving in the 1998 and 1999 cohorts. This effect was a decreased retention rate of approximately 9%, indicating a general negative trend. The causes were investigated further by looking at the possible effects of increased OPTEMPO during this period.

Of the deployment variables studied, two were found significant: the general deployment indicator and the hostile deployment indicator. They were found to have an

overall positive effect of 5.09% and 7.7% respectively. This suggests that MSC officers who deploy may have increased job satisfaction and a sense of duty that does not cause them to leave the service when called upon to deploy. These results support earlier studies that found those who deploy experience a sense of mission accomplishment and enhanced job satisfaction when they get to use their training in a "real situation" (Hosek, Kavanagh and Miller, 2006).

Even though these findings for the effects of deployments were interesting, the difference-in-difference estimators indicate that the effects of deployments for the two samples (pre- and the post-GWOT periods cohorts) are not statistically significantly different from each other, although the hypothesized signs of the parameter estimates were as expected, negative. This would suggest that other important factors are causing decreased retention rates such as fear of deployment, deployment uncertainty, or as was suggested in earlier research, non-deployers in a unit left behind were more likely to leave due to increased stress due to long work days and increased stress without the benefits of a deployment (Hosek, Kavanagh and Miller, 2006). Another possible reason is that there may be more civilian job opportunities for the 2001 cohort compared to their peers in earlier cohorts.

2. Secondary Research Questions

The secondary research questions of this retention study were to determine if there are there any differences in retention behavior among HCA, HCS and CCS officers within the MSC. In all models the MSC subgroups were very significant independent variables. Both CCS and HCS officers are much less likely to stay beyond a first term compared to their HCA peers. The decline in retention rates were approximately 5% and 8% for CCS and HCS officers respectively. This discrepancy in retention rates could be due to more civilian opportunities for CCS and HCS officers, or the presence of a military-civilian pay gap that may be motivating these officers to pursue civilian careers.

Another secondary question was to determine if different Medical Service Corps accession sources have a significant effect on retention. The sources of commission variables were all significant in all models. It was found that MSC officers who are

accessed through the IPP are more likely to stay by approximately 6% compared to their peers who were accessed by a direct commission. MSC officers accessed through the HSCP are, overall, approximately, 13% less likely to stay beyond their first term when compared to their peers who were accessed by a direct commission.

Several demographic independent variables were also included in the models as control variables. Two demographic factors were found to be significant for retention, age and number of dependents. Age had a positive effect, indicating that older MSC officers are more likely to be retained beyond their first term. Also, if an MSC officer had more than one dependent he or she was more likely to be retained beyond the first term.

3. Recommendations/Future Research

This study was successful in identifying several key indicators of MSC retention; however, there exist several factors that were not included the model. Some of these factors are satisfaction with military life and the possibility of military/civilian pay gaps. This study also identified a significant negative trend with respect to MSC officers starting in 2001. Future research could determine if this trend persists beyond this group and if so, determine reasons why through surveys and focus groups.

HCS and CCS officers were less likely to stay beyond a first term compared to their HCA peers. Follow on research could isolate these groups and perform a more detailed analysis on the causes of this retention disparity. A recommendation to address differences in retention rates among MSC groups is to develop creative incentives beyond what is currently offered, this could alleviate military/civilian pay gaps if this is indeed a problem.

The accession source variables could also be studied in more depth, including a cost-benefit analysis among the different accession sources, which could provide insight on accession source return on investment. A thorough cost/benefit analysis as a follow on to this study could be useful in developing an optimal accession source mix based on both financial and econometric analysis.

The deployment variables used in the study were limited as they did not identify the countries in which the deployments occurred, or what kind of operational platform was involved. The difference-in-difference deployment/time period variables proved to be inconclusive and therefore, it is difficult to determine whether or not there is an effect on retention from increased OPTEMPO strictly due to deployments of individuals after the initiation of major combat operations in the GWOT. As more data become available on deployments in the next several years, another attempt to isolate these effects may produce more significant results. It may also be useful to develop a post-deployment survey focused on career intentions of returning MSC officers.

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