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The Impact of the Navy's Tuition Assistance Program on the Retention and Promotion of First-term Sailors

12 June 2008

by

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Abstract

This study analyzes the impact of the Navy's Tuition Assistance (TA) program on the retention and job performance of first-term Navy enlisted personnel. Prior studies analyzing the retention effect of the Navy's TA program have produced conflicting results—one study finding that participants are more likely to leave the Navy, the other study finding they are more likely to stay. Our analysis of this relationship has several advantages over the prior studies. First, the analysis exploits a unique feature in the data to create a natural control group that allows us to adjust for the potential selection bias. Second, we use a larger data set consisting of cohorts of recruits who entered the Navy between 1994 and 2001. The recruits are tracked during their first five years of service. We find that first term sailors who use TA to enroll in college classes have a significantly higher probability of reenlistment and of promotion to both E4 and to E5 than those who participate but do not complete their courses. While these results are robust to the controls for selection, the results indicate that self-selection into the program is likely to explain as much as one-half of the baseline retention effect. An additional finding is that women and minorities are more likely to take college-courses and that retention and promotion rates of women and minority TA participants tend to be better than their peers.

Keywords: Tuition Assistance (TA) program, first-term Navy enlisted personnel, retention

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Executive Summary

This study analyzes the impact of the Navy's Tuition Assistance (TA) program on the retention and job performance of first-term Navy enlisted personnel. Although two prior studies were available that analyzed the retention effect of the Navy's TA program, they produced conflicting results—one study found that participants are more likely to leave the Navy, while the second found that they are more likely to stay. What is more surprising about these conflicting findings is that both studies used the same data on Navy enlistees who entered in 1992. This divergence in results demonstrates the inherent difficulties in establishing reliable causal effects on the behavior of program participants in program evaluation studies. Given the lack of consistent and reliable results on the program's impact and the absence of a convincing analysis of the return on investment in this program, the Navy requested that another study of the Tuition Assistance program be conducted. This report presents the results of our study of the TA program

Our analysis of the Tuition Assistance program has several advantages over earlier studies. First, we use a large sample of cohorts of recent recruits who entered the Navy between 1994 and 2001. For each new recruit we have data on their characteristics each year during their first term of service. Second, the data covers multiple cohorts (as opposed to the single cohort analyzed in the earlier studies) and represents a period when the TA program was expanding. Thus, the results are more likely to be externally valid than the prior studies; that is, our results are more likely to apply to the current (2008) environment and population of first-term sailors than the results of earlier studies that focused on a single cohort of recruits. Third, our study expands the scope of analysis to include program effects on sailor performance as well as on retention. Finally, and perhaps most importantly, our study differs in the methodological approach we adopt to deal with the inherent selection problem that affects statistical estimates of program effects. Unlike earlier studies that use instrumental variable techniques to solve potential selection

problems, we develop a natural control group to derive the causal effect of the TA program.

Our study focuses on the first term of service for sailors who entered the Navy between 1994 and 2001. We restrict the sample to recruits with 4-year obligations. These recruits are observed during their first 5 years of service to determine whether they attrite before the end of their initial contract or they reenlist or extend. The statistical analysis uses MEPCOM data on the characteristics of new recruits at entry and data from the Defense Manpower Data Center on career outcomes such as promotion, attrition, and reenlistment. The Navy Center for Personal and Professional Development provided data on TA course enrollments and course grades.

The statistical analysis relies on an estimation of multivariate models of the main behavioral outcomes. The first model analyzes the determinants of participation in the TA program during the first term of service. This model investigates whether the observed differences in TA usage rates are explained by individual attributes, such as educational attainment prior to enlistment or ability. Next, we estimate a reenlistment model in which the dependent variable measures whether the individual sailors reenlist or extend at their first decision point. Finally, we estimate the probability of achieving the rank of E-4 and E-5 by the 5th year of service. The re-enlistment and promotion models include race/ethnicity, gender, education, AFQT scores, marital status and dependents as control variables. In addition, all models include fiscal year dummies and rating dummies.

The analysis exploits a natural internal comparison group in the data to control for the potential bias due to self-selection of sailors into the TA program. The evidence is drawn from sailors who apply for TA assistance and enroll in college courses but who are forced by external circumstance (e.g., deployments and emergencies) to withdraw. The pool of those who withdraw provides a natural control group for those who successfully complete their college courses via TA.

Findings

The TA participation rate in this sample is .22, which is based on the rate for all eight accession cohorts during their 5-year service period. Women used TA at twice the rate of men (27% vs. 12%). Women also had higher successful course completion rates than men (81% vs. 77%). The mean reenlistment rate of TA users in our data exceeds that of non-users by 12 points (about 20%). In addition, the promotion rate to E4 and E5 was 3.6 points and 5.4 points higher, respectively, for TA users.

The results of the multivariate models of TA participation confirm the differences in means observed in the bivariate comparisons. Participation rates for women are 18 percentage points higher (nearly double) those of men, holding all other factors constant. In addition, most minorities, except Native Americans, are more likely to use TA than are whites.

Estimates of the TA effect in models that are not corrected for individual heterogeneity will be biased if participants are not randomly selected. Sailors who voluntarily participate in TA may be more motivated or have higher ability than sailors who do not take any college courses. Furthermore, these characteristics are likely to be correlated with job performance and the probability of re-enlistment. Our approach to adjust the estimates for selection bias is to use a sample consisting solely of TA users and to compare successful course completers with enrollees who do not complete their courses. We assume that all participants who use TA to enroll in college courses share similar motivation, initiative, and aptitude, but some are unable to complete the courses for exogenous reasons. Such reasons are often related to military deployments and other job duties beyond the individual's control. We use this exogenous variation in course completion among TA participants to estimate the program effect.

The results of the selection-adjusted indicate that TA users have re-enlistment rates that exceed those of non-participants by 6.2 percentage points.

Since the overall re-enlistment rate in this sample is .68, this represents an increase in reenlistment rates of about 9%. This effect is about one-half of the effect in the unadjusted estimates, suggesting there is an upward bias when no correction is made for individual heterogeneity.

The results of the promotion models using the full sample show that TA participation increases the probability of promotion to E-4 by 14.1 percentage points (about 23%). Again, there is some concern that these estimates are biased upward due to unobserved characteristics that affect TA participation and that are likely to be correlated with promotion. When we restrict the sample to only TA participants, the estimates indicate that course completers have a promotion rate only 3 points (about 5%) above that of non-completers. This pattern is repeated for the E5 promotion outcomes. In the full sample, TA appears to increase E5 promotion by 6.1 points (30%), but in the selection-adjusted estimates, this effect falls to 4.9 points (20%).

The average effects estimated for the full samples mask some important differences within demographic groups, especially blacks and women. African-American recruits who participate in TA are more likely to reenlist than white TA-users by about 13.6 percentage points (or 20%). In addition, within the African-American group, those who participate in TA also are more likely to reenlist than non-participant African-Americans by about 14.4 percentage points (or 21%). Similarly, African-Americans course completers are more likely to promote to E4 than African Americans who use TA but fail to complete their studies. This promotion advantage is 4.5 points (7.4%). Finally, among African Americans, course completion boosts E5 promotion rates by 4.6 points (22%).

In general, women are less likely to reenlist than are men. However, women who complete TA courses are more likely to reenlist than women who do not complete their courses (by 13%). This indicates that TA usage may have a positive effect on female retention, but this effect may be prone to endogeneity bias. These results also seem to indicate that TA may be an important reason for women to join and remain in the military, since the gender retention gap is about twice as large when analyzing course completion than when focusing on any TA use at all. The gender gap in promotion probabilities does not change much after restricting the sample. However, TA continues to have a positive (although much smaller) effect on female promotion rates.

In summary, the statistical analysis finds that first-term sailors who use TA to enroll in undergraduate college classes have a significantly higher probability of reenlistment and of promotion to both E4 and to E5 than those who participate but do not complete their courses. Additional findings suggest that women and minorities are more likely to take college-courses and that retention and promotion rates of women and minority TA participants tend to be higher than their counterparts.

We also conducted a cost-effectiveness analysis of the TA program. Based on our multivariate models, we were able to quantify and monetize the benefits associated with the higher retention (and an associated increase in average experience levels) and with the higher promotion outcomes. Based on previous estimates of the costs of increasing reenlistments via Selective Reenlistment Bonuses (SRB), we calculated the TA impact on retention saved the Navy between $57 million (a lower-bound estimate) and $125 million (an upper-bound estimate) annually. Based on annual program expenditures of $95 million, the program is cost-effective, using the upper-bound estimate but is not cost-effective using the lower-bound estimate. However, this calculation ignores numerous other potential benefits of the program, which we were not able to quantify. These include its potential effect on recruitment, its effect on the cross-rating of sailors to more technical ratings, its effect on sailors applying and qualifying for enlisted commissioning programs, and its demonstrated effect in this study on improving the Navy's diversity goals. When these important non-quantifiable benefits are considered in the cost-benefit assessment, it is our judgment that the Tuition Assistance program is a cost-effective program.

Recommendations

In a recent *Education Quick Poll* (2006) over 84-95% of respondents in pay grades E2-E7 reported that that a college degree would benefit them professionally (Uriell, Patrissi, Newell, & Whittam). Moreover, a clear majority in all three pay grade groupings (E2-E3, E4-E5, and E6-E7) agreed with the statement that "Educational Opportunities in Navy Positively Impact My Decision to Make Navy a Career." (Uriell, Patrissi, Newell, & Whittam). However, respondents also reported significant obstacles to TA participation; 78%-83% of those in pay grades E2-E5 reported it was not "easy to schedule courses." The most common reasons cited for difficulties in scheduling classes were a "lack of time" and "conflicts between work and education." Both factors were cited by roughly half of all respondents in all pay grades. Another barrier sailors identified was the "annual TA limit."

The results in this paper suggest that the Navy should consider policies that encourage TA participation and, in particular, encourage course completion by those who enroll in college classes. Sailors' suggestions on what could be done to make it easier to obtain a college degree seem to provide a base for recommendations to policy makers. The three top policies sailors recommended were: (1) to provide time off for classes during duty hours; (2) provide more flexible work schedules that accommodate courses; and (3) increase TA reimbursement rates. In particular, they recommended fully funding TA for degree completion and removing the 16-semester credit hour annual maximum. Finally, the results strongly suggest that sailors should be encouraged to use educational counseling services at Navy College Offices and to develop an individual educational plan. This plan would assist them in identifying the classes most closely associated with their career goals. This should improve course completion rates. Finally, the Navy should consider a more sailor-friendly policy of granting waivers for classes that sailors who were unable to complete due to work-related reasons. Sailors will always have to deploy and work schedules will continue to change frequently. However, sailors should not be penalized for such work-related changes; otherwise, incentives to use the TA program will be weakened.

Introduction

The observation that many organizations, for-profit and non-profit alike, often subsidize general education for their employees presents a challenge to the investment in human capital model (Becker, 1964). The human capital model suggests that profit-seeking firms operating in a competitive labor market will not invest in general education that has the effect of improving the labor market value of their employees. Despite this prediction, surveys indicate that the practice of subsidizing all or a portion of employees' costs of taking college- or graduate-level classes is widespread, with one survey indicating that 61% of private firms that employ 50 or more employees offer a tuition reimbursement program (Flaherty, 2007). In sharp contrast to the predictions of the human capital model, firms also indicate that one of the main reasons for offering tuition reimbursement programs is to reduce employee turnover (Flaherty, 2007). It appears that either the actual incentive structure in many internal labor markets is at odds with the implications of human capital theory or labor markets are not as competitive as the traditional model assumes.

