Sailors' Willingness to Complete Sea Tours: Does Money Matter?
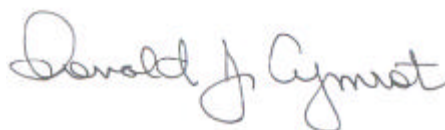
Heidi L. W. Golding
with
David Gregory

Approved for distribution: December 2002

Donald J. Cymrot, Director
Workforce, Education and Training Team
Resource Analysis Division

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Summary

The Chief of Naval Operations (CNO) has stated a goal of increasing sailors' choice in the assignment process while improving the efficiency of the distribution system. By restructuring the assignment system, the Navy expects to reap benefits from manning improvements, increased readiness, higher job satisfaction and retention, and, as a result, lower manpower costs. As a means of accomplishing the CNO's goal, the Navy is planning to rely on two new pay elements: the Location Selected Reenlistment Bonus (LSRB) and Assignment Incentive Pay (AIP). The LSRB was first offered to selected sailors at their reenlistment points in FY02. AIP is a monthly award to be paid to sailors for the duration of their tours in certain hard-to-fill billets and will be introduced in a limited fashion over the coming year. Although the primary purpose of these pay elements is to encourage sailors to volunteer for difficult-to-fill billets, an additional benefit for the Navy is that sailors should remain in these billets longer.

Little information exists, however, on how effective compensation is in fulfilling distribution goals.[1] What historical data there are relate to sea pay's effect on distribution. The purpose of this paper is to gain insights into the potential usefulness of the new pays in *keeping* sailors in hard-to-fill billets. To do so, we investigate the effect of additional sea pay on the willingness of sailors to remain or extend on sea duty.

Historically, the Navy has used sea pay as its primary distribution tool—both to compensate sailors for the arduous nature of sea duty and to encourage sailors to stay in billets that are more difficult to fill. Of course, the new pays differ from sea pay and, consequently, their effectiveness may also vary. In contrast to sea pay, the new distribution pays are more targeted to hard-to-fill billets and will be paid based on one assignment alone, rather than on the cumulative time sailors spend in hard-to-fill billets. The goals of sea pay and the new pays,

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1. Reference [1] discusses findings from a recent CNA survey on the expected effectiveness of incentives, including pay, to induce sailors to volunteer for hard-to-fill billets.

however, are ultimately the same—to increase manning in hard-to-fill billets. And, the mechanism is similar—using money to either encourage sailors to accept or remain in jobs that are difficult to fill.

Patterns in sea duty and sea pay

To examine whether sea pay affects sailors' time on sea duty, we first look at the patterns in sailors' time spent on sea duty and patterns in sea pay. We analyze sea tour completions and extensions separately because they potentially reflect different underlying incentives and behaviors. Because the Navy sets obligated sea tour lengths, if sailors regard their obligations as binding, completion rates could be unaffected by sea pay. There are means, however, for sailors to reduce their time on sea duty. At the extreme, sailors may curtail their sea duty tour by leaving the Navy (either by attriting or not reenlisting). For example, we find that, for sailors with 48-month tours ending in FY98, only 36 percent complete their sea tours and the average time on sea duty is about 30 months.

Despite our hypothesis that sea pay should keep sailors on sea duty longer, we do not see a clear correspondence between sea pay and completions (figure 1). The trough in sea tour completions occurred at the end of the drawdown, which is not surprising given that the Navy was encouraging sailors to leave the Navy. In addition, a large uptick in completions has occurred in recent years—before an improvement in sea pay rates. The rise corresponds instead to efforts of leadership to improve conditions on sea duty and, more generally, with attrition reduction initiatives. Although the highest completion rates occurred in the years around the 1989 sea pay rate change, it is not clear whether sea pay or other factors (e.g., relatively high quality of service at sea) drove the high completion rates—particularly in light of the more recent increases in completions.

Unlike completions, extensions are purely voluntary decisions on the part of sailors and, consequently, should reflect sailors' preferences for long sea duty. Overall, extensions of sea duty and changes in the value of sea pay do appear to be correlated over time (figure 2). Extensions peaked with the 1989 sea pay change at 14 percent and slowly declined as the real value of sea pay deteriorated over most of the 1990s. By FY98, only 8.5 percent of sailors scheduled to end

48-month sea tours extended more than 6 months. Again, however, we cannot be certain that other factors, such as increases in attrition or worsening sea duty conditions, are not driving the apparent correlation—particularly since extensions have increased since then.
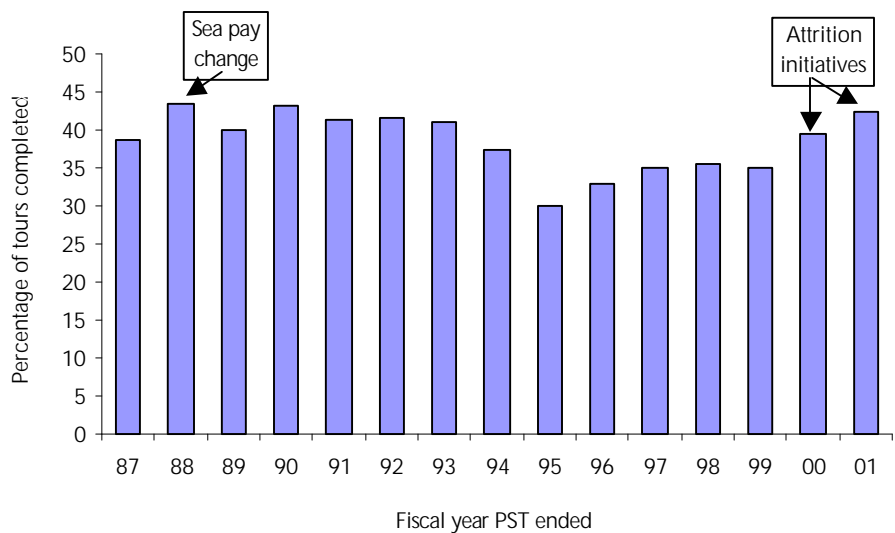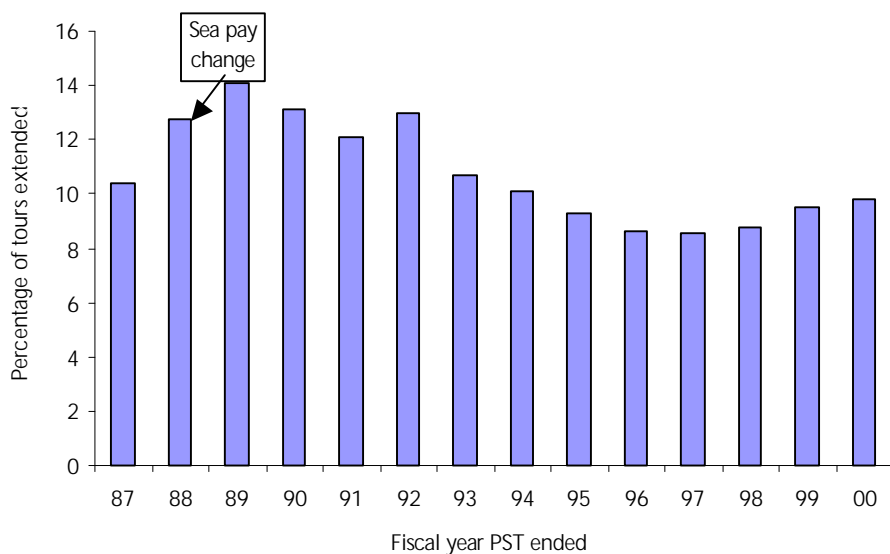
Figure 1. Percentage of 4-year sea tours completed

Figure 2. Voluntary extensions of sea duty over time, 4-year tours

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Statistical findings

Because, as we've seen, many factors may influence sailors' time on sea duty and sea pay, we wanted to establish whether there is a direct link between sailors' behavior and the sea pay they receive. We conducted regression analyses to measure the effect, if any, of sea pay on sailors' completions and extensions of sea duty. This allows us to hold constant other factors that also influence time on sea duty. To the extent that we cannot measure all influences on sea pay completions, we may overstate or understate the pay effect. We found, however, that in every model we ran the effect of sea pay is highly statistically significant. Our best estimates of its effect indicate that:

- *Sea pay affects sailors' willingness to complete their obligated tours.* In general, a $50 increase in total monthly sea pay boosts yearly completion rates between 0.8 (in the second year) and 2.5 percentage points (in the last year of the sea tour). In total, a $50 increase corresponds to increased completions of 48-month sea tours by 3.3 percentage points, or 11 percent.

- *Sea pay affects sea tour extension rates.* A $50 increase in monthly sea pay increases extensions of 48-month tours by 2.9 percentage points, or 5.8 percent.

Implications

Money matters. Sailors respond to monetary incentives. We estimate that the Navy would gain annually about 1,425 work-years of sea duty at a cost of $45 million if sailors received an additional $50 per month in sea pay.[2] At a cost of $31,600 per additional work-year generated, increased sea pay compares favorably to an E-4's total annual compensation of $37,200. In addition, with the increased work-years, crew turnover in seagoing billets is reduced. The Navy benefits in several ways.

- Lower turnover implies a reduction in training costs.

- Expenses for permanent-change-in-station (PCS) moves should decrease.

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2. Our results are consistent with previous CNA calculations based on survey data [2].

- A more experienced workforce increases readiness.

That said, although money increases work-years and, ultimately, readiness, factors other than pay can matter more, as illustrated by the increase in time spent on sea duty in FY00 and FY01. Sea tour completions rose by over 7 percentage points in those years—a magnitude twice a $50 boost in pay—with no corresponding increase in sea pay rates.

What are the implications for the new distribution pays? The Navy should benefit from lower turnover. Although we cannot be certain of the magnitude of the AIP effect, our best estimate is that the Navy would receive a modest 300 additional work-years from lower turnover in the hardest-to-fill CONUS shore billets given an AIP of $50 per month.

This may understate the benefit of the new AIP. Both the LSRB and AIP are likely to be more cost-effective than sea pay at keeping sailors in difficult-to-fill billets. Sea pay is paid to sailors in most sea billets; even those in preferred sea billets receive compensation. For the new distribution pays, however, the Navy will incur the expense for only a limited specific set of billets. In addition, because the sailors filling these undesirable billets voluntarily choose the billet, they should dislike it less than a sailor who was ordered into the billet. As a result, these sailors should require less pay than others to induce them to stay in the billets.

Remember, though, that keeping sailors in hard-to-fill billets is only a secondary benefit of AIP and LSRB. The primary goal is to induce sailors *to fill* certain billets. The continuation benefit when combined with the assignment benefits we anticipate means that the distribution pays are worth pursuing—at least for some hard-to-fill billets.[3] Because, however, there is uncertainty in the responsiveness of sailors to volunteer for hard-to-fill billets and the costs of the new pays, we recommend a gradual implementation of the pays so data can be collected for further analysis.

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3. Reference [3] explores the overall cost-effectiveness of a distribution pay.

Introduction

The Chief of Naval Operations (CNO) has stated a goal of increasing the amount of choice in the assignment process. By revamping the assignment system, the Navy expects to reap benefits from manning improvements, increased readiness, higher job satisfaction and retention, and lower manpower costs [4, 5].

The Navy has concluded that allocating sailors across billets can be accomplished by changing its compensation system. To move the assignment system away from reliance on a patchwork of nonmonetary incentives and involuntarily ordering sailors to billets, the Navy is designing and implementing two new distribution pays that sailors could receive for accepting hard-to-fill billets:

- Location Selected Reenlistment Bonus (LSRB)

- Assignment Incentive Pay (AIP).

The LSRB was first offered to selected sailors at their reenlistment points in FY02. AIP is a monthly award to be paid to sailors for the duration of their tours in certain hard-to-fill billets and will be introduced in a limited fashion over the coming year. The Navy has little direct evidence, however, on how compensation affects the willingness of sailors to volunteer for and remain in undesirable billets. Because the Navy must first have data on this to determine the potential cost-effectiveness of the new pays, N1B asked CNA to investigate whether sailors are more likely to stay in hard-to-fill billets when offered a special pay and, if so, for how much longer.[4]

To do this, we focus on one pay element—sea pay. It is the Navy's primary monetary distribution tool with an annual budget of over $200 million. Sea pay is an incentive for sailors to go to and remain on sea

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4. In a concurrent paper [5], we analyze survey data to determine the responsiveness of sailors to various potential assignment incentives.

duty. Although it is not as targeted toward hard-to-fill billets as the new pays would be, its function is the same—to increase manning in certain billets.

In this paper, we use historical information on sailors' time on sea duty and relate it to the levels of sea pay received. To accurately measure how much sea pay influences sailors' willingness to be on sea duty, we would like to analyze the amount of time sailors *choose* to be on sea duty given different levels of pay. Our analysis, however, is complicated by the fact that the Navy mandates sailors' assignments to sea duty. The Navy currently sets obligated or prescribed sea tour lengths (PSTs) of 3 to 5 years depending on the sailor's rating and paygrade. The Navy revises the PSTs based on manning levels.[5] One might conclude that time at sea reflects obligations and would not be responsive to changes in sea pay, but this is not wholly true.

The length sailors actually serve on sea duty does reflect both their sea duty obligation *and* their willingness to serve on sea duty. Sailors can reduce their time on sea duty. At the extreme, sailors may curtail their sea duty tour by leaving the Navy (either by attriting or not reenlisting). Also, sailors who reenlist may waive their sea duty commitment. The Guaranteed Assignment Retention Detailing Program (Guard 2000) allows first-term sailors to waive up to 18 months of sea duty in exchange for a reenlistment commitment. Even before this program, however, sailors were able to bargain with detailers to rotate to shore duty in exchange for reenlisting. Sailors may also use other means, such as medical complaints, as a way out of serving sea duty.[6]

That said, sailors' time spent on sea duty is not a perfect measure of their willingness to serve on sea duty. If some sailors view the PST obligation as binding, any effect of sea pay we measure on remaining on sea duty is dampened. To alleviate this problem, we examine

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5.   Historically, the Navy has revised sea tour lengths about every 3 to 4 years; in recent years, revisions have occurred with greater frequency.

6.   Sailors report that those deciding to leave the Navy before the end of obligation use the Navy's separation criteria as a means of doing so [6]. Similar use of unplanned loss reasons, such as medical complaints, to curtail time on sea duty is likely.

separately the effect of sea pay on sailors' completion of their obligated sea tour and on sailors' extensions of sea duty. These extensions are our only measure of voluntary behavior and reflect sailors' preferences for long sea duty. Changes in sea duty extensions in the face of different levels of sea pay should then accurately reflect sailors' responsiveness to sea duty incentives. There is a caveat, however. If some sailors who might have chosen to extend were not aware that they could or were not allowed to by their detailers, the relationship between sea pay and extensions may also be understated. Although this may not be much of an issue for sailors on longer tours, for sailors needed in shore billets (e.g., sailors in 36-month tours), this may be more of a factor.

Not all sailors on sea duty receive sea pay. As our first step, we review eligibility rules for sea pay and detail changes to sea pay over the past decades. Then, we examine sailors' completion and extension rates by PST and determine why sailors do not complete their sea tours. Then, we analyze the responsiveness of sailors to additional sea pay. We show trends in completion and extension rates over time, and correlate these variations to changes in the value of sea pay. Next, we link individual sailors' sea pay receipts to their subsequent completion of obligated sea tour. Factors other than sea pay, such as quality of life at sea and other pay, will also influence whether sailors complete their sea tours. To account for these other determinants of time spent on sea duty, we use regression analysis to estimate the responsiveness of sailors' time on sea duty to different levels of sea pay. We examine sea tour completions and extensions from FY83 onward. Based on our findings, we consider some implications for AIP.[7]

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7. Reference [7], a precursor to this research, uses many of the same data and much the same approach to investigate aggregate trends in sailors' time at sea, but, unlike this paper, it does not use statistical methods to measure the effect of a sailor's sea pay on completion.

Review of sea pay[8]

The Navy has traditionally considered sea pay as compensation to sailors for the arduous nature of sea duty (e.g., the long deployments and difficult working conditions). In recent years, the Navy has also used sea pay as an incentive to get sailors to rotate to sea duty and to complete their tours. Increases in sea pay, Navy officials were convinced, could improve sea/shore balance, reduce turnover, and increase readiness.

Structure of sea pay

The current system of sea pay evolved in the late 1970s and early 1980s when the military established Career Sea Pay (replacing sea duty pay) and the Career Sea Pay Premium. Career Sea Pay (CSP) is a monthly special pay that is paid to sailors on qualified sea duty. Sailors' CSP increases as they are promoted or accumulate additional years on sea duty. Although, beginning in FY02, sailors in paygrades E-1 through E-3 may receive CSP, it has been and remains primarily an incentive for careerists to serve at sea.

The Career Sea Pay Premium (CSPP) is a fixed $100-per-month bonus paid to sailors exceeding 36 consecutive months of sea duty. Through the 1990s, all sailors in paygrade E-4 and sailors in paygrade E-5 and above with less than 5 years of sea duty could receive the CSPP. Sailors below paygrade E-4 were ineligible, whereas the more senior sailors received a higher sea pay rate (not dependent on consecutive months at sea) embedded in the CSP table. As structured, CSPP rewarded junior sailors for long sea tours and provided an incentive for them to reenlist into sea duty or extend their tours. In FY02, eligibility has been broadened to both more junior and more senior sailors.

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8. Reference [8] provides a more extensive history of sea pay. This section draws heavily from that document.

Sea duty qualifying for sea pay

Eligibility for sea pay depends crucially on a sailor's sea duty assignment. Sailors on sea duty for rotational purposes may or may not receive sea pay. U.S. Code, Title 37, Section 305a, details sea duty qualifying for sea pay as the following:

    a. While permanently or temporarily assigned to a ship, and

- While serving on a ship, the primary mission of which is accomplished while under way; or

- While serving as a member of the off-crew of a two-crew submarine; or

- While serving as a member of a tender-class ship (with the hull classification of submarine or destroyer).

    b. While permanently or temporarily assigned to a ship and while serving on a ship, the primary mission of which is normally accomplished while in port, but only during a period that the ship is away from its home port [which it defines as (a) at sea or (b) in a port that is more than 50 miles from its home port].

    c. While permanently or temporarily assigned to a ship-based staff or other unit (at the discretion of the Secretariat).

Sailors assigned to deploying ships and submarines are, in general, eligible for sea pay for the duration of their sea tours—whether the ship is deployed or in home port. Crews in squadrons, other mobile units, and "category B" vessels (such as training ships), as well as most ship-based staffs, receive sea pay but only while under way or deployed at sea.[9] Other sailors, such as Seabees, sailors in P3 squadrons, and

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9. Sailors receiving sea pay only while under way typically accumulate sea duty credit for sea pay purposes only when under way. All category B vessel crew and some ship-based staff, however, receive a continuous sea pay counter toward cumulative time on sea duty for their entire tour. For the most recent publication of eligibility rules, see SECNAV Instruction 7220.77D (December 1996). SECNAV Instruction 7220.77C (May 1993) and SECNAV Instruction 7220.77B (November 1987) preceded the current instruction.

sailors assigned to overseas shore duty, who receive sea duty credit for rotational purposes do not receive sea pay.

In our analysis, we will focus on those sailors who receive sea pay continuously. As sea pay levels vary, these sailors face the largest changes in annual compensation. Consequently, they should exhibit the largest changes in sea tour completion and extension rates.

Changes in sea pay

Because CSP rates have been regulated by U.S. Code, any changes to the sea pay table have required congressional legislation.[10] As a result, few major modifications have been made since the inception of the CSP program.

The most sweeping transformation occurred in 1981 when the sea pay premium was introduced and career sea pay rates increased dramatically. Those rates, however, remained largely unchanged until 1988.[11] The top half of table 1 shows the portion of the enlisted sea pay table that applied to most sailors collecting sea pay. A footnote highlights those sailors who were eligible to collect the sea pay premium.

The rate changes in the FY88 NDAA legislation were, by comparison, much smaller. Sea pay was revised to provide additional sea pay to careerists. The CSP table was increased by up to $130 for sailors serving over 5 years on sea duty, although their eligibility for the sea pay premium was revoked. Overall, this restructuring served to increase the incentive to return to sea or to complete and extend a sailor's first sea tour. In contrast, sailors with little time on sea duty actually saw small declines in their CSP rates. The decreases were phased in with sailors on sea duty before January 1988 receiving the rates from the previous CSP table.[12] The lower half of table 1 shows a piece of the enlisted sea pay table from the 1990s.

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10. This held true until the FY01 National Defense Authorization Act (NDAA). At that time, Congress mandated maximum allowable CSP rates of $750 per month and allowed Secretariat discretion over servicemembers' rates.

11. Additional breakpoints for cumulative years of duty were added in 1985.

12. The grandfathering scheme is detailed in DoD Financial Management Regulation 7000.14-R, Vol. 7A, *Special Pay—Sea Duty,* February 2000.