Alternative theories have been advanced to explain why sponsoring general education may be beneficial for a firm. One hypothesis is that such employee benefits bond employees to the firm and allow it to extract more value from investments in firm-specific training (Glick & Feuer, 1984). The longer tenure could be because education subsidies may increase job satisfaction and loyalty to the firm. Another hypothesis is that education benefits are a component of the employee's overall compensation package, which would tend to improve job satisfaction and, indirectly, recruiting and retention. This particular fringe benefit may also attract higher-quality applicants than alternative benefit packages (Capelli, 2004). General education also may complement firm-specific training and may directly benefit the firm by increasing worker productivity. If general education enhances firm-specific skills, it can increase workers' pay and internal promotion prospects and, as a consequence, retention (Flaherty, 2007). Acemoglu and Pischke (1999) and Autor (2001) hypothesize that investments in general education may not increase turnover if individuals' search and mobility costs give firms some monopsony power in the labor market.

Very few studies to date have empirically evaluated these hypotheses. Feuer, Glick, and Desai (1987) find that firms that sponsor education have lower turnover. They find, however, that wages are similar for firms that sponsor general education and those that do not. Cappelli (2004) also finds that firms sponsoring general education have lower turnover rates. In contrast, Krueger and Rouse (1998) find no difference in turnover rates in two firms sponsoring literacy programs. One of the biggest challenges of this literature is data availability and quality. Studies using data from the private sector are limited to comparisons of firms that sponsor general education to those that do not. Ideally, it should be observed which individuals within the firm use general education subsidies and how their careers and turnover rates compare to those who do not use the subsidies. Recent studies have improved in this regard by using public sector data, which offer more detail on individual usage rates and careers. The Department of Defense (DoD) sponsors education for recruits, for many of whom educational benefits are a primary reason for enlisting. Military administrative data offer details on courses and grades and also identify individual participation and intensity of participation in the programs.

Despite the more accurate data, the empirical literature on tuition reimbursement programs in the Navy currently does not provide a definite answer to the question of whether general education subsidies reduce turnover. In fact, this literature to date has produced conflicting results about the effect of general education subsidies on retention. Garcia and Joy (1998) and Garcia, Arkes, and Trost (2002) find that tuition reimbursement improves retention. Buddin and Kapur (2002, 2005) produce estimates that indicate the opposite and attribute the prior findings to spurious correlation and endogenous instruments.

This divergence in results may be due ,in part, to the inherent difficulties in establishing convincing causal effects in program evaluation studies. This is especially important in this case since workers who voluntarily choose to take advantage of tuition reimbursement programs most likely systematically differ from those who do not. A second difficulty in obtaining causal effects stems from the difficulties in identifying the relevant sample. What seems to drive differences in the estimated program effects in this literature is not the methodological approach, but rather the restrictions that are imposed on the sample of sailors. In particular, the group of sailors assigned to the control group differs significantly between the two studies. Buddin and Kapur (2002, 2005) claim that recruits who leave the Navy before the end of their first contract do not have the same opportunity to take college courses and therefore need to be removed from the sample. By applying this sample restriction to the data used by Garcia and Joy (1998) and Garcia et al. (2002), they estimate negative retention effects of Navy tuition reimbursement programs. Overall, this literature focuses on turnover, without investigating why and how general education subsidies may affect turnover. In particular, no on has attempted to examine the direct productivity effects of such programs.

This study examines the effects of the Navy's tuition reimbursement program on enlisted personnel and offers several improvements over prior studies. In particular, the study analyzes the effect of program participation on enlistees' voluntary first-term retention decisions using a panel of several recent cohorts of Navy recruits. Given the recent increase in educational attainment in the general population, more recent data allow us to observe rates of participation in the tuition reimbursement program that exceed prior studies by about 100-150%. We also assess the direct job productivity effects of additional general education by investigating career progression and promotion rates of participants. Most importantly, the study offers improved causal estimates of the effects of the tuition reimbursement program on these outcomes. Prior studies have attempted to deal with selection bias using instrumental variables (IV) techniques and propensity score matching. The instruments used in the Garcia and Joy (1998) and Garcia et al. (2002) analyses are strongly correlated with participation but most likely are endogenous, whereas the instruments that are used in the more recent work by Buddin and Kapur (2002, 2005) are weakly correlated with participation. In contrast, this study exploits a unique feature of the data to control for selection and to identify the direct education effect of the program on retention and job productivity. More specifically, we exploit the fact that a number of sailors enroll in college-level courses but withdraw due to external (and most likely exogenous) circumstances, such as deployments, emergencies, or changes in work schedules. This group suggests a natural comparison that nets out motivation and ability when considering the choice to undertake more education.

We find that the tuition reimbursement program in the Navy improves retention of first-term sailors. However, our estimated effects are considerably reduced in models that control for self-selection into the program and are lower than those estimated in previous studies. We also find that those who make use of Navy-sponsored education are more likely to be promoted than their counterparts. These effects appear to vary across gender and race categories. In particular, we find that women and minorities are more likely to take college courses and their retention and promotion rates are disproportionately better than those of white males.

This study is organized into six sections. Section II describes the Department of Defense's Voluntary Education program and reviews prior studies on the effects of employer-subsidized education on the retention of civilian employees as well as enlistees. Section III describes the data and presents descriptive statistics for the relevant samples. Section IV presents the results of the statistical analysis, and Section V provides conclusions and recommendations.

Background

The Department of Defense's (DOD) Voluntary Education program (VOLED) is one of the largest employer-sponsored education programs in the world. VOLED allows members of the armed forces to attend courses during off-duty periods, and each year over 340,000 service members participate in post-secondary education courses (Faram, 2008). Students pursue different academic credentials, including high school diplomas, GEDs, non-degree programs aiming to improve basic academic skills, as well as undergraduate or graduate degrees. Expenditures (in nominal and real terms) on voluntary education programs between 1985 and 2006 are shown in Table 1.

Table 1. VOLED Expenditures by Service and Year in Nominal and Constant (2006) Dollars

(Navy Center for Professional and Personal Development, 2007)

	Nominal Dollars					Constant 2006 Dollars				
FY	Army	Navy	USMC	USAF	Total	Army	Navy	USMC	USAF	Total
1985	25.0	15.9	7.9	34.4	83.2	48.5	30.8	15.3	66.7	161.4
1986	65.8	21.6	9.8	40.0	137.2	126.3	41.5	18.8	76.8	263.4
1987	49.1	19.7	9.3	46.9	125.1	92.4	37.1	17.6	88.2	235.2
1988	27.1	18.8	7.6	43.4	96.9	49.7	34.5	13.9	79.6	177.6
1989	29.1	15.4	7.2	36.9	88.6	51.7	27.4	12.8	65.5	157.4
1990	32.6	18.6	7.3	36.2	94.7	55.7	31.8	12.5	61.9	161.8
1991	31.7	20.2	7.6	34.2	93.7	52.4	33.4	12.6	56.6	155.0
1992	38.2	24.5	9.5	46.9	119.1	61.6	39.5	15.3	75.6	192.1
1993	40.2	23.8	9.0	49.0	122.0	63.2	37.4	14.1	77.0	191.7
1994	38.2	24.4	9.7	57.6	129.9	58.6	37.4	14.9	88.4	199.3
1995	36.3	24.0	10.1	56.3	126.7	54.2	35.8	15.1	84.0	189.0
1996	36.1	20.8	10.9	53.1	120.9	52.2	30.1	15.8	76.8	174.9
1997	38.1	27.4	11.6	53.8	130.9	53.8	38.7	16.4	75.9	184.7
1998	38.2	30.9	13.0	49.4	131.5	52.9	42.8	18.0	68.5	182.3
1999	45.8	33.0	13.9	54.8	147.5	61.8	44.6	18.8	74.0	199.1
2000	48.5	35.8	16.7	56.2	157.2	62.8	46.3	21.6	72.7	203.4
2001	54.5	38.0	17.4	64.1	174.0	67.9	47.3	21.7	79.8	216.6
2002	58.9	42.6	18.5	67.2	187.2	71.7	51.8	22.5	81.8	227.8
2003	157.3	58.7	35.4	120.2	371.6	185.0	69.0	41.6	141.4	437.0
2004	217.4	71.3	37.7	140.6	467.0	245.0	80.4	42.5	158.5	526.3
2005	211.8	72.6	37.6	139.4	461.4	225.1	77.2	40.0	148.2	490.5
2006	140.9	95.2	45.5	149.4	431.0	140.9	95.2	45.5	149.4	431.0

From Table 1 it appears that VOLED expenditures have increased considerably across all services in the past two decades. The most dramatic increases, however, have occurred since the early 2000s.

Table 2 provides the number of enrollments in the various educational components of the Voluntary Education program by service branch. The four components are high school diploma classes, remedial education classes (“basic skills”), undergraduate college classes, and graduate classes. Table 2 shows that the undergraduate college program is by far the largest component of the Defense Department’s Voluntary Education program. All the service branches have experienced increased enrollments in recent years in the college (undergraduate and graduate) programs, with the exception of the Army. Falling Army enrollments may be due to the extensive deployment of soldiers overseas. The Navy’s undergraduate enrollment also includes enrollments in the Navy College Program for Afloat College Education (NCPACE). Note that course enrollment is not the same as the number of individuals participating, because an individual may take more than one course in a given year.

Table 2. Voluntary Education Enrollments by Service
(After: DOD Voluntary Education Online, 2007)

Branch	YEAR	High School	Basic Skills	Undergraduate	Graduate
ARMY	2006	146	12,616	238,479	26,178
	2005	55	15,577	255,945	29,541
	2004	118	19,072	319,451	37,018
NAVY	2006	58	10,004	176,318*	15,576
	2005	63	10,811	168,927*	13,261
	2004	87	13,547	165,545*	12,907
MARINE CORPS	2006	8	3,802	69,839	4,766
	2005	6	1,996	67,447	4,624
	2004	7	2,534	67,503	4,860
AIR FORCE	2006	0	1,450	225,586	42,229
	2005	10	2,239	238,464	41,317
	2004	74	3,236	269,545	44,648
TOTAL DOD	2006	212	27,872	710,222	88,749
	2005	134	30,623	730,783	88,743
	2004	286	38,389	822,044	99,433

Note: *Navy Undergraduate Contains NCPACE Data

Source: CPPD

Table 3 shows the number of enlisted sailors participating in TA by year and by rank. The annual participation rate averages about 18% of the total enlisted force. Table 3 also shows that participation is low for sailors in the early grades (E1-E2) and peaks in the middle grades (E4-E6). This is not surprising as sailors in the entry grades are occupied with completing basic recruit training and occupational training and have little time for off-duty education.

Table 3. Individual TA Participants by Year and Rank
(CPPD, 2007)

Rank	2004	2005	2006	2007*
E1	294	330	445	356
E2	1,209	1,212	1,362	1,221
E3	6,453	6,267	5,914	4,646
E4	10,008	9,696	10,100	7,734
E5	16,317	17,543	17,858	14,469
E6	12,027	13,815	14,876	11,703
E7	5,981	6,707	7,416	6,246
E8	1,833	2,064	2,274	1,817
E9	673	719	746	608
Total	54,795	58,353	60,991	48,800
Percent of end strength	0.17	0.19	0.20	0.16

Note: *Partial year data

The goal of the Navy's VOLED program is to cultivate the career potential of its sailors and marines by providing opportunities to increase educational attainment. In addition to the personal benefits, the Navy looks to increase the retention and readiness of quality personnel and strengthen job performance, while promoting a culture of continuous learning (Secretary of the Navy, 2005). The Navy's goal is to ensure that sailors have the opportunity to participate in the VOLED programs regardless of mission or duty assignment. Garcia and Joy (1998) provide a detailed description of the Navy's VOLED program.

Navy College Program for Afloat College Education (NCPACE)

The Navy assists sailors while deployed at sea by providing the opportunity to continue their education through Navy College Program for Afloat College Education (NCPACE). NCPACE is part of the Navy College Program and provides both academic skills courses and undergraduate and graduate college courses. The courses are offered through accredited colleges and universities and are provided tuition-free to sailors except for the costs of textbooks and other educational materials required (DoD Voluntary Education Online, 2007).