Table 1.   Portions of the Career Sea Pay table used through FY87 and through FY01

	Years of cumulative sea duty								
	1 or less	Over 1	Over 2	Over 3	Over 4	Over 5	Over 6	...	Over 12
Through FY87									
E-1 to E-3	0	0	0	0	0	0	0	...	0
E-4	50	60	125	160[a]	175[a]	175[a]	175[a]	...	160[a]
E-5	60	70	140	175[a]	185[a]	190[a]	205[a]	...	220[a]
E-6	125	135	170	190[a]	210[a]	215[a]	225[a]	...	280[a]
E-7	135	145	215	235[a]	255[a]	260[a]	265[a]	...	310[a]
E-8	165	180	225	255[a]	265[a]	270[a]	280[a]	...	320[a]
E-9	175	195	235	265[a]	280[a]	290[a]	310[a]	...	320[a]
	1 or less	Over 1	Over 2	Over 3	Over 4	Over 5	Over 6	...	Over 18
Through FY01									
E-1 to E-3	0	0	0	0	0	0	0	...	0
E-4	50	60	120	150[a]	160[a]	160[a]	160[a]	...	160[a]
E-5	50	60	120	150[a]	170[a]	315	325	...	350
E-6	100	100	120	150[a]	170[a]	315	325	...	450
E-7	100	100	120	175[a]	190[a]	350	350	...	500
E-8/E-9	100	100	120	175[a]	190[a]	350	350	...	520

a. Eligible for CSPP.

By the late 1990s, sea pay had lost over 40 percent of its value to inflation. Because of this and subsequent sea manning difficulties, the Navy pursued a joint reform of the structure of sea pay and increases in targeted areas of the table. Table 2 shows a portion of the new Navy sea pay table that became effective in October 2001. The most significant change is that it increased the incentive for sailors at the reenlistment point to stay on sea duty and to reenlist into sea duty; sea pay rates for sailors with over 3 or 4 years of sea duty nearly doubled. The Navy also opted to expand eligibility for the Career Sea Pay Premium to sailors in paygrades E-5 to E-9 and began paying sea pay to the most junior sailors (E-1s to E-3s).[13]

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13. Sailors with the most sea-intensive careers (i.e., those with over 8 years of cumulative sea duty) receive an additional $100 in CSP, instead of the eligibility for CSSP.

Table 2.   Portion of the new sea pay table[a]

| Paygrade | Years of cumulative sea duty | | | | | | | | | |
	1 or less	Over 1	Over 2	Over 3	Over 4	Over 5	Over 6	Over 7	...	Over 18
E-1	50	50	50	50	50	50	50	50	...	50
E-2	50	60	75	75	75	75	75	75	...	75
E-3	50	60	100	100	100	100	100	100	...	100
E-4	70	80	160	280	290	290	290	290	...	390
E-5	70	80	160	280	300	315	325	350	...	450
E-6	135	135	160	280	300	315	325	350	...	550
E-7	135	135	160	305	320	350	350	375	...	600
E-8/E-9	135	135	160	305	320	350	350	375	...	620

a. Career Sea Pay Premium eligibility extended for all sailors under 8 years of cumulative sea duty, whereupon the additional pay becomes embedded in the sea pay table.

To evaluate how changes in sea pay influence sailors' behavior, we require data on time on sea duty both before and after reforms. Because the latest restructuring of sea pay was implemented less than a year ago, we cannot yet determine its consequences. Instead, those changes from the late 1980s are key to identifying the magnitude of effect that sea pay has on manning sea billets.

What's happened to time served on sea duty

Our first step was to look at aggregate trends in sea duty completion and extension rates. To calculate the rate of completions and extensions, we follow sea tours from the time the tour began to the time the tour ended (i.e., we employ cohort analysis). Here, we describe the data we used and summarize our findings on when and why sailors leave sea duty.

Data

Our data track all tours qualifying as sea duty for rotational purposes[14] begun between FY83 and FY98 and having prescribed sea tour (PST) completions by FY02.[15] We separated the sample into three categories of tours:

- Those qualifying for continuous sea pay

- Those eligible for sea pay only while under way

- Those not eligible for sea pay.[16]

We included sea tours held by sailors in any paygrade because most sailors should meet the paygrade eligibility requirements for sea pay during their sea tour obligation. We did eliminate certain sea tours, however. First, we deleted tours following OCONUS/CONUS rotations because they do not follow published prescribed tour length

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14. To be included, the tour had to be type 2, 3, 4, 6, 7, or 8. Type 6 duty was sea duty for rotational purposes only between January 1994 and January 1998.

15. Sailors' active duty service dates ranged from FY55 through FY98.

16. We based our determination of sea pay eligibility on SECNAV Instructions 7220.77D (December 1996), 7220.77C (May 1993), and 7220.77B (November 1987), NAVADMIN 133/97, NAVADMIN 102/98, NAVADMIN 275/99, and NAVADMIN 080/01.

guidelines. In addition, we limited the data to tours held by men because many changes occurred in women's assignments over the time period that were difficult to track. For example, women's assignments to various ships were restricted and their tour lengths differed from men's depending on bunk availability. Training and Administration of Reserves (TARs) and Temporary Active Duty sailors (TEMACs) are also not included.

Our final sample consisted of over 900,000 sea tours. Over three-quarters, about 716,000 sea duty tours, were eligible for continuous sea pay. Most of the sailors associated with these tours were assigned to ships. About 163,000 sea tours (primarily sailors in squadrons) qualified only intermittently for sea pay, whereas the remainder (e.g., sailors attached to mobile construction units or on overseas shore duty) were tours typically not eligible for any sea pay. Although our sample contains all sea duty tours for rotational purposes, our focus is on sea duty qualifying for continuous sea pay. Sailors in these tours face the largest changes in incentives as sea pay reforms are enacted or as sea pay loses value with inflation. Consequently, these sailors should have the greatest responses to sea pay changes.

Once we determined the type of sea tour a sailor was serving, we calculated, for each sea tour, the time the sailor served on it.[17] Time spent in other activities, which idled the sea duty counter, were not counted toward time served. We then merged PST data to the individual tours to determine whether the sailors completed their obligations. Navy community managers establish PST lengths by rating/NEC and paygrade based on sea manning. We used two sources of information for the PST data: (a) NAVADMINs, which announce changes in PST tour lengths and grandfathering algorithms, and (b) the *Navy Times,* which publishes the tables.

Several factors complicate the determination of sea tour completion. For one, Navy policies and funding issues may entail small changes in sailors' projected rotation dates (PRDs) and actual time served. For example, in some years, the PCS account was underfunded, which

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17. For sailors with back-to-back tours, we considered the tours as one and calculated their total time on sea duty.

resulted in some sailors being held over in a tour for a month or two. Availability of a schoolhouse seat can also change sailors' PRDs. Finally, sailors are often able to move their PRDs by a couple of months for personal reasons. In these cases just cited, the Navy would regard those sailors as having completed their sea tours. In our data, however, they would appear to have not completed their sea tour if we compared their actual months served to their PSTs. As a way of resolving these issues, we define a sea tour as completed if the sailor served all but 6 months of the PST.[18] For the same reasons, we consider an extension as a sailor serving on sea duty for 6 months or more beyond the PST.

When and why sailors leave sea duty

In figure 3, we show the timing of sailors' departures from sea duty through FY01 for all sea tours with PSTs ending in FY98. This provides information on whether PSTs are binding and, if not, gives us an indication of sailors' willingness to serve on sea duty. The most striking finding from these data is that most sailors do not finish their PSTs (even when defined as completing all but 6 months of the initial PST).[19] Only among those serving 36-month tours do the majority of sailors fulfill their PSTs—with 71 percent completing compared with 36 percent and 27 percent for 48-month and 60-month tours, respectively. Overall, slightly more than one-third of sailors complete their sea tours, with careerists having completion rates 16 percentage points higher than first-term sailors.[20]

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18. We also used a 3-month window, but we do not present the results because, except for decreasing completion rates about 3 or 4 percentage points, the trends over time are the same.

19. The results we present in this section are consistent with those found in [7].

20. Some sea tour obligations, and consequently sea tours already in progress, were lengthened in the mid-1990s. When comparing sailors' PSTs at the end of their tours (or final PSTs) with actual time served, completion rates are about 2 percentage points lower than when comparing PSTs in effect at the beginning of their tours with actual time served.

Figure 3. Percentage of sailors remaining on sea duty by time served
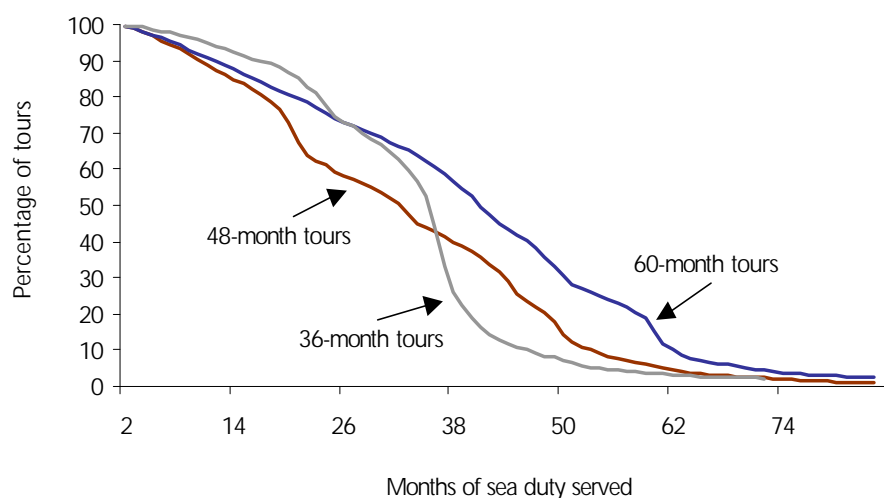
Of sailors who complete their entire initial sea tour obligation (e.g., through 36, 48, or 60 months), many do stay on sea duty even longer. For example, of sailors fulfilling 48- or 60-month tours, over 45 percent extend on sea duty (i.e., serve 6 or more months in addition to their initial obligation); under 40 percent of those completing 36-month tours extend.[21] Of those sailors extending, over 60 percent stay more than 1 year past their initial PST.

Although examining completion and extension rates reveals important information, viewed alone it would mask patterns in the timing of departure and, consequently, whether the Navy is getting the sea manning it expects. We see that sailors serving 36-month tours have the slowest decline in departures over the first 30 months of their sea duty tours. They also exhibit the steepest fall—about a 20-percent drop—in sea duty continuation in the 6 months before their PSTs end. For this group, the Navy is getting about 75 percent of the work-years it would have gotten had all the sailors completed their PSTs. Sailors on 48-month tours also experience a pronounced drop in continuation—about 15 percent leave in a 4-month period—but it is before the 2-year point in the sea tour. This is primarily the result of

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21. Comparable figures when comparing time served with final PSTs are 43 percent and 33 percent, respectively.

initial enlistees leaving the Navy. By 36 months, over half of the sailors assigned to 4-year tours have left sea duty.[22]

Why don't sailors complete their sea tours? Table 3 shows, for sailors whose tours had final PSTs in FY01, where they went if they did not complete their PSTs.[23] The patterns are very different for first-term sailors and careerists. Attrition from the Navy for first-term sailors is more than twice as high as for careerists; therefore, it is no surprise that more than twice as many first-term sailors leave sea duty because they attrite. What is more significant, however, is how many sailors rotate to shore duty early. Close to one-half of the careerists are not leaving the Navy but rather are rotating to shore duty. In contrast, only about 20 percent of first-term sailors rotate to shore early. Careerists' skills are particularly valuable to the Navy, so they may be better able than junior sailors to negotiate shortened sea tours. In addition, both Guard 2000, which waives sea duty time, and unplanned losses contribute to the high rate of sailors rotating to shore. Although we do not present the information for other PST groups, they also had the same general patterns within their losses.