Table 4. Navy PACE Enrollments and Courses Taken
(DOD Voluntary Education Online, 2007)

FY	NCPACE TOTALS		Instructor NCPACE		Technology NCPACE	
	Enrollm ents	Courses	Enroll-ments	Courses	Enroll-ments	Courses
2007*	6,483	8,359	2,878	3,698	3,680	4,661
2006	15,538	25,105	8,779	13,903	7,356	11,202
2005	13,048	20,918	7,681	11,873	5,925	9,045
2004	12,065	18,269	7,192	10,888	5,206	7,381
2003	15,209	24,221	9,239	13,618	6,460	10,603
2002	15,453	26,169	9,306	14,730	6,824	11,439
2001	17,905	30,638	11,190	18,696	7,519	11,942
2000	16,018	27,558	10,111	16,320	6,674	11,238
1999	13,169	21,172	7,976	12,511	5,813	8,661
1998	9,464	13,357	6,612	9,486	3,088	3,871

Note: *FY07 Data Incomplete

The Tuition Assistance (TA) Program

This study focuses on the largest component of the VOLED program: the Tuition Assistance (TA) program. Prior to 2002, the TA program reimbursed sailors for 75% of tuition. In 2002, the reimbursement rate was increased to 100% of tuition and fees, not to exceed $250 per semester hour (a maximum of 16 credits per year), $166.67 per quarter hour (a limit of 24), and $16.67 per hour (a limit of 240). To qualify, sailors must meet the following criteria:

> (a) Advancement-eligible Sailors must have taken and passed most recent advancement examination; (b) Must pass (or be medically waived) from the most recent physical readiness test; (c) Must not be under instruction in initial skills training or in a duty-under-instruction training status; (d) Must be recommended for promotion or advancement (as applicable); (e) Have not been awarded non-judicial or courts-martial punishment within the previous six months; and (f) Enlisted personnel with less than twenty years in-service are required to have at least one year remaining on their current enlistment contract prior to using TA. (NAVADMIN, 2007a)

In 2006, the Navy spent $127.9 million on all components of its VOLED program. Expenditures on the TA component were $95.2 million, or about 74% of total VOLED expenditures. Expenditures on TA have increased considerably in recent years. Prior to 2001, annual spending on TA averaged around $37 million (2006 dollars). In 2006, 60,991 individuals (about 18% of all enlisted personnel) enrolled in roughly 176,000 college courses, an average of more than two college classes per participant per year.1

After 2001, the Navy's TA budget increased sharply. A partial explanation for this increase in spending may lie with the 2001 Executive Review of Naval Training. In addition to identifying areas of potential training improvement for the Navy, the study pointed out that the Navy was losing a large portion of its recruitable market. According to Kennedy (2002) "between 1974 and 1999, the number of non-college bound high-school graduates—the Navy's traditional enlisted recruiting market—decreased by almost forty percent." This decrease was caused by a proportionate increase in college enrollment. The review recommended that the Navy increase the emphasis on off-duty education as a way to increase recruiting and retention prospects. Perhaps due to this renewed dedication to education tuition reimbursement rates were raised from 75% to 100% in 2002.

The importance of education in sailors' careers was strengthened when the Navy decided to require an Associate degree for promotion to E8 by 2010. However, that requirement was dropped in early 2008 and was replaced by the "Enlisted Learning and Development Strategy" in April 2008 (Faram, 2008, p. 8). The strategy maps required professional military education and training courses into the career paths for every Navy rating. Of key importance for this research, the strategy also builds off-duty education (via TA) into career paths. As sailors reach the petty officer grades, the strategy envisions greater emphasis on off-duty education and "rating-relevant" degree programs. Finally, the strategy encourages consideration of off-duty education for

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[1] Garcia and Joy (1998) show that 60,793 (18% of the total enlisted force) participated in 1997 for total course registration of 139,772. This represents about 2.3 courses per person, per year among participants. However, the data from Garcia and Joy includes all participants in VOLED and overstates the TA participation rate.

promotion to E7 and mandates education points for completion of Associate degrees and Bachelor's degrees for promotion to E6 and above.

Literature Review

Garcia, Arkes and Trost (2002) were among the first to analyze the Navy's VOLED program. The study analyzed the retention behavior of the 1992 cohort of Navy recruits who participated in any component of the VOLED program. To correct for the self-selection of sailors into the VOLED program, the authors used an instrumental variable that indicated whether sailors attended education counseling sessions. These sessions disseminated information on the VOLED program, and the authors hypothesized that better-informed sailors would be more likely to participate in VOLED. The estimates of the study suggest that VOLED participants have a probability of reenlistment that is 10.8 points above that of non-participants, or 12.9 points higher if factoring in self-selection. Buddin and Kapur (2002) argued that this instrument was most likely endogenous. The unobserved heterogeneity that drives sailors to participate in VOLED may be very similar to that which drives attendance in the information sessions. In addition, this study included in the control group individuals who left the Navy too early in their first term to participate in VOLED.

Buddin and Kapur (2002) replicated the results of Garcia et al. but restricted the sample to those who remained in service for at least four years. They claimed that this restriction was necessary to ensure that all recruits in the control and treatment groups had an equal amount of time to participate in TA. Their replication analysis found that participating in TA reduced retention by about 9 percentage points. Buddin and Kapur attributed the positive retention effect found previously to the spurious correlation between TA usage and survival in the Navy. That is, estimates did not reflect the causal effect of TA participation increasing retention, but rather the reverse—those who survive all 4 years of their first enlistment term have more time to enroll in TA courses. In this and in a related study, Buddin and Kapur (2005) provide new estimates of TA by using instrumental variables and propensity score matching to deal with the self-selection problem. The bivariate probit model treats TA usage as endogenous and includes instrumental variables (IVs) to predict TA usage. The IVs were based on the accessibility to college courses before enlistment and during service. In particular, the study used distance from the sailors' nearest 4-year college before enlistment, course offerings on base, base size, and an interaction of the last two variables to capture peer effects in college courses on base. Buddin and Kapur (2005) found that TA users had a lower retention rate (-16.5 percentage points) than non-users. Their propensity score estimates similarly indicated that the reenlistment probability of TA users was 7.5 points lower than that of non-TA users. The study concludes that TA users are more likely to leave the military for better job opportunities made possible by their increased education levels.

While the Buddin and Kapur critique of prior research on TA and retention is valid, their results suffer from several weaknesses. First, like Garcia and Joy (1998) and Garcia et al. (2002), Buddin and Kapur limit themselves to data from a single cohort of Navy enlistees. This raises questions about the external validity of the results of both studies. External validity of estimated program effects refers to the extent to which the effects can be generalized to different populations or different time periods. External validity may be questioned because the 1992 cohort may differ from the average cohort or from current entry cohort members. In addition, the program itself has changed—it has expanded and reimbursement rates have increased. Increase reimbursement rates and other changes in Navy policies on life-long learning have increased incentives for sailors to participate in TA.

Some specific features of the 1992 cohort also raise questions of external validity. The FY1992 cohort enlisted a few months after the 1990-1991 recession, during which unemployment rates were as high as 7.5 percent. The initial 4-year contracts for this cohort expired during 1997-1998, which coincided with the dot-com boom and historically low unemployment rates of 4.5-4.7% (Bureau of Labor Statistics, Employment Situation monthly news releases). This could also be the reason why the overall retention rate for this cohort is so low (about 30%). Enlistments tend to be high during economic downturns and retention tends to be low during economic booms. Therefore, part of the TA effect estimated with data from this special cohort may be due to external economic forces, rather than the program itself.

Second, while the instrument used by Garcia et al. (2002) (i.e., participation in VOLED information sessions) was potentially endogenous, the instruments used by the Buddin and Kapur are arguably weak and some of them may still be endogenous. The authors hypothesize that recruits who lived near a college before enlistment, have on net, a higher taste for college education.[2] However, Card (1993), when using this IV, argues that the main reason proximity to college and college education are positively correlated is that those who live closer have lower costs associated with college education. In support of this argument, Card indicates that about 34% of college students live at home.[3] The costs are not a part of the Buddin and Kapur argument when choosing this IV. However, they are relevant in the case at hand, since the reason some individuals join the military as a way to pay for college relates mostly to college costs rather than taste for education. In addition, for the exogeneity argument, one needs to investigate how taste for education interacts with taste for the military. The latter is most likely a strong predictor of retention. If, as argued by the authors, those who live closer to a college have higher tastes for education, the fact that they enlisted suggests they also have higher tastes for the military, and they would be more likely to stay in the military longer. Therefore, *a priori* it is unclear what the Buddin and Kapur "distance from college" IV is capturing, why it is correlated with TA use, and what is the relationship with retention. The other two IVs—course offerings on base and an interaction of base size and course availability—have a more intuitive relationship with

[2] Buddin and Kapur (2002) claim that a subset of recruits may have had a lower taste for college education since they decided to enlist despite the proximity to a college. However, they argue that the net effect is that proximity to college before enlistment is positively correlated with taste for education.

[3] Card also points out that it is important to control for family background, since parents who live closer to a college may be more educated or because living at home makes a bigger difference for poorer students. In fact, in his data, 39% of African-American college-goers lived at home.

TA use. The more courses available on base, the higher the probability of using TA. Similarly, the larger the number of recruits on base who take college courses, the more likely one is to participate in TA.

A general problem with instrumental variable estimation is that the estimates may be biased if the partial correlation between the IVs and the endogenous variable is small. Hahn and Hausman (2002) argue that using instruments with little explanatory power yields estimates that are just as biased as OLS estimates. Even if instruments are significant and large samples are used, Steiger and Stock (1997) show that the instruments can still be weak if they jointly do not predict a considerable portion of the endogenous variable. The Buddin and Kapur (2002, 2005) studies do not report information on the partial correlation between TA use and the instruments. However, we believe that the IVs used do not explain much of the variation in TA participation. The distance from nearest college, while partially significant, may only explain a small part of the decision to use TA. This finding is because the correlation of this IV with college education is muddled after condition on the decision to enlist. The empirical results indicate that course offerings on base do not explain a significant part of TA. Since recruits have some choice of where to live, they may choose to live in locations that facilitate taking college courses. Buddin and Kapur find that recruits living off-base are more likely to use TA, which is consistent with this argument.

The instrumental variable measuring peer effects is original and statistically significant. However, adding this instrument to the other two increases the estimated partial effect of TA from -8.9 to -16.5 percentage points.[4] One reason for this difference could be that the peer effects may not be entirely exogenous. If TA users are more likely to leave for better civilian opportunities, more such TA users on base may generate

[4] The Buddin and Kapur (2002) study did not include this IV. The comparison, therefore, is obtained from the 2002 and 2005 studies. The models appear very similar, the only difference being the way that course offerings are measured. In the 2002 study, the authors controlled for the number of schools at base, whereas in the 2005 study they measure the number of courses offered. With the exception of the TA effect, all other partial effects are close across these two models.

similar outcomes for an individual recruit and may reduce individual retention. Another reason may be that this is a symptom of weak IVs, and Hahn and Hausman (2002) show that the bias of IV estimates increases with the number of instruments. Finally, recent research shows that in non-linear models, interaction effects cannot be evaluated by looking at the sign and statistical significance of the coefficient. Ai and Norton (2003) point out that the interaction effect obtained after non-linear estimation may be positive for some observations and negative for others, and the same can be said about statistical significance. Therefore, it is not clear whether this instrument should be used, given the methodological issues—concerns about its exogeneity—and the large impact it has on the estimated TA effect.

The propensity score estimates depend on the same assumption as OLS estimates, namely that all selection into the program depends on observable characteristics. In the case of TA use, we are mostly concerned about the unobservable factors that drive some recruits to participate in TA. The propensity score estimates, however, compare more similar individuals than OLS estimates, and may include less bias. Overall, what seems to drive the main differences between the Garcia and Joy (1998) and Garcia et al. (2002) findings and those generated by Buddin and Kapur (2002, 2005), are not the estimation methods but the sample restrictions. When replicating the Garcia et al. findings with the same data, Buddin and Kapur obtain a negative retention effect on TA after restricting the sample to those who complete 4 years in service.

We could argue that the Garcia et al. and Buddin and Kapur studies are analyzing different questions, depending on whether they assume that participation and separation are joint decisions. If we assume that participation and separation are joint decisions, separation would be defined broadly to include any type of separation, including early attrition as well as non-reenlistment of first-term survivors. An alternative view is that early attrition and non-reenlistment reflect distinctly different behavior. Attrition represents a decision to leave/be discharged before termination of a legal contract, whereas non-reenlistment is generally a voluntary career decision by the individual. In principle, attriters are discharged due to a failure to complete required training or to adapt to the demands of military life or due to pre-service background characteristics that were not revealed during the recruitment process (e.g., drug use or criminal behavior). Moreover, most attrition occurs early in a sailor's career, often during the first few months. Hence, much attrition is non-voluntary, and the portion that is voluntary is due to maladjustment to military life. In addition, during this early period the individual is occupied with the demands of passing initial required training and has little time available to enroll in college classes.

Buddin and Kapur assume that the attrition-participation-reenlistment process is sequential; consequently, they drop attriters from their analysis samples. Garcia et al. (2002), on the other hand, assume that these are joint decisions, which supports keeping attriters in their analysis samples. Of course, it is an open question as to when the participation and retention decisions should be viewed as joint decisions. It is likely that prior to a given career point, attrition is not endogenous with participation, whereas beyond that point it may become endogenous. Garcia et al. (2002) implicitly assume that the decision is always made jointly during the first term of service, whereas Buddin and Kapur assume it is made jointly only during the last 2 years of the first term. Even so, removing individuals who leave early may cause a bias in the opposite direction since TA use may have a "lock-in" effect—those who want to benefit from the TA program must remain in the military to do so. We follow Buddin and Kapur and assume that attrition and reenlistment reflect inherently different behavior; accordingly, we restrict our sample to those who remain in service for at least 3 years. We also test how important this restriction is for our results by re-estimating the TA effects without imposing this sample restriction.

Most recently, Flaherty (2007) analyzed the effect of tuition reimbursement on employee retention in a non-profit organization. The institution implemented a tuition-reimbursement program in September 1999. The study contained snapshots of data from years 1999-2005, including information on demographics, wages, and date of hire. About 4.5% of the employees participated in the tuition assistance program. Flaherty found that employees who participated in the program were less likely to leave compared to employees who did not participate. She also found that the program effects varied largely among workers hired before 1999 and those hired after the implementation of the program. Flaherty attributes the positive retention result to complementarities between general and specific human capital, which lead to higher pay and better career possibilities within the firm, thus reducing turnover.

Methodologically, Flaherty (2007) follows Garcia et al. (2002) and Buddin and Kapur (2005). She restricts her sample to those who do not attrite within the first year (due to data issues), and she obtains bivariate probit estimates employing an IV similar to the peer-effect variable used by Buddin and Kapur. More specifically, the instrument captures the participation rate of peers in the tuition reimbursement program (excluding the individual from these calculations). The peers are defined as employees in the same division (out of 18 divisions) and job classification (i.e., administrative, professional, researcher, or manager).

Flaherty's simple probit estimates suggest that participation in the tuition reimbursement program reduces the probability of separating within 5 years by 22 and 24 percentage points, depending on whether the employee was hired before 1999 or during 1999-2001. The bivariate probit estimates are insignificant for the sample of employees hired before 1999, but they inflate to 52 percentage points for the sample of new hires. When focusing on the degree that employees are pursuing (i.e., undergraduate or graduate) the partial effects increase to 42 and 58 percentage points for the two groups, respectively.

The main issue with Flaherty's findings is that the predicted marginal effects are implausibly large; they range from 50% to 100% reduction in turnover rates. The estimated magnitude of the effect is especially large for the group of new hires. It could be that the tuition assistance program may have changed the ability composition of the new hires. At the very least, the bivariate probit results indicate that these two groups are different in unobserved characteristics. In particular, the correlation between errors in the participation and retention equations always appears positive and large (between 49-81%, although often insignificant) for the group of new hires, whereas for the pre-1999 hires, it is negative or insignificant (ranging from -44% to -50%). If the instrument used is weak, then this might explain the large estimate on the partial effect of the program.

In fact, as argued earlier, peer effects in participation may even be endogenous. Indeed, the more people in the peer group participate in the program, the more likely it is that the individual will do so, provided that participant peers proxy for information about the program. However, there is no reason to believe that peer effects are confined to the participation decision. In fact, it could be argued that if more peers leave the organization, it is more likely the individual will do so as well, perhaps due to improved information on external employment opportunities. If the overall participation rate in the tuition reimbursement program and retention are correlated within the firm, the more likely it is that peer participation rates and individual retention are also correlated, and the instrument is endogenous.

Little is known about the hierarchical structure of the organization in this study. However, if this organization is similar to other firms in which promotions are determined by local tournaments of employees for limited promotion slots, then the higher the proportion of peers that obtain general education, the less likely it is that the individual will be promoted. The main argument of the paper is that general education improves internal career progression of individuals, which is the reason they are more likely to stay. This implies a correlation between promotion probability and retention. In addition, the peer group consists of workers in similar positions within the firm who are more likely to compete with each other for promotions. Therefore, the peer participation rate may be correlated with program participation via increased information and also correlated with retention via increased competition for promotions. Assuming a hierarchical structure and internal competition for promotions makes the instrument potentially endogenous. A final issue with the estimates is the small sample of participants—only 385, of which only 132 represent new hires. In contrast, non-participants total 5,621 hired before 1999, and 2,361 hired after 1999. Instrumental variable estimations are consistent but biased in small samples.

Data and Descriptive Statistics

This section discusses the data used for the analysis and provides descriptive statistics. The analysis uses data obtained from three sources: the Military Entrance Processing Command (MEPCOM), Defense Manpower Data Center (DMDC), and the Center for Personal and Professional Development (CPPD) under the Naval Personnel Development Command (NPDC). The merged data set provides information on each sailor's career progression, background characteristics, and course enrollments under the Tuition Assistance (TA) program. The data consists of 8 cohorts who entered the Navy between 1994 and 2001. Each cohort is followed through the first 5 years of service to determine whether the recruits separate before completing their first term, whether they complete their first term of service, and whether they reenlist or extend.

The analysis focuses on the effect of TA on sailors' promotion and retention outcomes. We focus on the first term of enlistment for two reasons. First, the probability of remaining in the military for a career increases substantially for those who successfully complete their first enlistment term and reenlist. As we discussed above, those who remain in the military beyond their first term may have different goals from those who leave after the first term, and therefore, the effects of the TA program may be affected by this selection. Second, we aim to provide estimates that are comparable to prior studies, which focus exclusively on the first term of service.

The MEPCOM data provides demographic characteristics of Navy enlistees at the time of accession, including race and ethnicity, marital status and number of dependents, education, gender, Armed Forces Qualification Test score (AFQT), and length of initial contract. The DMDC data provides annual information on individuals during their first 5 years of service, including career progression and promotion, separation, and reenlistment. The sample was restricted in several ways. Only service members with 4-year obligations (enlistment contracts) were included in our sample (called 4YO's). Because 5- and 6-year obligors typically have much longer training pipelines, this restriction assures a more homogenous sample. In addition, following Buddin and Kapur , the sample enlistees who failed to complete their first term of service were deleted. Sailors who left the Navy early during their first term would not have had the same opportunity to use TA as those who completed their obligations. Finally, sailors with prior service were excluded from the sample since they may have systematic differences in tastes for the military and for further education and may enter at higher grades.

The CPPD data provide information on all course enrollments in the TA program by active duty enlisted personnel between 1994 and 2006. The file contains information on courses taken, course grades, authorized funding, cost of courses, and type of course (i.e., high school or GED, undergraduate, graduate). Our analysis sample is restricted to service members who used TA for undergraduate college courses. We remove from the sample all sailors taking high school courses, GED-prep classes, remedial classes, or graduate courses.

Variable Descriptions

This study measures the effect of TA usage on two career outcomes: retention and promotion. We base retention on enlistees staying in the Navy beyond their initial 4-year obligation (first reenlistment opportunity). We examine two promotion outcomes: the first indicator captures promotion to E4 (petty officer third class) before the end of the first term of service; the second indicator captures promotion to E5, which is a fairly rare event and signals a superior performer. Table 5 provides variable descriptions.

Table 5. Variable Descriptions
(Tabulated from MEPCOM, DMDC, and NPDC data)

VARIABLE DEMOGRAPHICS	DESCRIPTION
Female	=1 if female, =0 otherwise
White	=1 if Caucasian, =0 otherwise
Black	=1 if African American, = 0 otherwise
Hispanic	=1 if Hispanic, = 0 otherwise
Native	=1 if Native American, = 0 otherwise
Asian	=1 if Asian or Pacific Islander, = 0 otherwise
Other	=1 if race none of above, = 0 otherwise
CAT I	=1 if AFQT score 93-99, = 0 otherwise
CAT II	=1 if AFQT score 65-92, = 0 otherwise
CAT IIIA	=1 if AFQT score 50-64, = 0 otherwise
CAT IIIB	, = 0 otherwise =1 if AFQT score 31-49
HS Dropout	=1 if no high school diploma at accession, = 0 otherwise
High School Diploma	=1 if high school diploma at accession, = 0 otherwise
Some College	=1 if college credits at accession, = 0 otherwise
College Degree	=1 if college degree at accession, = 0 otherwise
Married	Marital status 3rd year in service (1=married, 0 otherwise)
Dependents	Dependents in 3rd year of service (1=dependent[s], 0 otherwise)
1994-2001	Dichotomous variables for accession year (1=accessed that year, 0 otherwise)
CAREER INFORMATION	
TIS	Time in service (in months). Calculated by subtracting Date of Separation (DOS) from Base Active Service Date (BASD). If no DOS info, September 30, 2006 used to calculate.
Pay grade	Categorical variable equivalent to numeric pay grade. Calculated for each FY.
Rating	Dichotomous variables for each Navy enlisted rating
TUITION ASSISTANCE	
Any TA Used	=1 if used TA for at least 1 college course, 0 otherwise
Passed Course	=1 if completed college course using TA, 0 otherwise
FY	Dummy variables for fiscal year course taken

The multivariate models below use the following variables: race, gender, education, AFQT scores, marital status, and dependents. The reenlistment variable was based on time in service (in months), which was estimated by subtracting date of separation (DOS) from Base Active Service Date (BASD). Sailors with no date of separation records were assumed to be on active duty. For them, the time in service was calculated by subtracting the date of enlistment from September 30, 2006, which is the last date of observation in the study.

Samples and Descriptive Statistics

The original sample was restricted to sailors who are 4YO's and who have no prior service. After applying the sample restrictions, we were left with 331,920 observations of active duty enlisted accessions. Annual accessions averaged about 34,000 during the 1994-1996 period, but they rose to an annual average of about 45,000 between 1997 and 2001.

Descriptive Statistics

After removing sailors who attrite during the first 36 months in service, observations on 217,872 sailors remained. Table 6 provides descriptive statistics on this sample. The TA participation rate in this sample was .22, which is based on the rate for all 8 accession cohorts during their 5-year service period. The sample consists of 17% women, 19% African-American, and 11.6% Hispanic. Most new recruits entered with at least a high school diploma (92%) and with a mean AFQT score of 61.2. Table 6 reveals that the reenlistment rate of TA users exceeds that of non-users by 12 points (about 20%). In addition, the promotion rate to E4 and E5 was 3.6 points and 5.4 points higher, respectively, for TA users.