Table 3.   Non-completions for 48-month tours
with PSTs that ended in FY01

	First-term sailors	Careerists
Attrite from Navy	38.0	16.3
EAOS loss	41.8	39.8
Rotate to shore	20.2	43.9

22. Although careerists do tend to serve slightly more of their sea tours before leaving their sea tours early, the patterns in departure are similar for first-term sailors and careerists within a PST category. The exception is for sailors with 48-month PSTs as described above.

23. There was a movement in the late 1990s toward 54-month sea tours, but most sailors have traditionally been obligated for 48-month sea tours—particularly first-term sailors. That is why we chose to present the results for sailors initially obligated to 48-month PSTs. Results for other tour lengths are available on request.

When we looked at the timing of losses within a sea tour for junior sailors, we found that losses early in sea tours were disproportionately the result of attrition from the Navy. Once in the third or fourth year of the sea tour, more than two-thirds of losses were because sailors were at EAOS and not reenlisting or were reenlisting into shore duty. For careerists, the proportion of losses due to EAOS losses were more evenly spread throughout the tour, although early rotations to shore occurred primarily in the final year of obligated service.

Trends in sea duty served over time

Should compensation influence sailors' behavior, we would expect to see changes in time spent on sea duty over the last 15 years for two reasons. First, a FY89 sea pay change increased rates for careerists. Second, the purchasing power of sea pay has eroded about 40 percent since then because of inflation.

Figure 4 shows completion rates over time for sailors serving 4-year tours—first-term sailors and careerists. The highest completion rates the Navy experienced in the last 15 years occurred in FY00 and FY01 and in the years immediately surrounding the sea pay increase.

Figure 4. Percentage of 4-year sea tours completed[a]
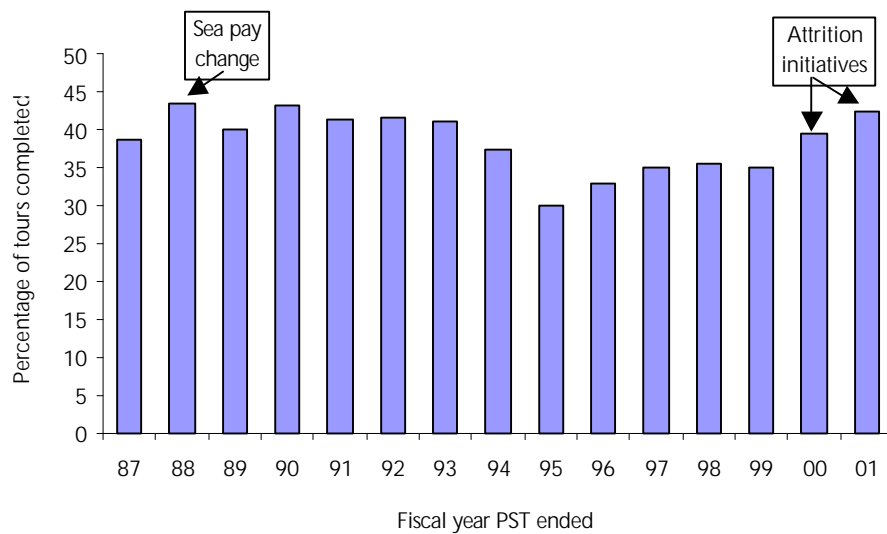
a. Completion rates significantly different at the 99-percent level post-1988 sea pay change.

22

The recent uptick in completions does not correspond to a pay hike; instead, it is likely the result of Navy initiatives to improve sailors' quality of service and retention. With conditions on sea duty and attrition improving, sailors are staying on sea duty longer. The other peak does occur when sea pay rates went up, but other factors may also be contributing to or even swamping the sea pay effect. For example, fleet attrition was low at the time; consequently, more sailors were completing their sea tours. Finally, over the decade, completion rates for all sailors on 4-year tours dropped—by about 20 percent. This corresponds to the decline in sea pay but also to the drawdown and increasing fleet attrition.[24]

Although these rates do not account for decommissionings that allowed some sailors to rotate to shore duty early, this does not appear to affect the trend significantly. We find that, although almost 10 percent of losses from sea duty were because of decommissionings in the early 1990s, sailors who experienced decommissionings were about as likely to complete their PST as those who did not.

We also compared completion rates for sailors serving on tours in which they were eligible for continuous sea pay versus intermittent sea pay. If sea pay didn't matter, one might expect the completion rates to track closely. However, we see that continuous sea tours declined in attractiveness (as measured by the completion rates) compared with the others. It could be that the sea duty experiences of sailors receiving continuous sea pay were worsening relative to other sailors on sea duty, but, just as plausibly, the loss in value to sea pay may have driven the drop (see figure 5).

Next, we look to sailors' extensions of sea duty (figure 6). Extensions reflect sailors' preferences for long sea duty and represent the only measure of truly voluntary behavior we have.[25] Extensions of sea duty and changes in the value of sea pay do appear to be correlated over

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24. Declining completion rates among sailors with 36- and 60-month tours also occurred during the 1990s, but the magnitude was about one-half that observed with the 48-month tours.

25. Although, if sailors do not know they may extend, any correlation between sea pay and extensions in the raw data would be dampened.

Figure 5.   Completion rates for sailors receiving continuous
             or intermittent sea pay
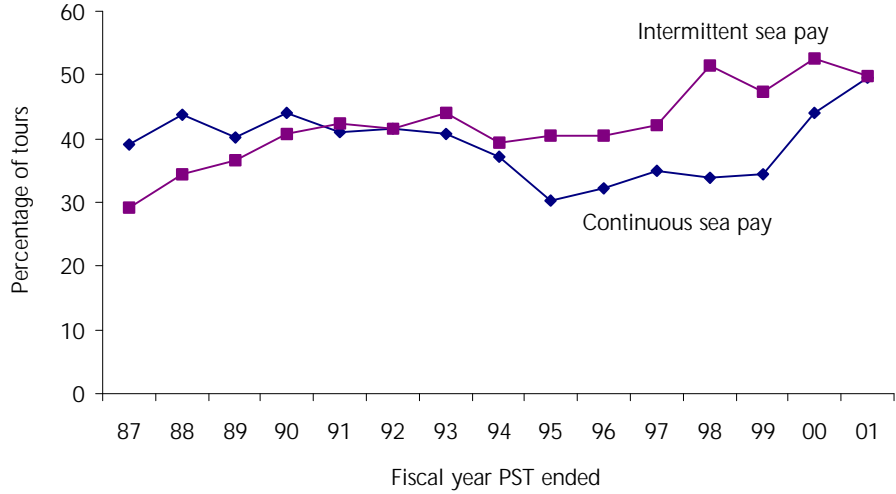
Figure 6.   Voluntary extensions of sea duty over time, 4-year tours[a]
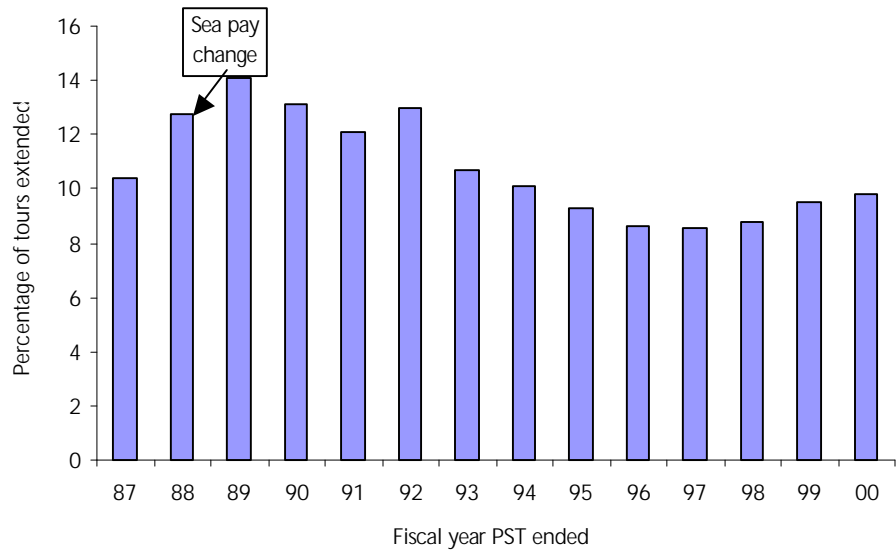
a. Extension rates significantly different at the 99-percent level post-1988 sea pay
   change.

time.[26] Extensions peaked at 14 percent in FY89—the year after the sea pay table changed. As the value of sea pay declined over the decade, the number of voluntary extensions has also dropped—by almost 40 percent. We cannot, however, exclude the possibility that other events over the 1990s might explain this apparent correlation, particularly in light of extensions rising again in FY00 and FY01—without a sea pay change.

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26. The sample here is of sea tours with initial PSTs of 48 months, as used previously. The Navy, however, extended many (already begun) 48-month tours to 54 months in the latter 1990s. If we look at sea tours that remained 48 months, we find the same downward pattern, although the recent increase in extensions is more pronounced. This is because the sea tours that remained at 48 months did not have manning problems. The sailors serving in them were more likely to complete and extend than those sailors whose sea tours were lengthened.

Sailors' responsiveness to sea pay

Although the previous aggregate data suggest that sea pay may influence sailors' willingness to remain on or extend their sea tours, we have not yet established a direct link between individual sailors' behavior and the sea pay they receive. To measure the effect of sea pay on sailors' willingness to remain on sea duty, we use various statistical methods. In this section, we describe our estimation and findings.

Methodology

To measure the effect of sea pay on behavior, we relied on statistical analyses of several datasets. The primary datasets were:

- The Enlisted Master Record
- PRIDE
- The Ship Employment History.