Table 6. Descriptive Statistics for Full Sample

Variable	Full Sample	ALL TA USERS	Non-Users
TA Usage Rate	.226	--	--
TA Completers	.177	.781	--
Reenlist Rate	.595	.679	.570
Promote Rate E4+	.562	.590	.554
Promote Rate E5	.160	.202	.148
AFQT Score (%)	61.20	62.5	60.83
Female	.170	.318	.127
Married	.239	.253	.234
White	.604	.547	.620
African-American	.190	.214	.182
Hispanic	.116	.137	.110
Asian	.054	.065	.050
H.S. Diploma	.890	.908	.884
Some College	.008	.008	.007
No Diploma/ GED	.088	.072	.094
Sample Size	217,872	49,414	168,458

Of the 217,872 new recruits in the sample 49,426, or 22%, used TA at some time during their first term of service (for all entrants, including early leavers, the TA usage rate was only 15%). Of all TA users, 38,786, or 78%, successfully completed at least one course. Thus, 10,640, or 21.5%, received tuition assistance but did not complete the class (either withdrew or failed). Women used TA at twice the rate of men (27% vs. 12%). Women also had higher successful course completion rates than men (81% vs. 77%). Among racial/ethnic groups, Asians had the highest percentage of successful completion (81%) while Native Americans had the lowest (75%). Sailors, with some college education, had higher TA usage rates (22%) than high school dropouts (8%), GEDs (10%), and college degree holders (10%). Sailors with higher entry-level education had more success in completing courses: those with some college education had successful completion rates of 85% versus about 72% for high school dropouts and GED holders.

To adjust for selection, the same models that are run on the full sample are run on the sample restricted to only TA users. Table 7 provides descriptive statistics for this sample in column 1, for TA completers only in column 2 and for non-completers in column 3. Table 7 shows that course completers in column 2 have higher reenlistment rates and promotion rates than non-completers in column 3. In addition, completers have slightly higher AFQT scores and are more likely to be female. On the other hand, completers are less likely to be black or not have a regular high school diploma.

Table 7. Descriptive Statistics for the Sample of TA Users Only

Variable	ALL TA USERS	COURSE COMPLETERS	NON-COMPLETERS
TA Usage Rate	--	--	--
TA Completers	.781	--	--
Reenlist Rate	.679	.691	.634
Promote Rate E4+	.590	.598	.562
Promote Rate E5	.202	.212	.165
AFQT Score (%)	62.5	63.06	60.71
Female	.318	.330	.278
Married	.253	.254	.252
White	.547	.549	.541
African-American	.214	.210	.231
Hispanic	.137	.138	.134
Asian	.065	.067	.056
H.S. Diploma	.908	.912	.894
Some College	.008	.020	.012
No Diploma/ GED	.072	.066	.092
Sample Size	49,414	38,779	10,635

Model Estimates

We first estimated a multivariate model of the determinants of TA program participation using the full sample of entry cohorts. We then estimate multivariate models of reenlistment. All models are estimated via non-linear maximum likelihood techniques, using the assumption of normally distributed errors (i.e., the probit model). For the baseline reenlistment model the sample is restricted to include only those who survive the first 36 months of service. To highlight the importance of this assumption, in our sample TA participation rates are 6% for early attriters versus 22% for those who survive at least 36 months. This clearly supports the assumption that those who attrite early have fewer opportunities to make use of the TA program and are not comparable to those who complete their first term of service. We also estimate probit models of promotion outcomes. The sample for the baseline promotion models, to both E4 and to E5, is restricted to those who survive the first 12 months of service. Since promotion to E4 can occur as early as 1 year of service, for the promotion probit models we delete from the sample those who do not survive at least 1 year. This group had no opportunity to receive a promotion to E4 or E5. These restrictions eliminate a source of potential bias by excluding those who attrite prior to being reenlistment-eligible or promotion-eligible (i.e., those who had no opportunity to make a reenlistment decision or to be considered for promotion).

The first model analyzes the determinants of participation in the TA program during the first 4 years of service. This model investigates whether the differences in TA usage rates across gender and race categories can be explained by observed characteristics, such as educational attainment prior to enlistment or ability. Next, we estimate a reenlistment model in which the variables of interest are the indicator of TA usage and the indicator of successful completion of college courses. In these models, the dependent variable measures whether individual sailors reenlist or extends at their first decision point (the fourth year of service). Finally, we estimate the probability of achieving the rank of E-4 and E-5 by the fourth year of service. These models include as control variables race/ethnicity, gender, education, AFQT scores, marital status and dependents. In addition, all models include fiscal year dummies and rating dummies (coefficients not reported). .

Determinants of Tuition Assistance Program Participation

Table 8 provides the results of the baseline TA participation probit model. Estimated coefficients are presented in column 1, with standard errors in parentheses and marginal effects (estimated via the delta method) in column 2. One noteworthy result in Table 8 is that participation rates for women are 18 percentage points higher (nearly double) than those of men. In addition, most minorities, except Native Americans, are more likely to use TA than whites. The difference is the largest for Hispanics, who are 7 points (about 30%) more likely to participate than whites. A possible explanation for this difference may be that the reasons for enlistment vary systematically across gender and race categories. Minorities may view military service as a vehicle for social advancement, and they have a higher propensity for using military benefits. They also may be less likely to afford postsecondary education, due to their potential disadvantaged socioeconomic status. Results in Table 8 also indicate that time constraints may be important in determining TA use. Individuals who are married at entry and do not have children tend to use TA at a higher rate than single sailors, whereas those with children (single or married) are less likely to use TA. Ability also plays a role. Compared to CAT II recruits, those in lower mental categories are less likely to use TA. Across educational categories, the only sailors who are more likely to use TA than high school graduates are those with some college education. Non-diploma graduates and GED holders are less likely to participate in TA (compared to high school diploma graduates). Finally, the fiscal year dummies indicate that TA participation has increased over time. This increase could be in response to the policy that increased the reimbursement rate in 2002.

Table 8. Probit Model of Tuition Assistance Participation (includes completed and non-completed courses)

	Dependent variable: Participate in TA	
	(1) Coefficient (standard error)	(2) Marginal Effect
Female	0.610 (0.007)***	0.180
Black	0.172 (0.008)***	0.045
Hispanic	0.262 (0.009)***	0.072
Native	-0.069 (0.019)***	-0.017
Asian	0.322 (0.013)***	0.091
Other	0.256 (0.029)***	0.072
age2	0.018 (0.001)***	0.004
sing_kid	-0.183 (0.015)***	-0.042
marr_nk	0.160 (0.079)**	0.043
marr_kid	-0.020 (0.014)	-0.005
tier_i	-0.004 (0.013)	-0.001
tier_iiia	-0.102 (0.007)***	-0.025
tier_iiib	-0.306 (0.007)***	-0.072
tier_iv	-0.451 (0.149)***	-0.088
tier_unk	-0.202 (0.069)***	-0.045
Non_high_sch_grad	-0.292 (0.018)***	-0.063
GED	-0.185 (0.012)***	-0.042
some_college	0.068 (0.032)**	0.018
college_degree	-0.484 (0.029)***	-0.094
fy95	-0.009 (0.013)	-0.002
fy96	-0.013 (0.013)	-0.003
fy97	0.027 (0.012)**	0.007
fy98	0.148 (0.012)***	0.039

fy99	0.174 (0.012)***	0.046
fy00	0.203 (0.012)***	0.054
fy01	0.225 (0.012)***	0.060
Constant	-1.462 (0.025)***	
Observations	276912	276912

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

These results mirror those in Buddin and Kapur (2005), who also find participation rates to be much higher for women (70% higher) and for Hispanics (20% higher) compared to white males. One difference in results between the two studies is that they find that both married sailors and those with children are less likely to use TA as compared to single sailors.

Reenlistment Models

The reenlistment models estimate the effect of TA use on the probability of reenlistment while controlling for race/ethnicity, gender, education, AFQT scores, marital status, number of dependents, and year dummies. Dummy variables for each Navy enlisted occupation (rating) are included in the models to control for economic and other unobserved factors associated with each rating that affect reenlistment decisions. Since ratings represent various occupational categories, civilian job opportunities may vary by rating and this may affect reenlistment decisions. Also, promotions in the Navy are based on vacancies in each rating, so ratings with low retention tend to have higher promotion rates and better opportunities for career advancement. In addition, ratings with historically low retention are normally offered higher selective reenlistment bonuses (SRB), which also affect retention behavior.

The results of the probit reenlistment model are presented in Table 9. The baseline model restricts the sample to new recruits who survive at least 36 months. The estimates are presented in columns 1 and 2 of Table 9. They indicate that those who use TA are 12.1 points (about 20%) more likely to reenlist. Females are 4.9 points less likely to reenlist than males, whereas minorities are more likely to reenlist than whites. Being married or having dependents (in the third year of service) increases the probability of reenlistment. High school graduates are more likely to reenlist than those with any other education level at accession.

Table 9. Probit Reenlistment Model

	Dependent Variable: Reenlist			
	FULL SAMPLE		TA USERS	
	(1)	(2)	(3)	(4)
Any TA Used	0.321 (0.007)***	0.121 (0.003)***	—	—
Passed course	—	—	0.171 (0.015)***	0.062 (0.005)***
Female	-0.125 (0.008)***	-0.049 (0.003)***	-0.121 (0.013)***	-0.044 (0.005)***
Black	0.261 (0.008)***	0.099 (0.003)***	0.256 (0.017)***	0.088 (0.005)***
Hispanic	0.054 (0.009)***	0.021 (0.004)***	0.089 (0.018)***	0.031 (0.006)***
Native American	0.039 (0.018)**	0.015 (0.007)**	0.069 (0.041)*	0.024 (0.014)*
Asian	0.319 (0.013)***	0.119 (0.005)***	0.269 (0.026)***	0.090 (0.008)***
Other Race	0.066 (0.030)**	0.025 (0.011)**	0.079 (0.057)	0.027 (0.019)
Married	0.087 (0.011)***	0.034 (0.004)***	0.043 (0.020)**	0.015 (0.007)**
Dependents	0.123 (0.011)***	0.047 (0.004)***	0.132 (0.021)***	0.046 (0.007)***
Age	0.008 (0.001)***	0.003 (0.000)***	0.009 (0.002)***	0.003 (0.001)***
CAT I	0.305 (0.014)***	0.114 (0.005)***	0.124 (0.028)***	0.043 (0.010)***
CAT IIIA	-0.256 (0.007)***	-0.100 (0.003)***	-0.090 (0.015)***	-0.032 (0.006)***
CAT IIIB	-0.291 (0.007)***	-0.114 (0.003)***	-0.018 (0.016)	-0.007 (0.006)
CAT IV	0.065 (0.138)	0.025 (0.053)	0.313 (0.375)	0.102 (0.109)
CAT UNKNOWN	-0.183 (0.073)**	-0.072 (0.029)**	-0.216 (0.143)	-0.080 (0.055)
High School Dropout	-0.074 (0.017)***	-0.029 (0.007)***	0.037 (0.042)	0.013 (0.015)
GED	-0.067 (0.012)***	-0.026 (0.005)***	0.028 (0.028)	0.010 (0.010)
Some College	0.013 (0.033)	0.005 (0.013)	-0.108 (0.060)*	-0.039 (0.022)*
College Degree	-0.172	-0.068	-0.205	-0.076

	(0.026)***	(0.011)***	(0.067)***	(0.026)***
fy95	-0.085	-0.033	-0.107	-0.039
	(0.012)***	(0.005)***	(0.027)***	(0.010)***
fy96	0.049	0.019	0.028	0.010
	(0.012)***	(0.005)***	(0.027)	(0.010)
fy97	0.194	0.074	0.223	0.076
	(0.012)***	(0.004)***	(0.027)***	(0.009)***
fy98	0.303	0.114	0.316	0.105
	(0.012)***	(0.004)***	(0.026)***	(0.008)***
fy99	0.246	0.093	0.276	0.093
	(0.012)***	(0.004)***	(0.025)***	(0.008)***
fy00	0.151	0.058	0.216	0.074
	(0.012)***	(0.004)***	(0.025)***	(0.008)***
fy01	0.023	0.009	0.046	0.016
	(0.011)**	(0.004)**	(0.024)*	(0.008)*
Constant	-0.092		-0.053	
	(0.025)***		(0.053)	
Observations	206,427	206,427	48,823	48,823

Notes: Sample includes only sailors who stayed in service for at least 36 months. All models include rating dummies. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

To assess the importance of the assumption about the endogeneity of the separation and participation decisions, we also estimated the baseline reenlistment model using a sample consisting of all new recruits. The approach follows Garcia and Joy (1998). The reenlistment model using this unrestricted sample is displayed in Appendix Table A. The estimated partial effect of TA in Appendix Table A is .264, which is much larger than the partial effect of .12 in Table 9, when the sample is restricted to only those who stay in the Navy for at least 36 months. The effect estimated from the full sample overstates the true program effect because the comparison group includes sailors who left the Navy early and therefore did not have the same opportunity to participate in TA as did the survivors. This finding reinforces the issue noted previously in the literature review: inclusion in the sample of sailors who do not have an equal opportunity to use TA will cause an upward bias in the estimated program effect. The 14-point difference in the estimated reenlistment effect of TA (between Appendix Table A and Table 9) represents the bias for failing to restrict the sample to non-attriters.

While the identification of the correct treatment and control groups is an important question in the research design, self-selection represents an equally important issue. The estimates of the TA effect in columns 1 and 2 of Table 9 may be biased because participants are not likely to be randomly selected. Sailors who choose to participate in TA may be more motivated or have higher ability compared to sailors who do not take any college courses. Furthermore, these characteristics are likely to be correlated with job performance and the probability of reenlistment.

To correct the estimates for self-selection, we exploit the fact that not all participants complete the courses in which they enroll. We assume that all participants who use TA to enroll in college courses share similar motivation, initiative, and aptitude, but some are unable to complete the courses for exogenous reasons. Such reasons are often related to military deployments and other job duties that are beyond the individual's control. Hence, we assume that the external forces that prevent sailors from completing their courses are exogenous, in that they are correlated with course completion but not with reenlistment or promotion. We use this exogenous variation among TA participants to estimate the program effect. The approach is to use a sample consisting solely of TA users and to compare successful course completers with enrollees who do not complete their courses. This way, the effect of TA represents the effect of increased education levels on performance and career advancement. The results of this estimation are presented in columns 3 and 4 of Table 9.

The estimated marginal effect of successful completion of TA courses is 6.2 percentage points in this model. Since the overall reenlistment rate in this sample is .68, this represents an increase in reenlistment rates of about 9%. This effect is much smaller than the 20% marginal effect of TA estimated with the entire sample of sailors in columns 1 and 2 of Table 9. As expected, the former estimates may have included an upward bias due to the higher ability and motivation of TA course taker.

Promotion Models

Next we investigate the effect of TA use on the promotion probability. Table 10 provides a comparison of pay grade distributions at the end of 4 years of service for TA users and non-users. Relative to sailors who did not use TA, those who used TA had a lower representation in pay grades E1-E3, and a higher representation in grades E4 and E5. Thus, it appears that TA users were more likely to be promoted than other sailors.

Table 10. Distribution by Pay Grade and TA Usage at the End of the Fourth Year (TIS greater than 12 months),
(Tabulated from DMDC and NPDC data)

Pay grade	TA Users		Non-TA Users	
4th Year	Freq.	Percent	Freq.	Percent
E1	65	0%	1,481	0.9%
E2	194	0%	1,848	1.1%
E3	7,913	17%	29,136	17.5%
E4	29,187	61%	94,334	56.5%
E5	10,001	21%	24,971	15.0%
E6+	25	0%	522	0.3%
Total	47,503	100%	166,833	100.0%

To investigate whether these differences are causal in nature, we estimate probit models of promotion probability as a function of TA use and other observable controls. In Table 11 we present estimates of the probability of promotion to E-4 or higher during the first term. In columns 1 and 2 we restrict the sample to those who survive at least 1 year of service. The results show that TA participation increases the probability of promotion to E-4 by 14.1 percentage points (about 23%). It is noteworthy to observe that women and African-Americans appear less likely to promote to E-4 during the first term. Later we investigate whether being a minority and participating in TA mitigates this effect.

Again, there is some concern that the estimates in columns 1 and 2 of Table 11 are biased upward because unobserved characteristics that affect TA participation are also likely to be correlated with promotion. In columns 3 and 4 of Table 10 we restrict the sample to TA participants and investigate the effect of more general education on the probability of promoting to E-4. It should be noted that this promotion is highly dependent on performance, hence the results are likely to indicate the effect of education on productivity. The estimates indicate that course completers have a promotion rate only 3 points (about 5%) above that of non-completers. This estimate is significantly smaller than the estimate obtained by comparing TA participants to non-participants, suggesting that the previous results included an upward bias. In columns 1 and 2, the coefficient on gender is no longer significant, which suggests that the gender differences in promotion rates may be due to unobserved ability and motivation (which are more likely to be held constant in the restricted sample).

Table 11. Probit E4 Promotion Models (Include Rating Specific Dummies)

	Dependent Variable: Promote to E4			
	FULL SAMPLE		TA USERS	
	(1)	(2)	(3)	(4)
Any TA Used	0.357 (0.007)***	0.141 (0.003)***	—	—
Passed course	—	—	0.078 (0.014)***	0.030 (0.006)***
Female	-0.109 (0.007)***	-0.043 (0.003)***	0.011 (0.013)	0.004 (0.005)
Black	-0.061 (0.007)***	-0.024 (0.003)***	-0.040 (0.016)**	-0.016 (0.006)**
Hispanic	0.069 (0.008)***	0.028 (0.003)***	0.011 (0.018)	0.004 (0.007)
Native American	-0.044 (0.016)***	-0.018 (0.006)***	-0.028 (0.039)	-0.011 (0.015)
Asian	0.198 (0.012)***	0.079 (0.005)***	0.030 (0.024)	0.012 (0.009)
Other race	0.033 (0.027)	0.013 (0.011)	0.055 (0.055)	0.021 (0.021)
Age	-0.006 (0.001)***	-0.002 (0.000)***	-0.002 (0.002)	-0.001 (0.001)
Single, with kids	-0.023 (0.013)*	-0.009 (0.005)*	0.047 (0.032)	0.018 (0.012)
Married, no kids	0.032 (0.075)	0.013 (0.030)	0.054 (0.143)	0.021 (0.055)
Married with kids	0.012 (0.013)	0.005 (0.005)	-0.049 (0.028)*	-0.019 (0.011)*

CAT I	-0.400 (0.012)***	-0.155 (0.004)***	-0.433 (0.027)***	-0.171 (0.010)***
CAT IIIA	-0.038 (0.007)***	-0.015 (0.003)***	-0.026 (0.015)*	-0.010 (0.006)*
CAT IIIB	-0.095 (0.007)***	-0.038 (0.003)***	-0.069 (0.016)***	-0.027 (0.006)***
CAT IV	-0.116 (0.118)	-0.046 (0.046)	0.235 (0.349)	0.088 (0.125)
CAT unknown	-0.374 (0.065)***	-0.145 (0.024)***	-0.141 (0.142)	-0.056 (0.056)
High school dropout	-0.224 (0.015)***	-0.088 (0.006)***	-0.039 (0.040)	-0.015 (0.016)
GED	-0.227 (0.010)***	-0.089 (0.004)***	-0.027 (0.027)	-0.011 (0.010)
Some college	0.034 (0.030)	0.013 (0.012)	-0.063 (0.059)	-0.025 (0.023)
College_degree	-0.094 (0.024)***	-0.038 (0.009)***	-0.121 (0.065)*	-0.048 (0.026)*
fy95	0.049 (0.011)***	0.020 (0.004)***	0.070 (0.027)**	0.027 (0.010)***
fy96	0.214 (0.011)***	0.085 (0.004)***	0.233 (0.027)***	0.088 (0.010)***
fy97	0.210 (0.011)***	0.084 (0.004)***	0.150 (0.026)***	0.057 (0.010)***
fy98	0.171 (0.011)***	0.068 (0.004)***	0.047 (0.025)*	0.018 (0.010)*
fy99	0.152 (0.010)***	0.061 (0.004)***	0.057 (0.024)**	0.022 (0.009)**
fy00	0.046 (0.010)***	0.018 (0.004)***	-0.091 (0.024)***	-0.035 (0.009)***
fy01	0.028 (0.010)***	0.011 (0.004)***	-0.041 (0.024)*	-0.016 (0.009)*
Constant	0.008 (0.023)		0.289 (0.052)***	
Observations	249,357	249,357	48,850	48,850

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Next we turn to the effect of TA use on E-5 promotion. Table 12 displays probit models of promotion to E-5 for both the restricted (TA users only) and the unrestricted samples. While TA users are 6.1 points (30%) more likely to attain E-5 according to estimates in columns 1 and 2, in the selection-adjusted estimates in columns 3 and 4 the marginal effect falls to 4.9 points (a 25% difference). Women and minorities are less likely to promote to E-5, all else equal, whether the sample is restricted to TA users or not.

Table 12. Probit Regression Estimates of Promotion to E-5 (Models Include Rating Specific Dummies)

	Dependent variable: Promote to E5			
	FULL SAMPLE		TA USERS	
	(1)	(2)	(3)	(4)
Any TA Used	0.301	0.061	—	—
	(0.008)***	(0.002)***		
Passed course	—	—	0.211	0.049
			(0.018)***	(0.004)***
Female	-0.235	-0.039	-0.208	-0.050
	(0.010)***	(0.001)***	(0.016)***	(0.004)***
Black	-0.241	-0.040	-0.209	-0.049
	(0.011)***	(0.002)***	(0.020)***	(0.004)***
Hispanic	-0.101	-0.017	-0.123	-0.029
	(0.011)***	(0.002)***	(0.022)***	(0.005)***
Native American	-0.031	-0.005	-0.026	-0.006
	(0.020)	(0.004)	(0.044)	(0.011)
Asian	-0.088	-0.015	-0.156	-0.036
	(0.016)***	(0.003)***	(0.030)***	(0.007)***
Other race	-0.168	-0.028	-0.256	-0.056
	(0.037)***	(0.005)***	(0.068)***	(0.013)***
Age	0.037	0.007	0.028	0.007
	(0.001)***	(0.000)***	(0.003)***	(0.001)***
Single, with kids	0.004	0.001	0.061	0.016
	(0.018)	(0.003)	(0.038)	(0.010)
Married, no kids	0.196	0.040	0.221	0.061
	(0.090)**	(0.021)*	(0.157)	(0.047)
Married with kids	0.153	0.030	0.182	0.049
	(0.015)***	(0.003)***	(0.031)***	(0.009)***
CAT I	0.624	0.155	0.622	0.193
	(0.012)***	(0.004)***	(0.027)***	(0.010)***
CAT IIIA	-0.405	-0.065	-0.393	-0.089
	(0.009)***	(0.001)***	(0.018)***	(0.004)***
CAT IIIB	-0.783	-0.120	-0.639	-0.136
	(0.010)***	(0.001)***	(0.021)***	(0.004)***
CAT IV	0.076	0.015	-0.050	-0.012
	(0.071)	(0.014)	(0.158)	(0.037)
CAT unknown	-0.275	-0.042	-0.126	-0.029
	(0.021)***	(0.003)***	(0.048)***	(0.011)***
High school dropout	-0.218	-0.035	-0.126	-0.030
	(0.014)***	(0.002)***	(0.031)***	(0.007)***
GED	0.234	0.049	0.183	0.050
	(0.034)***	(0.008)***	(0.064)***	(0.019)***
College degree	0.425	0.098	0.293	0.083
	(0.025)***	(0.007)***	(0.070)***	(0.022)***
fy95	0.046	0.009	0.114	0.030
	(0.018)**	(0.003)**	(0.041)***	(0.011)***
fy96	0.170	0.034	0.238	0.065
	(0.017)***	(0.004)***	(0.039)***	(0.011)***
fy97	0.485	0.109	0.622	0.189
	(0.016)***	(0.004)***	(0.036)***	(0.012)***
fy98	0.780	0.196	0.928	0.297

	(0.015)***	(0.005)***	(0.034)***	(0.013)***
fy99	0.750	0.185	0.877	0.275
	(0.015)***	(0.005)***	(0.034)***	(0.012)***
fy00	0.765	0.189	0.957	0.303
	(0.015)***	(0.005)***	(0.034)***	(0.012)***
fy01	0.685	0.164	0.872	0.270
	(0.015)***	(0.004)***	(0.033)***	(0.012)***
Constant	-2.170		-2.123	
	(0.030)***		(0.064)***	
Observations	249357	249357	48845	48845

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

Gender and Race Interactions

Because enrollment appears to vary systematically with race and gender, we next investigate differences in the impact of TA for minorities and women. Table 13 presents findings for African-Americans. Panel A uses the entire sample and compares TA-participants with non-participants in respect to reenlistment rates and promotion to E4 and E5. The *BLACK*TA_USE* interaction term is significant in all models, indicating that the returns to tuition assistance are different for African-Americans compared to whites. In particular, African-American recruits who participate in TA are more likely to reenlist than white TA-users by about 13.6 percentage points (or 20%). If African-Americans choose to participate for different reasons than whites, then this difference may be due to unobserved heterogeneity rather than TA participation. However, among African-Americans, those who participate in TA are also more likely to reenlist than non-participant African-Americans by about 14.4 percentage points (or 21%).