We merged these datasets and conducted regression analyses, with individual sailors as the unit of analysis. The advantage of this technique is that we could determine the importance of sea pay while controlling for the influence of other factors that may also affect time on sea duty. We looked at completions and extensions separately—including both first-term sailors and careerists in the analyses. Because the factors that may affect the completion of sea duty may change during the sea tour, we estimated separate regressions (probit specifications) for the probability that sailors leave sea duty within their first year, within the second year, and so forth, through their last year. We also estimated the probability that sailors stay on sea duty at least 6 months past their PRD. Because we observed different patterns in sailors leaving sea duty by PST, we analyzed sailors with 36-, 48-, and 60-month tours separately.

Data samples

Restrictions

For our primary statistical modeling, we used a more restricted dataset than that used in the previous section. Here, we included only sailors who began their *first* sea tour in FY83 or later and whose PSTs ended by October FY99.[27] We do not include sea tours for sailors who entered the Navy before FY83. We have insufficient data to calculate cumulative years of sea duty for sailors who entered the Navy before FY83 and thus cannot determine their sea pay.

We further restricted the tours to those that would qualify for continuous sea pay. For instance, sailors in squadrons or other mobile units are not included—we have insufficient deployment information to determine when the sailor would have received sea pay. We also excluded ship-based staffs because data on which staffs received continuous sea pay before FY96 are unreliable. As an incentive to encourage sailors to certain overseas sea duty, some overseas sea duty does/did not follow the prescribed sea tour guidelines. For that reason, we deleted OCONUS sea duty tours. Finally, we excluded sea tours that were not served continuously (e.g., interrupted as the sailor served neutral duty or other duty that stops the sea pay counter).[28]

Sailors will be in the dataset multiple times if they served more than one sea tour. We do, however, exclude TARs, TEMACs, and sailors with prior service before FY83. In addition, only men are included. Women had different PSTs until the 1990s, and we were unable to recreate those lengths.[29]

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27. We also used a dataset with sea tours through FY01; however, because we have ship employment histories only through FY99, it did not contain any post-FY99 ship deployment information.

28. Of the sea tours qualifying for continuous sea pay, 10.5 percent had idle periods.

29. Overall, the sailors in the dataset are younger and have less sea time than those in the data used in the previous section. The trends over time in sea duty are similar to those shown earlier; however, completion rates are usually 2 to 4 percentage points lower.

These conditions result in a sample containing:

- 7,333 sea tours with initial PSTs of 36 months

- 169,409 sea tours with initial PSTs of 48 months

- 59,677 sea tours with initial PSTs of 60 months.[30]

We also created a separate sample using the same restrictions as described above but for a subset of senior sailors for whom we could estimate their sea pay rates. Senior sailors are particularly interesting to analyze because they experienced a sizable increase (usually about $100 per month) in sea pay immediately on arrival into sea duty with the FY88 sea pay change. To be in the sample, the sailor must have started a sea tour between FY83 and FY98 and had an LOS of 15 or 16 years in the Navy at the beginning of the tour. This group accessed into the Navy between FY67 and FY83. Although we do not have accurate information on the time served on sea duty for many of the sailors in this sample, these sailors should all have served over 5 years of sea duty. Sea pay rates within paygrade for these sailors are quite flat. Thus, we were able to estimate the sea pay they earned and correlate the estimated sea pay to completions through 36 months.[31]

Variables

We included, in our samples, variables that would capture the effects of the following potential influences on sea duty completions and extensions:

- Incentives (disincentives) for sea duty

- Navy job characteristics

- Civilian opportunities and compensation

- Individual characteristics.

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30. We exclude other PST lengths from the analysis.

31. Sailors in this sample were close to retirement age by their fourth year of sea duty. We expect their completions to be affected by that and, thus, conduct the analysis for the completion of 3 years of sea duty.

For completion of the first year of sea duty, we included variables that reflected characteristics at the time of entering the tour as well as others that measured whether an event occurred within the first 12-month period. We used a similar methodology for subsequent years.

Incentives for sea duty—special sea duty pays

All sea duty pays should theoretically increase the likelihood of completion and extension rates because they compensate, at least in part, for the hardships of the duty. Our analysis included the following:

- *Total monthly career sea pay.* This equals the monthly pay a sailor receives in career sea pay and the career sea pay premium as calculated at the beginning of the 12-month period. To obtain sailors' CSP rates, we mapped the sailor's paygrade and cumulative years of sea duty to the relevant CSP table. In addition, we used sailors' paygrade and consecutive years on sea duty to determine eligibility for CSPP.

- *Family separation pay.* Sailors who have dependents are eligible for family-separation pay while deployed. We used the historical pay tables on family separation pay, sailors' dependency status, and months the sailor's ship was deployed in the 12-month period to calculate the total amount due to the sailor.

- *Hazardous duty pay/imminent danger pay.* We calculated the total hazardous duty pay sailors earned for Desert Storm/Desert Shield based on ship deployment information.[32]

Incentives for sea duty—conditions on sea duty

We captured the following in our analysis:

- *Ship's deployment.* We used two variables to describe the sailor's deployment through the year. The first is whether a deployment began during the year. Attrition is high before deploying, so we expect a negative relationship between this variable and

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32. We were not able to identify sailors who qualified for hazardous duty pay outside that time frame. Consequently, this estimate may reflect pay but it may be simply a Desert Storm/Desert Shield effect on completions.

completions. The second variable indicates how many months the sailor's ship was deployed during the 12-month period. Because it is more difficult to physically leave the ship while at sea, the more months deployed, the lower the chance of leaving sea duty.

- *Decrewing.* We checked whether a ship had been decrewed either for a ship's overhaul or because of a decommissioning. We consider sailors to experience a decrewing if the ship's crew size decreased 25 percent over 3 months in the 12-month period. We expect that some sailors with decrewing events have sea duty waived and, consequently, do not complete their PSTs.

- *PST length change.* We control for the number of months the PST length changed over the 12-month period and separately, over the previous months of the sea tour. We expect that an increase in PST may lower completion in that 12-month period if sailors react negatively to the change. However, total time at sea may increase if sailors do regard the PST obligation as binding.

Navy job characteristics

We control for other factors, such as working conditions, associated with the sailors' ratings by including *rating group* variables. We have partitioned ratings into 16 different rating groups.

Civilian opportunities and compensation

Because one way sailors can end their sea tours is by separating from the Navy, we must consider the relative attractiveness of Navy life and the ease of leaving the Navy. To do so, we included the following variables:

- *At EAOS:* This variable indicates whether the sailor faced a reenlistment decision in the 12-month period. All else constant, sailors who are not at EAOS must receive approval to leave the Navy. These sailors should have more difficulty separating from the Navy and, consequently, less ability to leave sea duty than sailors at EAOS.

- *Pay:* This variable is the difference in civilian to military pay.[33] We include this because the better the outside job opportunities for sailors, the less likely they are to remain in the Navy. Military

pay includes basic pay plus a housing allowance and is calculated by paygrade and years of service.[34]

- *Unemployment rate:* This is a state-level unemployment rate (as reported by the U.S. Bureau of Labor Statistics) for the state from which each sailor accessed. These data control for the relative strength of civilian labor markets, which may be an important consideration for sailors thinking about leaving the Navy.

Individual characteristics

We include the following information on individual characteristics:

- *Demographics:* These variables control for marital status, number of children, and race.

- *Sailor quality:* We control for sailor quality by quality cell—a weighted average of the level of eduation and Armed Forces Qualification Test (AFQT) score.[35] We also include the length-of-service (LOS) zone the sailor falls into at the beginning of each year to hold experience constant.

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33. Reference [9] shows that Annualized-Cost-of-Leaving (ACOL) models produce the best estimates of pay elasticities. Because ACOL models are costly to develop, however, we model the effects of regular pay on continuation on sea duty with a civilian-military pay difference. We conducted sensitivity analyses of our results using alternate pay specifications that included using a civilian-military pay ratio, defining military pay as basic pay and as basic pay plus allowances. The coefficients on the sea pay variable were stable and at most 10 percent lower.

34. In our final analyses, we exclude Selective Reenlistment Bonus (SRB) levels. It was not apparent whether SRBs would increase or decrease sea tour completions. Although sailors are more likely to reenlist if they receive SRB, these sailors are also those we expect the Navy would allow to waive sea duty time just to keep them in the Navy. Consequently, the effect of SRB could be positive or negative. We did include them in earlier specifications. In general, we found a positive effect, although the estimates are not stable. Because SRBs have a low correlation with the level of sea pay that sailors receive, the sea pay estimates are not sensitive to their exclusion.

35. Basic pay (which is largely driven by the paygrade to which a given sailor has advanced) and rating group also both partly serve as a control for sailor quality.

Findings

Completions and extensions

We find that sailors respond to additional sea pay both by completing their sea tours and by extending those tours. In every model we ran, the effect of sea pay is highly statistically significant. Because the Navy plans to pay AIP in increments of $50, we show, in figure 7, the *cumulative* effect on sea tour completions for an additional $50 per month in career sea pay. Overall, completions of sea duty rise 3.3 percentage points, or increase 11 percent, when evaluated at the mean continuation rates.[36] Yearly completion rates rise between 0.8 (in the second year) and 2.5 percentage points (in the last year of a sea tour).

Figure 8 shows that a $50-per-month increase in sea pay boosts extensions by 2.9 percentage points, or about 6 percent. Compared with the rises in yearly completion rates, extensions are, as expected, more responsive to changes in sea pay.

How do these results compare with other tour lengths? As shown in table 4, completions for sailors obligated to 36-month and 60-month tours do increase but not by as much.[37] It may be that sailors are self-selecting into ratings that are sea or shore intensive based on their preferences for sea duty. Those sailors who dislike sea duty have chosen ratings that tend to have shorter than average sea duty tours.

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36. A $50-per-month increase is quite large for this sample when examining the first and second years of sea duty because the sample is made up of primarily junior sailors receiving little or no sea pay. Consequently, the calculated effects for the first years are more tenuous but are consistent with our estimated effects for sailors later in their sea tours. Another way to measure the responsiveness of sailors is to calculate the percentage increase in completions for a 1-percent increase in sea pay. By this measure, the responsiveness of sailors is low in absolute terms and when compared with the pay response estimated using ACOL models. (See appendix B for the CSP elasticities.) This can be expected, however, under several conditions. For example, if sailors regard the PST as binding or if fulfilling a full sea tour and then rotating after PST is career-enhancing, fewer sailors would change their tour lengths and the elasticity would be small.

37. The pay elasticities as shown in appendix B are very similar, however.

For them, they are less likely to respond to a given change in sea pay. Also, sailors in shore-intensive ratings are needed in shore billets. They may not be given the opportunity to extend. But, then, why would sailors on 60-month tours also be less responsive to sea pay? If sea tour lengths of 60 months are just too long, increases in sea pay may not be able to compensate sailors adequately, and little change in behavior might occur.

Figure 7.   Sailors' responsiveness to sea pay, cumulative effect
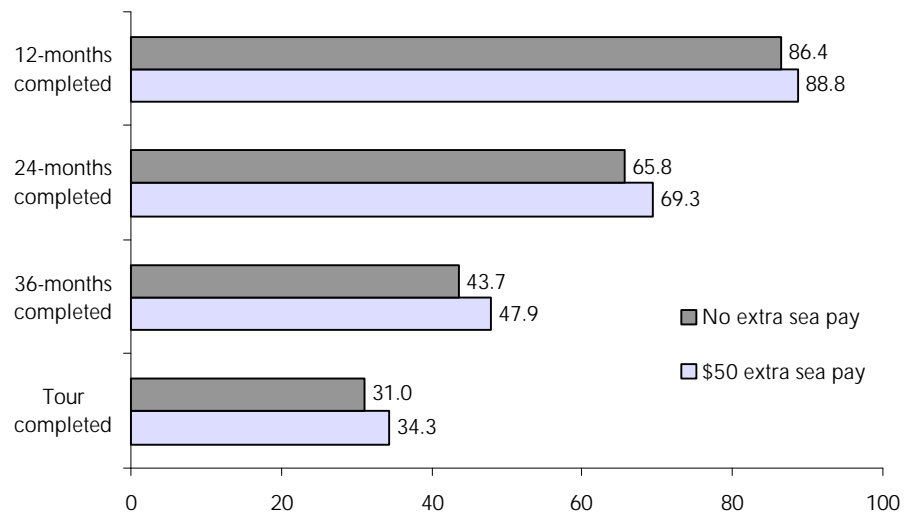

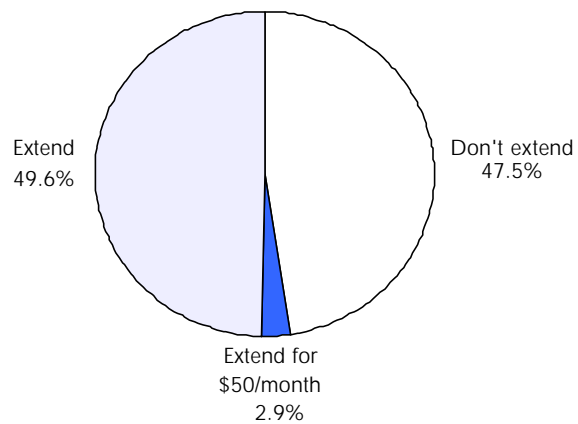Figure 8.   Extensions among sailors who complete their PSTs

Table 4.   Responsiveness of sailors to an extra
$50 per month in sea pay

	Extra sea duty (in percentage points)	
	36-month tours	60-month tours
Completions	2.3	0.8
Extensions	2.0	1.5

Applying our regression estimates, we estimate the amount of sea duty the Navy would gain given an additional $50 per month to every sailor receiving continuous sea pay. We calculate that the Navy would gain approximately 1,425 extra work-years of sea duty annually[38] at a total cost of about $45 million.[39] The cost of $31,600 per additional workyear generated compares favorably to a typical E4's total annual compensation of $37,200.

Sensitivity of career sea pay estimates

This dataset was not ideal. Obtaining robust estimates requires variation in the variable of interest that is not correlated with other variables. Apart from the change in the sea pay table in FY88, the primary variation in the amount of sea pay a sailor receives is caused by the loss of inflation and the sailor's time in the Navy. It is possible that the

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38. We assume that about 30,000 sea tours qualifying for continuous sea pay are begun each year. We then apply the estimated increases in sea duty to the 36-, 48-, and 60-month PST continuation rates to derive the number of sailors who complete each year of sea duty. Finally, to convert to additional work-years of sea duty, we assume that the additional completions through a given year add an extra 6 months of sea duty work-years on average. Using this methodology, we find in steady state that about 70,000 sailors would receive an additional $600 per year.

39. This is similar to estimates for an across-the-board increase in sea pay as estimated in [2]. Reference [2] found, however, based on survey data, that larger increases in the CSP table targeted to sailors at the first-term reenlistment point (as well as increases in the CSPP) generated more years of sea duty than an across-the-board increase in sea pay such as we've illustrated. Reference [10] also shows that the new sea pay reforms ought to be highly cost-effective.

sea pay variable is largely capturing a time trend. For instance, sea duty may have simply worsened over the time period and we were unable to control for that with the data available. To test how our results would vary if we assumed that changes in sea duty, or other events, were driving our results, we estimated several alternate specifications with a time trend and with time dummy variables. These estimates are lower bounds on the effect of sea pay. We find that 48 percent and 29 percent, respectively, of the sea pay effect on completions and extensions dissipates under the most stringent assumptions.

As an additional check on the sensitivity of our estimates, we used a sample of sailors with 15 or 16 years of service, as described earlier. Although we cannot calculate an exact number of cumulative years on sea duty for these sailors, sea pay varies little within paygrade as cumulative sea time exceeds 5 years of service. For such senior sailors, the vast majority should have more than that amount of time.[40] Because these sailors are approaching retirement, and retirement pay should be an incentive to keep them in the Navy and in their assignments, we did not expect a high responsiveness to pay from this group. Indeed, through the first 2 years of their sea tours, sea pay had no significant effect. However, for their third year (as they are approaching retirement), they exhibit about the same sensitivity as do the more junior sailors—an extra $50 per month increases completions of the third year by about 2 percentage points. This seems plausible. Many of the sailors have 36-month tours, and the additional sea pay induces them to finish their tours. When sea pay is relatively low, we expect that these sailors, who can probably rotate to shore early more easily than junior sailors, take advantage of this.

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40. Indeed, looking at sailors with 15 years of service in the late 1990s (i.e., sailors we have complete sea duty histories for), less than 10 percent have under 5 years of cumulative sea duty.

Implications for AIP

We have seen that sea pay does work as a distribution tool—it increases sailors' willingness to remain on sea duty. Pay, in the form of AIP, should also keep sailors in difficult-to-fill billets. The Navy will benefit from increased work-years in the targeted billets, will accomplish work more effectively by using more experienced sailors, and will lower PCS costs. Overall, readiness in difficult-to-fill billets should increase.

We cannot, however, be certain that sailors' responsiveness to AIP will be the same as for sea pay—indeed, it likely will not. AIP may be more or less effective. On one hand, because the sailors filling these undesirable billets voluntarily chose the billet, they should have less dislike than the typical sailor for the billet. As a result, these sailors should stay in the billets for less pay than other sailors. On the other hand, sea pay and AIP are not directly comparable, and sailors' response to sea pay could be higher because of its design. Sea pay depends on cumulative years of sea duty. Extending a sea tour today leads to higher income today and in the future. Consequently, sailors are responding not only to today's sea pay income but to the future stream of sea pay. AIP, however, is a set monthly amount, not dependent on whether a sailor filled an undesirable billet previously.

Given the uncertainty surrounding AIP's effectiveness in keeping sailors in hard-to-fill billets, our estimates do suggest that pay, specifically AIP, will help. Here, we calculate the amount of extra work-years the Navy would gain in hard-to-fill CONUS shore billets given that each sailor filling those billets receives an additional $50 per month for the duration of their tours. Using one location-based measure of hard-to-fill billets, up to 8,000 CONUS shore requisitions per year might be designated as hard to fill.[41] Assuming the tours are 36 months in

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41. We used JASS data to determine the demand for different locations by comparing the application to billet ratio for 18 CONUS regions. The hard-to-fill locations include Washington, DC, Los Angeles, inland California, Lemoore, and portions of the Midwest and Northeast. For more information on the location definition and the data used, see [5].

duration, we apply our sea pay estimates to obtain an estimate of AIP's likely effectiveness in keeping sailors in those billets. We calculate that the Navy would gain a modest 300 extra work-years annually[42] at a cost of about $15 million per year, or $50,000 per additional work-year generated. Although AIP keeps sailors in difficult-to-fill billets, if its only benefit were to increase sailors' time in billets, it would likely not be cost-effective. Instead, the cost-effectiveness of AIP rests on its ability to induce sailors to fill undersirable billets more efficiently than the current assignment system does.[43]

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42. Once we calculate the new completion rates, we convert the rate to additional work-years by assuming that the additional yearly completions add an extra 6 months of work-years on average.

43. See [3] for a cost/benefit analysis based on AIP's ability to induce sailors to difficult-to-fill billets.

Conclusions

Where does this take us? This analysis shows that money matters. Sailors remain in their billets longer when they receive additional compensation. We estimate that the Navy would gain annually about 1,425 work-years of sea duty at a cost of $45 million if sailors received an additional $50 per month in sea pay. Although other factors also affect the willingness of sailors to serve in typically more difficult-to-fill billets, compensation can be an important element in keeping sailors in less desirable billets.

What are the implications for the new distribution pays? Based on our sea pay estimates, we calculate that the Navy would gain a modest 300 extra work-years annually at a cost of about $15 million per year, or $50,000 per additional work-year. Although we are uncertain whether the sea pay estimates will understate or overstate the new pays' effectiveness, we believe that our estimates most likely underestimate the responsiveness. Sea pay is not highly targeted; even sailors in more desirable sea billets can receive sea pay. LSRB and AIP should be more effective at keeping sailors in difficult-to-fill billets at a lower cost. First, the pays are highly targeted. Sailors will receive the new pays only when no one will accept the job without additional compensation. Second, the sailors filling these undesirable billets will be volunteers and will be less likely than other sailors to find the billets undesirable. Consequently, sailors receiving LSRB or AIP won't need as much compensation as the typical sailor to keep them in the billets.

In addition, the effect of the pays in attracting sailors to hard-to-fill billets may alone justify pursuing implementation of the new pays—at least to certain billets [3]. Because, however, there is uncertainty in the responsiveness of sailors to volunteer for hard-to-fill billets and the costs of the new pays, we recommend a gradual implementation of the pays and further data analysis.

Appendix A: Descriptive statistics

Tables 5 through 7 show the sample means for factors that influence sea duty completions and extensions.