Promotion models indicated earlier that African-Americans were less likely to promote. Since the models hold constant AFQT scores, this could be due to other unobserved characteristics. Results in Table 13 indicate that African-Americans who participate in TA are just as likely to promote to E4 as whites who participate in TA. Therefore, it appears that TA usage helps minorities close the promotion gap. In fact, among African-Americans, those who participate in TA are far more likely to promote to E4 by about 17 percentage points (or 28%). When looking at promotion to E5, however, the black-white difference re-appears. Among TA-users, African-Americans promote at a rate that is 4.7 percentage points lower than that of white TA-users (or 22%). However, TA continues to benefit minorities; among African-Americans, those who participate in TA are 6.9 percentage points (or 33%) more likely to promote to E5.

Since TA usage may be positively correlated with other characteristics that influence job performance (such as motivation), these models are re-estimated using the restricted sample of TA users, with course completion as the treatment of interest. Panel B presents the estimates. In these models, the interaction terms *(BLACK*PASS_COURSE)* are insignificant, indicating that the different returns to TA-usage for African-Americans may have been due to unobserved heterogeneity. However, race differences remain significant. Among TA users, African-American course completers are 9.6 points more likely to reenlist than white course completers (or 14%). Among African-American TA users, course completers are 7.8 points more likely to reenlist (or 11.5%).

With respect to E4 promotion, African-Americans are less likely to promote than whites; however, the promotion gap is insignificant when focusing on course completers. Among African-Americans, course completers are more likely to promote than African-Americans who use TA but who do not complete their studies. This promotion advantage, however, is only 4.5 points (7.4%), which is much smaller than the 17 points (28%) estimated with the full sample. This suggests that motivation may play a large role in estimating the effect of TA usage on minority outcomes. The results in Panels A and B vary little when looking at promotion to E5. The black-white gap in promotion rates remains about 4.3 points (20%) for course completers. Among African-Americans, course completion boosts E5 promotion rates by 4.6 points (22%).

Next we turn to the effect of TA usage on females. Table 14 displays the results of models with interaction terms using both the entire sample (Panel A) and the restricted sample of TA users (Panel B). The interaction terms *Female*TA_USE* and *Female*Pass_Course* are significant in most models, suggesting that the returns to TA participation differ significantly by gender. With respect to retention, women who use TA are 13.4 percentage points more likely to reenlist than women who do not use TA (or 19.7%). However, because women, in general, are less likely to reenlist, women who use TA are 2.4 points less likely to reenlist than men who use TA (or 3.5% less). With respect to E4 promotion, TA usage appears to improve promotion rates for women. Results in Panel A, column 2 indicate that women who do not use TA are 5.7 percentage points (about 9%) less likely to promote than men who do not use TA. However, women who use TA are 1.8 points (or 3%) more likely to promote to E4 than male TA-users. Among women, TA usage appears to boost promotion rates by 19.3 points or 32%. However, when looking at E5 promotion, the gender gap reappears. Women appear less likely to promote than men by 18% (for non-TA users) and by 24% (for TA-users). However, among women, TA usage boosts promotion rates by 6.4 points (30%).

These differences, however, may be potentially due to differences in unobserved characteristics between men and women who participate in TA. Panel B restricts attention to TA users and investigates the differential impact of successful course completion between women and men on performance. Among TA users, women who do not complete courses are even less likely to reenlist than men (12%), compared to the 6.7% differential observed with the full sample. The gender gap in retention has increased somewhat even after focusing on course completers. However, women who complete TA courses are more likely to reenlist than women who do not complete at least one course (by 13%). This indicates that TA usage may have a positive effect on female retention, but this effect may be prone to endogeneity bias. These results also seem to indicate that TA may be a very important reason for women to join and remain in service, since the gender retention gap is about twice as large when studying course completion than when focusing on any TA use at all. The gender gap in promotion probabilities does not change much after restricting the sample. However, TA continues to have a positive (although much smaller) effect on female promotion rates.

Table 13. The Effect of VOLED on Minorities

Panel A.	Sample: ALL			Panel B.	Sample: TA USERS		
	Reenlist	Promotion to E4	Promotion to E5		Reenlist	Promotion to E4	Promotion to E5
BLACK	0.0931	-0.0252	-0.0357	BLACK	0.0773	-0.0308	-0.0438
	(0.0033)***	(0.0030)***	(0.0016)***		(0.0119)***	(0.0125)**	(0.0079)***
TA USE	0.1016	0.1382	0.0798	PASSED COURSE	0.0596	0.0254	0.0457
	(0.0036)***	(0.0037)***	(0.0030)***		(0.0073)***	(0.0074)***	(0.0057)***
BLACK * TA USE	0.0427	0.0302	-0.0111	BLACK * PASS COURSE	0.0187	0.0195	0.0004
	(0.0066)***	(0.0070)***	(0.0049)**		(0.0130)	(0.0138)	(0.0091)
Black participants vs. white participants	0.1358 (0.0060)***	0.0049 (0.0065)	-0.0468 (0.0047)***	Blacks who pass vs. whites who pass	0.0959 (0.0063)***	-0.0112 (0.0068)	-0.0434 (0.0049)***
Black participants vs. black non-participants	0.1443 (0.0056)***	0.1684 (0.0060)***	0.0686 (0.0039)***	Blacks who pass vs. blacks who do not pass	0.0783 (0.0108)***	0.0450 (0.0117)***	0.0461 (0.0070)***

Notes: All interaction effects are estimated via linear probability models with robust standard errors. The differences in outcomes between participant vs. non-participant minorities and minority vs. non-minority participants are obtained by including separate categories for each minority-VOLED combination in linear probability models and by leaving out the appropriate control group. All models include controls for demographics.

***significant at the 1%; **significant at the 5%; *significant at the 10%.

Table 14. The Effect of TA on Females

Panel A.	Sample: ALL			Panel B.	Sample: TA USERS		
	Reenlist	Promotion to E4	Promotion to E5		Reenlist	Promotion to E4	Promotion to E5
FEMALE	-0.0466 (0.0035)***	-0.0570 (0.0031)***	-0.0379 (0.0017)***	FEMALE	-0.0810 (0.0108)***	-0.0324 (0.0110)***	-0.0444 (0.0070)***
TA USE	0.0226 (0.0061)***	0.0752 (0.0061)***	-0.0132 (0.0043)***	PASSED COURSE	0.0471 (0.0062)***	0.0166 (0.0065)**	0.0473 (0.0049)***
FEMALE * TA USE	0.1113 (0.0031)***	0.1173 (0.0033)***	0.0773 (0.0026)***	FEMALE*PASS_COURSE	0.0456 (0.0118)***	0.0457 (0.0122)***	0.0003 (0.0080)
Female vs. male participants	-0.0240 (0.0050)***	0.0183 (0.0053)***	-0.0510 (0.0039)***	Females who pass vs. males who pass	-0.0353 (0.0051)***	0.0133 (0.0053)**	-0.0441 (0.0039)***
Female participants vs. female non-participants	0.1339 (0.0053)***	0.1926 (0.0052)***	0.0642 (0.0034)***	Females who pass vs. females who do not pass	0.0927 (0.0101)***	0.0623 (0.0103)***	0.0477 (0.0063)***

Notes: All interaction effects are estimated via linear probability models with robust standard errors. The differences in outcomes between participant and non-participant minorities and minority vs. non-minority participants are obtained by including separate categories for each minority-VOLED combination in linear probability models and by leaving out the appropriate control group. All models include controls for demographics.

***significant at the 1%; **significant at the 5%; *significant at the 10%.

Cost-Effectiveness Analysis

In this section we analyze the financial costs and benefits of the TA program based on our estimated program effects on retention and job performance. In assessing the benefits derived from the retention effects we follow the approach in Garcia et al. (2002) Of the sailors who entered in the cohorts we analyzed, the TA usage rate is about .23 (among survivors). Of these, approximately 80% complete their courses, which is about 18.4% of all first-term sailors. Above (see Table 9) we found that successful participation in the TA program increased retention to the 5-year point by about 6.2 percentage points (or roughly 9%). Thus, our estimates suggest that the TA program, based on successful participants, increases overall first-term retention by about 1.14 points. To determine the monetary value of this increase in retention we can base it on the cost savings to the Navy from the higher retention generated via this program versus the retention from an alternative program that would generate the same retention improvement. There are several available estimates of the cost to the Navy of increasing first-term retention via paying higher selective reenlistment bonuses (SRB). For example, Moore, Golding, and Griffis (2001) argue that increasing reenlistment rates by 2 percentage points costs the Navy between $66 and $157 million annually. More recent figures in Hansen and Wenger (2003) suggest that this figure is about $86.6 million. If we use the more recent estimate of $86.6 million as a lower bound and $157 million as an upper bound, the TA program saves the Navy somewhere between $49 and $117 million. When these cost savings are compared to annual TA program expenditures of $95 million, the program would not be cost-effective using the lower-bound estimate but would be cost-effective using the upper-bound estimate.

However, the direct retention effect is only one economic benefit of the program to the Navy. Hansen and Wenger (2003) argue that increased reenlistment rates also produce a more senior force, which increases individual performance and unit readiness. Their study attempts to estimate the monetary value of the additional productivity gain to the Navy of the added experience. Based on data from civilian workers, Hansen and Wenger estimate productivity increases for sailors in the 4% range for every year of additional service (beyond the first term of service). When they apply this percentage to individual ratings, Hansen and Wenger estimate, on average, a 1 percentage-point increase in reenlistment rates generates additional productivity gains per year, per sailor of between $1,900 and $1,600 (depending on rating). If we apply the average ($1,750) per person productivity gain to the population of additional reenlistees generated by the TA program (approximately 2,280), we obtain seniority benefits of approximately $4 million per year.

However, all the above calculations are based solely on benefits derived from the higher retention. Our analysis also found that promotion rates of TA users during their first term of service tend to be higher non-TA participants. We can assume that individual productivity increases as rank and responsibilities increase. Promotion in the Navy is based on promotion points, which are based on factors such as test scores and supervisor evaluations. Hence, promotion reflects the Navy's assessment of an individual's on-the-job performance. We are not aware of any studies on the direct productivity advantage associated with increased enlisted promotion, but we can assume as a first approximation that a promotion is as least as valuable as 1 year of additional experience ($1,750). We further assume that those who are promoted to E4 spend 1 year in that pay grade during their first term of service as do those who are promoted to E5 (again, in comparison to those who are not promoted). If we use the estimated promotion advantage to TA users (observed to be 3 percentage points to E4 and 5 points to E5 in Table 10) and apply this to the relevant populations, a promotion-related productivity effect of $1.16 million for the TA-related E4 promotions and $3.06 million for E5 promotions is obtained.