Table 5.   Sample means: 48-month sea tours

	Entry to 12 months	12 to 24 months	24 to 36 months	36 months to completion	Extensions
Continuation of sea duty	0.86	0.76	0.67	0.71	0.50
Sea duty pays					
Career sea pay (per month)	17.22	23.45	81.60	241.74	296.06
Family separation pay (per year)	41.53	59.12	83.87	106.56	133.53
Imminent danger pay (per year)	76.28	76.78	84.65	83.43	81.28
Sea duty					
Began deployment during year[a]	0.45	0.41	0.41	0.41	0.37
Months deployed during year	2.99	2.88	2.99	2.89	2.62
Married & deployed during year[a]	0.12	0.17	0.22	0.28	0.36
Decrewing during year[a]	0.03	0.04	0.05	0.07	0.08
Months PST changed during year	0.42	0.39	0.47	0.05	0.00
Months PST changed previously	--	0.40	0.61	0.94	0.44
Initial rating group					
Construction battalion[a]	0.00	0.00	0.00	0.00	0.00
Surface engineer[a]	0.00	0.00	0.00	0.00	0.01
Hull, mechanical, electrical[a]	0.00	0.00	0.00	0.00	0.00
Aviation maintenance[a]	0.01	0.01	0.01	0.01	0.02
Aviation operations[a]	0.01	0.01	0.01	0.01	0.01
Aviation supply[a]	0.01	0.01	0.01	0.01	0.01
Administration[a]	0.01	0.01	0.01	0.01	0.01
Deck[a]	0.01	0.01	0.01	0.01	0.01
Supply[a]	0.03	0.03	0.03	0.03	0.05
Cryptography[a]	0.00	0.00	0.00	0.00	0.00
Surface operations (combat systems)[a]	0.09	0.09	0.10	0.12	0.23

Table 5.   Sample means: 48-month sea tours (continued)

	Entry to 12 months	12 to 24 months	24 to 36 months	36 months to completion	Extensions
Surface operations[a]	0.08	0.08	0.09	0.11	0.13
Submarine[a]	0.01	0.01	0.01	0.01	0.03
Gendet[a]	0.76	0.75	0.73	0.68	0.50
Civilian opportunities					
Reenlistment decision during year[a]	0.02	0.12	0.30	0.73	0.48
Military - civilian pay difference	-2,420.07	-1,736.53	-884.26	5.51	769.36
Unemployment rate	6.31	6.15	6.04	5.92	5.78
Sailor characteristics					
Married[a]	0.16	0.23	0.32	0.41	0.57
Number of children	0.16	0.21	0.28	0.38	0.64
White[a]	0.65	0.65	0.65	0.65	0.63
Black[a]	0.22	0.22	0.22	0.22	0.25
Other race[a]	0.13	0.13	0.13	0.13	0.12
A cell[a]	0.43	0.44	0.43	0.46	0.52
B cell[a]	0.07	0.06	0.05	0.05	0.04
C+ cell[a]	0.48	0.49	0.51	0.48	0.43
C- cell[a]	0.01	0.01	0.01	0.01	0.01
D cell[a]	0.00	0.00	0.00	0.00	0.00

a. Statistic represents proportion of sample with this characteristic.

Table 6.   Sample means: 36-month sea tours

	Entry to 12 months	12 to 24 months	24 months to completion	Extensions
Continuation of sea duty	0.93	0.87	0.85	0.26
Sea duty pays				
Career sea pay (per month)	94.01	104.00	188.12	311.59
Family separation pay (per year)	117.81	118.62	142.15	135.86
Imminent danger pay (per year)	81.75	91.88	108.13	92.14
Sea duty				
Began deployment during year[a]	0.43	0.41	0.43	0.42
Months deployed during year	3.05	2.92	3.16	3.04
Married & deployed during year[a]	0.30	0.31	0.36	0.36
Decrewing during year[a]	0.02	0.03	0.04	0.04
Months PST changed during year	0.88	0.73	0.10	1.34
Months PST changed previously		0.91	1.63	0.04
Initial rating group				
Construction battalion[a]	0.00	0.00	0.00	0.00
Surface engineer[a]	0.02	0.00	0.00	0.00
Hull, mechanical, electrical[a]	0.02	0.01	0.01	0.01
Aviation maintenance[a]	0.13	0.14	0.14	0.15
Aviation operations[a]	0.19	0.19	0.18	0.18
Aviation supply[a]	0.04	0.04	0.04	0.05
Administration[a]	0.26	0.28	0.29	0.27
Deck[a]	0.00	0.00	0.00	0.00
Supply[a]	0.10	0.10	0.10	0.12
Cryptology[a]	0.10	0.11	0.12	0.12
Surface operations (combat systems)[a]	0.06	0.06	0.05	0.05
Surface operations[a]	0.04	0.04	0.04	0.03
Submarine[a]	0.03	0.02	0.02	0.02
Gendet[a]	0.00	0.00	0.00	0.00
Civilian opportunities				
Reenlistment decision during year[a]	0.08	0.14	0.32	0.52
Military - civilian pay difference	-1,109.85	-805.92	-267.54	155.12
Unemployment rate	6.09	6.08	5.99	5.89

Table 6.   Sample means: 36-month sea tours (continued)

	Entry to 12 months	12 to 24 months	24 months to completion	Extensions
Sailor characteristics				
Married[a]	0.45	0.47	0.52	0.51
Number of children	0.65	0.63	0.67	0.68
White[a]	0.73	0.74	0.74	0.75
Black[a]	0.16	0.15	0.16	0.14
Other race[a]	0.11	0.10	0.10	0.11
A cell[a]	0.69	0.69	0.69	0.69
B cell[a]	0.08	0.07	0.07	0.07
C+ cell[a]	0.22	0.23	0.23	0.24
C- cell[a]	0.01	0.01	0.01	0.01
D cell[a]	0.00	0.00	0.00	0.00

a. Statistic represents proportion of sample with this characteristic.

Table 7.   Sample means: 60-month sea tours

	Entry to 12 months	12 to 24 months	24 to 36 months	36 to 48 months	48 months to completion	Extensions
Continuation of sea duty	0.90	0.84	0.76	0.38	0.73	0.34
Sea duty pays						
Career sea pay (per month)	27.86	42.36	135.32	284.02	295.77	381.52
Family separation pay (per year)	51.75	67.07	89.27	108.51	147.46	163.08
Imminent danger pay (per year)	69.37	65.09	74.98	63.86	63.90	93.52
Sea duty						
Began deployment during year[a]	0.45	0.41	0.42	0.40	0.41	0.39
Months deployed during year	2.96	2.79	3.03	2.88	2.84	2.65
Married & deployed during year[a]	0.15	0.19	0.24	0.28	0.38	0.39
Decrewing during year[a]	0.03	0.04	0.06	0.07	0.07	0.08
Months PST changed during year	0.00	0.00	0.00	0.00	-0.03	--
Months PST changed previously	--	0.00	-0.01	0.00	-0.01	-0.01
Initial rating group						
Construction battalion[a]	0.00	0.00	0.00	0.00	0.00	0.00
Surface engineer[a]	0.38	0.39	0.39	0.40	0.43	0.44
Hull, mechanical, electrical[a]	0.29	0.30	0.31	0.32	0.30	0.28
Aviation maintenance[a]	0.00	0.00	0.00	0.00	0.00	0.00
Aviation operations[a]	0.00	0.00	0.00	0.00	0.00	0.00
Aviation supply[a]	0.00	0.00	0.00	0.00	0.00	0.00
Administration[a]	0.01	0.01	0.01	0.01	0.01	0.01
Deck[a]	0.05	0.05	0.05	0.05	0.05	0.06
Supply[a]	0.05	0.05	0.05	0.06	0.04	0.06
Cryptology[a]	0.00	0.00	0.00	0.00	0.00	0.00
Surface operations (combat systems)[a]	0.13	0.11	0.10	0.08	0.09	0.05
Surface operations[a]	0.09	0.09	0.09	0.08	0.08	0.11
Submarine[a]	0.00	0.00	0.00	0.00	0.00	0.00
Gendet[a]	0.00	0.00	0.00	0.00	0.00	0.00

Table 7.   Sample means: 60-month sea tours (continued)

	Entry to 12 months	12 to 24 months	24 to 36 months	36 to 48 months	48 months to completion	Extensions
Civilian opportunities						
Reenlistment decision during year[a]	0.02	0.07	0.23	0.68	0.50	0.30
Military - civilian pay difference	-3,671.02	-3,119.85	-2,213.82	-1,399.76	-636.32	-363.15
Unemployment rate	6.25	6.25	6.14	6.00	5.69	5.68
Sailor characteristics						
Married[a]	0.21	0.27	0.34	0.41	0.58	0.68
Number of children[a]	0.19	0.24	0.29	0.37	0.63	0.87
White[a]	0.71	0.73	0.73	0.73	0.72	0.65
Black[a]	0.16	0.15	0.15	0.15	0.17	0.22
Other race[a]	0.13	0.12	0.12	0.12	0.12	0.13
A cell[a]	0.57	0.56	0.56	0.57	0.64	0.52
B cell[a]	0.06	0.06	0.05	0.05	0.04	0.05
C+ cell[a]	0.36	0.36	0.37	0.37	0.30	0.42
C- cell[a]	0.01	0.01	0.01	0.01	0.01	0.01
D cell[a]	0.00	0.00	0.00	0.00	0.00	0.00

a. Statistic represents proportion of sample with this characteristic.

Appendix B: Results

Tables 8 through 11 show the effect of factors that influence sea duty completions and extensions.

The marginal effects reflect the percentage-point change in the completion or extension of sea tours associated with a unit change in the variable. For example, from table 8, the marginal effect of the months deployed on completion to 12 months is 0.007. This means that each 10-percentage-point increase in time deployed raises completion to 12 months by 0.7 percentage point.

Table 8.   Regression results for likelihood of completing or extending sea duty: sailors obligated for 48-month sea tours

Variable[a]	Entry to 12 months[b]	12 to 24 months	24 to 36 months	36 months to completion	Extend
Sea duty pays					
Total monthly career sea pay/100[c]	0.053**	0.048**	0.075**	0.016**	0.069**
Family separation pay/100	0.001	-0.001	-0.001	-0.006**	-0.003
Imminent danger pay/100	0.000	0.002**	0.002**	0.002**	0.007**
Sea duty					
Began deployment	-0.031**	-0.042**	-0.039**	-0.038**	-0.058**
Months deployed during year	0.007**	0.009**	0.008**	0.001	0.007**
Married & deployed during year	-0.022**	-0.037**	-0.026**	0.041**	-0.018
Decrewing during year	-0.071**	-0.127**	-0.082**	-0.130**	-0.088**
Months PST changed during year	-0.003**	-0.006**	-0.004**	-0.058**	
Months PST changed previously		0.001	0.001	-0.038**	-0.007**
Rating groups					
Surface engineer	0.039**	0.029	0.077**	0.048	-0.343**
Hull, mechanical, electrical	0.025	0.038	0.007	0.002	-0.305**
Aviation maintenance	0.075**	0.147**	0.196**	0.038**	-0.347**
Aviation operations	0.012	0.084**	0.074**	-0.101**	-0.291**
Aviation supply	0.070**	0.116**	0.147**	0.064**	-0.351**
Administration	0.045**	0.108**	0.088**	0.020	-0.382**
Deck	0.029**	-0.005	-0.006	0.040**	-0.290**

Table 8.   Regression results for likelihood of completing or extending sea duty: sailors obligated for 48-month sea tours (continued)