Summing the benefits based on the additional reenlistments, the additional seniority, higher E4 promotion rates and higher E5 promotion rates, the total monetized annual benefits associated with the TA program are between $57 million (using the lower-bound retention benefit) and $125 million (using the upper-bound retention benefit). Based on annual TA expenditures of $95 million, incorporating the benefits associated with additional job productivity and higher promotion rates does not change our basic conclusion on program cost-effectiveness—the program is not cost-effective if the lower-bound retention benefits estimate is used, but is cost-effective if the upper-bound estimate is used.

However, to this point the analysis omits numerous benefits that cannot be quantified or analyzed. The most salient of these is the potential recruiting impact of the TA program. A significant proportion of new enlistees respond in surveys that their enlistments were motivated by the availability of subsidized college education in the military. The financial benefit to the Navy would be the potential reductions in other enlistment incentives or recruiting resources that could be achieved due to additional recruits generated by the TA program. As an illustration, Cylke, Hogan and Mackin, (2000) estimate that each additional $1 million spent on enlistment bonuses generates enough additional enlistments to save between 18-20 recruiters per year, saving the Navy between $220-320 million. To apply this to the TA program, suppose that each $1 million spent on TA were to increase enlistments commensurate with a similar increase in enlistment bonuses. In this case, the TA program would be highly cost-effective based solely on the recruitment benefit. Of course, it is unlikely that $1 million of TA expenditures would have a commensurate recruiting effect as an enlistment bonus program. However, it is plausible that the entire $95 million annual TA expenditure would have at least the same effect as $1 million spent on enlistment bonuses. If the entire TA program enhanced recruiting sufficiently to eliminate 18-22 recruiters, the ratio of benefits to costs for the TA program would be between 3:1 and 2:1, based solely on the recruiting benefits.

Other effects of the TA program also are difficult to quantify but must be weighed in a full cost-benefit analysis. Garcia and Joy (1998) point out that the Navy's Voluntary Education program helps sailors increase their ASVAB scores, which directly contributes to their attending A-School and changing from lowerskilled to high-skilled ratings. Their analysis found that Voluntary Education participants were 3 times as likely to change their ratings as non-participants. We can assume that the VOLED program is a relatively efficient method of increasing the number of sailors in more technical ratings as compared to recruiting them directly (Cylke et al., 2000)

Another potential benefit that has not been previously analyzed is the effect of the TA program on the ability of sailors to apply for and complete officer commissioning programs. Since TA increases the number of college credits and allows sailors to assess their chances of successfully completing a degree, it should increase the rate of applications for enlisted-to-officer commissioning programs, such as the Seaman-to-Admiral program. Again, to the extent that this effect is positive, we assume that TA is more cost-effective in generating additional officers than alternative methods.

Finally, our analysis found that the TA program has a differential positive effect on African-American and female sailors as compared to other demographic groups. Improvements in the promotion and reenlistment rates of these demographic groups make an important contribution to the achievement of the Navy's diversity goals. While the value of this benefit cannot be reliably evaluated in monetary terms, it should be given a significant weight in a full cost-benefit analysis.

On balance, based on the benefits we quantified, the TA program was found to be cost-effective if we use the upper-bound retention effect based solely on its positive retention effect. The program is not cost-effective when we use the lower-bound retention benefit estimate. However, it is our judgment that the benefits we have quantified and monetized, in combination with the incommensurables—including the potential recruiting benefit, the contribution to the Navy's diversity goals, the increases in cross-ratings to more technical rating and the increases in enlistee applications to officer commissioning programs—are sufficient to render the program cost-effective on normal financial criteria.

Conclusions and Recommendations

This study analyzes the effects of participation in the Navy's Tuition Assistance (TA) program on enlistees' reenlistment and promotion outcomes. The analysis indicates that sailors who use TA for college reenlist at higher rates than those who do not use it. The mean reenlistment rate for the sample is 39.1%, but among those who use TA the reenlistment rate is 54.6percent. Successful completion of courses may be correlated with ability and motivation; therefore, these results may be biased upward. To mitigate this problem, all models were conditioned on AFQT test scores. Sailors who participate in TA also exhibit a higher likelihood of advancing to E-4 or E-5 by the end of their fourth year of service. The promotion rates to E-4 and E-5 among the sample are 37.4 and 10.7%, respectively. For sailors who use TA, promotion rates are 42.6 and 14.8% to E-4 and E-5, respectively. Successful completion of at least one class has a positive effect on the E-4 promotion rate.

This analysis confirms the positive relationship between reenlistment (i.e., retention) and educational opportunities found in a previous study conducted by CNA (Garcia et al., 1998). Garcia et al. found that sailors who used TA were more likely to reenlist. Additionally, the availability of more recent data that focuses on TA enrollments, participation, and completion rates, and the exclusion of sailors who attrite prior to their reenlistment opportunity make this analysis a refinement of CNA's study.

Buddin and Kapur (2002) found that service members who participate in TA are actually less likely to reenlist, suggesting that TA users are more likely to leave the Navy after their first-term of service for better job opportunities. The data used in our study was insufficient to reproduce the instrumental variable approach used to control for selection bias in the Buddin and Kapur study. The findings presented here confirm RAND's theory that inclusion of sailors who attrite will upwardly bias the apparent effect of TA use on retention (i.e., causing the effect of TA use to be overestimated). However, in this analysis (unlike RAND's), the effect of TA use on retention and promotion remained positive.

Although the college courses that sailors complete under the TA program are building general human capital, our results suggest sailors do not use TA to prepare for civilian jobs. Rather, they are building human capital and skills for Navy jobs, which offers returns to the Navy in improved retention and on-the-job performance. Our estimates suggest the TA program is cost-effective under certain reasonable assumptions, but it is not cost-effective under all assumptions. However, when the various potential effects of the program are weighed in the cost-benefit analysis, including those that we were not able to quantify or monetize, we are confident that the program is a cost-effective alternative to other programs that also impact retention, promotion, and the other outcomes. For example, the program is likely to improve recruiting, which saves recruiting resources. In addition, the results indicate that TA promotes diversity goals because women and minorities are more frequent users of TA and members of these groups who use TA have higher reenlistment and promotion rates.

Recommendations

In a recent Navy *Education Quick Poll* (2006) over 84-95% of respondents in pay grades E2-E7 reported that that a college degree would benefit them professionally (Uriell et al.). Moreover, a clear majority in all three pay grade groupings (E2-E3, E4-E5, and E6-E7) agreed with the statement that "Educational Opportunities in Navy Positively Impact My Decision to Make Navy a Career." However, respondents also reported significant obstacles to TA participation; 78%-83% of those in pay grades E2-E5 reported it was not "easy to schedule courses." The most common reasons cited for difficulties in scheduling classes were a "lack of time" and "conflicts between work and education." (Uriell et al. Both factors were cited by roughly half of all respondents in all pay grades. Another barrier sailors identified was the "annual TA limit."

The results in this paper suggest that the Navy should consider policies that encourage TA participation and, in particular, that encourage course completion by those who enroll in college classes. Sailors' suggestions on what could be done to make it easier to obtain a college degree seem to provide a base for recommendations to policy makers. Sailors recommended three top policies: provide time off for classes during duty hours, provide more flexible work schedules that accommodate courses, and increase TA reimbursement rates. In particular, they recommended fully funding TA for degree completion and removing the 16-semester credit hour annual maximum. Finally, the results strongly suggest that sailors should be encouraged to use educational counseling services at Navy College Offices and to develop an individual educational plan. This plan would assist in identifying the proper class in which to enroll and help increase course completion rates. Finally, the Navy should consider a more sailor-friendly policy of granting waivers for classes that sailors were unable to complete due to work-related reasons. Sailors must deploy and work schedules change frequently. Sailors should not be penalized for such changes or their incentives to use the TA program may be reduced.

Although this study has extended and improved on existing research on the Navy's program, a number of topics remain for future research. To date, all research on this program has been conducted on first-term sailors. However, the highest usage of the program is among sailors in their second-terms and later. It remains to determine what the impact of TA is on these more-senior sailors, measured perhaps in terms of their retention for a career, promotion speed, and probability of achieving Chief Petty Officer, Limited Duty Officer and Chief Warrant Officer ranks. In addition, the effect of the program of increasing officer commissions among this group remains a topic for future study.

Within the group of first-term enlistees, other work remains to be done. The effects of the program on cross-ratings to more technical ratings needs to be re-estimated and compared to the early research by Garcia et al. (2002). The impact of the program on applications for officer commissioning programs has yet to be analyzed. Finally, a separate study needs to be conducted on the potential effect of the program on recruitment. Analyzing the impact of the program on recruiting may require the use of a survey approach.

In Spring 2008, the Navy announced its new “Education and Learning Strategy” (Faram, 2008). This was preceded by the introduction of the new “Life-Work Balance Strategy”. The Tuition Assistance and the overall Voluntary Education program will play a key role in the implementation of these strategies. In terms of the Education and Learning Strategy, TA will need to be used by many sailors to acquire the additional rating-related skills needed to advance in their career paths and to achieve higher pay grades. To the extent that the Navy intends to count advanced education toward promotion, especially in the highest pay grades, sailors must have ready access to college courses and the completion of Associates and Bachelor’s degrees for this strategy to succeed. Similarly, the Life-Work Balance Strategy envisions similarly making education more readily available to sailors to improve their quality of work life and their attitudes toward Naval Service. In general, the Navy must increase its commitment to funding the program and finding ways for sailors to improve their access to the program.

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Appendix Table A

	Dependent Variable: Reenlist	
	(1)	(2)
Any TA Used	0.678	0.264
	(0.007)***	(0.002)***
Female	-0.171	-0.067
	(0.007)***	(0.003)***
Black	0.196	0.078
	(0.007)***	(0.003)***
Hispanic	0.099	0.039
	(0.008)***	(0.003)***
Native American	0.011	0.004
	(0.016)	(0.006)
Asian	0.376	0.149
	(0.012)***	(0.005)***
Other race	0.079	0.032
	(0.027)***	(0.011)***
Single, with kids	0.043	0.017
	(0.012)***	(0.005)***
Married, no kids	0.051	0.020
	(0.074)	(0.030)
Married, with kids	0.178	0.071
	(0.012)***	(0.005)***
Age	0.009	0.003
	(0.001)***	(0.000)***
CAT I	0.245	0.097
	(0.011)***	(0.005)***
CAT IIIA	-0.222	-0.088
	(0.006)***	(0.003)***
CAT IIIB	-0.268	-0.105
	(0.006)***	(0.002)***
CAT IV	-0.045	-0.018
	(0.114)	(0.045)
CAT unknown	-0.251	-0.098
	(0.060)***	(0.023)***
High school	-0.202	-0.079
dropout	(0.014)***	(0.005)***
GED	-0.195	-0.076
	(0.010)***	(0.004)***
College degree	0.051	0.020
High school	(0.030)*	(0.012)*
dropout	-0.153	-0.060
	(0.023)***	(0.009)***
fy95	-0.088	-0.035
	(0.011)***	(0.004)***
fy96	0.045	0.018
	(0.011)***	(0.004)***
fy97	0.194	0.077
	(0.010)***	(0.004)***
fy98	0.256	0.102

	(0.010)***	(0.004)***
fy99	0.232	0.092
	(0.010)***	(0.004)***
fy00	0.159	0.063
	(0.010)***	(0.004)***
fy01	0.064	0.025
	(0.010)***	(0.004)***
Constant	-0.417	
	(0.022)***	
Observations	267815	267815

Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

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