Variable[a]	Entry to 12 months[b]	12 to 24 months	24 to 36 months	36 months to completion	Extend
Supply	0.025**	0.035**	0.105**	0.043**	-0.389**
Surface operations (combat systems)	0.016**	0.102**	0.121**	0.104**	-0.335**
Surface operations	0.044**	0.075**	0.084**	-0.077**	-0.330**
Submarine	0.062**	0.154**	0.219**	0.096**	-0.287**
Civilian opportunities					
Reenlistment decision during year	-0.499**	-0.699**	-0.653**	-0.090**	-0.036**
Military - civilian pay difference/100	0.000	0.004**	0.003**	0.002**	0.001**
Unemployment rate	0.005**	-0.002**	-0.004	-0.009**	0.005*
Sailor characteristics					
Married	-0.012**	0.033**	0.044**	0.035**	0.031**
Number of children	-0.015**	-0.025**	-0.000	0.006**	-0.004
Black	0.005*	-0.087**	-0.039**	0.030**	-0.007
Other race	0.029**	0.001	0.018**	0.039**	-0.068**
A cell	-0.016**	-0.053**	-0.008**	-0.071**	-0.040**
B cell	-0.144**	-0.166**	-0.085**	-0.063**	-0.028
C- cell	-0.112**	-0.108**	-0.061**	-0.007	0.023
D cell	-0.032**	-0.031*	0.052*	0.023	0.008
LOS 7 - 10	0.013**	0.040**	-0.017**	0.057**	-0.024
LOS 11 - 14	0.046**	0.110**	-0.092**	0.034**	-0.122**
LOS 15 or above	0.090**	0.141**	-0.025	0.005	0.026
Observations	169,409	148,797	106,477	65,822	14,996
Log likelihood	-63,907	-63,437	-45,354	-36,029	-8,866

a. Reference group is Gendet sailors not deployed, not married, and C+ cell.

b. ** Statistically significant at the 95-percent confidence level.

  *   Statistically significant at the 90-percent confidence level.

c. The percent change in completion or extension of sea duty for a 1-percent change in total career sea pay, or the pay elasticity, is calculated as (marginal effect of total sea pay) * (mean total career sea pay) / (mean completion or extension rate). We calculate that the CSP elasticities equal 0.01, 0.01, 0.09, 0.08, respectively, for the first second, third and final year of sea duty and 0.41 for extensions. These are low rates—very few additional completions or extensions occur with a 1-percent-change in sea pay.

Table 9. Regression results for likelihood of completing sea duty: sailors obligated for 60-month sea tours

Variables[a]	Entry to 12 months[b]	12 to 24 months	24 to 36 months	36 to 48 months	48 months to completion
Sea duty pays					
Total monthly career sea pay/100 [c]	0.013**	0.011**	0.064**	0.032**	-0.004**
Family separation pay/100	0.003**	-0.004**	-0.005**	-0.002	-0.002
Imminent danger pay/100	0.001**	0.001*	0.000	0.001	-0.001
Sea duty					
Began deployment	-0.019**	-0.040**	-0.034**	-0.031**	-0.042**
Months deployed during year	0.005**	0.007**	0.007**	0.004**	0.002
Married & deployed during year	-0.015**	-0.003	0.000	-0.021	0.031*
Decrewing during year	-0.028**	-0.077**	-0.077**	-0.106**	-0.090**
Months PST changed during year	0.005	0.011	-0.018	-0.006	-0.151**
Months PST changed previously		0.018	0.002	-0.052	-0.093*
Rating groups					
Surface engineer	-0.108**	0.053**	-0.038	0.128**	-0.127*
Hull, mechanical, electrical	-0.082	0.064**	-0.031	0.061**	-0.119*
Deck	-0.137	0.023	-0.065**		-0.048
Supply	-0.114	0.025	-0.055*	-0.029	-0.112
Surface operations (combat systems)	-0.073*	0.066**	-0.084**	0.121**	-0.362**
Surface operations	-0.091	0.064**	-0.068**	0.016	-0.137*
Civilian opportunities					
Reenlistment decision during year	-0.375**	-0.456**	-0.515**	-0.635**	-0.280**
Military - civilian pay difference/100	0.000	0.002**	0.001**	0.004**	0.000
Unemployment rate	0.003**	0.001	-0.007**	-0.009**	-0.008**
Sailor characteristics					
Married	-0.021**	-0.003	0.025**	0.112**	0.035**
Number of children	-0.011**	-0.011**	0.002	0.018**	0.023**
Black	-0.003	-0.055**	-0.003	0.019*	0.073**
Other race	0.023**	0.018**	0.023**	0.008	0.029*
A cell	-0.020**	-0.025**	-0.003	0.060**	-0.064**
B cell	-0.113**	-0.138**	-0.085**	0.021	0.002
C- cell	-0.047**	-0.104**	-0.071**	-0.023	-0.053
D cell	-0.065**	-0.062*	-0.046	0.012	0.157
LOS 7 - 10	0.013	-0.018*	-0.219**	-0.015	0.019
LOS 11 - 14	-0.011	-0.036**	-0.053**	0.014**	0.015
LOS 15 or above				0.199**	0.028

Table 9. Regression results for likelihood of completing sea duty:
sailors obligated for 60-month sea tours (continued)

Variables[a]	Entry to 12 months[b]	12 to 24 months	24 to 36 months	36 to 48 months	48 months to completion
Observations	59,677	52,608	41,543	28,962	9,702
Log likelihood	-18,658	-20,820	-17,680	-12,479	-4,721

a. Reference group is sailors in surface operation ratings, not deployed, not married, and C+ cell.
b. ** Statistically significant at the 95-percent confidence level.
    * Statistically significant at the 90-percent confidence level.
c. The career sea pay elasticities equal 0.01, 0.01, 0.011, 0.24, and -0.16, respectively, for the first second, third, fourth and final year of sea duty.

Table 10. Regression results for likelihood of completing sea duty:
sailors obligated for 36-month sea tours

Variables[a]	Entry to 12 months[b]	12 to 24 months	24 months to completion
Sea duty pays			
Total monthly career sea pay/100[c]	0.027**	0.014*	0.023**
Family separation pay/100	-0.002	-0.004	0.007*
Imminent danger pay/100	0.000	0.001	0.002
Sea duty			
Began deployment	-0.020**	-0.016	-0.025**
Months deployed during year	0.003**	0.004**	-0.000
Married & deployed during year	0.007	0.004	-0.049**
Decrewing during year	0.004	-0.142**	-0.247**
Months PST changed during year	-0.002**	-0.003**	-0.028**
Months PST changed previously		-0.003**	-0.020**
Rating groups			
Surface engineer	0.047	0.023	-0.885**
Hull, mechanical, electrical	0.048	0.088	-0.891**
Aviation maintenance	0.060*	0.095	-0.962**
Aviation operations	0.072**	0.106	-0.971**
Aviation supply	0.052*	0.071	-0.910**
Administration	0.079*	0.113	-0.970**
Supply	0.059*	0.092	-0.943**
Cryptology	0.061**	0.092	-0.958**
Surface operations combat systems	0.047	0.058	-0.925**
Surface operations	0.051*	0.077	-0.911**
Submarine	0.046	0.072	-0.898**

Table 10. Regression results for likelihood of completing sea duty:
sailors obligated for 36-month sea tours (continued)

Variables[a]	Entry to 12 months[b]	12 to 24 months	24 months to completion
Civilian opportunities			
Reenlistment decision during year	-0.208**	-0.446**	-0.195**
Military - civilian pay difference/100	0.000	0.001**	0.001**
Unemployment rate	-0.001	0.001	-0.000
Sailor characteristics			
Married	0.011	0.016	0.003
Number of children	-0.002	-0.007	0.009
Black	-0.006	-0.014	-0.004
Other race	0.008	0.012	0.024
A cell	-0.009	-0.012	-0.001
B cell	-0.068**	-0.081**	-0.024
C- cell	-0.047	-0.038	-0.124**
D cell		-0.157*	0.017
LOS 7 - 10	-0.011	0.047**	0.030
LOS 11 - 14	-0.011	0.060**	0.033
LOS 15 or above	0.016	0.078**	0.036
Observations	7,333	6,625	5,383
Log likelihood	-1,631	-1,997	-1,928

a. Reference group is Gendet or sailors in Deck occupations, not deployed, not married, and C+ cell.

b. ** Statistically significant at the 95-percent confidence level.
    * Statistically significant at the 90-percent confidence level.

c. The career sea pay elasticities equal 0.03, 0.04, and 0.07, respectively, for the first, second, and final year of sea duty.

Table 11. Regression results for likelihood of completing sea duty: sailors obligated for 36-month and 60-month sea tours

Variables[a]	36-month tours[b]	60-month tours
Sea duty pays		
Total monthly career sea pay/100[c]	0.040**	0.030**
Family separation pay/100	0.006	-0.001
Imminent danger pay/100	0.000	-0.005*
Sea duty		
Began deployment	-0.031	-0.039*
Months deployed during year	-0.007	0.007
Married & deployed during year	0.028	-0.002
Decrewing during year	-0.039	-0.045
Months PST changed during year		
Months PST changed previously	-0.014**	-0.099**
Rating groups		
Surface engineer		-0.007
Hull, mechanical, electrical	0.089	-0.025
Aviation maintenance	-0.097	
Aviation operations	-0.081	
Aviation supply	-0.096	
Administration	-0.187	0.095
Deck		0.176**
Supply	-0.098	0.190**
Cryptography	-0.226*	
Surface operations (combat systems)	0.017	
Surface operations	-0.166	0.251**
Submarine	0.151	
Civilian opportunities		
Reenlistment decision during year	0.042**	0.039**
Military to civilian pay/100	0.002**	0.001**
Unemployment rate	0.012**	0.019**
Sailor characteristics		
Married	-0.055*	0.003
Number of children	-0.001	-0.001
Black	-0.046	0.034
Other race	-0.012	-0.036
A cell	-0.008	-0.091**
B cell	0.006	-0.014

Table 11. Regression results for likelihood of completing
sea duty: sailors obligated for 36-month and
60-month sea tours (continued)

Variables[a]	36-month tours[b]	60-month tours
C- cell	-0.096	-0.153**
D cell	0.139	-0.196
LOS 7 - 10	-0.038	0.006
LOS 11 - 14	-0.134**	-0.075**
LOS 15 or above	-0.082*	0.014
Observations	2,549	3,806
Log likelihood	-1,354	-2,346

a. Reference group is sailors not deployed, not married, and C+ cell.
b. ** Statistically significant at the 95-percent confidence level.
   * Statistically significant at the 90-percent confidence level.
c. The career sea pay elasticities equal 0.39 and 0.36, respectively, for the
   36-month and 60-month sea tours.

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